CREDIT SUISSE

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Global
Equity Research
Energy

Alternative/Renewable Energy

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THEME

There Is an Alternative

Source: Corbis.

The rise of alternative and renewable energy is being driven by the combination of higher-for-longer oil prices, increasing social and political consensus on the need to tackle carbon emissions and climate change, and the changing legislative landscapes that accompany this.

Alternative energy is a hot topic and a broad one. In this report, we examine the alternatives themselves, the lateral implications in capital goods and elsewhere, the impact on conventional oil and gas markets, and the various approaches to carbon emission mitigation.

The conclusions are many, and we see more immediate potential on the demand side from greater energy efficiency than on the supply side from more renewable power generation.

To play this highly complex theme, we present the *Credit Suisse Alternative 30*, 30 global equities with meaningful leverage to the various implications of climate change, energy efficiency, and alternative energy.

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Source: Credit Suisse.

Executive Summary

The rise of alternative energy is being driven by higher-for-longer oil prices, by increasing social and political concern over carbon emissions and climate change, and by the changing legislative landscapes that accompany this.

Alternative energy is a hot topic and a broad one. In this report, we examine renewable electricity generation, biofuels, and other alternative energy products and systems. We look at the lateral plays on alternative energy in capital goods, in aerospace, in the auto industry, and elsewhere. We also examine the likely impact of alternative energy on the mainstream oil and gas industry.

We conclude that the debate over global warming is now virtually over. The political debate is now shifting toward what to do about CO_2 emissions and climate change.

Government alternative policies will remain largely local affairs in the medium term, we think, with differences in emphasis. Europe already has carbon emissions trading and is adopting tough targets for renewable energy. The U.S. is likely to adopt some sort of national renewable portfolio standard in the next few years, while non-Japan Asia (meaning mainly China and India) is still trying to find its feet in this policy area.

One economic and political link between countries and regions may come from the emergence within the next few years of a global consensus on carbon emissions trading.

We see more potential for CO_2 mitigation on the demand side of the equations via greater efficiency of energy use in electrical appliances, automobiles, power generation, etc.

Not all alternative energies are created equal. Wind power looks to be closest to being stand-alone economically, and will therefore likely dominate the first phase of renewable electricity rollouts. Solar power will need continued government support for some time in most areas. Some alternatives are not renewable (gas-to-liquids, coal-to-liquids, clean coal).

Nuclear power is a ready-made answer to carbon emission control but is struggling to overcome entrenched popular resistance in most countries.

First-generation biofuels (corn, wheat, ethanol, and biodiesel) will help ease transportation fuel bottlenecks, but their tightening impact on global food markets will limit scalability, we think. Cellulosic ethanol is still some way off.

In capital goods, we see sustainable medium-term potential for those companies involved in demand-side efficiencies. The supply-side effects of much more wind power and a possible future revival of nuclear power will also bring benefits.

We see the rise of alternative energy potentially pushing medium-term oil demand growth down from our base case of 1.5% per annum to 1% per annum, lowering the required conventional oil supply by 7 MMBD by 2020.

How to invest? There are many different ways to invest in alternative energy. To help shorten the list, we identified 30 key stocks that have meaningful leverage to the themes of alternative energy, renewable energy, and global climate change. These stocks are grouped as the *Credit Suisse Alternative 30*.

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Alternative Energy at Credit Suisse

As the evidence surrounding climate change becomes compelling, the social, economic, political, and (increasingly) legislative debate has become more intense and complex. Drawing definitive investment conclusions are difficult, with the goalposts often shifting. The potential implications cut across many varied industry groups and geographies.

The breadth of platform offered by Credit Suisse's comprehensive global research coverage allows us to provide investors with a way to navigate the risks and opportunities in this increasingly significant arena. Indeed, we already estimate that some 350 publicly listed companies around the world are in some way sensitive to alternative energy and global warming.

This research spans the full spectrum of our Global Research Team: we draw together analyses from our strategists and from eight of our global industry teams to focus on the principal issues at the heart of the subject. We draw out the implications for companies directly affected but also the more lateral plays that can often provide the more investable opportunities.

We have also brought to bear insights offered by Credit Suisse's unique valuation tool, HOLT® and its cash-flow-based CFROI® framework. This allows us to provide the broadest possible analysis of companies given the depth of HOLT's company coverage and also an assessment of the expectations already embedded in these stocks as a guide for investors.

As comprehensive as this report may be, it can in no way mark the final word in terms of its investment conclusions. We see it more as a primer on the topic of alternative energy and of the associated themes.

We intend to revisit the subject on a regular basis in single-issue reports in the weeks and months ahead as the implications broaden. As part of its commitment to thematic research, Credit Suisse Research intends to remain at the heart of this debate among investors.

Stefano Natella—Global Head of Equity Research

Richard Kersley—Head of European Equity Research Product

Lara Warner—Head of U.S. Equity Research

How to Read This Report

Alternative energy is a hot topic and also a broad one. This report aims to bring forward areas for further research. We have split the report into six main sections.

1. **Introduction and Overview.** Global warming and investment strategy, overview of alternative energy, key stock recommendations, stock exposure maps.
2. **The Alternatives.** Renewable electricity, biofuels, other alternative fuels, other alternative energy systems.
3. **The Laterals.** Capital goods, aviation efficiency, building efficiency, U.S. auto trends, the rise of diesel and hybrids.
4. **The Impact on Oil & Gas.** Stock selection in an alternative world, oil supply remains challenged, global gas still looks like a winner, the IEA's Alternative Policy Scenario.
5. **Carbon Trading and Capture.** European Emissions Trading (EETS), carbon mitigation by the consumer, carbon capture and sequestration/storage.
6. **Valuation and Description.** Alternative energy through the HOLT® lens, valuation tables and stock watch list, performance charts, company descriptions.

Introduction

Global warming and climate change. Our global strategist looks at global warming and climate change and suggests investment responses to the various subthemes.

There is an alternative. We set the scene with an overview of the main alternative energy areas (wind, solar biofuels, demand-side efficiency, etc.). We identify our favorite stocks within the broad alternative energy theme.

Alternative energy maps. A visual representation of exposure to the alternative energy space by subsegment and market capitalization.

The *Credit Suisse Alternative 30*. How to play the themes in this report.

The Alternatives

Renewable power generation. Renewable power already has a great platform and fits perfectly with targets for lower carbon emissions. However, stand-alone economics are still challenged. Wind power appears to be the best positioned right now.

Renewable economics. Most renewable energies require some government support in Europe and the United States to make them fully economical today.

The cost of a renewables rollout. A U.S. case study in how much it might cost to meet various renewable energy targets by 2020.

Renewables regulation. Targets and subsidies are still very much a local affair, with a surprisingly wide array of policies already in place.

Wind power. The best positioned renewable, with big potential in Europe and the U.S.

Solar power. Still expensive but benefiting from economies of scale, government support, and potential technological breakthroughs.

Nuclear power. Essentially renewable, but still battling for recognition as such. Nuclear power has to overcome political hurdles, and questions remain on uranium availability.

Biofuels. The trade-offs involved in turning agricultural products into transportation fuels. A detailed look at ethanol and biodiesel, and at rising food prices.

XTL feedstock to liquids. Both coal (CTL) and gas (GTL) can by synthesized into liquid fuels; although this is not a renewable, it is an alternative.

Micro-generation. How to generate up to 50 kW of electricity and 45 kW of thermal power.

Wave power. Still in is infancy, but the potential is huge—and so are the costs.

The Laterals

Capital goods. Demand-side drivers will likely be the most important. The supply-side implications of more renewable power and more "clean coal."

Asia energy efficiency plays. The renewal of aging capital stock plus the possibilities for leapfrogging technology development in some areas.

Civil aerospace. Tighter air travel emission limits may drive the replacement cycle.

Energy efficiency and advanced building materials. So far, a mainly European phenomenon; focus on insulation.

U.S. auto trends. Engine sizes are already shrinking in the U.S., and this should continue.

Hybrids or diesel, or both? We look at the comparative economics of diesels and of gasoline-battery hybrid vehicles in Europe and the United States.

The Impact on the Oil and Gas Sector

Alternatives will change the hydrocarbon balance. Alternative energy could lower oil demand growth by one-third, to 1% per annum, and will help promote natural gas.

Global oil supply outlook. Consuming governments will have more incentive to develop alternative energy if OPEC supplies a greater proportion of global oil in the future.

Global gas market outlook. The "cleaner hydrocarbon" looks set to be a winner in a world of carbon emission control.

The IEA Alternative Policy Scenario. The International Energy Agency estimates that Alternative Energy would "save" US$560 billion of required investment over the period 2004-2030.

Carbon Trading and Capture

EETS. The European Emissions Trading Scheme and how it works.

Consumer carbon mitigation. How to reduce your own carbon footprint.

Carbon capture and sequestration. Major changes in global energy infrastructure will be required if a significant amount of carbon is to be captured and stored.

Valuation and Descriptions

Alternative energy through the HOLT® lens. We use the HOLT® tool to evaluate the various alternative energy subsectors.

Alternative energy stock watch lists. Comparative valuation tables for identified plays on alternative energy in Europe, North America, and elsewhere.

Share price performance charts. One- and three-year performance.

The Credit Suisse Alternative 30

The *Credit Suisse Alternative 30* highlights stocks under coverage at Credit Suisse that should be strong beneficiaries of the trend toward lower emissions from fossil fuel combustion, more nuclear and alternative fuels, and more demand-side energy efficiencies. The main groupings follow.

- *Nuclear.* Net nuclear capacity could increase by as much as 57% over the next 15 years. Alstom, ABB, and Shanghai Electric Group are all exposed to this expansion. Uranium, which is already in short supply, is another potential beneficiary. Cameco accounts for 20% of world uranium mine production.
- *Solar.* For the time being, this is a high-cost alternative, but given substantial R&D the costs should continue to fall. In China, we expect solar capacity to reach 2,000 MW by 2020 (compared with 65 MW in 2005). Beneficiaries include Q-Cells, REC, SunPower, and Tokuyama.
- *Wind.* This is economical with oil at US$60-80 even without a subsidy. EDF Energy, Nouvelles, FPL, and Iberdrola all offer significant exposure to wind energy and associated strong growth rates.
- *Biofuel.* While not that economical in Europe, biofuel is a sensible option in more tropical areas. Cosan (Brazilian ethanol producer) is competitive with oil at US$35/bbl. Palm oil plays in Malaysia (IOI Corporation, Golden Hope) also make sense. Agricultural productivity will need to rise—hence, the inclusion of Deere and Kubota.
- *Demand-side efficiencies.* The IEA estimates that 80% of the reduction in emissions could come from demand-side efficiencies. More efficient light bulbs, air conditioning, jet engines, cars, electricity transmission, and distribution systems are a few of the themes. Boeing, BorgWarner, Continental, Implats, Johnson Controls, and Schneider offer exposure to this part of the theme.

Exhibit 1: The *Credit Suisse Alternative 30*

Company	Region	Recommendation
Solar		
Q-Cells AG	Europe	OUTPERFORM
Renewable Energy Corp.	Europe	OUTPERFORM
Sino-American Silicon	International	OUTPERFORM
SunPower Corp.	North America	OUTPERFORM
Tokuyama Corporation	International	OUTPERFORM
Biofuels		
Cosan SA Industria Comercio	International	OUTPERFORM
Golden Hope Plantations Bhd.	International	OUTPERFORM
IOI Corporation Bhd.	International	OUTPERFORM
Utilities		
EDF Energies Nouvelles SA	Europe	OUTPERFORM
EDF	Europe	NEUTRAL
Fortum Oyj.	Europe	NEUTRAL
FPL Group Inc.	North America	NEUTRAL
Iberdrola SA	Europe	NEUTRAL
Capital Goods		
ABB Ltd.	Europe	OUTPERFORM
Alstom	Europe	OUTPERFORM
BorgWarner Inc.	North America	OUTPERFORM
Continental AG	Europe	OUTPERFORM
General Electric Co.	North America	OUTPERFORM
Johnson Controls Inc.	North America	NEUTRAL
Kubota Corp.	International	NEUTRAL
Schneider Electric SA	Europe	NEUTRAL
Shanghai Electric Grp Co.	International	OUTPERFORM
Siemens	Europe	OUTPERFORM
Spirax-Sarco Engineering Plc.	Europe	NEUTRAL
Laterals		
Boeing	North America	OUTPERFORM
Deere & Co.	North America	OUTPERFORM
Impala Platinum Holdings Ltd.	International	OUTPERFORM
GTL		
Sasol Ltd.	International	NEUTRAL
Nuclear		
Cameco Corp	North America	OUTPERFORM
Natural Gas		
BG Group Plc.	Europe	NEUTRAL

Source: Credit Suisse.

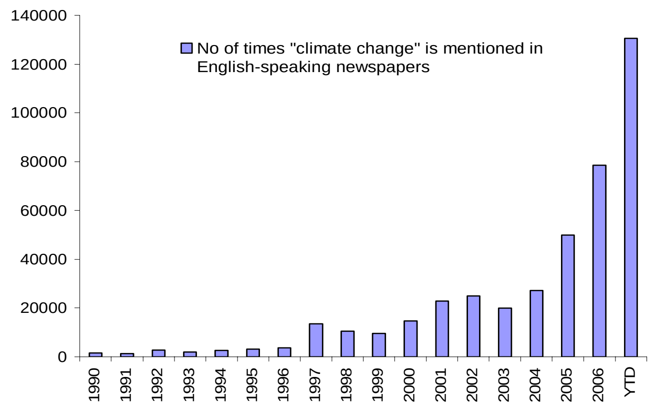
Global Warming and Climate Change

Andrew Garthwaite

There are four reasons why we believe the issues related to global warming need to be tackled:

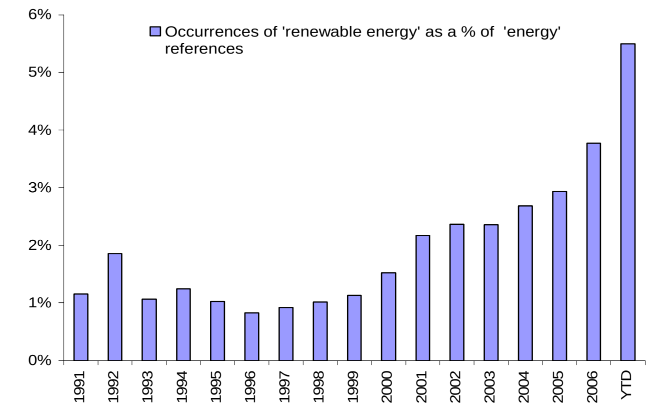
1. There is overwhelming evidence that it is happening and that it can be linked to the rise in carbon dioxide. The onus now is for scientists to prove that this is not a problem rather than the other way around.
2. Global warming has hit the public/political conscience. (See Exhibit 1 and Exhibit 2.)

Exhibit 1: News Flow on Climate Change Clearly Picking Up



Source: Factiva.

Exhibit 2: Renewable Energy an Increasing Area of Interest



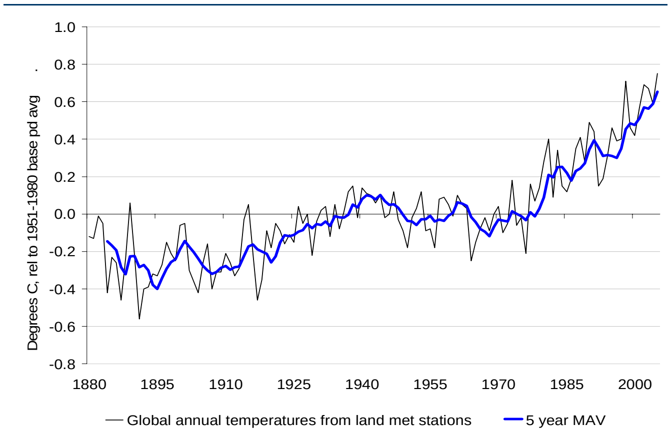
Source: Factiva.

3. Legislation is being passed.
4. Energy efficiency in consumption makes sense despite the threat of global warming given the economics of high fuel prices.

The Evidence

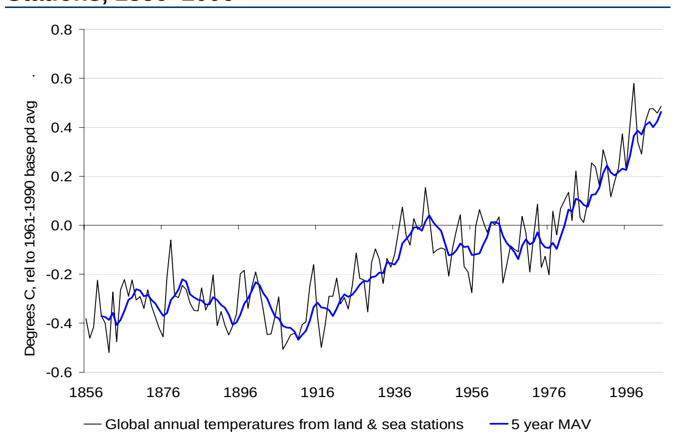
A very consistent set of data shows the global temperature is rising. Evidence is available from a variety of sources: land and sea meteorological stations, ice cores, and tree rings.

Exhibit 3: Temperature Readings from Land Stations, 1880–2006



Source: NASA GISS Surface Temperature (GISTEMP) Analysis.

Exhibit 4: Temperature Readings from Land and Sea Stations, 1856–2006



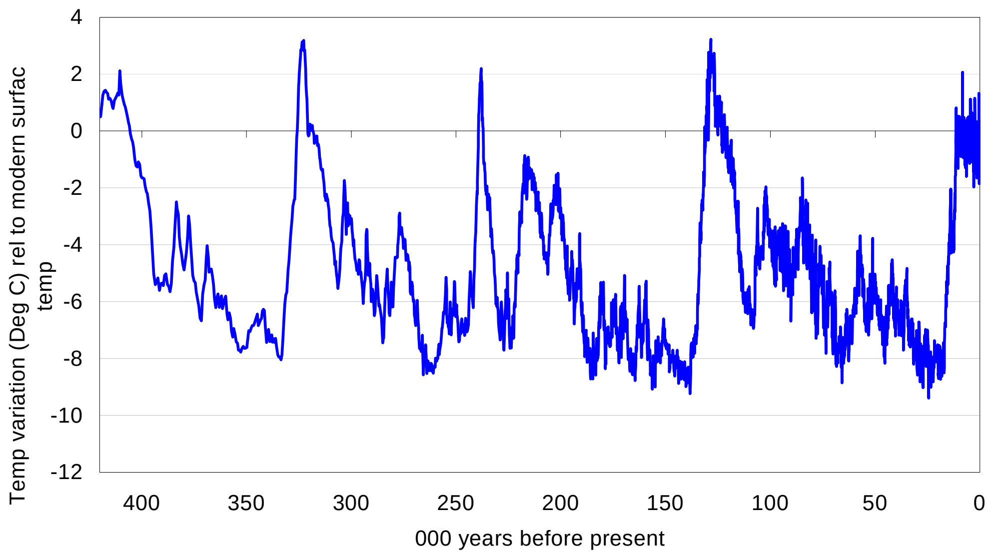
Source: NASA GISS Surface Temperature (GISTEMP) Analysis.

As illustrated in Exhibits 4 and 5, the global temperature is up 0.76°C over the past 150 years, with the strongest rises recorded since the early 1970s. Furthermore, 11 of the last 12 years (1995-2006) rank among the 12 warmest years in the instrumental record of global surface temperature (since 1850). In its *Fourth Assessment* report (February 2, 2007, the Intergovernmental Panel on Climate Change (IPCC) spelled it out in no uncertain terms: *"Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level."*

That the temperature has risen is not a particularly contentious point among scientists. The charts speak for themselves. However, skeptics of the global warming phenomenon point out that this rise in temperature could simply be part of the long-run cycle (caused, for instance, by small variations in the earth's orbit).

Long-run data sets show that the rise in temperature over the last century is not significantly out of step with previous cycles. One such set of data is the time series of temperature readings derived from the ice-core drilled in Vostok, Antarctica.

Exhibit 5: **Temperature Variation over the Past 400,000 Years (from the Vostok Ice Core)**

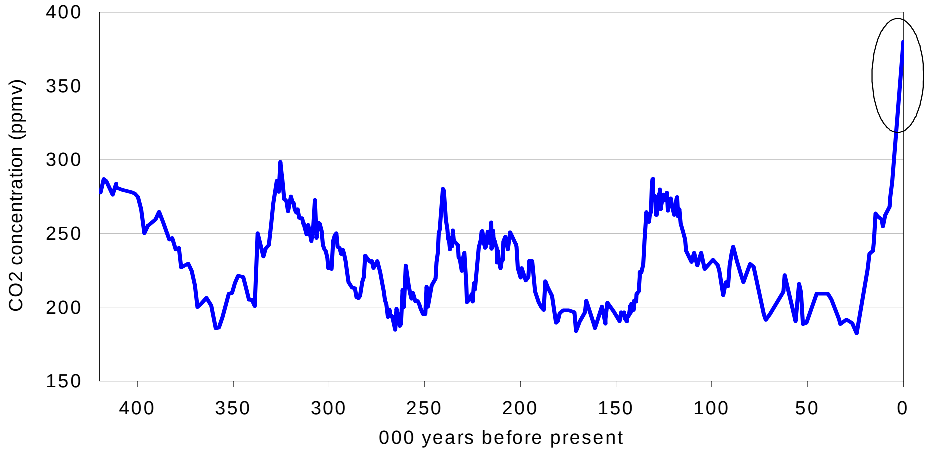


Source: Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy.

Exhibit 5 illustrates the point: according to the Vostok data, there have been four other periods in the past 400,000 years that have seen similar rises and levels of temperature as those recorded today.

However, the significant concern is that the corresponding data on CO_2 concentrations show a dramatic increase in the last 150 years, well outside the range established in the previous 400,000 years.

Exhibit 6: CO_2 Concentration in the Atmosphere over the Past 400,000 Years (from the Vostok Ice Core)



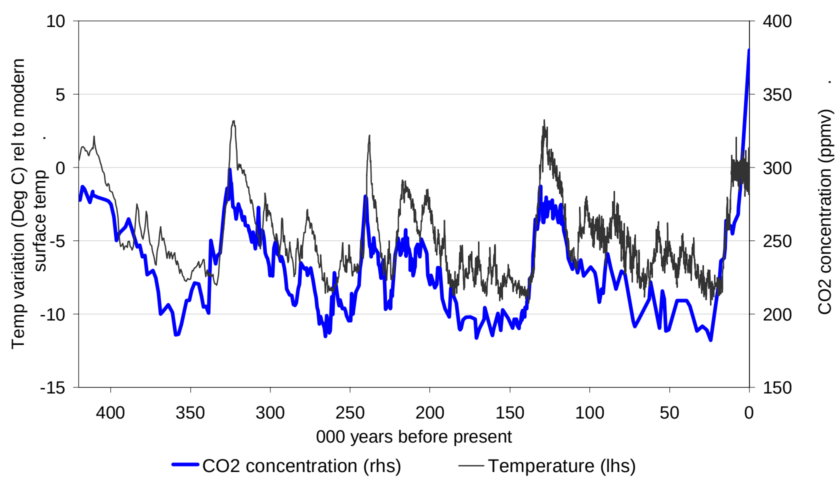
Note: ppm (parts per million) is the ratio of the number of greenhouse gas molecules to the total number of molecules of dry air. E.g. 300 ppm means 300 molecules of a GHG per million molecules of dry air.
Source: Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. DOE.

As Exhibit 6 shows, the 2005 level of CO_2 concentrations (at 379 parts per million [ppmv] by volume) is some 5 standard deviations above the 400,000-year average. This sharp rise in CO_2 concentration corresponds with the activities of the modern industrial age—in other words, burning fossil fuels.

How much of the rise in CO_2 concentration is attributable to the energy released from fossil fuels? Data from the IEA show that over the 1990s, the carbon release from fossil fuel combustion averaged 6.4 GtC (gigatonnes of carbon) *per annum,* or 23.5 Gt CO_2. Add to this the carbon released by deforestation (about 1.6 GtC per annum) and we can calculate that human activities in the 1990s alone would have increased the CO_2 concentration in the atmosphere (*ceteris paribus*) by 40 ppmv. Extrapolate the trend over the last 150 years and it is easy to understand how the CO_2 concentration has increased so dramatically.

The Vostok data are worrisome because there is a clear correlation between CO_2 concentration and temperature. We combined the two sets of data in Exhibit 8.

Exhibit 7: CO_2 Concentration in the Atmosphere and Temperature over the Past 400,000 Years (from the Vostok Ice Core)



Source: Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. DoE.

- *The feedback mechanism.* Historically, it may have been the case that rises in temperature (driven by orbital variations or solar flare) preceded rises in CO_2. As temperatures rose, the atmospheric concentration of CO_2 increased as, for instance, the rate of plant decay increased. In turn, higher levels of CO_2 influenced climate via the greenhouse effect. Additionally, the warming of the Arctic tundra accelerates the release of CO_2 as does the reduced reflection of light from melting polar ice caps. Thus there is a classic, positive feedback between the two. This helps explain the very rapid rises in temperature and CO_2 that have historically occurred.

- *Temperature rise lags CO_2 increase.* This time around it is arguably the rise in CO_2 levels that is driving the rise in temperatures. Why haven't temperatures matched the sharp increase in CO_2? This is probably due to the ability of the oceans to function as a heat sink and thereby delay the increase in atmospheric temperatures. The IPCC notes that since 1961, observations show that the average temperature of the global ocean has increased to depths of at least 3,000 meters and that the ocean has been absorbing more than 80% of the heat added to the climate system. This leads to two further concerns: (1) warming causes seawater to expand, contributing to the sea level rise, and (2) the warmer the water relative to the atmosphere, the lower the water's ability to act as a heat sink.

- *The ultimate circuit breaker.* The current interglacial period is the longest on record. Paleoclimatologists further suggest that interglacial periods come to an end when polar ice caps melt rapidly and increase the amount of fresh water in the subpolar oceans, thereby altering the thermohaline circulation patterns that govern global climate. The thermohaline "conveyor belts" essentially shut down and stop moving warm water and air away from the equator toward the poles. The end result is colder water and air temperatures. Researchers from the U.K.'s National Oceanography Centre in 2005 found that the Gulf Stream had already slowed by 30% over the past 12 years.

- *Other greenhouse gases.* In addition to CO_2, the global atmospheric concentration of other greenhouse gases (GHGs) has also increased. Exhibit 9 summarizes the trends.

Exhibit 8: Major Greenhouse Gas

	Current reading	Pre-industrial level	650,000 yr range	Growth rate
Methane	1774 ppb	715	320 - 790 ppb	Slowing
Nitrous Oxide	319 ppb	270	NA	Constant since 1980
CO_2	379 ppm	280	180 - 300 ppm	Avg rate in last 10 yrs = 1.9 ppm per annum; avg rate bet 1960 and 2005 =1.4 ppm per annum.

Source: IPCC AR4, Stern Review.

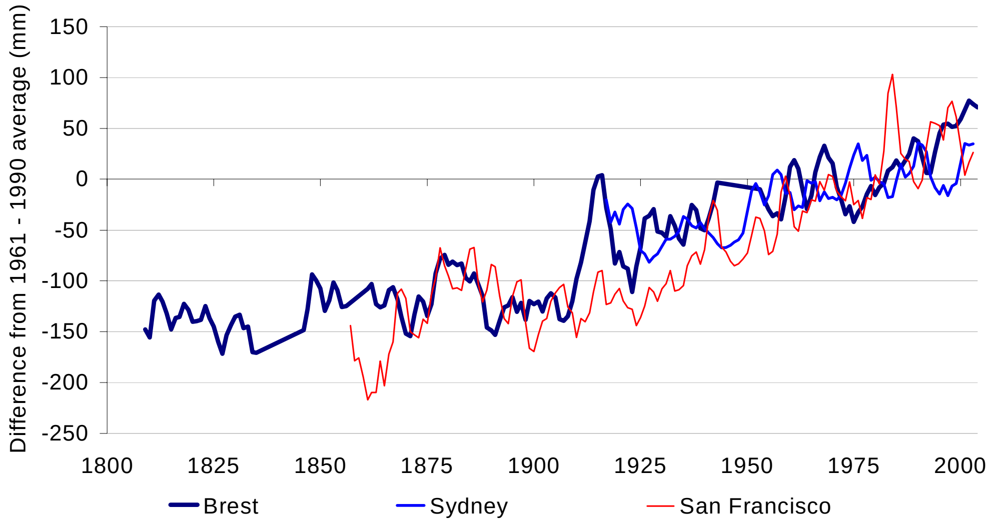
What Next?

The *Fourth Assessment* report from the IPCC predicts a temperature increase for this century of 2.0-4.5°C. Where we end up on this scale depends on the quantity of fossil fuels burned.

The most obvious effects of global warming can be allocated to two broad categories: rising sea levels, and changing climate and weather patterns.

- *Rising sea levels.* Sea level rise can be a product of global warming through two main processes: expansion of sea water as the oceans warm and melting of ice over land. The sea level has risen around 130 meters since the peak of the last ice age about 18,000 years ago. Most of the rise occurred before 6,000 years ago. From 3,000 years ago to the start of the 19th century, the sea level was almost constant, rising at 0.1-0.2 millimeters per year (mm/year). Since 1900, the level has risen at 1-3 mm/year. Since 1992, satellite altimetry indicates a rate of rise about 3 mm/year. *The total rise in sea level over the 20th century is 17 cm.* Exhibit 10 illustrates the observations taken at three long-running measuring stations.

Exhibit 9: Sea Level (Relative to 1961–1990 Averages) for Sydney, San Francisco, and Brest (Three-Year Moving Average)



Source: PSMSL (Permanent Service for Mean Sea Level).

The IPCC estimates the contribution to sea level rise from four main sources: thermal expansion, Greenland, Antarctica, and all other glaciers. So far, the main contributor is estimated to be smaller glaciers and ice caps.

Exhibit 10: Sources of Sea Level Rise

Source of sea level rise	Rate of sea level rise (mm per year) 1961—2003	1993—2003
Thermal expansion	0.42 ± 0.12	1.6 ± 0.5
Glaciers and ice caps*	0.50 ± 0.18	0.77 ± 0.22
Greenland ice sheet	0.05 ± 0.12	0.21 ± 0.07
Antarctic ice sheet	0.14 ± 0.41	0.21 ± 0.35
Sum of individual climate contributions to sea level rise	1.1 ± 0.5	2.8 ± 0.7
Observed total sea level rise**	1.8 ± 0.5	3.1 ± 0.7

**excluding Greenland and Antarctica.*
*** Data prior to 1993 are from tide gauges and after 1993 are from satellite altimetry.*
Source: IPCC.

In February 2007, the IPCC's Fourth Assessment *report predicted that by 2100, global warming will lead to a sea level rise of 19-58 cm. (31 cm if the increase in sea levels between 1993-2003 is maintained.)*

Contraction of the Greenland ice sheet is projected to continue to contribute to the sea level rise after 2100. At relatively high increases in global temperature (about 4.5°C), the risk is that the Greenland ice sheet would be completely eliminated, which would raise the sea level by about 7 meters.

Current global model studies project that the Antarctic ice sheet will remain too cold for widespread surface melting and will gain in mass due to increased snowfall. If it were to melt, the IPCC estimates that Antarctica would contribute more than 60 meters of sea level rise.

IPCC assessments suggest that deltas and small island states may be particularly vulnerable to sea level rise. *Relative* sea level rise (mostly caused by subsidence) is causing substantial loss of lands in some deltas. *Serious risks are to Bangladesh, Vietnam and the Netherlands, small islands in the Caribbean and the Pacific, and large coastal cities: Tokyo, New York, New Orleans, Cairo, and London.*

- *Changing climate and weather patterns.*

Exhibit 11: Recent Climate Trends and Forecasts

	Recent trends and forecast
Temperature	Up 0.76°C over the last 150 years. High latitude areas such as Canada, Russia, and the Arctic are warming more rapidly than the tropics. The IPCC calculates a rise of 2.0-4.5°C in global surface temperature over the rest of this century.
Precipitation	Increases in the level of precipitation are expected in high latitudes, while decreases are likely in most subtropical land regions. Within each land mass it is generally expected that the West Coast will see lower levels of precipitation while the East Coast will be wetter.
Snow cover	Projected to contract. Thaw depth over most permafrost regions is projected to increase. Melting glaciers increase flood risk and then reduce water supplies. Areas particularly at risk are in the Indian subcontinent, China, and the Andes.
Sea-ice	Projected to shrink in both the Arctic and Antarctic under all scenarios. In some projections, Arctic late-summer sea ice disappears entirely by the end of 21st century.
Hurricanes and tropical storms	Intensity and frequency of hurricanes appears to have increased in the Gulf of Mexico (although the data is not conclusive). The IPCC predict storms are likely to become more intense with higher wind speeds and heavier precipitation.
Vegetation	Crop yields in subtropical regions look set to decline. Worst affected may be Africa and parts of Southern Europe. (Crop yields in S Europe are expected to decline 20% with a 2°C increase in temperatures.) At high latitudes, crop yields may increase with moderate temperature rises. Beyond 4.5°C, all crop yields look set to suffer.
Eco-systems	Around 15-40% of species face long-term negative effects after only 2°C in warming.
Ocean acidification	Increasing CO_2 concentrations leads to increasing acidification of the ocean. Since the start of the 20th century, ocean pH has decreased by 0.1 units. Forecasts suggest a further fall in ocean pH of 0.14 and 0.35 units over 21st century. This is likely to have major effects on marine life, with adverse effects on fishing stocks.

Source: IPCC, Stern Review, Nature.

Legislation

With this array of evidence and the forecasts of further detrimental trends in the climate, legislation to tackle the issues is accumulating.

The most well-known legislation on GHG emissions is probably the Kyoto Protocol. Adopted by the United Nations Framework Convention on Climate Change (UNFCCC) at its third meeting in Kyoto in 1997, this treaty was legalized in February 2005.

Under the Kyoto Protocol, some countries undertook binding emission caps to be achieved between 2008 and 2012. The overall aim was a reduction in emissions of 5.2% relative to 1990 levels, with different countries undertaking different targets within that total.

Exhibit 12: Kyoto Protocol: Greenhouse Gas Emission Targets

	Target (relative to 1990)
EU-15	-8%
Bulgaria, Czech Republic, Romania, Switzerland	-8%
U.S.	-7%
Canada, Hungary, Japan, Poland	-6%
Croatia	-5%
New Zealand, Russia, Ukraine	0%
Norway	+1%
Australia	+8%
Iceland	+10%

Source: UNFCCC.

Is Kyoto on track? Data from the European Environment Agency show that “with existing domestic policies and measures, total EU-15 greenhouse gas emissions will only be 0.6% below base-year levels in 2010.” Taking into account additional domestic policies and measures being planned by member states, a total EU-15 emissions reduction of 4.6% is projected.

Hitting the 8% reduction target therefore requires (1) the use of carbon sinks (such as forests), which could soak up an additional 0.8% of emissions and (2) the use of offsetting mechanisms. Offsets are available via the Clean Development Mechanism (CDM), or Joint Implementation (JI) projects, which allow member states to undertake emission reduction measures elsewhere in the world. In 2005, CDM contracts worth US$5.6 billion changed hands. CDM projects are expected to add approximately 2 billion tons of CO_2 allowances by 2012.

Nevertheless, despite potential shortcomings on current Kyoto targets, the E.U. has unilaterally promised to deliver further aggressive cuts in emissions. The latest plan is 20% reduction in emissions relative to 1990 levels by 2020.

China was not involved in the Kyoto Protocol, and the U.S. and Australia did not ratify the treaty and are today not bound by these emission controls.

The U.S. did go on to develop the Asia-Pacific partnership on Clean Development and Climate (AP6) with five Asia-Pacific nations in July 2005. However, since there are no binding targets in this agreement, it is not clear what will actually be achieved. At the U.S. state level, developments have been more concrete. See points 5 and 6 in the summary below on U.S. state targets for renewable energy and the Regional Greenhouse Gas Initiative (RGGI) designed to cap emissions from utility companies in nine of the U.S. states.

Further legislation looks highly likely across the board. In the U.K., the government's annual legislative calendar from mid-November 2006 stated that a climate change bill would be introduced in the 2006-07 parliamentary session, and that this bill would include statutory commitments to reduce GHG emissions by 60% relative to 1990 levels by 2050. In the U.S., leading candidates for both the Democratic and Republican presidential nominations support mandatory GHG emission limits.

The Response to Global Warming

The response to global warming and climate change can be divided into three broad categories:

- *Supply side*. The aim is to produce energy more efficiently and to reduce emissions. We consider the implications for nuclear energy, natural gas, clean coal, bio-fuels, and other energy alternatives in points 1-5 in the summary below, as well as in more detail later in the report. Carbon trading is one policy initiative used to encourage supply-side efficiency. (See point 6.)
- *Demand side*. More efficient end-user appliances and lower consumer demand for electricity reduce the need to burn as much fossil fuel. Energy-saving light bulbs, more efficient air conditioners and freezers, and turning off stand-by buttons are a few examples. (See point 7.)
- *Adaptation*. Measures such as strengthening flood defenses can be taken to adapt to the effects of climate change.

Supply Side

Today U.S. and European generating capacity is dominated by fossil fuel combustion. However, some utility companies already exhibit an above-average exposure to non-fossil-fuel generation, as we show in Exhibit 13.

Exhibit 13: Utility Companies' Exposure to Renewable and Nuclear Fuel
% of revenues

Company	Region	Wind	Geothermal	Hydro	Nuclear	Total
EDF Energies Nouvelles SA	Europe	79%	15%			94%
Kansai	Japan	1%		11%	46%	58%
Kyushu	Japan	3%		5%	44%	52%
Iberdrola SA	Europe	9%		14%	27%	50%
Exelon Corp.	U.S.				50%	50%
Hokuriku	Japan			20%	30%	50%
Shikoku	Japan	0%		7%	39%	46%
Hokkaido	Japan	3%		14%	26%	43%
TEPCO	Japan	1%		6%	35%	42%
Entergy Corp.	U.S.				40%	40%
Constellation Energy Group	U.S.				40%	40%
Public Service Enterprise Group	U.S.				40%	40%
EDP	Europe	4%		33%	2%	39%
FPL Group	U.S.	20%			15%	35%
Tohoku	Japan	3%		15%	15%	33%
ENEL Spa	Europe	5%	27%	1%		33%
Chubu	Japan			7%	23%	30%
Fortum Oyj	Europe			18%	21%	39%
ACEA Spa	Europe	6%		16%		22%
International Power Plc	Europe	1%			19%	20%
Chugoku	Japan			6%	14%	20%
Scottish Power Plc	Europe	11%		4%		15%
AEM Spa	Europe			13%		13%
China Light and Power	HK			2%	6%	8%
Scottish & Southern Energy	Europe	1%		7%		8%
E.ON AG	Europe	<1%		1%	4%	5%
RWE AG	Europe			1%	4%	5%

Source: Company data, Credit Suisse estimates.

In points 1 to 5 below we look at the plans to shift supply toward cleaner sources.

1. Nuclear

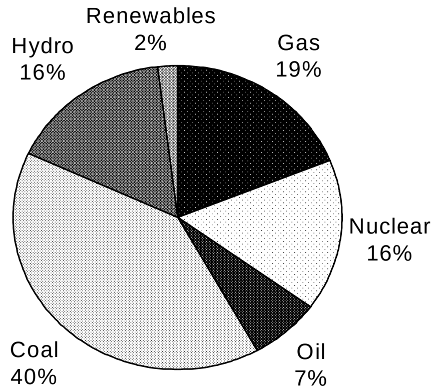
There is a significant body of opinion that believes nuclear power is the only sensible long-term answer to climate change. (We on the Global Strategy Team certainly believe this to be the case.)

Nuclear power's negatives (security of facilities, how to dispose of nuclear waste, radiation safety) are already well known and have been identified as problems for at least 55 years, (the age of the U.K.'s oldest nuclear plant.)

The positives, however, are immense: no CO_2 emissions as well as security of supply at a time when oil supplies from OPEC and gas supplies from Russia look vulnerable owing to logistical and political issues. Clearly the problem with many alternative energies is that they are either very expensive (solar), intermittent (wind/solar), or have other undesirable environment consequences (wind farms are unsightly, palm oil/sugar production exacerbates deforestation).

There are currently 435 nuclear power reactors in 30 countries (plus Taiwan), with a combined capacity of about 370 Gwe. In 2005, these provided 2,626 kWh, about 16% of the world's electricity needs.

Exhibit 14: Global Electricity Generating Capacity



Source: BP Statistical Review of World Energy.

Increased nuclear capacity in some countries is resulting from the expansion of existing plants (particularly in the U.S., Belgium, Sweden, and Germany). Twenty-eight power reactors are currently being constructed in 11 countries, notably in China, South Korea, Japan, and Russia. A further 64 are in the planning stage and over 150 more are proposed.

Exhibit 15: Current and Forecast Nuclear Electricity Generation

	Nuclear elec generation 2005	Reactors operable (Jan 07)	Reactors under construction	Reactors planned	Reactors proposed					
	billion kWh	% share	No	Mwe	No.	Mwe	No.	Mwe	No.	Mwe
Brazil	9.9	2.5	2	1901	0	0	1	1245	4	4000
China	50.3	2	10	7587	5	4170	13	12920	50	35880
France	430.9	78.5	59	63473	0	0	1	1630	1	1600
Germany	154.6	31	17	20303	0	0	0	0	0	0
India	15.7	2.8	16	3577	7	3178	4	2800	15	11100
Japan	280.7	29.3	55	47700	2	2285	11	14945	1	1100
Korea	139.3	44.7	20	17533	1	950	7	8250	0	0
Russia	137.3	15.8	31	21743	3	2650	8	9600	18	21600
U.K.	75.2	19.9	19	10982	0	0	0	0	0	0
U.S.	780.5	19.3	103	98254	1	1200	2	2716	21	24000
World	2626	16	435	368860	28	22735	64	68861	158	124225

Source: World Nuclear Association.

According to the International Atomic Energy Agency (IAEA), six nuclear power plants are currently in long-term shutdown mode, which will take out 3,879 Mwe of generating capacity. If we tally up the new generation capacity from the 28 reactors under construction and the 94 reactors either planned or proposed to be built, and adjust for the six plants that are in long-term shutdown, then capacity could rise by 57% from current levels.

As detailed in Exhibit 15, the greatest absolute and relative increase in nuclear capacity is taking place in China.

According to our Asian Utilities Team, the Chinese government is targeting a rise in nuclear power to 4% of total power by 2020 from 2% currently. This represents a 31 GW increase in nuclear power production, with an estimated annual investment between 2010-20 of US$3.6 billion. *Shanghai Electric Group* looks the best positioned geographically (as most new power stations will be built around eastern coastal regions). *Alstom* is the number 1 player globally in nuclear power (most of its other businesses also benefit, directly or indirectly, from increased concerns on global warming), with about 5% of current sales from nuclear-related business. Builders of nuclear-related equipment are listed in Exhibit 16.

Exhibit 16: Companies with Exposure to Nuclear-Related Equipment

Company	Sales Exposure (% of historical sales)
AECL	6% of worldwide nuclear reactors
Siemens	5% of business from nuclear
Alstom	No 1 in building conventional 'island' for nuclear, 5% of sales (40% coal;6% pollution control in coal, 40% rail)
ABB	45% T&D
Areva	70% nuclear
General Electric	6% of energy business, 3% of infrastructure segment; 1% of manufacturing sales
Mitsubishi Heavy Industries	6% of sales
Ishikawajima-Harima Heavy Industries	2% of sales
Shanghai Electric	5% power generation, 14% T&D

Source: Company data, Credit Suisse research.

The power utilities with a heavy nuclear exposure are listed in Exhibit 18. Clearly a more pro-nuclear world will see increased subsidies for nuclear and probably longer lives for nuclear power plants. These are more indirect plays, but an extension of nuclear plant life would be beneficial for the German power companies (e.g., it would add about 3-5% to valuations, according to our analysis).

Exhibit 17: Power Generators with Significant Nuclear Exposure

Company	Region	Nuclear exposure (% of historical sales*)
British Energy	U.K.	80%
EdF	Europe	83%
Fortum	Europe	50%
Suez (Electrabel)	Europe	40%
E.ON	Europe	31%
Iberdrola	Europe	28%
Exelon	U.S.	50%
Entergy	U.S.	40%
KEPCO	Korea	42%
Kansai	Japan	46%
Kyushu	Japan	44%
Shikoku	Japan	39%
TEPCO	Japan	35%

** % of generation in Japan.*

Source: Company data, Credit Suisse research.

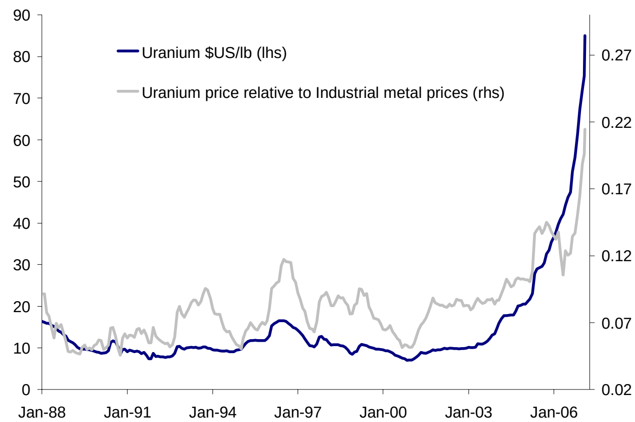
The third way to play the nuclear trend is through the companies responsible for recycling nuclear waste. (They are responsible for about a fifth of uranium supply.) However, direct plays tend to be unlisted or there are limitations given strategic security concerns (for instance, reprocessing nuclear fuel in the U.S. is prohibited given concerns about access to plutonium for building bombs). The exception is *Areva* in France where nuclear fuel enrichment and recycling account for roughly 23% of sales. There are smaller-cap plays such as *INS* and *Redhall*.

The fourth nuclear power play is *uranium*. Since 2001, uranium prices have been increasing fast, owing to increasing nuclear electricity generation capacity, increasing reactor fuel requirements, and falling inventories of uranium.

The uranium production industry is fairly focused, with a small number of companies operating in relatively few countries. In 2005, eight producers provided approximately 80% of the estimated world production of 108 million pounds of U_3O_8. However, production from world uranium mines supplies only 62% of the requirements of power utilities. Twenty percent of demand is sourced from recycling and producer/consumer inventory (likely to be depleted over the next few years), and the other roughly 20% comes from highly enriched uranium (HEU) derived from the dismantling of Russian nuclear weapons. (The HEU treaty ends in 2013.)

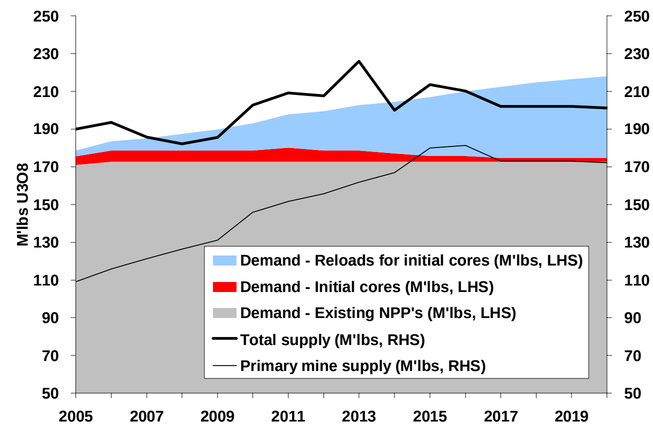
High prevailing prices reflect two decades of underinvestment. Our Global Mining Team does not expect the uranium market to return to balance for some time (5-10 years).

Exhibit 18: Uranium Price
US$/lb



Source: Datastream.

Exhibit 19: Uranium Supply and Demand



Source: Credit Suisse Global Mining Team.

Eight mining companies control 78% of world mine production.

Exhibit 20: Companies with Largest Uranium Production

Companies with largest Uranium mine production (both listed and state owned)	tonnes of mine production	% of world mine production	Uranium revenues as a% of company total revenues
Cameco	8276/td>	20	77%
Rio Tinto	5583	13	1%
Areva	5174	12	66%
KazAtomProm	4032	10	n/m
BHP Billiton	3688	9	1%
TVEL	3431	8	n/m
Navoi	2300	6	n/m

Source: Word Nuclear Association, Credit Suisse research.

Exhibit 21: Large-Cap Listed Uranium Pure Plays

Large cap listed Uranium pure plays	Uranium revenues as a% of company total revenues
UrAsia Energy*	100%
Energy Resources of Australia	99%
Denison Mines	79%
Cameco	77%
Areva	66%
SXR Uranium One	NA

** in the process of being acquired by SXR.*
Source: Worldscope, Credit Suisse research.

2. Lower CO_2 Emissions from More Conventional Power Generators

The second supply-side shift toward cleaner energy sources involves holding down CO_2 emissions in conventional electricity generation.

There are three strands to this argument.

- Natural gas wins over other fossil fuels.
- Lower emission “clean coal” technology may benefit.
- Carbon capture and sequestration should increase.

Natural gas wins relative to other fossil fuels. Natural gas has the highest heat transfer rate and the lowest carbon emissions of the fossil fuels. It is about half as dirty as coal, with 20% less nitrogen oxide, 95% less sulphur dioxide, 50% less CO_2. This might benefit the gas-fired power machinery makers and operators. General Electric is the leader in this field, according to our analysis. The growing problem with gas is its lower security of supply relative to coal, which is abundant in the U.S., China, and parts of Europe. The following companies have exposure to gas: 16% of *Siemens'* most recent revenue is power generation and T&D, 4% of GE’s revenue is from power generation, about 7% of *Alstom’s* revenue is from gas, *Mitsubishi Heavy Industries* generates revenues of around 6% from this area. Natural-gas-biased producers include *Bunge, XTO, Chesapeake, Quick Silver Resources, and Woodside.*

A move toward lower-emission “clean coal” technology. We believe that there is significant potential to reduce emissions from coal-fired power generation given the huge share of power produced from coal. The IEA estimates that coal accounts for 39% of global electricity production, and that the power sector accounts for 40% of the CO_2 emissions.

The latest equipment from *Alstom,* for example, reduces sulfur dioxide emissions by 80% compared with plants built during the 1980s, and new power plants are believed to be 50% more efficient at converting coal to energy, and hence reduce CO_2 emissions by a similar amount. Around 40% of Alstom’s current sales are from coal-fired power generation equipment and after-market service. Within five years, Alstom claims coal technology could be as clean as gas. *General Electric* and *Siemens* use coal to gas (IGCC) technology to achieve this. Other companies involved in this area are *Foster Wheeler, Mitsubishi, Hitachi*, and *GEA*. Alstom and Foster Wheeler make filters to reduce emission controls while most of the other companies simply produce more efficient forms of power generators.

We see substantial future opportunity for emissions scrubbers. Only a quarter of coal power plants and less than a quarter of total capacity is equipped with selective catalytic reduction (SCR) systems, which reduce the nitrous oxide emissions in flue gas as a secondary control. This helps the likes of Shaw Group, Washington Group, McDermott International, URS Corp. (small degree), and Fluor.

Carbon capture. One solution to greenhouse gas emissions is to capture the CO2 generated in power plants or industrial installations and store it underground, e.g., in depleted oil or gas fields or in underground water layers. The U.K. government’s recent *Stern Review on the Economics of Climate Change* suggests that up to 55% of future reduction in CO_2 emissions could come from carbon capture.

The main underground CO_2 storage potential is in saline water layers and in partially depleted oil and gas fields. These underground reservoirs allow for storage of significant amounts of CO_2, equivalent to decades or even hundreds of years of global emissions.

Carbon capture and storage (CCS) technologies offer the opportunity to continue using fossil fuels (coal, oil, natural gas) without causing significant emissions of CO_2. In addition, captured CO_2 may be used to enhance the output of oil (and to a lesser extent gas) in the respective fields. The high costs for capturing CO_2 could thus at least partially be offset by additional hydrocarbon recovery from existing fields.

There are two ongoing large-scale projects to test CO_2 storage: the Sleipner Project in the North Sea, off the Norwegian coast (storage in a deep underground saline water reservoir), and the Weyburn Project in Canada (storage in an oil field).

The main capture potential is in the electricity sector, but interesting opportunities exist in the fuels processing and industrial sectors as well. Most CO_2 is currently released in coal-fired power plants. More than half of the potential of CCS is associated with coal-fired processes. CCS could start on a large scale in IEA member countries from 2015 onward. Today the cost of capturing and storing CO_2 ranges from $50 to $100 per tonne. Costs could potentially fall to $25-50 by 2030, but more efforts in research and development would be required. Even if costs are reduced, policy incentives would be needed to stimulate the market uptake of CCS technologies. Emissions trading systems may offer such incentives, if carbon prices are high enough to make CCS competitive.

Some oil companies are experimenting with CCS (e.g., Statoil, Shell, BP) and the capture technology required will probably benefit certain chemical companies (e.g., BSF).

3. Biofuels

There is still significant growth ahead in bio-fuels despite the huge rise in input costs, which is undermining profitability in the sector. Key drivers are government targets and subsidies. The E.U. recently increased its target to 10% of fuel from bio-fuel by 2020. Previously, it was targeting 5.75% bio-diesel by 2010 compared with 2.5% now.

In his State of the Union address in January, President Bush announced an aspiration for 35 billion gallons of renewable and alternative fuels by 2017. As a mandate, this would be nearly 5 times the 2012 target already in law, and would displace 15% of projected annual conventional gasoline use. However, this aspiration could not be met with first-generation biofuels (corn and sugar cane).

To us, palm-oil-based biodiesel seems a better choice than corn/wheat-based ethanol (a gasoline blendstock). The recent plan by Malaysia and Indonesia to increase their use of bio-diesel in vehicles and power production would, it is estimated by our analysis, use 6.2 million tonnes of bio-diesel capacity (which equates to a fifth of the current palm oil production or 125% of palm oil inventories) and a 2% conversion to bio-diesel from petroleum diesel would deplete the current global vegetable oil inventory.

It is estimated by *Oil World* that palm oil inventories will fall to their lowest ever level in 2007. Palm oil is arguably one of the better ways to play the bio-diesel theme. It is one of the cheaper forms of bio-fuels (excluding subsidies), it has other uses (it benefits from transfat legislation in the U.S.), it takes four years for new trees to mature (suggesting a lengthy period of supernormal profits), and, finally, it offers a free land bank in a very undervalued currency (the current account surplus in Malaysia is 13.7% of GDP). Our favored plays on this are the entry vehicle into Synergy Drive (Golden Hope and Sime Darby).

Exhibit 22: Break-Even Oil Price at which Biofuels Become Economical
*US$**

	Without subsidy
Ethanol (U.S.—corn based)	50-55
Ethanol (Europe—wheat based)	70-75
Ethanol (Brazil—sugar based)	35
Rapeseed (Europe)	75-80
Palm oil	55–60

**based on current prices of input costs.*
Source: Company data, Credit Suisse oil team estimates.

Wheat-based ethanol (still the standard in Europe) is suffering from a disastrous wheat harvest that has sent inventories to their lowest level in 30 years. In Australia, wheat production is running at half of normal levels and prices are at their highest level in 10 years. As Exhibit 23 implies, wheat ethanol production in Europe is a costly exercise.

Nevertheless, Brazilian (sugar-based) ethanol remains economical (even with the current US$0.54 per gallon import tariff to the U.S.) given low costs of production and abundant arable land. Cosan stands out on the HOLT® valuation screen as an attractively valued Brazilian ethanol play. Higher sugar prices (as the world sugar inventory is reduced) further benefit pure-sugar plays elsewhere (for example, Tongaat Hullet and Illovo Sugar in South Africa).

According to our U.S. food analyst, David Nelson, U.S. ethanol production is economical until corn prices hit US$4 per bushel (US$5 per bushel for wet milling) against US$3.50 per bushel currently. With the current US$0.51 per gallon blending tax credit, U.S. ethanol prices remain above the level needed to justify new expansion.

4. Agricultural Productivity Has to Increase

Generally, the need for increased bio-diesel and ethanol production in conjunction with the need to reduce deforestation (which accounts for a quarter of CO_2 emissions) suggests that globally there will have to be sharp rise in agricultural productivity as well as upward pressure on crop prices. Global warming will also reduce crop yields and further exacerbate this trend. (According to the IPCC, crop yields in Southern Europe could fall by 20%, with a 2^{o}C rise in temperatures.)

Beneficiaries of these trends are likely to be stocks supporting agricultural productivity, which also ties in with other positive structural drivers: increased urbanization (= loss of farm land/labor); increased calorie intake per capita (with income per capita in developing regions rising); the single farm payment in Europe (where subsidies are no longer based on output).

Increased agricultural productivity will help names such as Deere, Monsanto, Syngenta, AGCO, Iseki, Kubota, and Scania. Oil seed processors (Archer Daniels Midland, Bunge) should benefit from the general trend to ethanol.

5. Other Alternatives: Wind, Solar

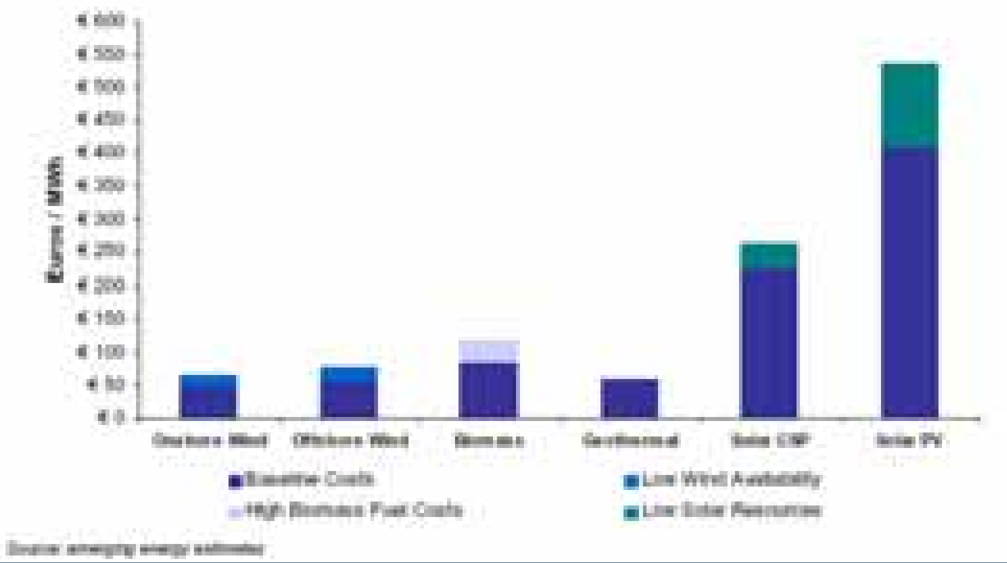
There are two critical issues regarding the viability of alternative power sources: the degree and longevity of government subsidies and the rate at which the cost of producing renewable power falls.

Europe very recently adopted a binding target for 20% of total electricity production by 2020 from renewable energies compared with 7-8% now. In the U.S., renewable portfolio standards (RPS) are in place in 20 states plus the District of Columbia. RPS is a state policy that requires electricity providers to obtain a minimum percentage of their power from renewable energy resources by a certain date. Targets range from 2.2% by 2011 in Wisconsin to 24% by 2013 in New York State.

As our global Energy Team points out, alternative energies with the most promise are those that are self-supporting economically at an oil price of around US$50/bbl.

In practice, this puts wind well ahead of solar technology. Our Utility Team believes that without a subsidy, wind requires an oil price of around US$60-80 per barrel in Northern Europe but that with subsidies it is already competitive. This is also the case in the U.S. where wind is becoming ever more competitive with natural-gas-fired power generation as U.S. natural gas prices increase.

Exhibit 23: Renewable Energy Costs under Varying Conditions



Source: Emerging Energy estimates.

The cost of wind power has fallen by some 75% from 1990 to 2005, and given substantial R&D spend further cost savings are probable.

Our Utilities Team specifically highlights EDF Energy Nouvelles as a nearly pure play on wind power generation (wind and hydro account for roughly 90% of 2006 EBITDA with 770 MW of net capacity as of December 2006), with plans to increase its capacity by more than 400% by 2011. Another utility with significant exposure is *Iberdrola* (15% 2006 EBITDA), the world's largest operator and developer of renewables with 4,102 MW of net wind capacity (as of December 2006) and plans to reach 10,000 MW by 2011. Iberdrola's proposed acquisition of Scottish Power will add approximately 2,000 MW of additional wind capacity to the group.

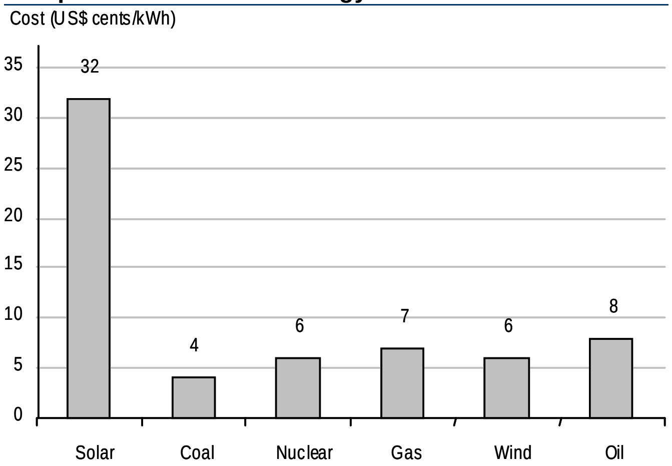
Our Utilities Team also highlights EDP, the Portuguese utility (6% 2006 EBITDA but likely to reach around more than 20% by the end of the decade) with 1,069 MW of net wind capacity as of December 2006 and a target of reaching 3,700 MW by 2010.

Not a utility, but highly exposed to wind power generation is Spanish construction & energy group Acciona (38% 2006 EBITDA, with 2,348 MW of net wind capacity). More direct plays on the growth in wind capacity are in the capital goods space: Gamesa, Suzlon, Clipper Wind Power, and Vestas manufacture and develop wind turbines. The latter three also stand out as relatively attractive on our CFROI® valuation screen.

Solar power remains significantly more expensive, still 3-7 times more expensive than that produced by conventional sources on average. Our Utilities Team expects China solar capacity to reach 2,000 MW by 2020 (compared with 65 MW at the end of 2005). Solar subsidies in China come from regional and state governments. In Korea, KEPCO says it believes the cost of solar is 11 times that of wind; thus, solar has to be heavily subsidized while wind appears to be already competitive against LNG and oil.

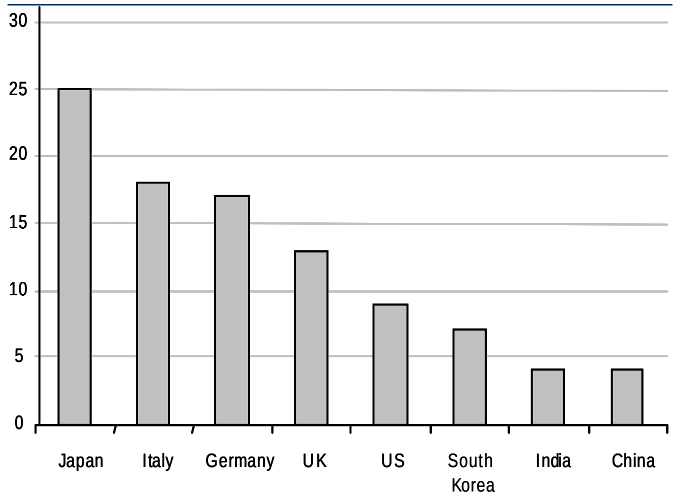
Note that while the average cost of solar energy is still significantly higher than other generating capacity, solar panels are competing against *retail* and not *wholesale* electricity prices. This means that only a modest decline in the price of solar power is required to make solar competitive without subsidy in countries with high retail electricity prices (e.g., Japan and Italy).

Exhibit 24: Average Unit Power Generation Cost Comparison of Different Energy Sources



Source: Company data, Credit Suisse utility team research.

Exhibit 25: Average Residential Power Prices in 2004
US$ cents per kWh



Source: IEA, Credit Suisse research.

Our European Semiconductor Team believes that the price of photo voltaic (PV) cells for solar power generation can fall by about 5% per annum. At this rate, in 10 years' time in Northern Europe solar will be competitive against oil (an expensive and shrinking source of European power).

According to our Asian Utilities Team, *Suntech Power* believes that third-generation solar cells could deliver triple the productivity of today's cells, but it could take perhaps 15 years to produce 3G solar cells commercially.

Given the current shortage in polysilicon supply (the main input in PV manufacturing), the best way to play the solar theme is probably via the polysilicon producers (*Tokuyama, Wacker-Chemie*) and via *REC* (as a fully integrated player in the solar space). We also recommend solar chip makers *Q Cells* (the largest pure play in PV cells) and *SunPower* (manufacturing the most efficient solar cell).

6. Carbon Emission Vouchers

We believe that the price of carbon emission vouchers will have to rise and carbon trading schemes be extended to other geographies. For carbon emission trading to be effective and force power producers to switch to cleaner fuels (in greater quantities), in the opinion of our Utilities Team, the price of carbon vouchers has to rise to around €40/tonne (assuming a fully depreciated plant). This is nearly double the current price for Phase 2 carbon emission vouchers.

According to the U.K. government's *Stern* report, 15-55% of the reductions in CO_2 will come from carbon capture, and to make carbon capture economical we need to see CO_2 voucher prices in excess of €50 per tonne.

Indeed the European commission suggests that there would be no extra cost of building renewables if oil is priced at US$78/bbl and carbon vouchers are €25/tonne (nearly double current prices).

Additionally, it seems improbable that Germany will repeat the mistakes of the previous allocation (where it overallocated CO_2 vouchers) and surely more industries will be introduced into the scheme.

Moreover, some of the government-sponsored schemes appear to be a very expensive way of reducing CO_2. Ofgem, the electricity regulator in the U.K., has calculated that the cost of savings a tonne of carbon via the ROC (renewable obligation certificates) varies from £107 to over £500 per tonne.

Higher power prices would be excellent news for the low CO_2 power producers (hydro, wind, nuclear, solar), with higher CO_2 prices pushing up the price of electricity.

The European emissions trading scheme (EETS) is a cap and trade scheme designed to limit, via allowances, the CO_2 emissions from certain industries (power, refineries, building materials, and pulp and paper). The total number of allowances is set by each E.U. member under a national allocation plan (NAP) consistent with Kyoto obligations. The Compliance Phase 1 of the E.U. ETS covers 2.1 billion tonnes of CO_2 emissions (or 42% of what is produced in the E.U.). If a company does not possess enough rights to cover its emissions a fine of €40 per tonne will be levied in April 2008. The Compliance Phase 2 of the E.U. ETS begins on January 1, 2008, and includes higher fines for noncompliance (€100 per tonne) and will also cover other greenhouse gases. For the time being, only France and Poland are allowed to transfer Phase 1 allowances across to their Phase 2 targets.

Short-term correlations between CO_2 vouchers and oil prices are fairly high. The rationale is simple: higher energy prices imply greater coal-fired (high emission) electricity generation, therefore driving up the price of CO_2 vouchers. Longer term, the price of the vouchers is more dependent on the politics. On that point, note the significant surpluses that Russia and the Ukraine have accumulated in CO_2 allowances. Under Kyoto, these two were required to stabilize emissions at 1990 levels, but given significant improvements in industry emission standards, surplus allowances have built up. In Russia, the surplus could make up as much as 15% of the national budget. Dumping these certificates on the market could undermine the system. No firm decision has been taken yet, but the respective governments could commit to releasing only a certain amount to the market each year to prevent a collapse.

The vast majority (80%) of E.U. emission allowances (EUAs) are traded OTC at the moment. The other 20% of EUAs are traded on one of five exchanges (the European Climate Exchange, NordPool, Powernext, EXAA, and EEX).

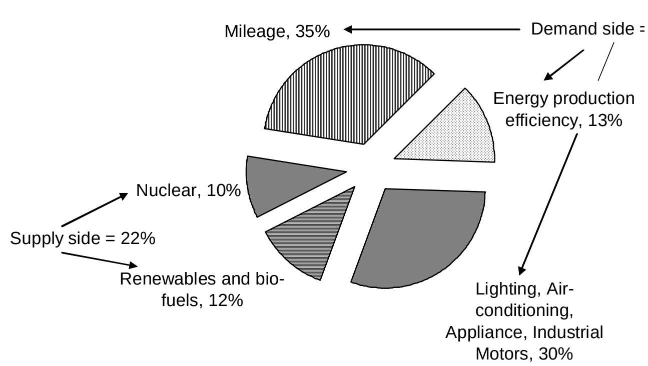
Carbon trading is still not legislated in the U.S., but there is growing acceptance that some form of cap and trade is on the way. Several states, including California, have moved to implement their own schemes. The Regional Greenhouse Gas Initiative (RGGI) involves nine states and will cap carbon emissions from power plants from 2009.

7. Demand Side . . . the Real Answer

Clearly one issue is global warming; the other issue is the economics of a high fuel price. So even if the threat from global warming is exaggerated, many of the trends discussed below will continue.

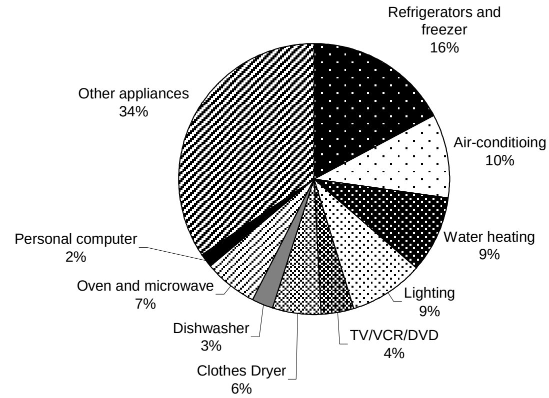
The demand-side response to CO_2 emissions is projected to be far more significant than supply-side measures. As we illustrate in Exhibit 26, nearly 80% of the IEA projections for CO_2 emission reduction comes from demand-side efficiencies.

Exhibit 26: The IEA Alternative Scenario: CO_2 Savings by Type, 2030



Source: IEA.

Exhibit 27: U.S. Residential Consumption of Electricity by End Use, 2001



Source: EIA.

- *Lighting.* In the U.S., lighting accounts for about 9% of domestic consumption. At a global level, factoring in industry and vehicle lighting, the IEA estimates that lighting accounts for 19% of global demand, or 2,550 TWh of electricity. The carbon dioxide produced by generating all of this electricity amounts to 1,889 $MtCO_2$. This is equivalent to 70% of global emissions from passenger vehicles, and is three times more than emissions from aviation, according to the IEA.

  There is a significant spread in the efficacy of different types of light bulbs. Targeting low-energy bulbs through mandatory minimum energy performance standards (MEPS) and voluntary efficiency agreements (VAs) could lead to significant savings in lighting costs and CO_2 emissions. In Australia, the government has pushed ahead with clear policies to cut emissions and pledged to ban the sale of incandescent light bulbs within three years. Instead, households and commercial users will be pushed to use energy-efficient alternatives, such as compact fluorescent lights. Cuba and Venezuela have undertaken similar measures. Fluorescent bulbs contain a gas that reacts with electricity to provide light, while light from an incandescent bulb comes from a filament that heats up, producing comparatively more greenhouse gas. Compact fluorescent light bulbs use only 20% of the energy used by an incandescent bulb and their higher retail cost is offset by the fact that they last 4-10 times longer. Phillips is a leader in low-energy light bulbs. Advances in LED technology have resulted in significant further strides in light energy efficiency, which, over the medium term, could replace both incandescent and fluorescent bulbs. For the time being, the new LED bulbs are still relatively expensive to manufacture, but as production runs increase these costs should fall. The manufacture of blue and white LED chips requires gallium-nitride (GaN) semiconductor production equipment. There are only three makers worldwide that produce the necessary equipment in this process—namely, *Taiyo Nippon Sanso, Aixtron AG*, and *Emcore Corp*.

- *Stand-by switches.* On the theme of efficiency, in domestic appliances a major saving could be made in reducing the use of stand-by switches. *The Times* reported in June 2006 that a U.K. government energy review put the cost of stand-by switches on games consoles at £70 million. There is no legislation in place yet (in the U.K. or elsewhere) to deter the use of stand-by switches although manufacturer's may chose to voluntarily modify their hardware.

In the U.K., the Energy Savings Trust highlights that equipment on stand-by produces a total of 3.1 million tonnes of CO_2, or 2% of the U.K. total CO_2 emissions.

Our Tech Team suggest *Power Integrations* and *OZMicro* given their focus on highly efficient energy products and solutions to address the stand-by issue. Other plays include *Fairchild Semiconductor* (75% power exposure), *On Semiconductor* (70%), and *International Rectifier* (70-80%). Other larger companies are also tackling the same issues in their respective segments, e.g., computing *(Intel and Advanced Micro Devices)* and handsets *(Texas Instruments)*.

- *Air conditioning* uses about a tenth of global energy, and in a world of global warming the demand for air conditioning should rise LG's latest technology, for example (Twin Power Cooling System) is known to save 52% more energy than existing models. For now, Twin Power accounts for only 4% of LG's sales. In the U.S., it is estimated that current AC technology is roughly 30% more efficient than installed capacity. Regulations could drive a significant replacement cycle by 2010. Nearly two-thirds of *American Standard's* revenue is related to air conditioning. For *United Technologies*, it is about a quarter.

- *Insulation.* The E.U. introduced the Energy Performance of Buildings Directive in 2003. A key aspect of this directive is likely to be the introduction of a Building Energy Rating (BER) certificate, which will detail the energy efficiency of any given property. It is expected to be fully implemented by the end of 2008. *Saint Gobain, CRH, SIG,* and *Kingspan* are manufacturers of insulation products. For Saint Gobain and CRH, insulation is a relatively small part of its business. Insulation is the core part of Kingspan's business, accounting for about 65% of group profit.

- *Transportation systems*. The rise of mass transit system/railways is perhaps ultimately the answer. Low CO_2 emission forms of electricity generation (wind/nuclear/solar) to fuel electrically driven trains/tubes/trams/metros should be good for the likes of *Alstom, Siemens, Invensys*, and *Bombardier*.

- *More efficient (and less polluting) jet engines.* Today's average jet engine is 15 years old; the latest generation of engines is around 20% more efficient, with improvements in emissions to match. If tougher legislation is implemented, then older aircraft would be retired and the reduction in CO_2 emissions could be closer to 30%. (*ACARE* is looking to reduce emission by half by 2020.) Air travel is set to become more relevant to the global warming debate, with airlines already included in the second round of carbon trading in Europe (2011 for domestic, 2012 for international). This should be good for the aero engine makers. Our Transport Team highlights *Boeing* and *Rolls-Royce* as potential winners in the fleet replacement cycle. This trend would also help *GE, UTX*, and other component companies (*SGL*).

- *More efficient electric motors.* Our Capital Goods Team estimates that electric motors account for 60% of industrial electricity usage. The most efficient electric motors today are some 20-25% more efficient than the installed capital stock, and while the penetration rate of efficient motors is 70% in the U.S. and Canada (owing to legislation), it is just 15% in Europe. *ABB, Siemens and Baldor* are a few of the companies that should benefit as Europe catches up.

- *Energy management/power controls.* The key recommendation here is *Schneider*. Using its latest technology, Schneider could save 10-30% on the electricity consumption across its complete set of products. This makes Schneider a cheap global warming play, in our view. *Emerson* and *Rockwell* (where roughly a fifth of revenues are related to intelligent motor controls) should also benefit. *IMI* has 12% of its revenue from thermostatic controls. Most of the capital goods industry touches energy efficiency in one way or another (whether it is helping improve industrial processes, reducing friction from new bearings, improving motor control, promoting efficient energy management, thermostatic controls, etc.).

- *More efficient transportation and distribution systems.* The electricity grid has to become not only more efficient but also must link up with more disparate wind/solar farms. (This impacts stocks such as *ABB, Quanta Services, Coopers,* and *SPX*.)

  Our Capital Goods Team highlights *Schneider Electrical* as a global leader in final low voltage electricity distribution. *Alstom* and *Spirax-Sarco* are also set to be beneficiaries of the grid extension.

- *More efficient consumption of gasoline.* In addition to the alternative fuel target announced in this year's State of the Union address, President Bush also announced a reform of the Corporate Average Fuel Economy (CAFE) standards for cars, with the aim of reducing projected annual gasoline use by 5%, or 8.5 billion gallons per year. Details on how this will be implemented remain few. In the U.K., higher road tax charges have been levied on larger (less-fuel-efficient) car engines. The simplest answer to this is to encourage the conversion to diesel-powered vehicles. (The penetration rate in Europe is over 50%, in the U.S. just 3%.) Most recent diesel engines are 30% more economical than gasoline (for the same engine size) and the particulate problem has been resolved. The clear play on this is platinum. It also happens to be a precious metal hedge, a tight cartel, a loose play on China (a fifth of global platinum demand is from Chinese jewelry fabrication) as well as an alternative energy play (via fuel cells). Platinum stocks trade at roughly only half the multiple of gold stocks. Pure plays on this include *Implats* and *Angloplats*. *Volkswagen* is the largest supplier of diesel-powered light vehicles, *Ford* is in second place. *Toyota* is the fastest growing diesel-powered vehicle producer.

- *Hybrid cars.* Hybrid car sales currently account for less than 0.5% of global sales but are forecast to rise to 4% of global sales by 2012 by consultants JD Power. Our Autos Team highlights *Continental AG* and *Valeo* as two suppliers that should benefit from the shift to hybrids.

8. Adaptation

Sea defenses are an obvious area of focus for adaptation investment given projections of a rising sea level. Raising the Thames barrier and bolstering flood defenses around other major cities (such as New York, New Orleans, and Tokyo) are ongoing concerns. Flood defenses are particularly topical in the Netherlands. More than two-thirds of the Netherlands' 16 million population lives below sea level, and Dutch policymakers are forecasting a rise in sea level of around 80 cm over the next 100 years. A one meter rise in sea level would displace two-thirds of the Dutch population. The United Nations estimates that as many as 200 million people could be affected by rising a sea level.

In December, the Dutch government approved a new €14 billion (US$18.5 billion) increase in spending on water defenses and water-quality improvements over the next 20 years. This is on top of €3 billion (US$4 billion) in projects already approved against the threat from river floods, as Dutch climate models predict global warming will lead to more abrupt showers in the Rhine catchment area, whose water ultimately funnels through the Netherlands on its way out to the sea. The country also spends €500 million (US$660 million) annually on maintaining its system of sea and river dikes that date from medieval times. A mass evacuation drill in the Netherlands is planned to be held in 2008.

Capital goods stocks exposed to greater demand from this area include *Royal Boskalis* (one on the main contractors in *Dutch Delta Works) Grontmij, Royal BAM Group*, and *RPS Group* (specialists in flood control and sea barriers).

9. Deforestation

Nearly a quarter of CO_2 emissions comes from this source, according to the CDIAC. It seems sensible that governments will seek to limit deforestation largely by improving agricultural efficiency. (See point 4.) Alternatively, the Clean Development initiative could be used to finance the existence of large forest areas. There is a case that some intensive timber-owing companies would achieve a carbon credit.

There Is an Alternative

Mark Flannery

Edward Westlake

It is becoming clear to governments and consumers that energy prices in general are now likely to stay higher for longer, and when combined with the rising political awareness of global climate change and the rising concern over energy import dependence (particularly in the U.S. oil sector), many consuming nation governments are looking to develop more coherent policies on alternative energy.

Alternative energy has provided a potential fix for rising carbon emissions *and* energy insecurity for many years, but at a price that was deemed unacceptably high versus the prevailing price of traditional sources (oil, gas, coal). Low oil prices kept most alternative technologies dormant for much of the period 1986–2002.

Now with crude oil prices expected to hold over $50/bbl for the foreseeable future, and with some jurisdictions (Europe) already attempting to ascribe a cost to carbon emission, the outlook for certain forms of alternative energy is vastly improved.

While some alternative energies (U.S. and Brazilian ethanol, wind power) are close to being stand-alone economic propositions even without carbon emission pricing, some other alternative energies (solar, certain biodiesels, wave power) are not even close to being economical even at current hydrocarbon prices.

One of the main political debates yet to be completed in alternative energy centers on the acceptable level of government subsidy or support for certain alternative energies to increase their market penetration, at least until larger-scale deployment or technological breakthroughs significantly reduce the costs.

While most politicians and consumers already agree that more clean energy is *a good thing*, the issue of how much consumers and taxpayers are willing to pay for it is far from settled.

What Is Alternative Energy?

Broadly speaking, alternative energy can be divided into three subgroups:

1. Nontraditional hydrocarbons: biofuels, gas-to-liquids, coal-to-liquids, coal-to-gas.
2. Nontraditional electricity generation: solar, hydro, wind, biomass, geothermal, wave.
3. Other alternative energy systems: fuel cells, micro turbines, hydrogen power, etc.

Much of the debate so far has been focused on the first two of these categories, as this is where the bulk of the world's existing energy is consumed. However, since the transportation sector is by far the world's largest user of liquid hydrocarbons, alternative vehicle propulsion technologies (gasoline hybrid vehicles, diesel vehicles, even hydrogen fuel cells) are also at the forefront of the alternative energy discussion.

Some of the alternative energy technologies are fairly new, but most represent improvements on existing technologies (biofuels, coal transformation, gas synthesis) or even very old technologies indeed (wind, biomass).

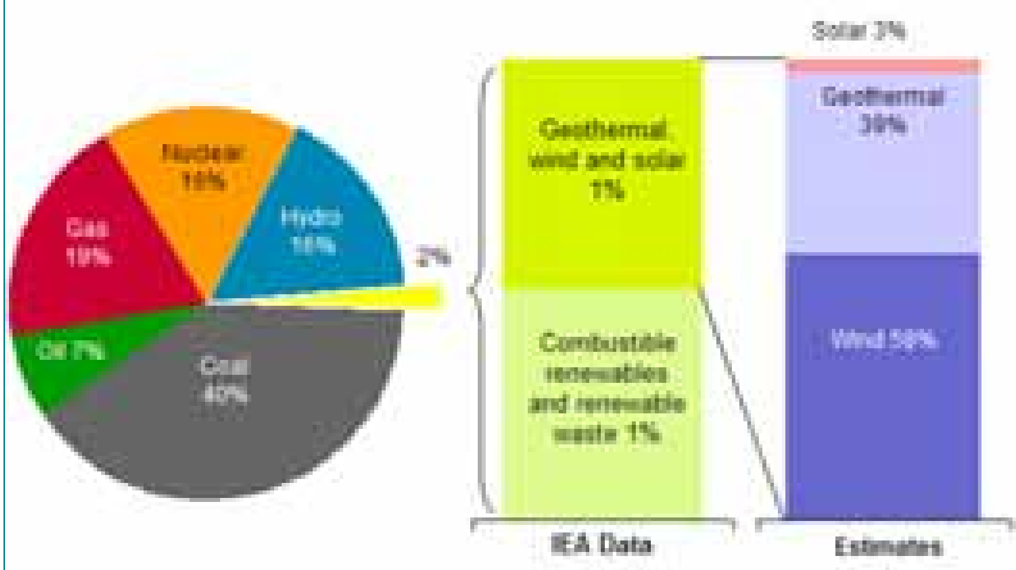
A further important distinction within the alternative energy space is between renewable/clean sources of energy (biofuels, solar, wind, hydro, wave, geothermal) and nonrenewables (coal transformation, gas synthesis).

Finally, though it is not strictly renewable, it seems likely that nuclear will have an expanded global role in energy supply in the future, though the political debate around this energy source is often more emotional than rational.

Accurate measurements of the size of the alternative energy markets are not easy to come by, mainly because the segment is still very small.

BP and the IEA estimate that renewable energy (excluding the well-established hydro sector) accounts for 2% of the world's current installed electricity generating base. (See Exhibit 29.)

Exhibit 28: Renewables Share of Global Electricity Generating Capacity, 2005



Source: BP statistical review of world energy.

As for transportation fuels, the share is even lower, with 2005 global ethanol production at approximately 500 kbd, 90% of which was produced in the U.S. or Brazil. This represents approximately 0.6% of the world's crude oil consumption. The global biodiesel market is even smaller, at approximately 50 kbd, or less than 0.1% of global oil demand. Both of these biofuels are set for considerable growth in the coming decade, as we discuss in more detail later in this report.

Government Policies and Alternative Energy

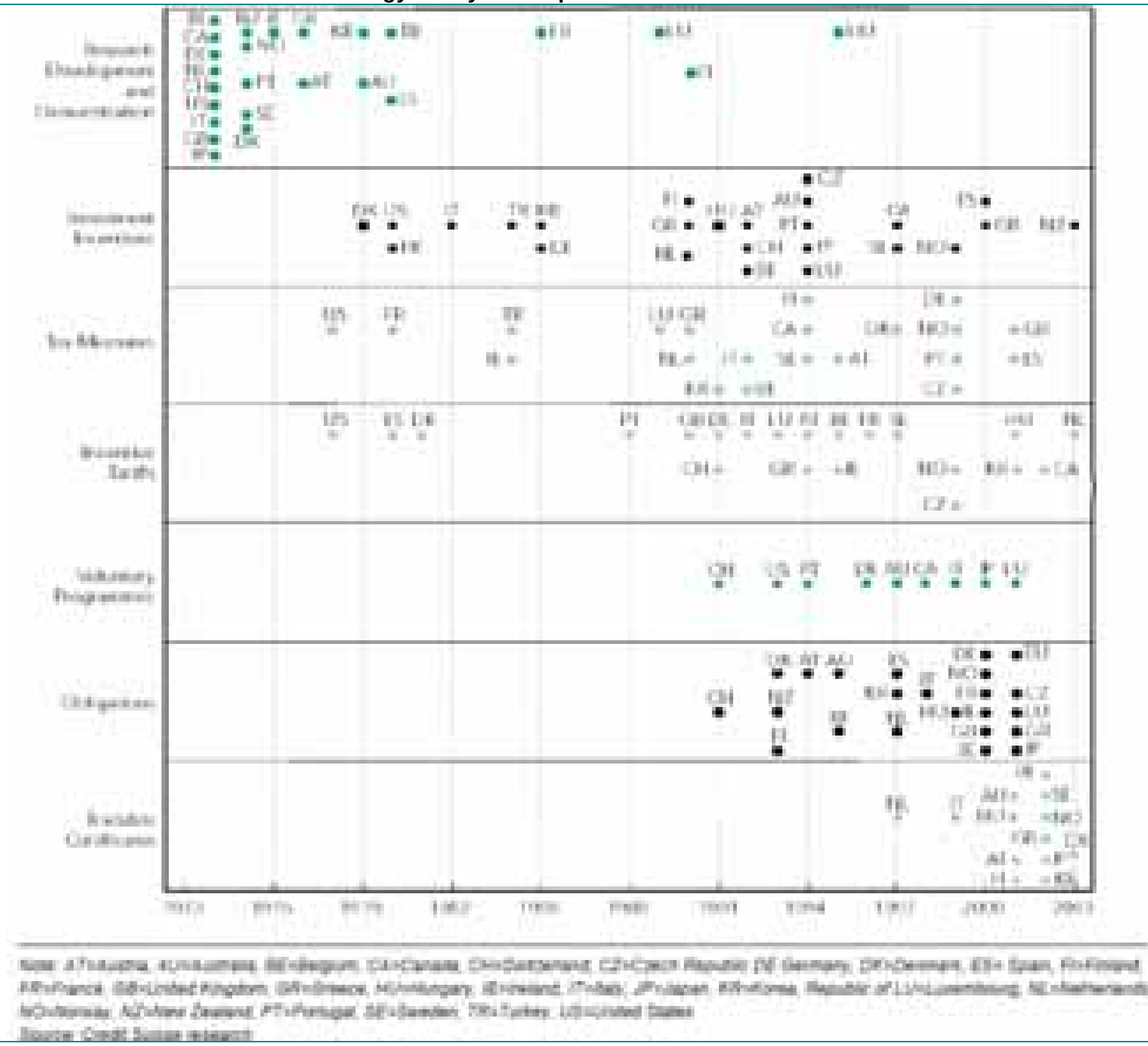
Government support for alternative energy around the world has waxed and waned with oil prices and with the global political security cycle.

For example, in the late 1970s and 1980s the U.S. government was heavily involved in promoting and subsidizing alternative energy sources, particularly after the second oil shock sent oil prices and energy security concerns soaring. The collapse of the oil price in 1985-86 effectively ended U.S. government support in all but a few instances (corn-based ethanol, for example). Now the issue is back on the U.S. legislative agenda, though few decisions of consequence have yet been made.

European governments, either singularly or through the E.U., have recently been moving to increasing support of various forms of alternative energy, notably biofuels and renewable electricity, as set out in the 2001 Renewable Electricity Directive. Certain of Europe's alternative energy businesses have also received something of a boost through the implementation of an E.U.-wide system of carbon credit trading, effectively adding another layer of subsidy to low-emission technologies.

Governments have generally offered three forms of policy support to alternative energy: (1) R&D support, (2) market deployment support, and (3) usage mandates or targets. (There is a difference between usage mandates generally imposed by local or national governments and backed up by fines for noncompliance, and usage *targets* favored by other bodies, such as the E.U. Commission.) Exhibit 30 shows evolution of these policies.

Exhibit 29: Government Alternative Energy Policy Development



The final two categories of government policy development shown in Exhibit 30, Obligations and Tradeable Certificates, are the logical end to the process of government support and generally presage the gradual withdrawal of subsidies and other market-distorting mechanisms. However, virtually no alternative energy systems may currently be described as “market mature.”

Despite the progress outlined above, most governments around the world have failed to provide consistent or predictable policy frameworks for alternative energy industries, and this has retarded their development. This inconsistency may be starting to change, and a period of higher-for-longer oil prices plus rising consumer concern over global climate change would likely offer a window for energy politics to catch up with energy economics.

E.U. and U.S.—Roughly in the Same Place, Asia Is Behind

For all the perception of “green” Europe and the “dirty” U.S., both economic blocs currently consume roughly similar quantities of energy from alternative and renewable sources: around 7-8% of the total in both cases. Asia has been the laggard in the share of alternative energy despite Japan’s embrace of solar power.

The European Commission is aiming to increase the share of renewable sources in the E.U.'s gross energy consumption from 6% in 1997 to 12% in 2010. This includes targets for electricity generation and for biofuels (5.75% of total transport fuel). It is not clear how these targets are to be enforced, however.

Individual European countries have also set their own targets and mandates. For example, Germany is targeting 6.75% of its fuel usage to come from biofuels by 2010 and 8% by 2012. Germany also intends to *mandate* a 2% ethanol blend component in gasoline by 2008, rising to 2.8% in 2009 and to 3.6% in 2010.

The European system of overlapping European Union and individual government targets and mandates can appear confusing and unworkable, but in many ways it mirrors the situation in the U.S.

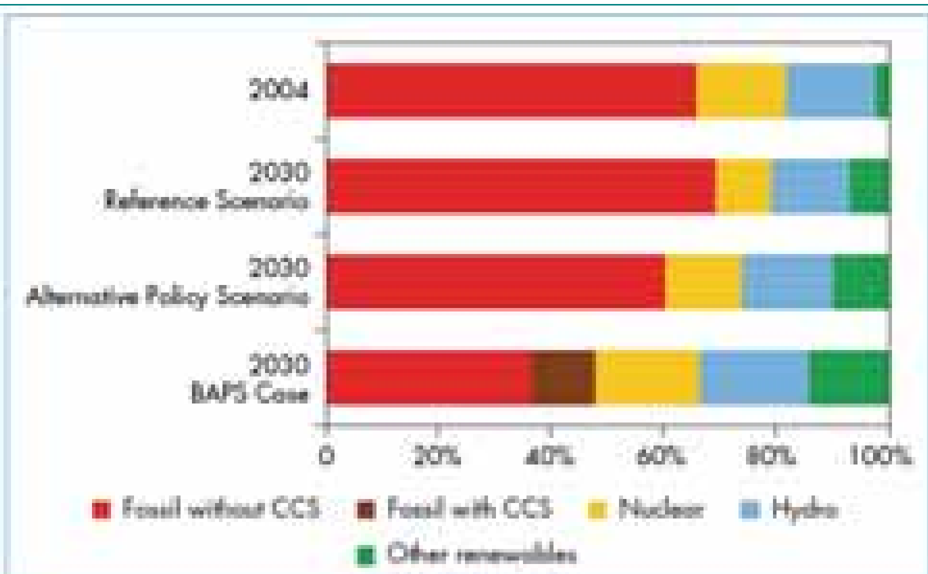
In the U.S. there are also two main layers of policy development: federal and state. The federal government used the Energy Policy Act of 2005 to institute a minimum mandate for renewable fuels in gasoline (essentially an ethanol mandate), which calls for 7.5 billion gallons of renewables in U.S. gasoline by 2012, a goal that seems certain to be easily exceeded well before then. Some individual state governments have instigated tougher renewable transport mandates than this, and these mandates are continuing to evolve.

U.S. state governments have so far taken the lead in renewable mandates for electricity generation. With the Democratic party now in control of the U.S. Congress, we should expect more discussion on federal alternative energy policy initiatives, and possibly some progress on this measure before the next presidential election in 2008.

In Asia, it is China that is charging ahead in alternative energy, with sizable investment and government support programs for solar power, coal-to-liquids, coal gasification, and other alternative energy forms. The Chinese government has said that it is willing to spend up to $184 billion on renewable energy by 2020 in addition to nonrenewable alternatives.

In its World Energy Outlook 2006, the International Energy Agency (IEA) estimates that global traditional energy demand could be 10% lower than the base-case forecast if the world ends up adopting a so-called *alternative policy scenario*. In this scenario, renewables would increase to around 10% of global power generation (from 2% currently), with larger roles for nuclear and hydro (neither of which is currently considered to be alternative energy).

Exhibit 30: Fuel Mix in Power Generation in Different IEA Scenarios



Source: IEA.

Which Alternative Energies Hold the Most Promise?

We believe that most promise lies with those alternative energies that can be economically self-supporting at an oil price of around $50/bbl and that can scale up relatively easily.

For those alternative energies that are much further from economic break even at a $50 oil price, then growth rates will depend on government subsidies and policy decisions, which are likely to vary significantly by jurisdiction.

The expected deployment of carbon emission pricing or control systems around the world (yes, even in the U.S.) will create further economic advantage for low- or zero-emission technologies, we think.

Alternative energies that we believe are set for significant expansion over the coming five years include the following:

Biofuels. Today this means ethanol in the U.S. and Brazil, and biodiesel in Europe and Asia. Government subsidies will be needed to keep investment dollars flowing, particularly in Europe. We expect large-scale investments in the coming four or five years. R&D will focus in particular on second-generation biofuels such as cellulosic ethanol that could reduce or eliminate biofuels' feedstock competition with food.

Wind. This technology is gaining significant traction as part of renewable portfolio standards around the world, and is likely to account for the bulk of renewable power generation investment in the next five years. Recent cost reductions from technological improvement (larger turbines) and increases in scale have improved the economics significantly, although government support is still required. Wind power is likely to encounter some local opposition in certain areas, and this may encourage further development of offshore installations.

Solar. This technology is far from being stand-alone economically and will require continued government support and subsidy for some time. However, despite this, solar is already making notable inroads in China and in parts of the U.S. The cost of solar generated electricity is currently 3-5 times that produced from conventional sources and is much higher than wind power. Significant further cost reductions could come from one of several technological breakthroughs currently in the R&D process, but these will take time.

Gas-to-liquids or coal-to-liquids. Known as GTL or CTL, this relatively old technology refers to the transformation of existing gaseous hydrocarbon or fossil coal into syngas and then into liquids. This is not renewable energy and it does emit CO_2 in the production process, but the end product is a cleaner-burning transport fuel, normally diesel. GTL and CTL projects have recently become more popular as larger oil companies struggle to overcome more limited access to traditional hydrocarbon resources. GTL does not receive consuming government subsidy, and cheap feedstock gas is essential to the economics. CTL economics work best in countries with high or rising transport fuel import bills and with abundant coal resources where the CTL plant is located close to the mine mouth and where the cost of carbon emission is low. China currently fits these criteria and is rolling out the technology. The U.S. also fits these criteria, but CTL development remains stalled mainly on worries over the future cost of emissions control.

More marginal sources of alternative energy, in our opinion, include geothermal, biomass, and wave.

Geothermal. The main constraint on extensive deployment of geothermal technology is the limited number of suitable sites. Geothermal economics are attractive if the generation and consumption locations are relatively close together as they are in Iceland and California, but if not then transmission investment (and losses) can alter the economic profile sharply.

Biomass. The burning of industrial or agricultural waste is an attractive option given the very low cost of the fuel and the low capital costs of an incinerator/generator. However, generation needs to be located near the feedstock, or the low-cost fuel benefits can be eroded quickly. In addition, previous generations of incinerators were large emitters of CO_2

and this will need to be addressed before the technology can expand in the expected future world of carbon pricing. Biomass economics tend to be highly location specific and while the technology has a role, it is not likely to become a major energy source.

Wave. This technology could hold future promise, but wave power is still very much in the R&D phase of its development, and economic discussions are not meaningful at this point. More progress is expected in the coming five years.

An Outline of the Major Alternative Energy Segments

The following represents a brief outline of the main alternative energy segments. We treat each of these in more detail later in this report.

Biofuels

Ethanol is an alcohol distilled from plant material (corn in the U.S., sugar cane in Brazil, wheat in Europe) and used as gasoline substitute or blendstock. The U.S. and Brazil account for 90% of global ethanol production and consumption, and this is not expected to change significantly in the near future. Ethanol can be blended to around 10% of the gasoline pool without any noticeable impact on vehicle performance, but higher blend proportions require some engine modifications. Ethanol has a higher octane rating than conventional gasoline, but has a 20-25% lower energy content and can create some difficulties in meeting existing clean air regulations as it raises the vapor pressure of the blended gasoline fuel.

Much research is being undertaken in the area of cellulosic ethanol, a method of distilling ethanol from plant biomass (stalks, stems, grasses, etc.) and not from food crops as is currently the case. Cellulosic ethanol is not yet a commercial undertaking, but it is expected by many to be close to providing a significant breakthrough in the next several years.

Biodiesel is produced by the transformation of animal fat or vegetable oil into a conventional diesel substitute. Unlike ethanol, biodiesel has a similar energy content to conventional diesel and has fewer limitations on its blending percentage into the existing diesel pool. Biodiesel also exhibits lower overall emissions than conventional diesel.

Feedstock represents more than 80% of the total costs of producing biodiesel compared with around 60% for ethanol. The global biodiesel industry is much smaller and more fragmented than the ethanol industry, and has a large potential range of feedstocks available. We believe that biodiesel also has potential for growth and development in areas such as China/India/Malaysia/the Philippines where cheap feedstock can be secured and in the large existing markets of Europe and the U.S.

Wind Power

Wind power is very old mechanical energy technology recently deployed for electrical generation purposes. Wind power is the subject of much economic and aesthetic debate in the United States and in European Union. Discussions of wind power normally refer to a collection of wind turbines in grouping—known as a wind farm—normally feeding power back into the national grid, but sometimes meeting local electricity demand where appropriate.

Wind power is still a little expensive versus conventional fossil fuel generation, but the cost is estimated to have fallen by some 75% between 1990 and 2005, and it is now the closest renewable generation technology to being stand-alone economically. We believe U.S. wind power is competitive with natural gas at $7-8/mcf U.S. natural gas prices.

Despite closing much of the economics gap, further large-scale deployment of wind power will likely require some government subsidy or renewable portfolio standard mandates, both of which are likely, in our view.

Wind power's major drawback is its intermittency in many locations; the economics of wind are significantly affected by the reliability and strength of the available airflow (stronger wind equals lower cost). Its secondary drawback is the local controversy that can be stirred up by its deployment in more densely populated areas. This is not likely to abate any time soon, although prospects for more offshore deployment remain encouraging, particularly in Europe.

Solar Power

Most solar power systems in use today use the photovoltaic (PV) cell, which converts sunlight into electric current. Solar is best known as a residential or commercial electrical generation technology (solar panels on the roof), and the technology performs well in dispersed or remote, nongrid environments.

Solar can suffer from unpredictability and intermittency issues also common to wind power and other renewable energy sources, but these are dealt with relatively easily. The main problem with solar is its currently high cost. A kW/h of electricity from solar power currently costs five to seven times a kW/h generated from traditional fossil fuels.

Nevertheless, the technology of solar cells is advancing very rapidly and a meaningful reduction in cost is expected in the next few years, followed potentially by much higher conversion "third-generation" cells at some point in the next decade. In the meantime, the cost of solar grade polysilicon (60-70% of the cost of a PV cell) is rising sharply owing to growing demand and limited supply.

Global uptake of solar is being driven by a combination of government support and subsidy (notably in China) and by higher disposable income. Consumers may be more willing to stomach the high cost of deployment of a domestic solar system. Uptake may be driven further by renewable portfolio standards, although solar power is not competitive with wind power in most cases.

Geothermal Power

Geothermal power accesses heat from below the earth's surface and uses low temperature applications to heat domestic water supplies or higher temperature applications to generate electricity. The domestic geothermal application is well proven and more or less economical at current U.S. and European fuel prices. However, consumer take-up has been slow so far, given limited tax incentives and relatively high upfront capital costs.

The high-temperature electrical generation application is geographically limited to zones where geology has created trapped hot water and steam relatively close to the surface of the earth. There are existing sizable generation plants in California, Nevada, and Iceland.

Biomass

Biomass refers to several different energy conversion uses of residual bio matter or household and industrial garbage. At its simplest, biomass energy is the release of heat through burning (think log fire), but energy from the same combustion process can be contained and used to heat water to create steam and drive an electrical turbine. Much of the residual bio matter feedstock for existing commercial biomass plants comes from the wood industry, and the largest source of wood energy is pulping liquor or "black liquor," a waste product of the pulp and paper manufacturing process, though waste products such as wood chips are also in use.

Garbage feedstock comes principally from municipal or manufacturing waste, or from the methane gas captured from garbage landfills. However, public concern over potentially hazardous emissions (i.e., dioxins), waste ash (i.e., heavy metals), carbon dioxide, and unpleasant odors means that planning permission in some European countries is difficult to obtain despite the adoption of modern exhaust air scrubbing technology. Countries such as Sweden, Denmark, Switzerland, and Germany are significant users of waste incineration.

It is difficult to generalize about the economics of the biomass segment, as much depends on the cost of the feedstock, which is mainly the cost of transportation to the incinerator since waste bio matter and garbage tend to have little intrinsic value.

The term biomass is sometimes used to refer to the creation of liquid fuels from plant matter, but we consider this to be a wholly separate category within biofuels.

Hydropower

Hydroelectricity is generated by the controlled release of river water through the turbines of a dam erected for the purpose. This very old energy technology (think water mills) is by far the most mature and most widely adopted renewable energy source. As such, it is sometimes excluded from discussions of alternative energy, and governments tend to exclude it from their renewables or clean energy targets.

Hydropower has two attractive generation characteristics: it can be used both for constant and peak load requirements, assuming a full reservoir and good water supply, and the technology has very low operating costs. The advantages have made hydro power a significant part of the generation mix in several European countries, notably Norway (in years of high rainfall over 90% of electricity can be generated through hydro), and Italy, Spain, and France.

To the downside, the capital costs of dam construction can be very high. Hydro today represents about 16% of the world's electrical-generating capacity, but its further deployment is limited by the need for ample water supply and by controversy over the environmental impact of flooding upstream of the dam. In addition, hydroelectric schemes are often located some distance from centers of demand, requiring large-scale infrastructure and transmission investments.

Hydroelectric schemes are limited by the availability of appropriate locations but, as with most renewable sources, they suffer from intermittency problems. Precipitation levels determine the level of water in reservoirs and hence the amount of hydroelectricity that can be generated. Dry weather may result in a switch to more expensive (marginal cost) forms of generation, prompting a need for a diversified supply mix.

Wave Power

Wave power is still at the fringe of the alternative energy world. Questions over its economical competitiveness are virtually meaningless at this stage, as wave power still needs to demonstrate that it is sufficiently functional. The first medium-scale wave generation plant is currently under test in Portugal and initial results are expected later in 2007. In theory, the scope for wave power deployment is large, but several more years of R&D work lie ahead before wave power will be able to offer a viable scalable source of electrical power, we think.

Nuclear Power

Nuclear power is essentially a renewable energy source (i.e., it is derived from a resource that is regenerative or practically infinite), although this remains a disputed proposition, and governments rarely treat nuclear as a renewable. The rationale behind exclusion lies in the controversy over environmental damage from waste deposits and over safety fears regarding radiation leaks or more serious accidents.

Despite these fears, the public debate is changing, with some environmental groups now embracing nuclear as a legitimate option in the battle to control carbon emissions. (Nuclear power emits virtually no CO_2.)

Nuclear represents approximately 18% of Europe's installed generations capacity and around 10% of global generation. Its main drawback, safety concerns aside, is its long lead time for construction (7-12 years) and (in the U.S. at least) the still unsettled question of spent nuclear fuel storage or reprocessing.

Other Alternative Energy Systems and Storage

This category principally encompasses fuel cells, but extends to include such applications as micro turbines, distributed power systems, etc. Fuel cells, which combine hydrogen with oxygen to produce electricity and heat, were first demonstrated in the mid-19th century, but they have found it difficult to overcome the twin problems of high cost of manufacture and difficulty in scaling up. Research and development work is still ongoing in the area, and significant advances have been made in recent years. However, we think fuel cell economics remain unconvincing, and moving this technology out of its existing niche into mainstream applications could take many more years.

Gas-to-Liquids

The process of turning natural gas into liquid hydrocarbon fuels is also a well-established technology, which has spent much of the last 40 years at the economic fringes of the energy market, mostly confined to niche markets with strategic needs like South Africa. Gas to liquids (GTL) is today mainly performed as an indirect operation using the Fischer-Tropsch method. The main output from GTL is usually an extremely pure (low sulphur) diesel blendstock, with lubricant as the main coproduct. The large number of GTL plants now under construction worldwide in a diverse number of locations suggest that the economics of this technology work sufficiently well at oil prices above $50/bbl.

While growth in GTL capacity should be meaningful between now and 2010, we think its contribution to global liquid hydrocarbons markets will likely remain small for the foreseeable future. For larger oil companies, it represents an opportunity to monetize otherwise ”stranded” deposits of natural gas, although the capital costs required for a world-scale GTL plant can be daunting, in the $3-5 billion range.

Coal Transformation (Coal-to-Liquids, Coal Gasification)

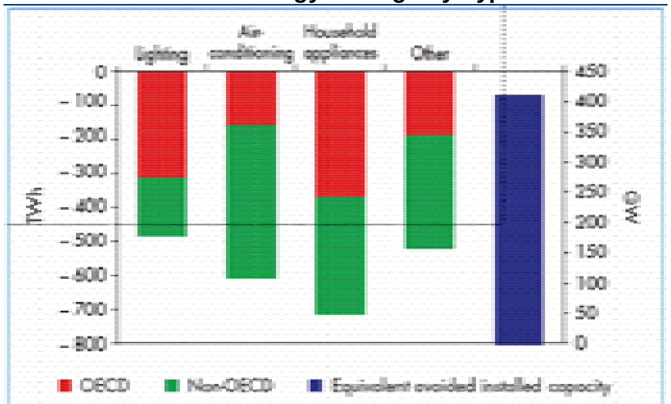
The transformation of coal into liquid fuels (coal-to-liquids, or CTL) and the gasification of coal are both relatively old technologies, and while they are alternatives to traditional hydrocarbon and carbon use, they are not renewable. CTL economics depend on the spread between coal and liquid hydrocarbon fuels, and the industry will continue to be location constrained, working best in those areas with abundant coal supplies and liquid hydrocarbon deficits. These countries include (most obviously) China and the U.S., and less obviously Indonesia, the Philippines, and India. CTL brings environmental challenges. While the process removes sulphur and ash from the coal, it is energy intensive, consumes a large amount of water, and emits significantly higher quantities of CO_2 than the traditional hydrocarbon extraction process does.

Coal gasification has been around for many years, and coal gas or town gas predates electricity as an urban domestic lighting medium. Newer applications of coal gasification are mainly related to power generation, but many of these (outside of China at least) have struggled to overcome high capital costs, high energy consumption, and carbon dioxide emission/sequestration issues. We estimate that a coal-to-liquids plant breaks even at an oil price equivalent of around $45, *before* counting any cost of CO_2 emissions.

Energy Efficiency—a Key Response to Higher Prices

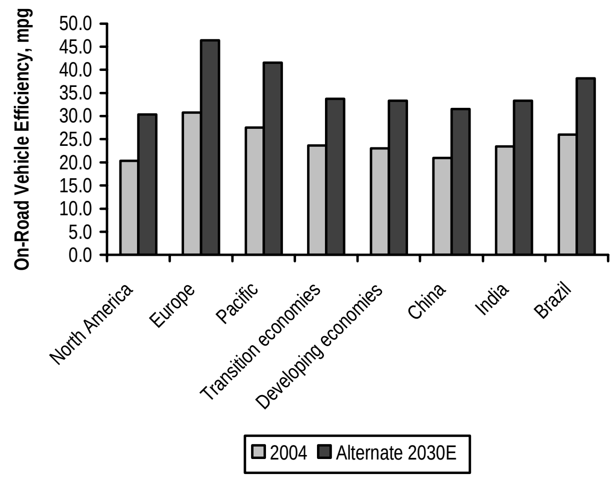
In addition to a greater focus on renewable generation and alternative power generation, we expect a renewed global drive to improve energy efficiency (e.g., lighting, household appliances, air conditioning, space heating, motors and controls) and vehicle fuel efficiency.

Exhibit 31: Potential Energy Savings by Type



Source: IEA.

Exhibit 32: Potential Mileage per Gallon Improvements



Source: IEA.

Key Stock Recommendations

- Although the wind and solar subsectors are trading more richly than peers', stocks in these areas are delivering stronger overall real asset growth and returns.
- Within the solar subsector, shares that look relatively attractive through this HOLT® screen versus their peers include Phoenix Sonnenstrom, Solar Fabrik, and Solon in Germany, Carmanah Tech Corp. in Canada, and Tokuyama listed in Japan.
- Within the wind subsector, Vestas (Denmark), Acciona (Spain), and Suzlon (India) look more attractive. FPL is one of the utilities with the most exposure to wind in the U.S. Iberdrola and Energy Nouvelles have higher-than-average exposure in Europe.
- Within the global biofuels, COSAN (a Brazilian ethanol producer) scores well on valuation. Aventine (AVR) looks cheaper than Verasun (VSE) in the U.S.

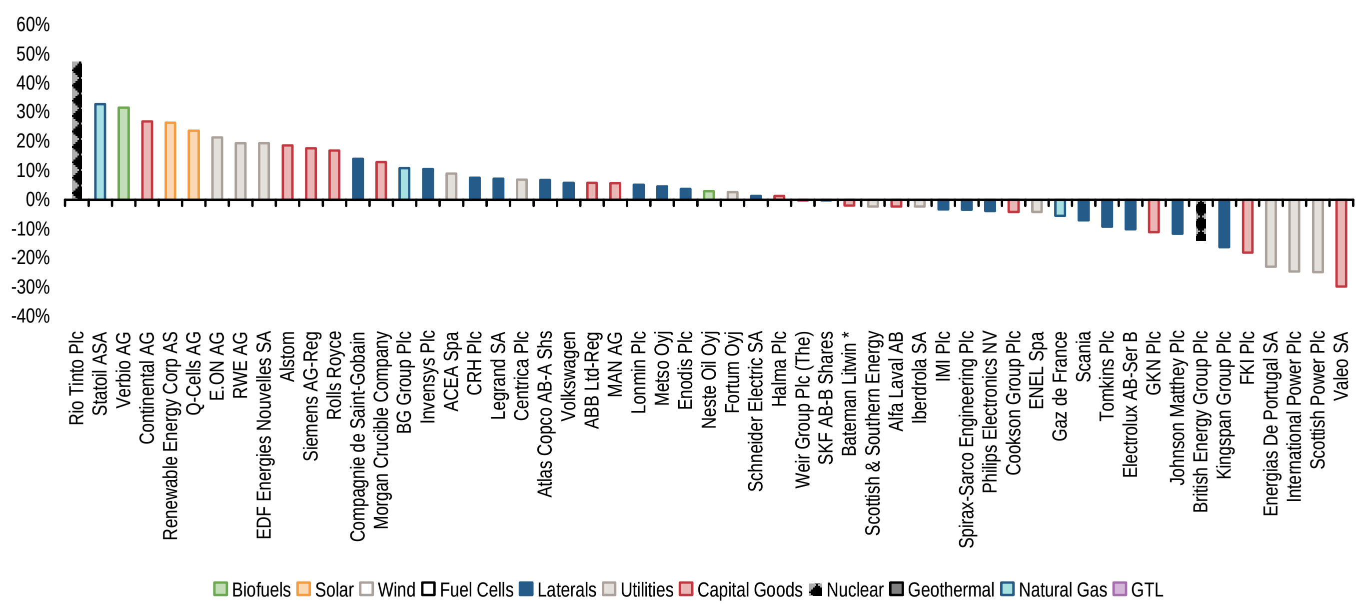
Within the Asia plantation group, there are stocks trading close to their inflation-adjusted gross invested capital, such as Highland and Lowlands, and Kumpulan Guthrie. There should offer absolute value upside, assuming CFROI® improves, driven by rising prices for biodiesel inputs, such as palm oil.

- Within the utility space, companies such as Fortum (Finland) and Jaiprakash HydroPower (India) look attractively valued and also have a reasonable focus on renewable production.
- Although not strictly alternative energy, gas continues to be an area of faster investment focus within the fossil fuel space, and selected natural gas producers such as Quick Silver Resources, XTO, Pogo Producing, Statoil, and BG Group offer absolute value at current levels.

- More broadly, we argue that shares of companies exposed to renewable themes but not direct plays look to offer more value than the purer plays and could offer a better opportunity as the market appreciates their faster-growing subsegments over time. Within the capital goods sector, Siemens looks relatively attractive and is exposed to positive order flow trends in wind installation, power generation refits, and environmental controls. ADM should benefit from rising demand for its agricultural produce in the next few years.

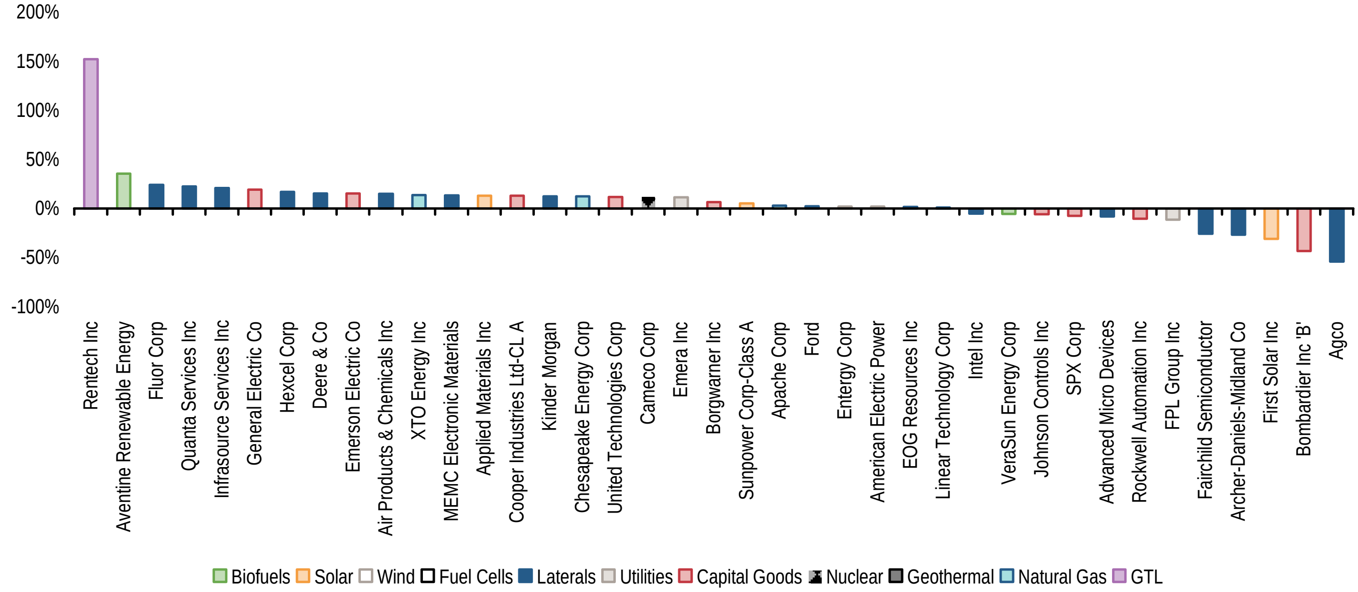
Upside/Downside by Region

Exhibit 33: European Stocks—Upside/Downside to Target Price



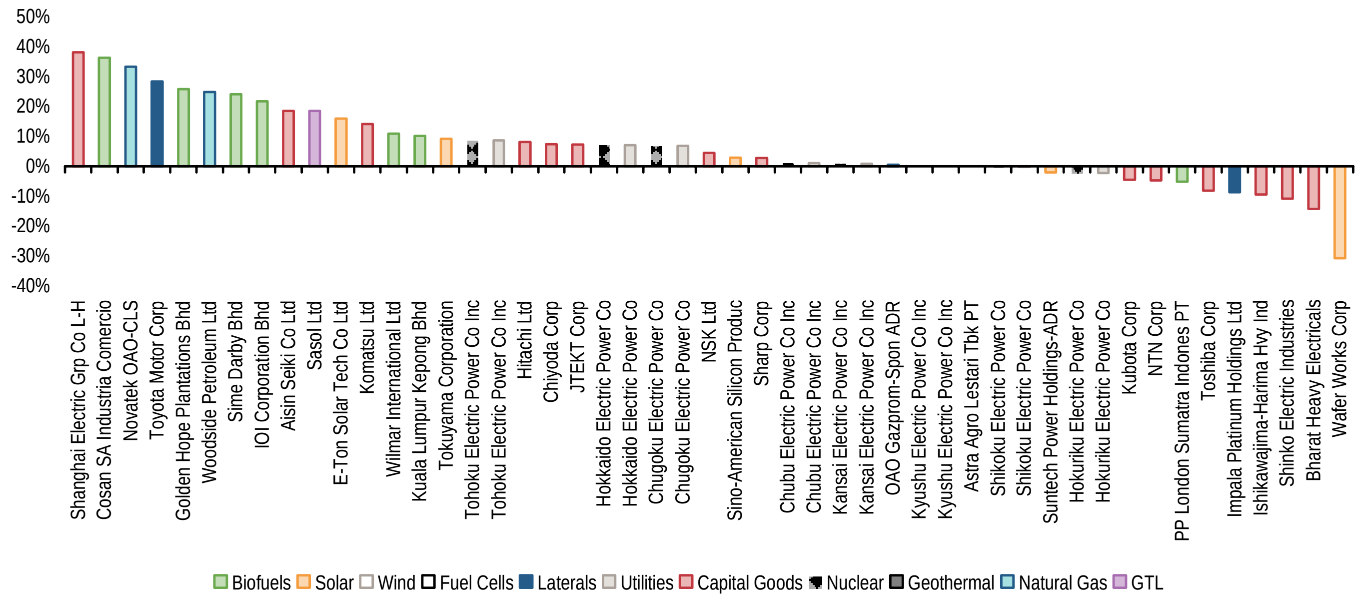
Source: Credit Suisse estimates, Bloomberg.

Exhibit 34: North American Stocks—Upside/Downside to Target Price



Source: Credit Suisse estimates, Bloomberg.

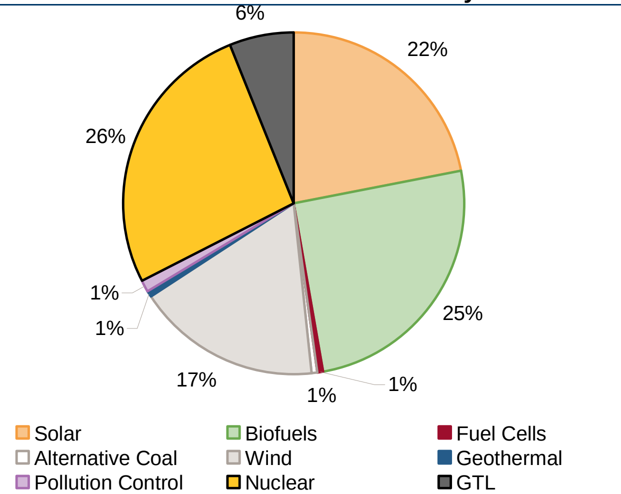
Exhibit 35: Non-U.S./Europe Stocks—Upside/Downside to Target Price



Source: Credit Suisse estimates, Bloomberg.

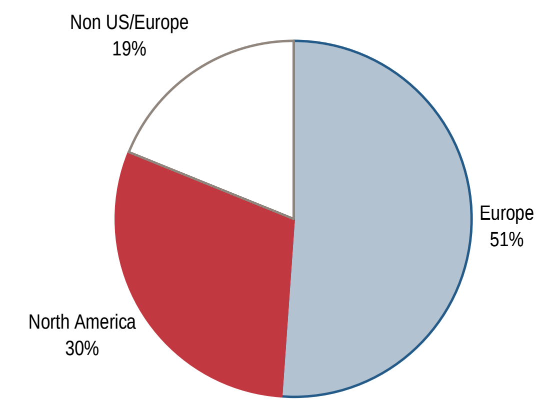
Map: Alternative Energy Universe

Exhibit 36: Broader Alternative Universe by Subsector



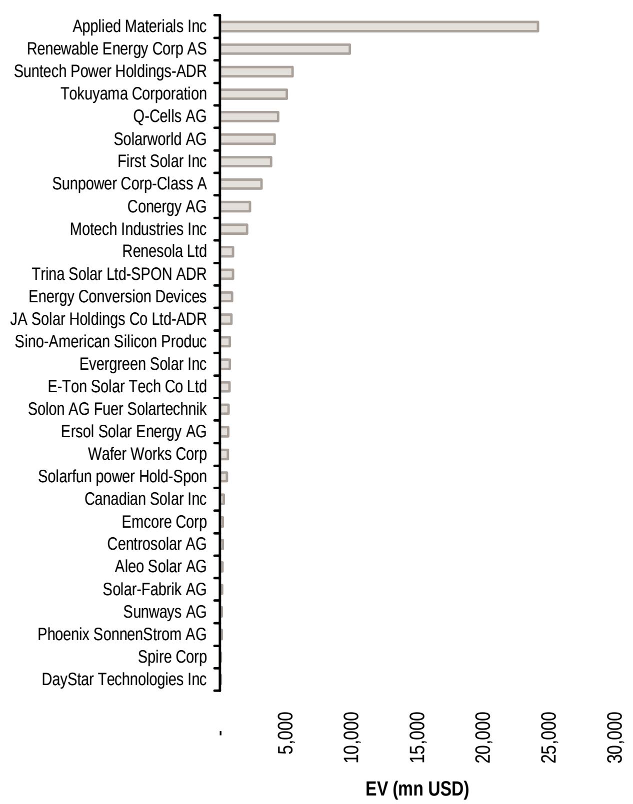
Source: Bloomberg, Credit Suisse, Reuters.

Exhibit 37: Broader Alternative Universe by Geography



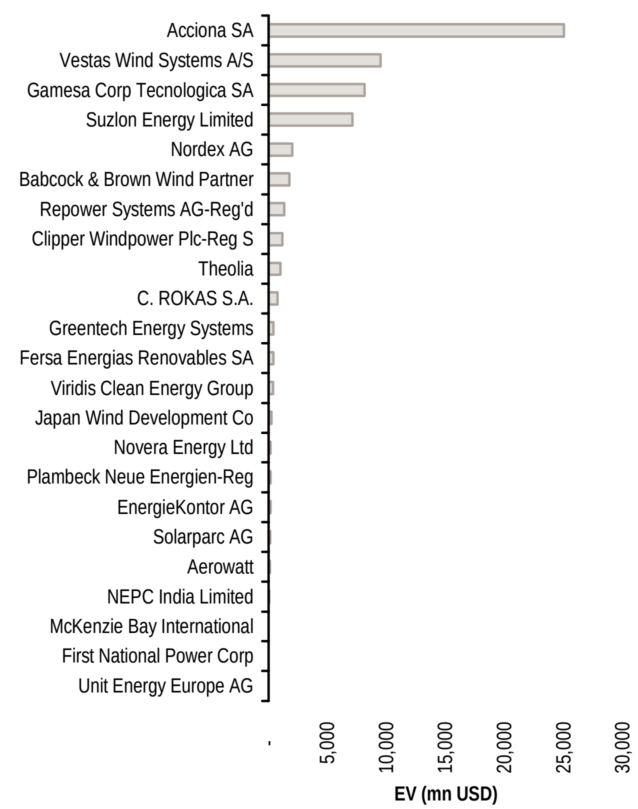
Note : Includes Solar, Biofuels, Fuel Cells, Wind, Geothermal, GTL, Pollution Control, Nuclear, and Alternative Coal Companies.
Source: Bloomberg, Credit Suisse, Reuters.

Exhibit 38: Global Solar Stocks by Enterprise Value
USD



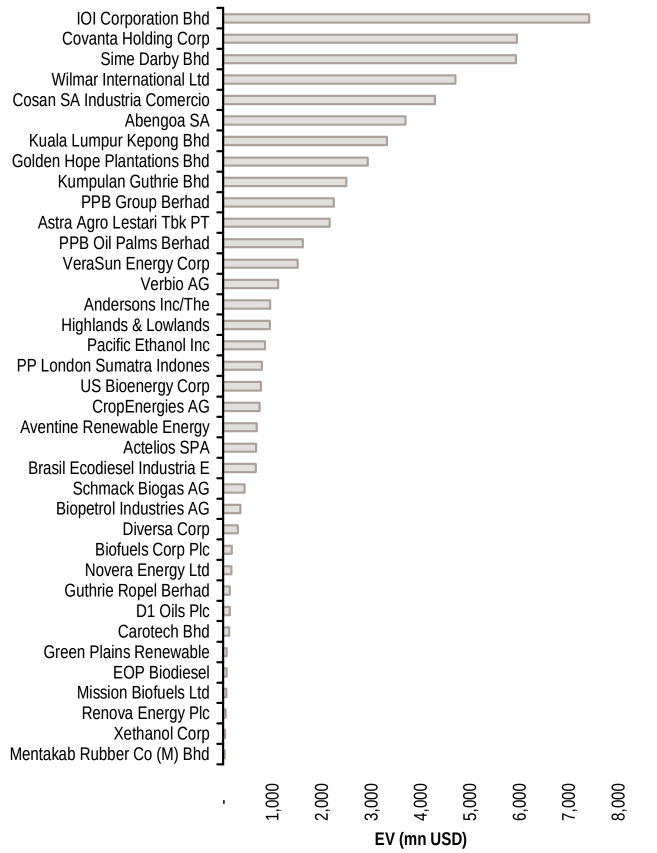
Source: Bloomberg, Credit Suisse, Reuters.

Exhibit 39: Global Wind Stocks by Enterprise Value
USD



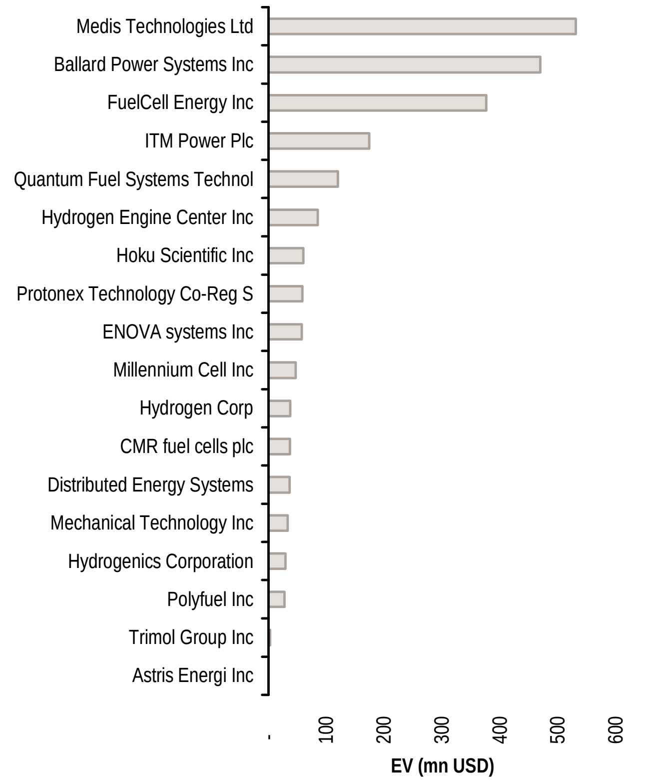
Source: Bloomberg, Credit Suisse, Reuters.

Exhibit 40: Global Biofuel Stocks by Market Cap



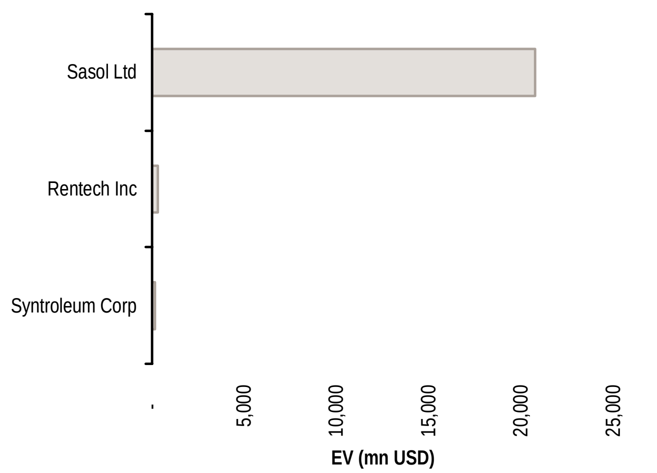
Source: Bloomberg, Credit Suisse, Reuters.

Exhibit 41: Global Fuel Cells Stocks by Enterprise Value
USD



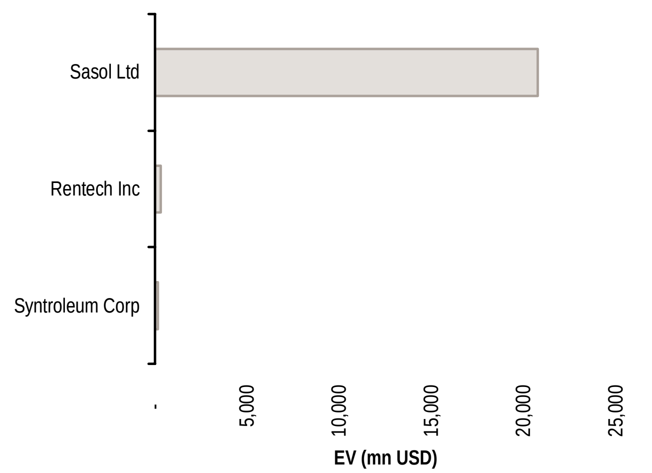
Source: Bloomberg, Credit Suisse, Reuters.

Exhibit 42: Global GTL Stocks by Enterprise Value
USD



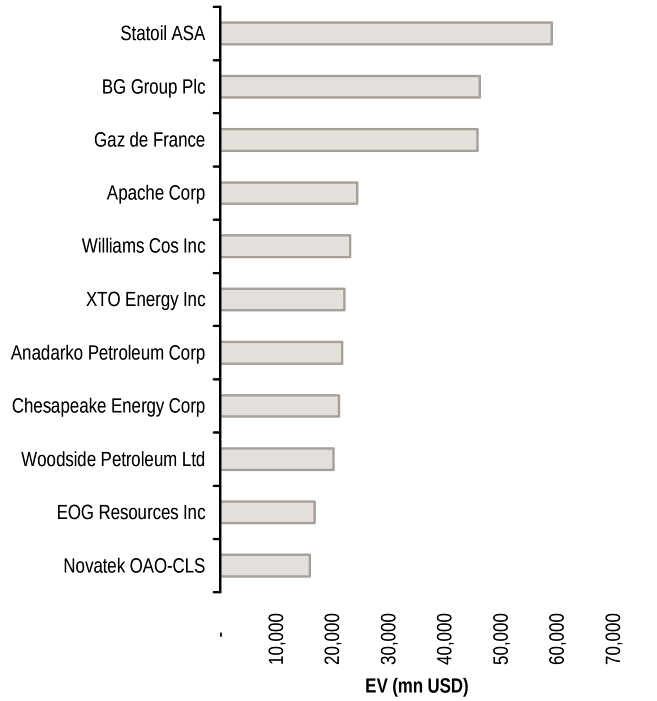
Source: Bloomberg, Credit Suisse, Reuters.

Exhibit 43: Global Pollution Control Stock by Enterprise Value
USD



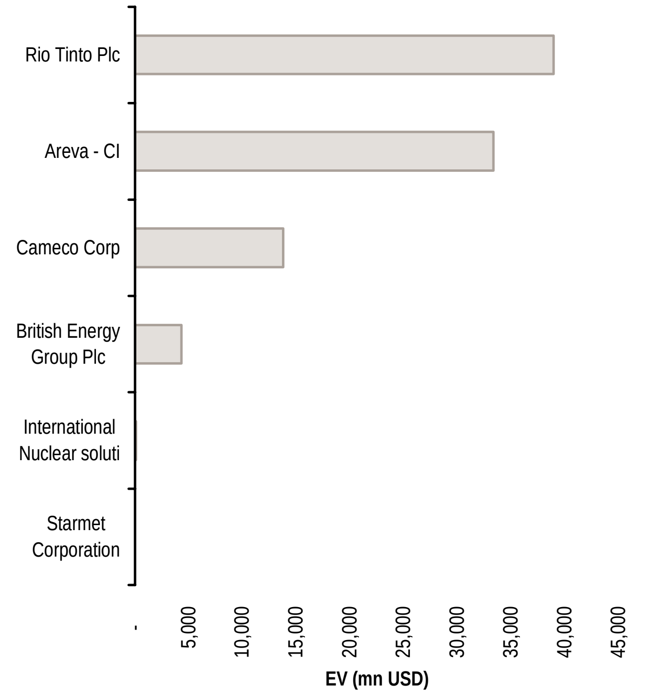
Source: Bloomberg, Credit Suisse, Reuters.

Exhibit 44: Global Natural Gas Stocks by Enterprise Value
USD



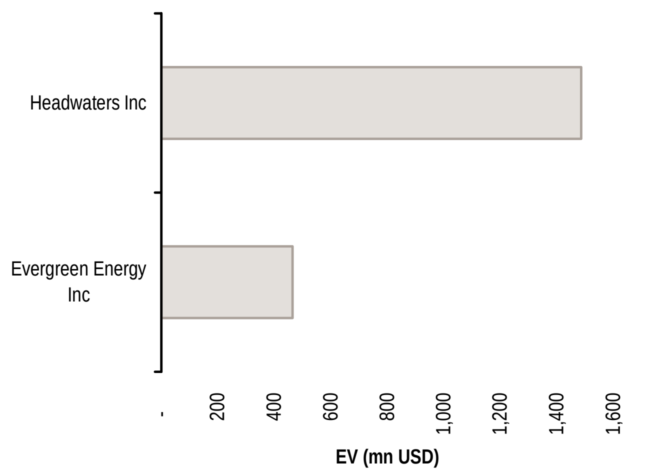
Source: Bloomberg, Credit Suisse, Reuters.

Exhibit 45: Global Nuclear Stocks by Enterprise Value
USD



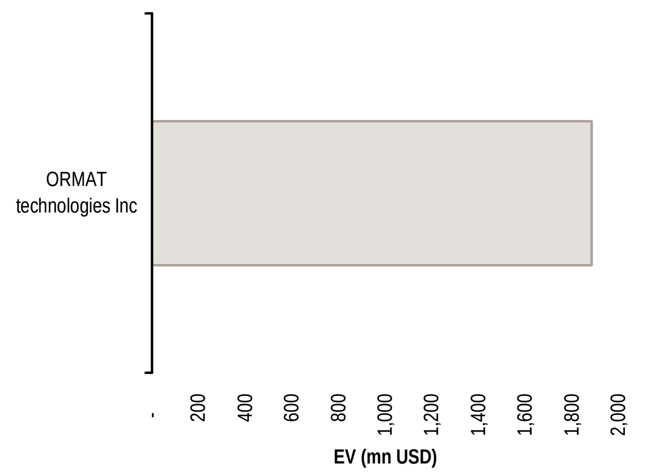
Source: Bloomberg, Credit Suisse, Reuters.

Exhibit 46: Global Alternative Coal Stocks by Market Cap



Source: Bloomberg, Credit Suisse, Reuters.

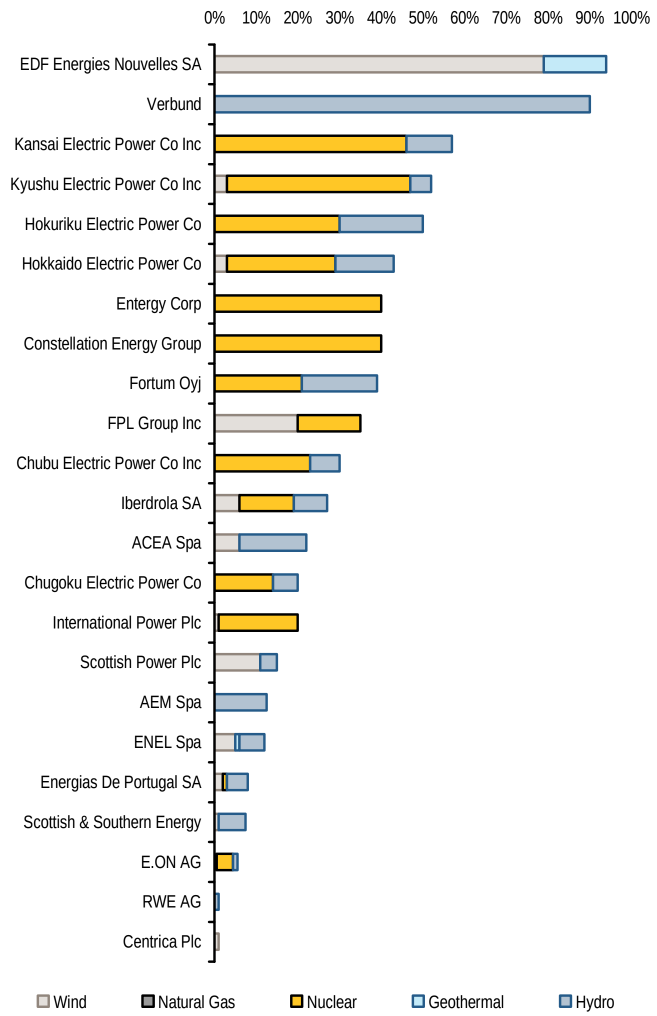
Exhibit 47: Global Geothermal by Market Cap



Source: Bloomberg, Credit Suisse, Reuters.

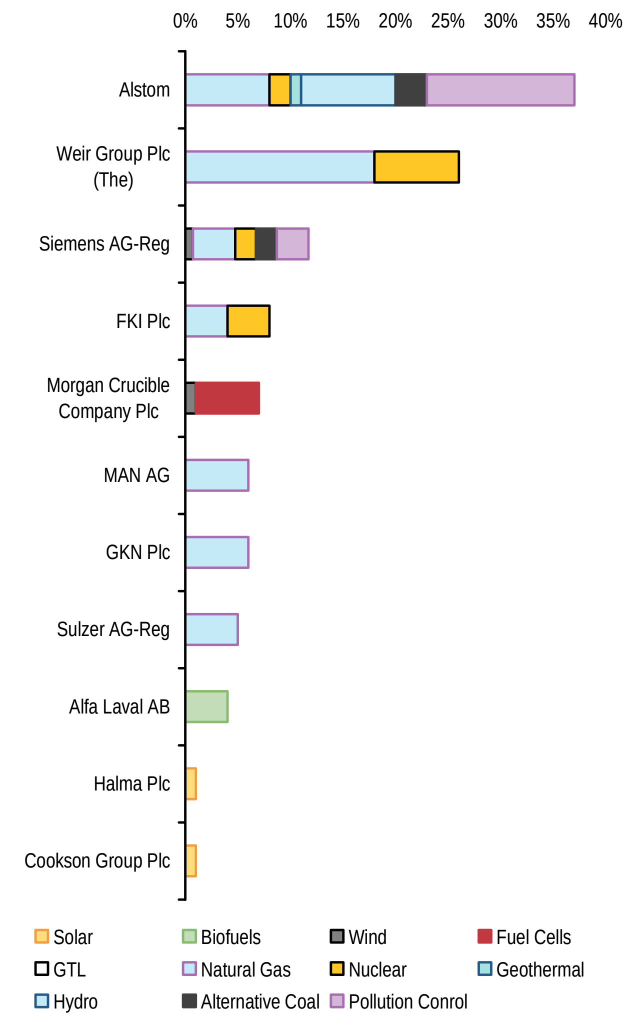
Alternative Energy Subsegment Exposure

Exhibit 48: Utilities Exposure to Renewables by Percent



Source: Company data, Credit Suisse estimates.

Exhibit 49: Capital Goods Exposure to Renewables by Percent



Source: Company data, Credit Suisse estimates.

Renewable Power Generation

A Great Platform . . .

Angello Chan
Dan Eggers
Richard Gray

Renewables for the power industry relate to building and operating assets that harness naturally occurring energy sources such as wind, water, solar, biomass, and a whole host of other resources and converting them into deliverable electricity.

Renewable energy sources have a number of positive attributes.

- Renewables ideally produce zero emissions and are in infinite supply (i.e., wind and solar), helping to reduce carbon emissions plus providing distance from volatile oil and natural gas prices.
- Renewables are powered by resources naturally occurring in the region of operation, in turn reducing reliance on imported fossil fuels from politically sensitive areas such as the Middle East.
- Renewables currently generate considerable social and political goodwill, shaping policy on issues somewhat removed from actual economics.

We see the renewables business as a compelling investment driver for the global power business and believe a more thorough conversation related to market backdrop, investment economics, regulation, and the leading technologies of wind and solar generation is warranted.

. . . but Not without Some Issues

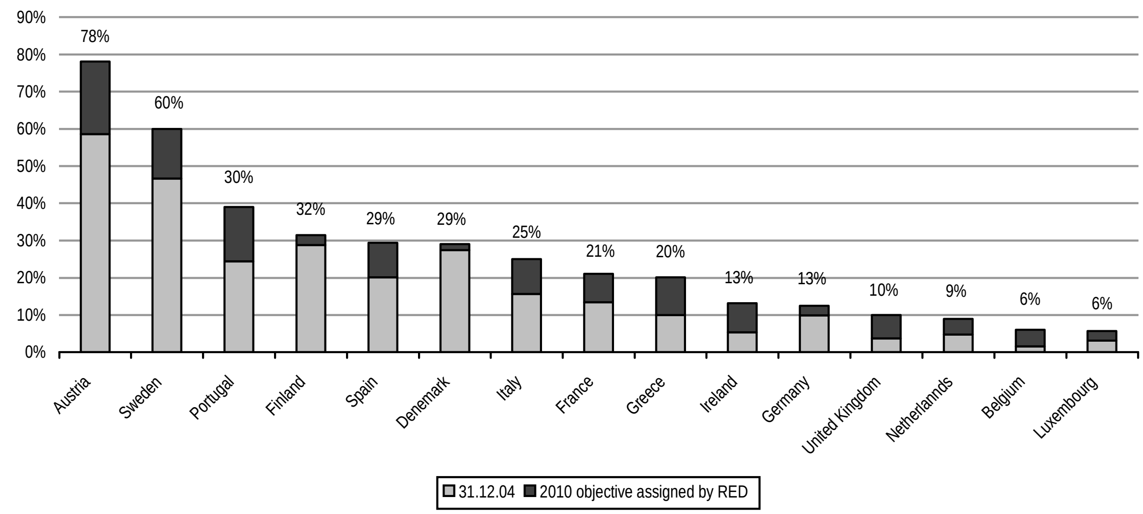
The constructive case for renewables is not hard to craft; they tend to pollute less, have less volatile variable operating costs, and support energy independence from less politically stable but resource-rich regions. That said, renewables have not single-handedly replaced conventional natural gas and coal-fired generation from the construction queues on a global basis. Before we discuss specific returns and policy issues, we point out some of the challenges associated with renewables.

Government Involvement Is Key

Stand-alone economics as measured today almost universally fails to justify investment in new renewables generation. In the U.S., wind assets produce an IRR of less than 7% on their own. Fortunately, government involvement through subsidies, compensation systems, and tax credits has created environments supportive of renewables investment.

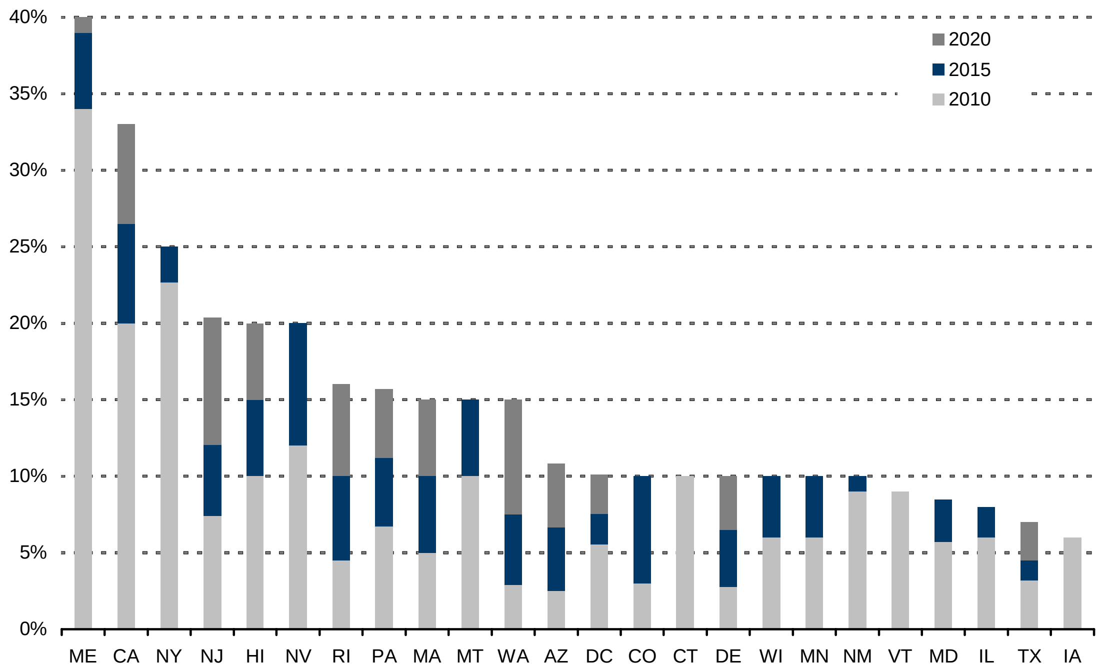
Europe is generally ahead of the rest of the world in renewables additions and composition of the total electricity resource base (Exhibit 50), although U.S. policy is being set at the individual state level with some success (Exhibit 51) and China has shown a higher level of commitment to renewables (Exhibit 52).

Exhibit 50: Total Renewable Energy to be Produced by 2010 Assigned by the E.U.'s Renewable Energy Directive
in %



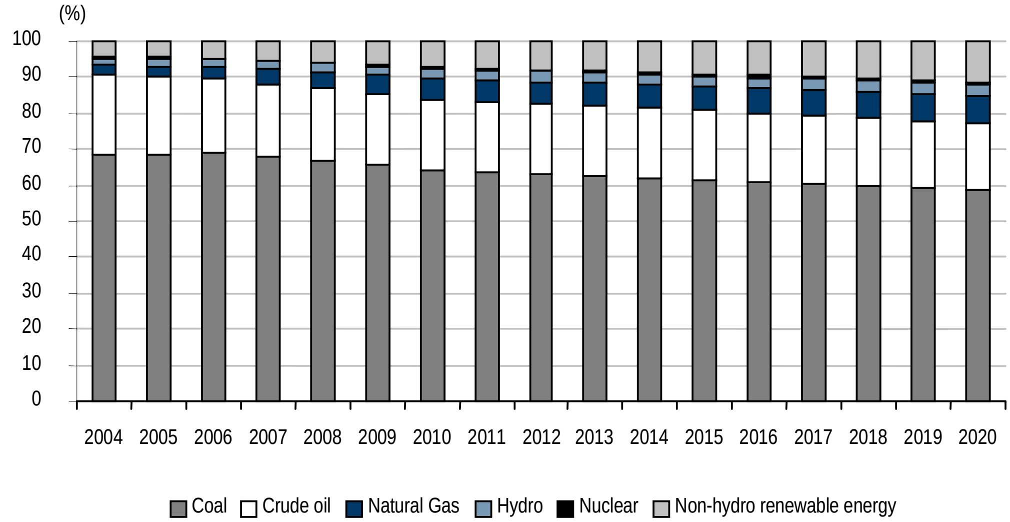
Source: 2005 European Barometer of Renewable Energies, EurObserver.

Exhibit 51: Targeted Renewable Generation by State in 2010, 2015, and 2020



Source: DOE, State Regulatory Filings, SNL Financial.

Exhibit 52: Composition of China's Energy Consumption

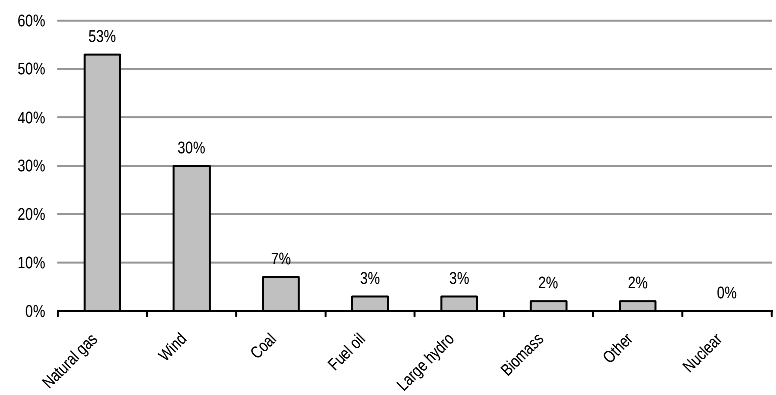


Source: Company data, Credit Suisse estimates.

More Capacity Coming, but Not Necessarily Faster Than Conventional

The projected growth in installed renewable generation capacity is dramatic (Exhibit 50) as countries more aggressively target emission reductions; improving project economics are also helping. The growing presence of wind can be seen in the fact that wind energy represented 30% of all electricity generating capacity installed in the E.U. in the past five years, second only to gas. (See Exhibit 53.)

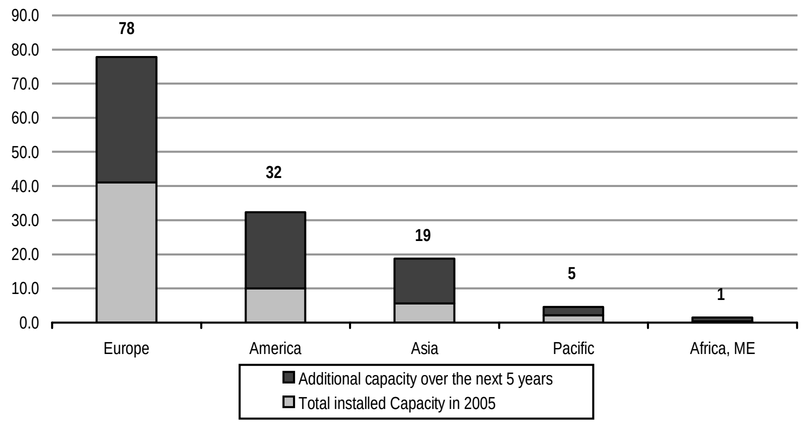
Exhibit 53: New Installed Capacity in Europe, 2001–05
in %



Source: Platts, EWEA.

Even with more meaningful additions coming, in its *2006 International Energy Outlook* the EIA estimates that the renewable share of world electricity capacity will fall very slightly from 23% in 2003 to 22% by 2030 (in its Reference Scenario) due to a large build in fossil-fuel generation in the developing economies of China, India, and Asia. The true economic advantages of conventional generation versus renewables is also affecting full-scale capacity addition decisions.

Exhibit 54: Total Worldwide Renewable Installed Capacity Projected over the Next Five Years
in GW



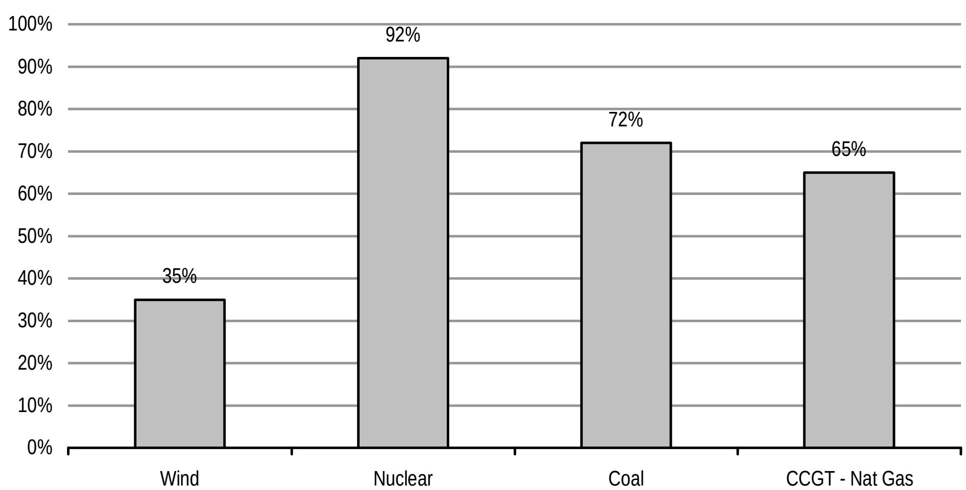
Source: GWEC, BTM consult APS.

Utilization Is Generally Low and Less Dependable

When considering thermal efficiency for renewables generation—particularly wind and solar—we see utilization rates well below that of conventional generation, with renewables in the <35% level versus conventional generation typically above 60% utilization and critical baseload capacity over 80%.

The most significant disadvantage is that renewable technologies often offer only intermittent or fluctuating output; they generally do not offer the load-generating reliability of traditional fossil fuel generation since one cannot guarantee a windy or sunny day. Accordingly, power system operators still require backup conventional generation be available in case the renewable generation is not, effectively adding to the capital cost.

Exhibit 55: Illustrative U.S. Utilization by Plant Type



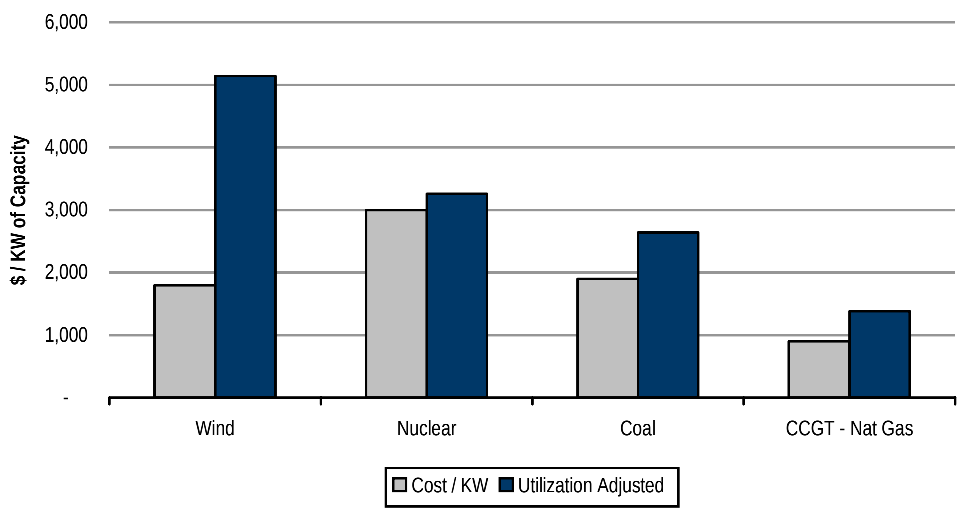
Source: Company data, Credit Suisse estimates.

Not Cheap to Build

Capital costs tend to be high for renewables and can even be multiples of competing conventional generation, although technological developments and scale continue to reduce the cost component. To fairly compare capital costs, we recommend looking at the cost of capacity on a utilization adjusted basis. In Exhibit 58 we provide a simple example of absolute cost of new generation construction in the U.S. on an absolute basis and on a utilization-adjusted basis.

On top of capacity costs, renewables such as wind often require large expanses of land and are often far from population centers requiring more transmission infrastructure (additional capex) to link renewable supply to demand.

Exhibit 56: Cost of Capacity per kW and Utilization Adjusted



Source: Company data, Credit Suisse estimates.

Leading Exposure by Country

United Kingdom

- *Centrica*. Very small (building some wind turbines).
- *International Power*. Very small (just bought some turbines and development pipeline in Germany).
- *Scottish & Southern*. Small. (We estimate that hydro and wind account for about 7.5% of 2007E generation output.) Some interesting technology investments, but very small.
- *ScottishPower*. Small. (We estimate that hydro and wind account for about 9% of 2007E generation output.)
- *Clipper Wind Power*. High (U.K. turbine manufacturer).

Italy

- *ENEL*. Medium. (Renewables—mainly hydro plus some wind and geothermal—account for about 40% of 2007E generation capacity.)
- *ACEA*. Small. (We estimate that wind and hydro account for about 13% of 2007E generation output.)
- *AEM*. Small. (We estimate hydro accounts for about 12.5% of 2007E generation output.)

Germany

- *E.ON*. Small. (About 8% of 2007E generation output—mainly hydro.)
- *RWE*. Very small. (About 1% of 2007E generation output—mainly hydro.)

Iberia

- *Iberdrola*. Significant. (About 15% EBITDA in 2006E, rising to about 27% EBITDA in 2012E.)
- *Acciona*. Significant. (About 35% EBITDA in 2006E.)
- *Gamesa*. Very significant. (Wind turbine manufacturer and wind farm developer.)

Scandinavia

- *Fortum*. Significant. (We estimate hydro generation accounts for about 27% of 2007E EBITDA.)
- *Vestas*. Very significant (Wind turbine manufacturer.)

France

- *Energies Nouvelles*. Very significant. (Wind and hydro about 90% of 2006E EBITDA.)

United States

- *FPL Group. (*Largest owner of wind generation capacity in the U.S., although still a relatively small component of the overall earnings profile, 20%.)
- *Edison International*. Relatively small, but a growing piece of merchant power business.
- *Ormat*. Very significant, as geothermal power generation is the company's primary business.

Renewable Economics

The Cost of New Entry

Angello Chan
Dan Eggers
Richard Gray

The obvious question that comes up with a conversation about renewables is whether investments in the equipment are economically viable. Better asked, *Do renewables make sense and can they survive without government subsidy*? The easy answer is, It depends on where and how you count.

European Newbuild Economics

For the European markets, we attempt to compare the cost of a new entrant (i.e., the sort of power price required to attract investment into that particular generation technology) using generic underlying assumptions such as required rate of return and oil/coal/gas prices. (See Exhibit 60.)

We should stress that this analysis is more academic that pure science since not is there only a difference across Europe in inputs such as fuel costs, but variations of the same technology can make a significant difference to the capital costs involved. Even the site of a wind turbine can alter the ultimate building costs (onshore/offshore, close to existing road and electricity infrastructure). However, we think this gives an interesting illustration of the relative competitiveness of new generation technology and provides a useful platform for discussion.

On this look, we see that on a pure economic basis conventional generation assets are still the most rational, with nuclear at the top of the heap followed by combined cycle gas turbines and then coal. However, wind is closing the gap and not that far behind gas-fired generation.

Caveats to the Analysis

There are, however, two important variables that we were not able to include in the model.

- *The associated cost of nuclear decommissioning and treating nuclear waste*—the subject of worldwide debate and a question to which no definitive answer has ever been given (mainly because most examples of nuclear decommissioning have involved specific circumstances or certain technologies). The answer is largely dependent on the view of how long the process might be required to take (with time value being the greatest aid in keeping the net present value of the costs down). According to the Nuclear Energy Agency, the extent of the differences is explained by the experimental nature of each dismantling project and the type of reactor. For an EdF type of reactor (pressurized water reactor, or PWR), the cost would be around €410/kW, while it could reach €423/KW for a WER (Russian type of PWR) and €538/KW for a BWR (boiling water reactor).

- *The issue of politics.* This can be reasonably subtle—for instance, the burning of subsidized (domestically produced) coal in some Spanish plants. It can also be overt—the European wide provision of market-based subsidies for renewable generation (in particular, wind). What might make a significant difference, however, is a decision on carbon. For instance, where a new CCGT plant receives a 100% allocation of free permits, the ”new entry cost” falls by €10MW/h (all other things being equal). In other words, any decision to build a new generation plant involves a large capital project with a lifespan measured in decades, where the outlook for governmental energy and environmental policy is as important as the cost of fuel itself.

Exhibit 57: The Cost of New Entry for Thermal and Renewable Generation

Financing costs		Long-term oil price forecast		Exchange rate	
Pre-tax Required Return	10.0%	Brent (US$/barrel)	48	Exchange rate (€/US$)	1.32

ETS costs		Long-term gas price forecast		Coal price inc. freight	
CO_2 permit (€/tonne)	25.0	Gas price ($/Mbtu)	6.5	Coal price (US$/tonne)	70

Coal assumptions		CCGT assumptions		Nuclear assumptions		Wind assumptions		Hydro (base load) assumptions		Fuel-oil assumptions	
Coal price (US$/tonne)	70.0									Brent Oil (US$/barrel)	48.0
Exchange rate (€/US$)	1.32									Exchange rate (€/US$)	1.32
Coal price (€/tonne)	53.0									Oil price (€/barrel)	36.4
Coal price (€/MWh)	6.9	Gas price (€/MWh)	16.9	Fuel price (€/MWh)	10.0	Fuel price (€/MWh)	-	Fuel price (€/MWh)	-	Fuel-oil price (€/MWh)	12.7
Thermal efficiency	45%	Thermal efficiency	57%	Thermal efficiency	-	Thermal efficiency	-	Thermal efficiency	-	Thermal efficiency	32%
CO_2 emissions (kg/MWh)	800	CO_2 emissions (kg/MWh)	390	CO_2 emissions (kg/MWh)	-	CO_2 emissions (kg/MWh)	-	CO_2 emissions (kg/MWh)	-	CO_2 emissions (kg/MWh)	900
O&M variable cost (€/MWh)	2.0	O&M variable cost (€/MWh)	2.0	O&M variable cost (€/MWh)	3.5	O&M variable cost (€/MWh)	2.0	O&M variable cost (€/MWh)	2.0	O&M variable cost (€/MWh)	2.0
O&M fixed costs (€/MW)	30,000	O&M fixed costs (€/MW)	10,000	O&M fixed costs (€/MW)	40,000	O&M fixed costs (€/MW)	8,000	O&M fixed costs (€/MW)	20,000	O&M fixed costs (€/MW)	6,000
Plant life (yrs)	40	Plant life (yrs)	25	Plant life (yrs)	60	Plant life (yrs)	20	Plant life (yrs)	50	Plant life (yrs)	30
Load factor (%)	75%	Load factor (%)	60%	Load factor (%)	90%	Load factor (%)	25%	Load factor (%)	50%	Load factor (%)	5%

Coal cash costs		CCGT cash costs		Nuclear cash costs		Wind cash costs		Hydro (baseload) cash costs		Fuel-oil cash costs	
Fuel cost (€/MWh)	15.3	Fuel cost (€/MWh)	29.6	Fuel cost (€/MWh)	10.0	Fuel cost (€/MWh)	-	Fuel cost (€/MWh)	-	Fuel cost (€/MWh)	39.8
Carbon cost (€/MWh)	20.0	Carbon cost (€/MWh)	9.8	Carbon cost (€/MWh)	-	Carbon cost (€/MWh)	-	Carbon cost (€/MWh)	-	Carbon cost (€/MWh)	22.5
O&M variable cost (€/MWh)	2.0	O&M variable cost (€/MWh)	2.0	O&M variable cost (€/MWh)	3.5	O&M variable cost (€/MWh)	0.5	O&M variable cost (€/MWh)	2.0	O&M variable cost (€/MWh)	2.0
Total marginal cost (€/MWh)	37.3	Total marginal cost (€/MWh)	41.3	Total marginal cost (€/MWh)	13.5	Total marginal cost (€/MWh)	0.5	Total marginal cost (€/MWh)	2.0	Total marginal cost (€/MWh	64.3
O&M fixed costs (€/MWh)	4.6	O&M fixed costs (€/MWh)	1.9	O&M fixed costs (€/MWh)	5.1	O&M fixed costs (€/MWh)	3.7	O&M fixed costs (€/MWh)	4.6	O&M fixed costs (€/MWh)	13.7
Total cash costs (€/MWh)	41.9	Total cash costs (€/MWh)	43.2	Total cash costs (€/MWh)	19	Total cash costs (€/MWh)	4	Total cash costs (€/MWh)	7	Total cash costs (€/MWh)	78

Coal capital cost		CCGT capital cost		Nuclear capital cost		Wind capital cost		Hydro (baseload) capital cost		Fuel-oil capital cost	
Build cost (€ per kW)	1,000	Build cost (€ per kW)	500	Build cost (€ per kW)	1,750	Build cost (€ per kW)	1,200	Build cost (€ per kW)	1,200	Build cost (€ per kW)	350
Plant life (yrs)	40	Plant life (yrs)	25	Plant life (yrs)	60	Plant life (yrs)	20	Plant life (yrs)	50	Plant life (yrs)	30
Cost of capital (%)	10%	Cost of capital	10%	Cost of capital	10%	Cost of capital	10%	Cost of capital	10%	Cost of capital	10%
Load factor (%)	75%	Load factor	60%	Load factor	90%	Load factor	25%	Load factor	50%	Load factor	5%
Total capital cost (€/MWh)	16	Total capital cost (€/MWh)	10	Total capital cost (€/MWh)	22	Total capital cost (€/MWh)	64	Total capital cost (€/MWh)	28	Total capital cost (€/MWh)	85

Coal cost (€/MWh)	57	**CCGT cost (€/MWh)**	54	*** Nuclear cost (€/MWh)**	41	**Wind cost (€/MWh)**	69	**Hydro cost (€/MWh)**	34	**Fuel-oil cost (€/MWh)**	163

* N.B. Does not take into account cost of nuclear decommissioning

Source: Company data, Credit Suisse estimates.

U.S. New-Build Economics

The U.S. also battles with the challenges of a creating a level starting point for analyzing new-build power plant economics. Unique market conditions exist between states ranging from regulated versus deregulated, coal on the margin versus gas on the margin, more restrictive environmental policies versus less, etc.

To bridge the gap between markets, we look at the economics of different generation technologies using a life-of-asset DCF valuation methodology specific to each generation asset class. We assume a standard power price and associated operating cost assumptions for each type of generation, deriving an IRR calculation for the particular investment.

In a world of $60-65/MWh power prices, all forms of generation produce returns in the 8% range—adequate to meet most returns thresholds. While mathematically the assets appear close from a return on capital perspective, several factors could impact the investment decision.

- The calculations do not include any sort of carbon-related costs, which would increase the clearing cost for coal and even natural gas fired generation or conversely would lower the cost for nuclear and wind.
- Our wind economics calculation assumes the currently allowed 10-year production tax credit (PTC) remains in place; stripping away the credit would lower wind's IRR to just over 6%.
- Natural-gas-fired generation economics are highly dependent upon the market clearing heat rate relative to the natural gas price. For example, if gas prices were $7/mcf instead of our assumed $6.50 but the heat rate was 9,000 Btu/kWh rather than 9,500 Btu/kWh—meaning the price of power was effectively unchanged—the observed IRR falls to 7.3% from 8.2%, a significant change from a total investment proposition.

These issues aside, we see a market for a mix of new generation additions but with a bias away from natural gas (as much as possible) given the more significant volatility in this fuel input cost and the more meaningful buildout of this capacity over the past decade. We think a reasonably sound argument can be made for wind today, although deficiencies around pricing (hard to justify a market price for intermittent power) and need for redundant generation do take some of the luster from the wind story.

Exhibit 58: New Generation Investment IRRs Derived from Asset-Specific DCFs

Natural Gas Price	6.50			
Heat Rate	9,500			
Power Price	61.75			
Nuclear Cost / KW	3,000			
Coal Cost / KW	1,900			
Gas Cost / KW	900			
Wind Cost / KW	1,800			
Wind Tax Credit	19.00			
	Wind	**Nuclear**	**Coal**	**Natural Gas**
NPV	571	13	1,684	800
Investment	(475)	(1,901)	(1,699)	(789)
PV / I	1.20	0.01	0.99	1.01
IRR	**11.1%**	**8.0%**	**8.0%**	**8.2%**
Wind w/o Tax Credits	6.2%			

Source: Company data, Credit Suisse estimates.

The Capital Cost of Renewables

U.S. Renewables Policy as a Case Study

Angello Chan

Dan Eggers

Richard Gray

With political and social winds supporting further expansion of renewables generation, consideration of the capital investments required to achieve these aspirations is warranted. With U.S. renewables policy the least developed (and hence in most need of investment), we narrow our conversation to the capital and capacity additions required to meet various renewables standards currently proposed in the U.S.

It Isn't Easy (or Cheap) Being Green

The Ground Rules

The U.S. currently has a rather disorganized renewables policy in place, led by state mandates rather than a centralized and consistently applied federal standard. In the following examples, we look at the spending and capex addition requirements assuming compliance with (1) only the state standards currently in place; (2) implementation of Senator Bingaman's 2006 federal plan, which would require 10% of total U.S. electricity demand to be met by renewables by 2020; and (3) an outlier assumption that enough renewable generation is built to keep up with U.S. demand growth for electricity. (The two preceding scenarios still require incremental investment in conventional generation to keep up with demand.)

Our forecast capex requirements assume that all new renewables capacity comes from wind-powered generation—the lowest cost relative to other renewables—beyond solar specifically required in the state standards (not a significant amount). Our analysis does not include the cost of building associated transmission and distribution infrastructure nor the cost of redundant conventional generation to support system reliability, since renewables cannot be guaranteed to be available when needed (a big issue in the power business). We recognize that from an available wind resource perspective, wind cannot be the sole source of renewable generation in the U.S., but in this case we believe it a reasonable base-line assumption.

The Results

We were admittedly surprised by the implied size of a total U.S. renewables program. On our estimates, the spending obligations through 2025 would range from $180 billion in the base-line plan to $320 billion with implementation of Senator Bingaman's plan to $865 billion if renewable additions were to keep up with demand growth for electricity from 2015-2025. (See Exhibit 59.) By way of capacity, the math would suggest construction of between 100,000 MW and 450,000 MW, or 50,000-225,000 wind turbines, over the next 15 or so years. (See Exhibit 60.)

To help put the dollar amounts in context, the U.S. power sector market capitalization is about $450 billion, meaning the industry would spend 50-200% of its market cap building renewable generation. Another way, U.S. utilities spend approximately $75 billion per year on capex; the renewables initiatives would increase this spending by 15-30% per year under our more conservative scenarios.

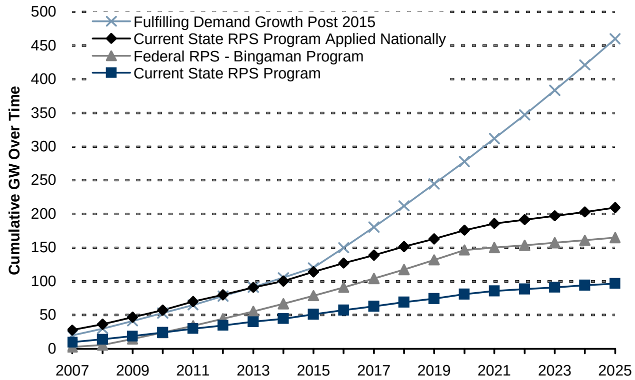
The Conclusions

The primary take-away from the U.S. build-out scenario is that significant capital is going to be required to meet renewable standards as proposed. Based on conversations with industry groups, we are not convinced those pushing for more stringent renewable standards fully appreciate the capital costs that come along with a construction program as proposed. That said, we believe the political will is currently in place to support more far-reaching renewables targets, in turn driving investment opportunities for the manufacturers of the equipment but also for the owners of said generating capacity.

Interested in More Detail?

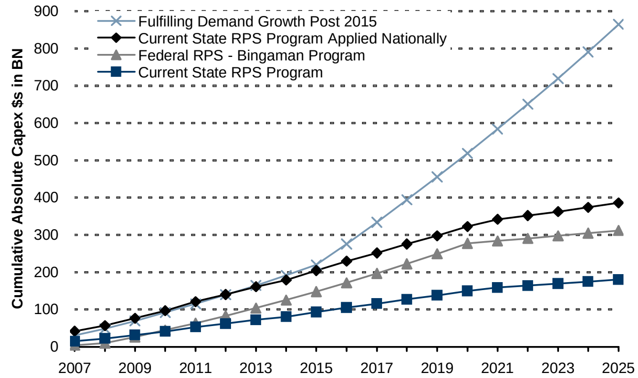
Our report, *Being Green Ain't Easy or Cheap*, dated December 20, 2006, offers a more comprehensive look at each scenario and the implications.

Exhibit 59: Cumulative Capacity Additions



Source: Company data, Credit Suisse estimates.

Exhibit 60: Total Cumulative Absolute Capex Cost



Source: Company data, Credit Suisse estimates.

Renewables Regulation

Unique to Everyone

Angello Chan
Dan Eggers
Richard Gray

Surveying the landscape of regulation across Europe, the U.S. and Southeast Asia, we see global support for construction of more renewable generation, although the policies and incentives used to reach this common goal are quite different. In this section, we walk through the standards by country (in the case of the U.S., by state) to help provide a broader look at renewables policy.

For ease of reference, Exhibit 64 provides a consolidated look at renewables policy by country.

Do Not Overlook the Economic Importance of Governmental Involvement

We stress that the economic case for almost all new renewables capacity is dependent upon the political support for this form of power generation by way of subsidies, tax breaks, mandatory off-take agreements, and potentially even penalties for not producing enough from renewables. Some of the most common incentives (1) include a minimum tariff and guaranteed off-take; (2) incorporate into wider scheme of increasing targets for the overall level of electricity generated from renewable resources; utilities must reach specific output levels with penalties possible for failing to reach the targets; and (3) include a tax credit directly linked to output from renewable generation output—the preferred approach in the U.S.

Accordingly, with such a dependence upon future governmental support and the potential for politicians to change their minds, we recommend that investors incorporate government benefits when evaluating project economics only for the visible period of enacted law (avoid capitalizing benefits on the assumption of future extensions).

Exhibit 61: Renewable Energy Targets Comparison by Country

Australia	78.1% of electricity output by 2010
Belgium	6% of electricity output by 2010
Brazil	Additional 3300 MW from wind, small hydro, biomass by 2016
China	15% of total energy consumption by 2020
Cyprus	6% of electricity output by 2010
Czech Republic	5-6 % of TPES by 2010
	8-10% of TPES by 2020
	8% of electricity output by 2010
Denmark	29% of electricity output by 2010
Estonia	5.1% of electricity output by 2010
Finland	35% of electricity output by 2010
France	21% of electricity output by 2010
Germany	12.5% of electricity output by 2010
Greece	20.1% of electricity output by 2010
Hungary	3.6% of electricity output by 2010
Ireland	13.2% of electricity output by 2010
Israel	2% of electricity from renewable energy resources by 2007
	5% of electricity from renewable energy sources by 2016
Italy	25% of electricity output by 2010
Korea, Republic of	- 2% of total energy consumption from new and renewable energy, including solar, wind and biomass energy by 2006
Latvia	6% of TPES (excluding large hydro) by 2010
	49.3% of electricity output by 2010
Lithuania	12% of TPES by 2010
	7% of electricity output by 2010
Luxembourg	5.7% of electricity output by 2010
Mali	15% of TPES by 2020
Malta	5% of electricity output by 2010
Netherlands	12% of electricity output by 2010
New Zealand	30 PJ of new capacity (including heat and transport fuels) by 2012
Norway	7 TWh from heat and wind by 2010
Poland	7.5 % of TPES by 2010 (Development Strategy of Renewable Energy Sector)
	14 % of TPES by 2020 (Development Strategy of Renewable Energy Sector)
	7.5% of electricity output by 2010 (As per Directive 2001/77/EC)
Portugal	45.6% of electricity output by 2010
Singapore	Installation of 50,000 m2 of solar thermal systems by 2012
	Complete recovery of energy from municipal waste
Slovak Republic	31% of electricity output by 2010
Slovenia	33.6% of electricity output by 2010
Spain	29.4% of electricity output by 2010
Sweden	60% of electricity output by 2010
Switzerland	3.5 TWh from electricity and heat by 2010
Turkey	2% of electricity from wind by 2010
US	No national policy to date; 24 states have standards ranging from 10-20% of total load in 2015-2020
U.K.	10% of electricity output by 2010

Source: IEA, Credit Suisse estimates.

European Regulation

European support for renewables has been around for some time, with roots in the 1997 E.C. White Paper and *2001 E.U. Directive on Renewable Energy*, which sets ambitious targets for the increase in renewable capacity. The 2001 Directive aimed to increase renewables' share of electricity within the European Union from 14% in 1997 to 21% in 2021. Below we discuss policy on a country-by-country basis.

United Kingdom

Renewable Obligation Certificates

Renewable obligation certificates (ROCs) are issued to provide evidence that power producers are fulfilling their obligation for the generation of electricity from renewable resources, and to provide incentives to invest in these areas. A ROC is equivalent to 1 MWh of qualifying electricity. The recent *U.K. Energy Report* (July 2006) noted the current level of obligation is 6.7% but should rise annually to 15.4% in 2015-16.

Government targets for these ROCs often exceed the actual supply proportion contributed by renewables, designed to raise incentives for renewable development. These incentives are also influenced by difficulty of entry to the electricity grid and planning barriers related to the creation of new plants. ROCs can be produced by “pure renewable” schemes such as wind farms and small hydroelectric installations (capacity up to 20 MW). A scarcity of ROCs drives up their price (ultimately borne by consumers) and thus acts as an incentive to build additional ROC-qualifying capacity.

Co-Fired Renewable Obligation Certificates

An income stream can be generated from the sale of certificates arising from co-firing biomass in coal generators under the U.K.'s renewables obligations certificates scheme. These co-fired renewable obligation certificates (CROCs) make up a percentage of the total available ROCs.

Biomass (e.g., short-rotation coppice, Miscanthus, Reed Canary grass, olive pips, tall oil) can be crushed alongside coal in grinding mills or “directly injected” into the station's furnaces. The idea is that biomass energy sources are carbon neutral over their life cycle.

The cap on CROCs was reduced from 25% to 10% on April 1, 2006. Under this revised limit, vertically integrated utilities with coal-fired capacity are no longer required to purchase additional CROCs to meet their own supply objectives. There is therefore no longer a market for CROCs produced by independent generators.

Spain

The law guarantees that, in normal circumstances, all the output from renewable sources must be purchased by the system. In 1999, the Spanish government approved the *Plan de Fomento de Energias Renovables*, setting out the key elements of its strategy to increase the growth of renewable energy and targets:

- Renewables are to cover at least 12% of primary energy consumption in 2010.
- The planning document envisages/targets over 19,000 MW of renewables by 2011, almost trebling the 6,600 MW of capacity as of 2002.
- The bulk of the increase in renewables will come in the form of wind power, which would also treble its capacity, reaching 13,100 MW in 2011.

In 2004, the government approved a new legal and economic framework for the so-called Special Regime (which also includes nonrenewable energy areas such as cogeneration), building on previous legislation from 1994 and 1998. The law offers operators two choices for the sale of their output:

- *Regulated price*. Operators can sell to a distribution company at a regulated price established as a fixed percentage of the reference tariff in the period. For wind power, the percentage is in the range of 80–90%.
- *Premium on the market price*. Operators can sell their energy freely in the market. The generator receives the market price, or whatever price it has negotiated, plus an incentive to participate in the market and a premium. The premium plus incentive is set at 50% (40% + 10%) of the reference tariff for the period.

Generators will choose either option according to their expectations on pool prices, with the choice then binding for a period of 12 months.

Portugal

In Portugal, wind power benefits from a fixed-price system based on two categories of feed-in tariffs.

- Plants licensed before February 2005 (including some wind plants belonging to the transition period group) receive €85/MWh for a period of 15-20 years.
- Plants licensed after February 2005 receive €75/MWh for the first 15 years followed by a further five-year period based on a new regulated system of "green certificates."

France

French wind generation is governed by the Advanced Renewable Tariff scheme established in 2006. This regulation differentiates the price paid per kilowatt-hour by technology, location, size of the installation, and the number of operational years. We highlight two main rates in the French feed-in tariffs.

- Wind farms in operation prior to July 26, 2006, receive €83.8/MWh for the first five years, followed by a second period of 10 years with lower tariffs (between €83.8/MWh and €30.5/MWh) established according to full power equivalent hours observed during the first period.
- Onshore wind farms in operation after July 26, 2006, receive €82/MWh for the first 10 years and a reduced tariff (between €82/MWh and €28/MWh) for the next five years depending on the performance observed in the first period. Note that offshore wind plants will receive a higher rate of €130/MWh for the first 10 years followed by five years of lower tariffs of between €130/MWh and €30/MWh.

Greece

Greek wind generation is sold through 10-year power purchase agreements (which can potentially be extended for a further 10 years), providing compensation rates as follows:

- €73/MWh for plants connected to the main grid;
- €84.6/MWh for wind parks located on islands not connected to the main network;
- €90/MWh for offshore wind power plants.

Other supportive systems are available for the generation of renewable energy, e.g., direct project subsidies (from 35% to 55% of eligible project costs) and tax exemptions or reductions of payment by the state of salary costs for the first three years of the project. These subsides cannot cumulatively exceed €20 million for the same project over a five-year period.

Italy

Italian wind farms sell their “green energy” into the wholesale power market and release “green certificates” for every 50 MWh of produced electricity during their first 12 years of operation. (This period was extended from eight years in 2006.) The national transmission system operator (GRTN) issues green certificates to wind farms and balances their trade on the green certificates market.

Belgium

In Belgium, wind generation is also regulated by green certificates. Green certificates for offshore wind farms are set at €107/MWh for the first 216 MW of produced output during the first 20 years of operation, falling to €90/MWh in subsequent years.

Germany

In Germany, renewable power generation is governed by the Renewable Energy Act (EEG), effective since 2000 and amended in 2004.

Under this law, all renewable energy fed into Germany's grid must be purchased by the system operator at regulated prices. Grid operators are then allowed to pass on to end consumers all surcharge payments (above average electricity wholesale prices) related to renewables.

Regulated feed-in tariffs are generally guaranteed for a fixed period of time (15-30 years) and differentiated by technology as well as installed capacity. Depending on these factors, feed-in tariffs are then annually reduced by a fixed percentage.

United States

U.S. renewable policy is an interesting combination of federal and state involvement, with most incentives (by way of tax credits) coming from the federal government and targeted generation contribution from renewable resources coming only from the state level (for now).

Production Tax Credits

The U.S. federal government offers tax credits for output from specific renewable resources, the most common of which is a production tax credit (PTC) offered to wind plant owners that pays $19/MWh for every unit produced on the system. The PTCs are available to all production over the first 10 years of the plant’s operation and vary with generation output, further increasing the importance of higher utilization to improve project economics. In the case of wind generation, the PTCs along with five-year accelerated depreciation (five-year MACRS depreciating schedule) account for over half of the total economic value of new capacity. The government’s role is vital to success in the U.S.

A major impediment to even more new wind generation construction has been U.S. Congress’ relative inconsistency in extending the PTCs, with extensions generally limited to only one or two years upon each approval. While only in part of 2004 did the industry face construction delays due to a lack of PTCs, the limited visibility makes it more difficult for equipment manufacturers to build new production capacity because of uncertainty about whether there will be a market for their wind equipment a couple of years into the future if the PTCs are not extended.

The government provides additional incentives for generation output from solar, geothermal, etc., but with the bulk of new renewables capacity coming from wind in the U.S. as in Europe, today’s discussion about economics should emphasize wind production.

State Regulation/Renewable Portfolio Standards

Uniquely, U.S. renewable policy is being set at the state level rather than at the federal level. (In the U.S., environmental policy initially flows up from the states to the federal government.) At present, 23 states and the District of Columbia now have renewable portfolio standards in place. States with standards in place are shown in Exhibit 65. Many of the states without standards are either engaged in the renewables business already (North Dakota, for example) or do not have good renewable resources (e.g., the southeastern U.S. is not particularly windy or consistently sunny).

We concisely address these state standards in Exhibit 63, which highlights the percent requirements for total energy supply from renewables by year and by state as required to be in compliance with the rules currently in place. Note that rules vary considerably as far as timing and amount of energy required to come from renewables, with many/most reaching the 10-15% range in the 2015-20 time frame.

A Federal Initiative?

Considering the resonance renewables and greenhouse gas controls have with voters (and accordingly politicians), in the 2006 Congressional session Senator Bingaman (D-NM) introduced legislation for a federal RPS and a renewable energy credit trading program under *Title III—Federal Programs for the Conservation of Natural Gas* within the *Enhanced Energy Security Act of 2006* (Senate Bill 2747). Targets for renewables by year as a percent of total electricity supply would be set at:

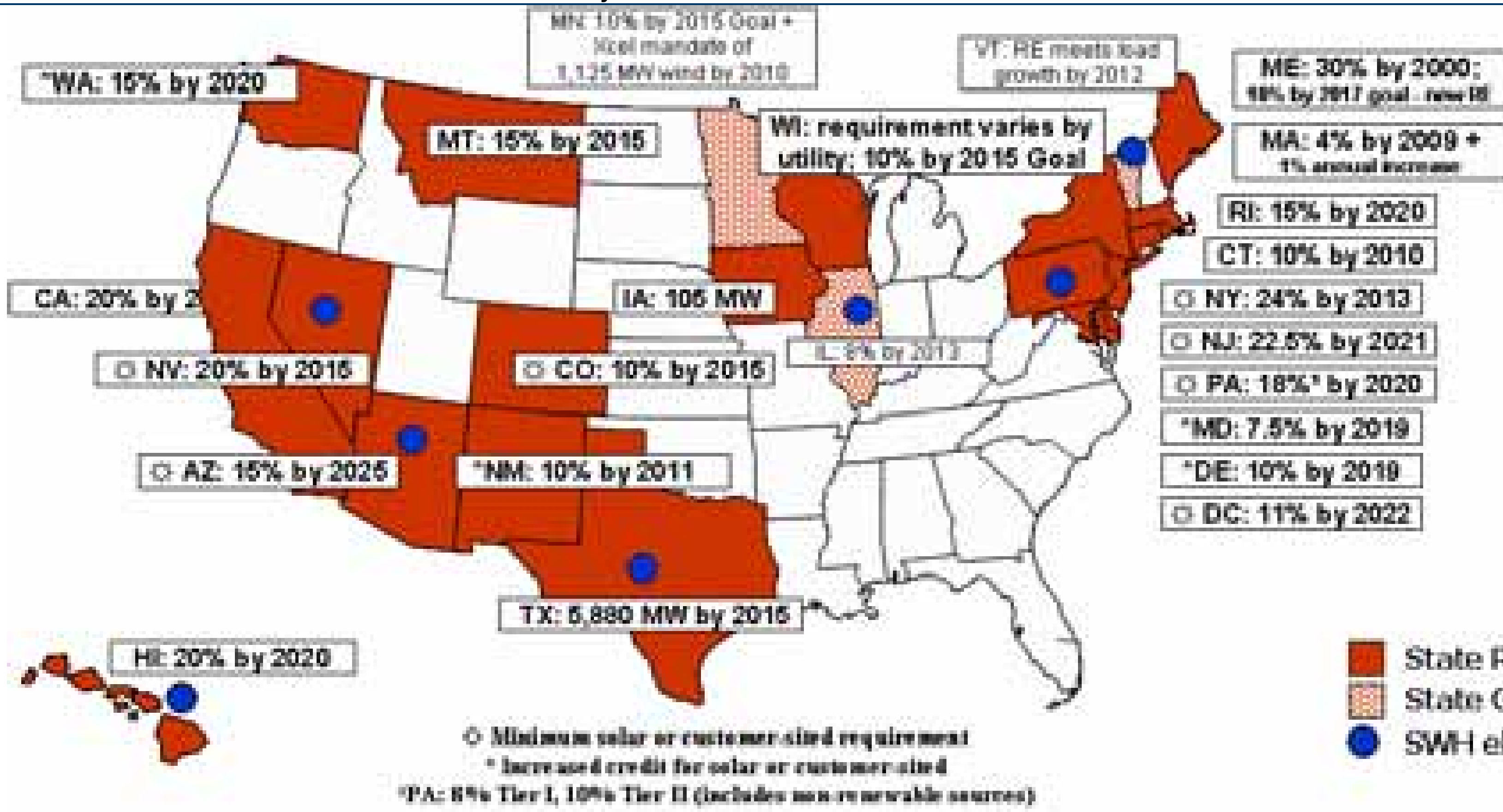
- 2.55% for 2008-11;
- 5.05% for 2012-15;
- 7.55% for 2016-19; and
- 10.0% for 2020-30.

An interesting aspect of the Bingaman proposal is the establishment of a market for exchanging renewable credits whereby utilities will be awarded credits or can buy them (at $15 per MWh, growing by inflation). This approach will allow states without natural renewable resources to still do their part. The proposal also includes penalties for noncompliance at the greater of $15 per MWh or 200% of the market value for renewable credits. Implementation of this standard would have even more significant implications for the industry, since the state requirements apply to just under half of the total market for U.S. power sales and generally do not have significant penalties for noncompliance.

With Senator Bingaman now chairman of the Senate Energy and Natural Resources Committee and a groundswell of support in the U.S. both for addressing global warming and pursuing energy independence, we would not be surprised if a federal plan was approved during the current Congress (2007 or 2008).

Credit Suisse

Exhibit 62: Current U.S. Renewable Portfolio Standards Summary



Source: U.S. DOE.

Exhibit 63: Current U.S. Renewable Portfolio Standards by State

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
AK																				
AL																				
AR																				
AZ	0.50%	1.00%	1.50%	2.00%	2.50%	3.33%	4.17%	5.00%	5.83%	6.67%	7.50%	8.33%	9.17%	10.00%	10.83%	11.67%	12.50%	13.33%	14.17%	15.00%
CA	11.51%	13.63%	15.75%	17.88%	20.00%	21.30%	22.60%	23.90%	25.20%	26.50%	27.80%	29.10%	30.40%	31.70%	33.00%	33.00%	33.00%	33.00%	33.00%	33.00%
CO	3.00%	3.00%	3.00%	3.00%	3.00%	6.00%	6.00%	6.00%	6.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%
CT	6.50%	6.50%	8.00%	9.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%
DC	0.00%	4.01%	4.52%	5.03%	5.54%	6.05%	6.57%	6.89%	7.22%	7.54%	7.87%	8.19%	8.83%	9.47%	10.11%	10.75%	11.39%	11.39%	11.39%	11.39%
DE	0.00%	1.00%	1.50%	2.00%	2.75%	3.50%	4.25%	5.00%	5.75%	6.50%	7.25%	8.00%	9.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%
FL																				
GA																				
HI	7.22%	7.92%	8.61%	9.31%	10.00%	11.00%	12.00%	13.00%	14.00%	15.00%	16.00%	17.00%	18.00%	19.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%
IA	6.24%	6.34%	6.26%	6.18%	6.10%	6.03%	5.95%	5.88%	5.81%	5.74%	5.65%	5.55%	5.46%	5.37%	5.27%	5.18%	5.09%	5.01%	4.92%	4.83%
ID																				
IL	2.00%	3.00%	4.00%	5.00%	6.00%	7.00%	8.00%	8.00%	8.00%	8.00%	8.00%	8.00%	8.00%	8.00%	8.00%	8.00%	8.00%	8.00%	8.00%	8.00%
IN																				
KS																				
KY																				
LA																				
MA	4.00%	4.00%	4.00%	4.00%	5.00%	6.00%	7.00%	8.00%	9.00%	10.00%	11.00%	12.00%	13.00%	14.00%	15.00%	16.00%	17.00%	18.00%	19.00%	20.00%
MD	3.50%	4.05%	4.60%	5.15%	5.70%	6.25%	6.80%	7.35%	7.90%	8.45%	9.00%	9.55%	10.10%	7.50%	7.50%	7.50%	7.50%	7.50%	7.50%	7.50%
ME	30.00%	31.00%	32.00%	33.00%	34.00%	35.00%	36.00%	37.00%	38.00%	39.00%	40.00%	40.00%	40.00%	40.00%	40.00%	40.00%	40.00%	40.00%	40.00%	40.00%
MI																				
MN	2.00%	3.00%	4.00%	5.00%	6.00%	7.00%	8.00%	9.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%
MO																				
MS																				
MT	5.00%	6.25%	7.50%	8.75%	10.00%	11.00%	12.00%	13.00%	14.00%	15.00%	15.00%	15.00%	15.00%	15.00%	15.00%	15.00%	15.00%	15.00%	15.00%	15.00%
NC																				
ND																				
NE																				
NH																				
NJ	3.50%	4.58%	5.51%	6.50%	7.41%	8.30%	9.21%	10.14%	11.10%	12.07%	13.08%	14.10%	16.16%	18.25%	20.37%	22.50%	22.50%	22.50%	22.50%	22.50%
NM	5.00%	6.00%	7.00%	8.00%	9.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%
NV	6.00%	9.00%	9.00%	12.00%	12.00%	15.00%	15.00%	18.00%	18.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%
NY	19.63%	20.40%	21.16%	21.93%	22.70%	23.47%	24.23%	25.00%	25.00%	25.00%	25.00%	25.00%	25.00%	25.00%	25.00%	25.00%	25.00%	25.00%	25.00%	25.00%
OH																				
OK																				
OR																				
PA	4.39%	5.70%	5.70%	6.20%	6.70%	9.20%	9.70%	10.20%	10.70%	11.20%	13.70%	14.20%	14.70%	15.20%	15.70%	18.00%	18.00%	18.00%	18.00%	18.00%
RI	3.00%	3.00%	3.50%	4.00%	4.50%	5.50%	6.50%	7.50%	8.50%	10.00%	11.50%	13.00%	14.50%	16.00%	16.00%	16.00%	16.00%	16.00%	16.00%	16.00%
SC																				
SD																				
TN																				
TX	1.93%	2.04%	2.44%	2.82%	3.18%	3.53%	3.86%	4.18%	4.34%	4.49%	5.03%	5.55%	6.06%	6.54%	7.00%	6.88%	6.77%	6.65%	6.54%	6.42%
UT																				
VA																				
VT	9.22%	7.60%	8.51%	9.42%	9.66%	9.57%	9.47%	9.38%	9.28%	9.19%	9.08%	8.94%	8.79%	8.64%	8.49%	8.35%	8.20%	8.06%	7.92%	7.79%
WA	2.67%	2.72%	2.78%	2.83%	2.89%	2.94%	3.00%	4.50%	6.00%	7.50%	9.00%	10.50%	12.00%	13.50%	15.00%	15.00%	15.00%	15.00%	15.00%	15.00%

Source: Company data, Credit Suisse estimates.

Association of Southeast Asian Nations (ASEAN)

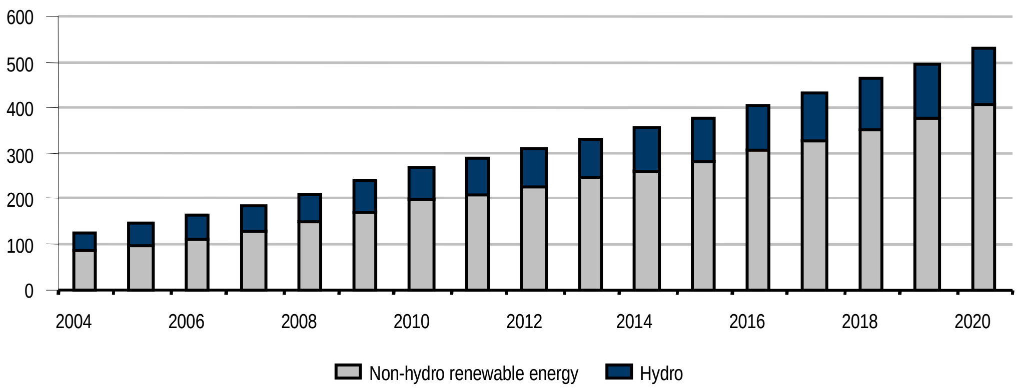
Looking to Southeast Asia, we see a growing embrace of renewable energy policy both as a nod to the environmental and societal benefits associated with development of renewable infrastructure (China, Japan) but also with the practical benefits of distributed photovoltaic generation in developing/rural areas that do not currently have significant access to existing power grid infrastructure.

We remain impressed by China's efforts to pursue development of renewable infrastructure alongside conventional generation, putting forward healthy government-sponsored tax subsidies (over 1% of GDP) to support development of new renewables. Keeping away from a lecture about global warming concerns, we do believe joint efforts by developing and developed nations are key to reaching an encompassing approach to managing emissions.

China

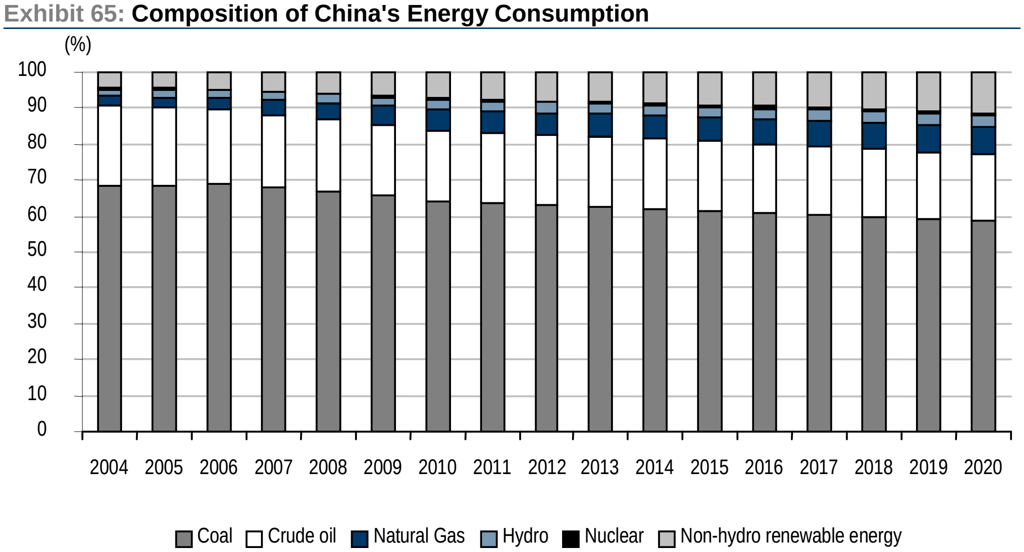
The PRC's Renewable Energy Law was implemented in January 2006, with a target of 10% of total energy consumption by 2020 from only 3% at the end of 2003. Exhibits 65 and 66 illustrate the growth in China's renewable footprint in absolute and in relative terms.

Exhibit 64: China's Renewable Energy



Source: Company data, Credit Suisse estimates.

Exhibit 65: Composition of China's Energy Consumption



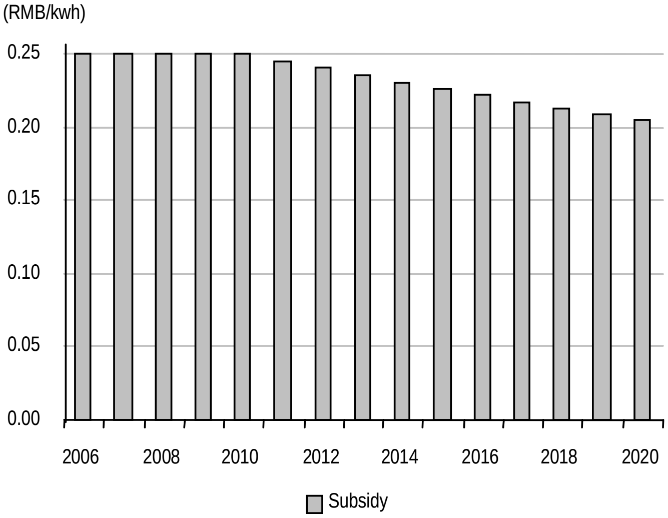
Source: NDRC, SCDRC, CNPC, ERI, Credit Suisse estimates.

China's focus on renewables development is rather expansive. According to a market study conducted by China National Development and Reform Commission (NDRC) and the World Bank, the installed capacity of PV systems in the PRC will reach 600 MW in 2010 and 30 GW in 2020, representing a CAGR of 41% during 2003-10 and a CAGR of 48% during 2010-20 in installed capacity of PV systems.

China's renewables initiatives will come at a hefty cost, with an estimated spending program of up to RMB800 billion (US$100 billion) through 2020 and some of the investment expected to come from international and private investors.

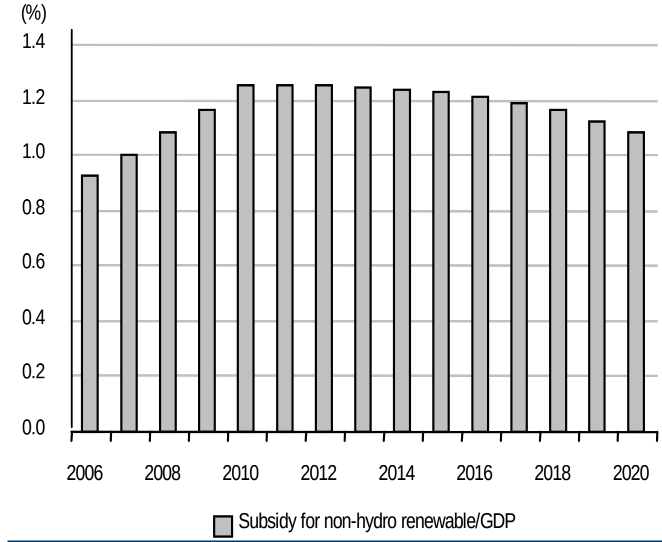
To further these goals, the government is also offering a 50% tax break for investors in solar, wind, and renewable energy. Currently, the government is considering more favorable incentives to encourage business to invest in renewable energy projects. By way of magnitude, the proposed RMB0.25/kWh (which should decline by 2% per annum after 2010) subsidy for electricity generated using nonhydro renewable energy represents approximately 0.90%, 1.25%, and 1% of China's GDP in 2004, 2010, and 2020, respectively, assuming a GDP CAGR of 7.5% in 2005-10 and 4% in 2010-2020.

Exhibit 66: China—Government Subsidy for Nonhydro Renewable Energy



Source: Company data, Credit Suisse estimates.

Exhibit 67: China Subsidy Percentage of GDP



Source: Company data, Credit Suisse estimates.

Malaysia

Malaysia had set a target to achieve 5% power from renewable sources by 2005, but it is currently a long way short of its goal. We believe that the target has been deferred to 2010. The Malaysian government has put most emphasis on biomass energy in its renewable energy development plan. To encourage the generation of energy using biomass that is renewable and environmentally friendly, companies that undertake such activities are eligible for Pioneer Status, or ITA (investment tax allowance). These incentives are also extended to the use of hydropower (not exceeding 10 megawatts) and solar power.

The Philippines

The Expanded Rural Electrification Program started in April 2003, aiming to strengthen and integrate all rural electrification efforts of the government and the private sector. The Philippines has embarked upon a number of relatively small-scale projects all aimed at reaching the goal of more widespread power availability.

Thailand

The government aims to have renewable energy account for 8% of the total by 2011, up from 0.5% in 2002. Its target for solar energy usage is 250 MW by 2011.

Korea

South Korea has a rather ambitious target of 1.3 GW of photovoltaic installed capacity by 2011, compared with 10 MW as at the end of 2004. This target is part of the government's plan to generate 5% of total energy from renewable sources by 2011. Incentives exist in the form of investment subsidies and feed-in tariffs.

South Korea copied the Germany renewable energy law, but also made an addition: newly built houses have to generate 50% of their energy requirements from renewable energy, creating greater demand for PV than is currently available.

Japan

The RPS Law requires all electric power utilities to supply 1.35% of total electricity from renewable sources by 2010.

The Trade Ministry has drawn up a plan requiring Japanese power producers to generate 16 billion kilowatt-hours of energy from renewable sources by March 2015. This would be an increase of 31% from the target of 12.2 billion kilowatt-hours, equal to 1.35% of total output, set for March 2010. However, the Federation of Electric Power Companies of Japan has responded that the target maybe too tough, with an anticipated capital investments of ¥100 billion, or US$820 million, to reach the 2010 target.

India

India aims to reach full electrification by 2012, mostly through extension of the existing grid but also including a certain component of PV. However, a two-year-old policy mandates that Indian producers sell their modules at US$2.5/watt, leading most Indian modules to the export market instead.

Wind Power

Marie Fedotov

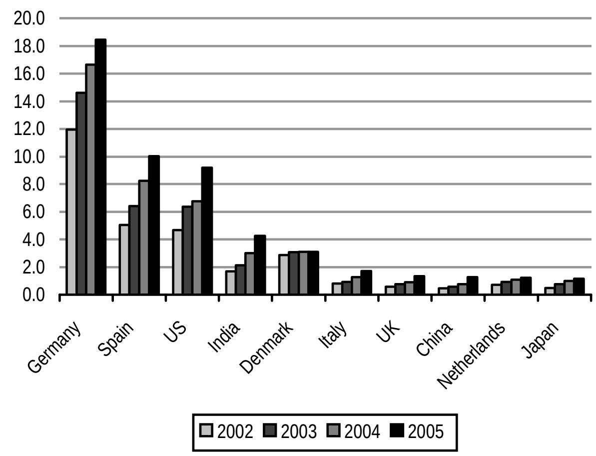
As a result of advances in available technology and political support, wind generation is broadly serving as the renewable of choice in Europe and the United States. Increased size and higher productivity have enabled wind generation to become an increasingly competitive alternative to more traditional methods of power generation. Plus, with attractive financial incentives in place in most markets, the total return proposition from wind investments is attractive to most investments, with calculated IRRs on new wind of 11% on average (versus a group return threshold closer to 8%).

Growing Presence of Windmills

According to the European Wind Energy Association (EWEA), in 1994 Europe had installed capacity of 1,683 MW; by the end of 2005, this had grown to 40,594 MW. EWEA estimates Europe's exposure at over 75% of the world's installed wind capacity and estimates that in 2005 wind met 2.8% of Europe's electricity demand.

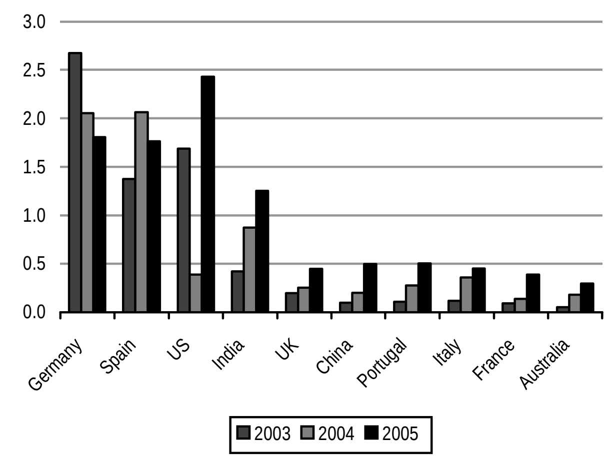
In contrast, the U.S. wind generation portfolio is still relatively small at 9,149 MW at year-end 2005, up from 4,275 MW in 2001 and relative to a U.S. total installed capacity base of 1,067,000 MW at year-end 2005.

Exhibit 68: **Historical Worldwide 10 Largest Wind Markets by Installed Capacity**
in GW



Source: Company data, Credit Suisse estimates.

Exhibit 69: **Historical Worldwide 10 Largest Wind Markets by New Capacity Year on Year**
in GW



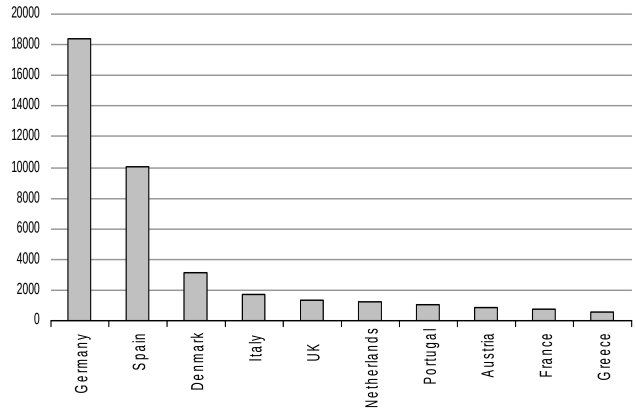
Source: Company data, Credit Suisse estimates.

Market Share and Penetration

Exhibit 70 shows the European countries with the largest installed capacity; the dramatic increase in available wind capacity in Europe can be seen in Exhibit 71. At the end of 2005:

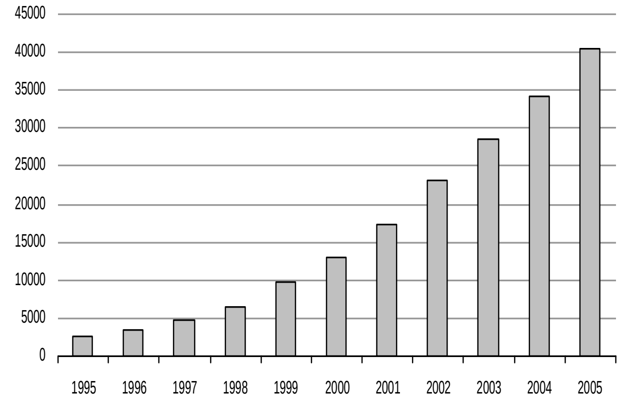
- Germany accounted for about 47% of total European wind capacity. The Renewable Energy Law in Germany has supported the country's rise as the world's leading wind energy developer. However, only about 5.7% of total electricity demand in Germany is met by wind.
- Spain accounts for about 26% of installed European wind capacity, with output making up about 8% of the country's total demand, and set to increase to 15% by 2010.
- Denmark generates approximately 20% of its electricity requirements from wind.

Exhibit 70: European Leaders—Top 10 Wind Power Markets (End 2005)
MW installed



Source: EWEA Briefing 2006.

Exhibit 71: European Wind Capacity, 1995–2005
MW installed



Source: EWEA Briefing 2006.

With a Bright Future for More Wind Capacity Construction

Taking the conversation even further, specific industry targets suggest wind capacity could increase to 180,000 MW by 2020 (180 GW) and 300,000 MW by 2030 (300 GW), at which point wind would account for nearly a quarter of European delivered generation. Exhibit 72 provides a breakdown of future capacity forecasts for broader Europe. While admittedly these estimates appear overly optimistic, they do show that wind will likely to play an important role in European energy supply in the years to come.

We see room for addition of 100 GW and upwards of 450 GW of new renewable capacity through 2025, with a substantial component coming from wind generation given the resource's relatively competitive economic dispatch.

Taking the conversation to a global scale, according to the Global Wind Energy Council (GWEC) the total worldwide installed capacity for wind energy should reach 135 GW by 2010 compared with current capacity of 60 GW. The majority of the forecast installed capacity (i.e., 58%) will be located in Europe, 24% in America, and 14% in Asia.

Exhibit 72: Varying Future Estimates of Wind Power in Europe (IEA, European Commission, EWEA)

	2000	2005	2010	2020	2030
Actual installed		40			
1997 EWEA scenario EU		40	40	100	
2000 EWEA scenario EU		60	60	150	
2006 EWEA scenario EU		75	75	180	300
1996 EU 15 conventional scenario (including solar)	4	6	8	12	
1996 EU 15 advanced scenario (including solar)	7	12	18	30	
1999 EU 15 conventional scenario (including solar and geothermal)	9	16	23	46	
2003 EU 25 baseline scenario (including solar)	13	28	74	105	149
2004 EU 25 Gothenburg type targets (wind only)			80	145	213
2002 IEA reference scenario		33	33	57	71
2004 IEA conventional scenario		66	66	132	174
2002 IEA advanced scenario			75	145	202

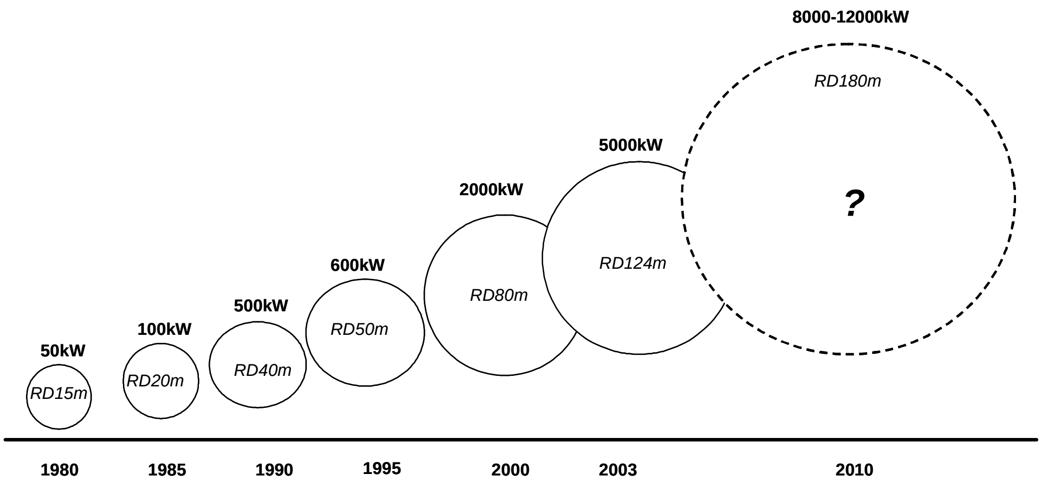
Source: EWEA Briefing 2006.

Turbine Size Matters

According to the EWEA, at the end of 2004 an average onshore turbine had capacity of 1.3 MW and an average offshore turbine capacity of 2.1 MW. A current turbine can produce around 180 times more than its equivalent 20 years ago, with the cost of generation (per kilowatt-hour) halving over that period.

The evolution of turbine and fan blade size creates opportunity for future gains in individual windmill output, although logistical challenges related to the height of towers (some areas impose height restrictions) and ability to transport fan blades (can only move so large of a truck on conventional roads) could limit the terminal size of wind turbines.

Exhibit 73: Evolution of Commercial Wind Turbines Size
in kW and rotor diameter (RD) in meters



Source: European Commission.

Problems with Wind Generation

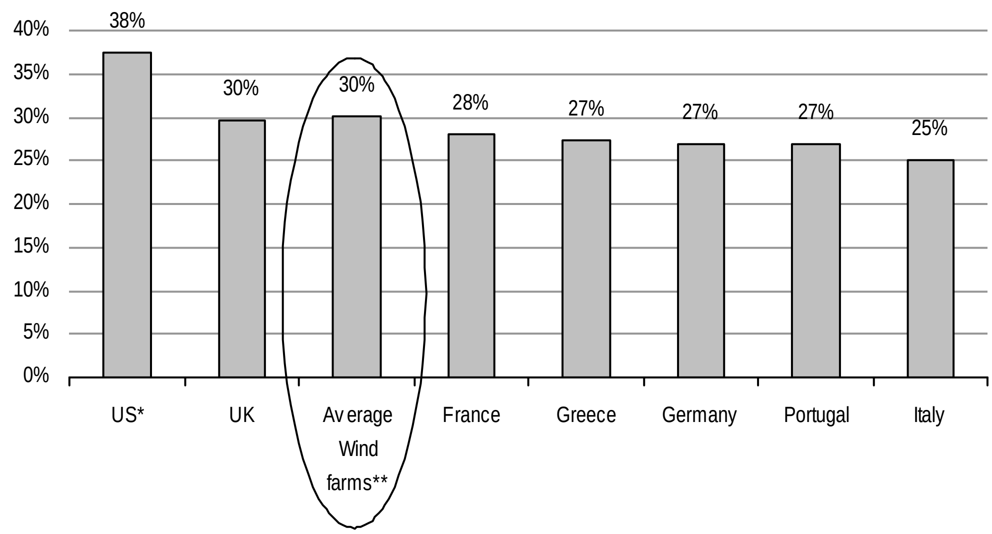
Uncertainty is the main problem with wind production owing to the inherent unpredictability of weather conditions (somewhat offset by portfolio effect). However, the impact of a single turbine on the grid going offline is negligible, particularly compared with larger thermal systems. Wind power can also be more effectively managed through detailed weather forecasts and modelling.

The increasing size of turbines also creates environmental conflicts, and their isolated locations create infrastructure issues. Legislation and local opposition have made it increasingly difficult to obtain planning consent for onshore wind.

Additionally, we have seen a marked increase in the capital costs for new wind generation as demand to add capacity outstrips growth by manufacturers and rising raw material costs are passed through. In the U.S., wind generation capacity that cost approximately $1,100/KW of capacity to build three years ago now costs $1,600-1,800/KW and could potentially go higher. Aspirations of wind being economically viable in the U.S. without tax credits have largely been dropped; PTCs are necessary to justify investment in most markets.

Utilization for wind generation is generally rather low, with most in the 25-35% utilization rate. When comparing the cost of wind capacity to conventional generation, we recommend considering the costs on a utilization-adjusted basis since a comparison between a coal plant costing $1,900/KW and a wind farm at $1,700/KW would not provide a truly fair market impact comparison without taking into account utilization rates (80% versus 35%); effectively two to three times as much wind capacity would need to be built to match the productive capacity of the coal plant.

Exhibit 74: Typical Wind Load Factors
in %



**U.S. Load factor in average for new installed capacity.*
***Including onshore and offshore wind sites.*
Source: Credit Suisse estimates.

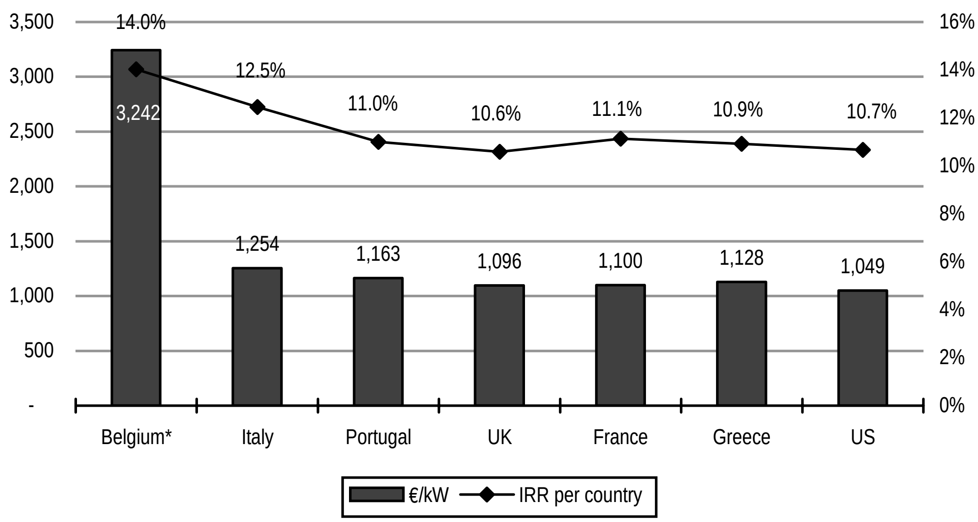
Wind: IRR Analysis

In order to define value-creation potential from new wind generation, we constructed a simple DCF model by country. Notably, we observe average weighted IRRs of 11% for new wind capacity installed between 2007E and 2020E; considering the longer-duration nature of these assets and the lower relative investment hurdles versus conventional coal/nuclear generation capacity, we believe the observed returns certainly warrant incremental investment.

In Exhibit 75, we show an unlevered IRR range of 14% (Belgian offshore wind) to 10.6% (U.K. onshore wind).

- Onshore wind capacity enjoys similar levels of unlevered IRRs across most of the countries (11% in France, Portugal, Greece, the U.S., and the U.K.), with one exception; in Italy, an IRR of 12.5% is due to very high tariffs.
- Offshore wind capacity (located in Belgium) shows an even higher IRR of 14%. This is mainly due to extremely advantageous tariffs as well as a higher load factor compared with onshore projects.

Exhibit 75: Estimated IRRs and Value per Kilowatt in Wind by Country
in %, € per kW



**Offshore wind capacity.*
Source: Credit Suisse estimates.

In terms of value per kilowatt of capacity, we assess the value of wind generation in Italy at €1,254/kW, with a total value created of €565/kW; in Portugal at €1,163/kW, with €480/kW of value created (followed closely by Greece, France, and the U.K.); and in the U.S. at €1,049/kW, for €374/kW of value created. We value the offshore wind power at €3,242/kW, for a created value of €1,723/kW.

Solar Power

Adrien Bommelaer

Angello Chan

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Shannon Mikus

Solar energy is generally captured in two forms: via photovoltaic cells for electricity generation or via thermal panels for heating purposes. The industry has been around for some time and has periodically enjoyed surges in popularity, before dying down once conventional fuel prices fell or reliability issues increased. Solar power remains an expensive method of generating electricity compared to conventional sources and compared to other renewable sources such as wind or hydro power. However, recent advances in technology and continued support from certain governments have continued to drive solar penetration.

Solar Industry Overview

The solar industry has grown on average by 25% per annum over the past 20 years but has been increasingly in the spotlight in the past couple of years as oil prices have risen sharply. In 2004, solar energy installations jumped by 62% worldwide to 927 MW, with the strongest growth coming from Germany.

The 2003 and 2004 PV installation estimates were recently revised upwards by about 5%, but without any geographic breakdown. Exhibit 79 shows the original figures.

Exhibit 76: Photovoltaic Installations by Country
MWp

By geographical region	2000A	2001A	2002A	2003A	2004A
Japan	97	122	161	219	277
Growth (%)		25.8	32.0	36.0	26.5
Germany	44	79	83	145	366
Growth (%)		79.5	5.1	74.7	152.4
ROE	15	23	25	53	75
Growth (%)		53.3	8.7	112.0	41.5
United States	23	37	57	66	84
Growth (%)		60.9	54.1	15.8	27.3
ROW	75	84	101	91	126
Growth (%)		12.0	20.2	-9.9	38.5
World market	**254**	**345**	**427**	**574**	**927**
Growth (%)		35.8	23.8	34.4	61.5

Source: Solarbuzz.

Photovoltaic applications can be broken down into three segments: consumer product, off-grid, and on-grid.

- The consumer-product segment includes all smaller-size applications, watches, calculators, etc. It has been in existence for a long time and represents only a 3% share of the total market.
- The off-grid segment covers all instances where photovoltaic installations are used to produce electricity without a connection to the main power grid. These installations include telecommunications towers, road signs, stand-alone residential power, etc. Solar power competes with the cost of extending the grid to that location, the cost of using batteries and replacing them regularly, and wind power if available. This segment represents around 21% of the market.
- The on-grid segment, at 76% of the total market, is by far the largest application of photovoltaic power. It covers all instances where solar power is used in locations with a connection to the electric grid. In these situations, solar power competes with the cost of electricity at the location of consumption, i.e., the cost of production plus transport all the way to the user. In most instances, the economics of photovoltaic power are not competitive and the industry must rely on government incentives. One potential exception to this is Japan.

Exhibit 77: Photovoltaic Systems: Type of Applications

Type of application	% of installed base	Competitive
Off-grid industry applications	10	Yes
Off-grid residential applications	11	Yes
Consumer	3	Yes
On-grid applications	76	No
Total	**100**	

Source: EPIA.

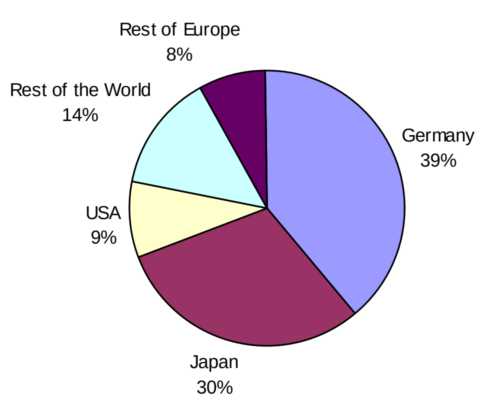
The Economics of Solar Power

The following factors shape the economic viability of solar power:

- *The cost of grid power* at the point of consumption, reflecting production and transport costs.
- *The amount of sunlight* received at the point of consumption.
- *Interest rates*, driving the cost of financing an installation. A typical European home installation requires approximately €30,000 of upfront investment, yielding savings of 5–7% over 20 years.
- *Regulatory incentives*, ranging from feed-in tariffs (allowing solar users to resell excess power to the grid during peak generation hours), tax incentives, subsidies, and guarantees on the financial savings/returns of an installation. These regulatory measures can fill the gap between the stand-alone economics of solar power and those of conventional grid solutions. In addition, the gap should narrow over the long run as the solar industry grows in scale and performance.

These four factors are largely country specific. As a result, more than 75% of current solar capacity is located in three countries where governments have actively promoted its development through favorable regulation: Germany, Japan, and selected U.S. states.

Exhibit 78: Global Photovoltaic Market Installations, 2004
in MW

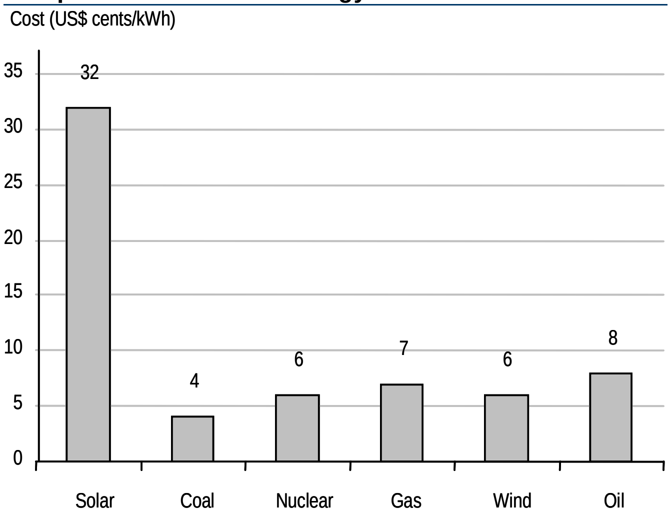


Source: Solarbuzz.

Solar Power Generation Costs Are High versus Conventional Energy Sources

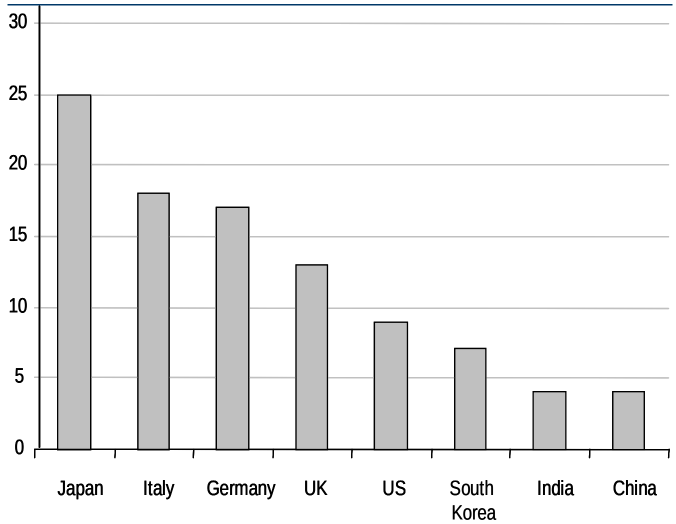
Solar power generating costs—$0.25-0.40 per kWh, depending on system cost and hours of sunlight—are very significantly higher than other sources of electric power. Exhibit 82 shows that the cost of solar power is much higher than other energy sources.

Exhibit 79: Average Unit Power Generation Cost Comparison of Different Energy Sources



Source: Company data, Credit Suisse estimates.

Exhibit 80: Average Residential Power Prices in 2004
$ cents per kWh



Source: Company data, Credit Suisse estimates.

PV installations compete with the *retail* price of power, which includes generating costs, transmission and distribution costs, taxes, profits, and other fees and thus are much higher than generation costs. Exhibit 83 shows that Japan, with the world's highest electricity price, has average residential power prices of $0.25 per kWh, very close to the lower-end stand-alone cost of solar power generation.

Solar power can be cost competitive in sunnier areas particularly during peak electricity demand periods when power tariffs are usually significantly higher than off-peak periods. According to the *Solar Energy Report* for the Federal Republic of Germany, electricity generated by PV systems in certain areas such as southern Europe could become competitive with peak electricity by 2008-10 even without government subsidies.

In the long term, solar-power-generating costs should decline as PV system prices fall under the influence of greater production economies of scale.

The cost of PV products is already falling fast as manufacturers gain experience and scale. According to Cambridge Energy Research Associates, every doubling in production capacity should lead to a 20% reduction in production costs. With market growth of more than 30% per year over the last decade, this translates into more than a 5% annual cost reductions.

According to Solarbuzz, long-term analysis of the data shows that solar module prices have declined 15-24% in total during 1997-2004, while solar cell prices have declined by 33-55% during the same period. As an example, Japan's solar power generation cost had fallen to $0.42 per kWh (¥40 per kWh) in 2004 from $2.61 per kWh (¥260 per kWh) as Japan built up installed solar power capacity. Further significant reduction to around US$0.23 per kWh by the end of the decade is expected.

Ongoing PV manufacturing cost improvements and recent price increases for grid power in solar markets have enabled solar to be more competitive each year regardless of incentives. Manufacturing scale improvement is likely to provide more near-term economic benefits to solar than any anticipated R&D breakthroughs. Laboratory innovation has already raised PV cell thermal efficiency to more than 30% versus existing commercial cells' 15% efficiency, but very significant breakthroughs are likely to be several years away still.

Over the long term, the likely imposition of emission costs/controls on conventional energy sources will further improve the cost competitiveness of all low emission alternative energy sources, including solar.

Government Support Is Key to Realizing Economies of Scale

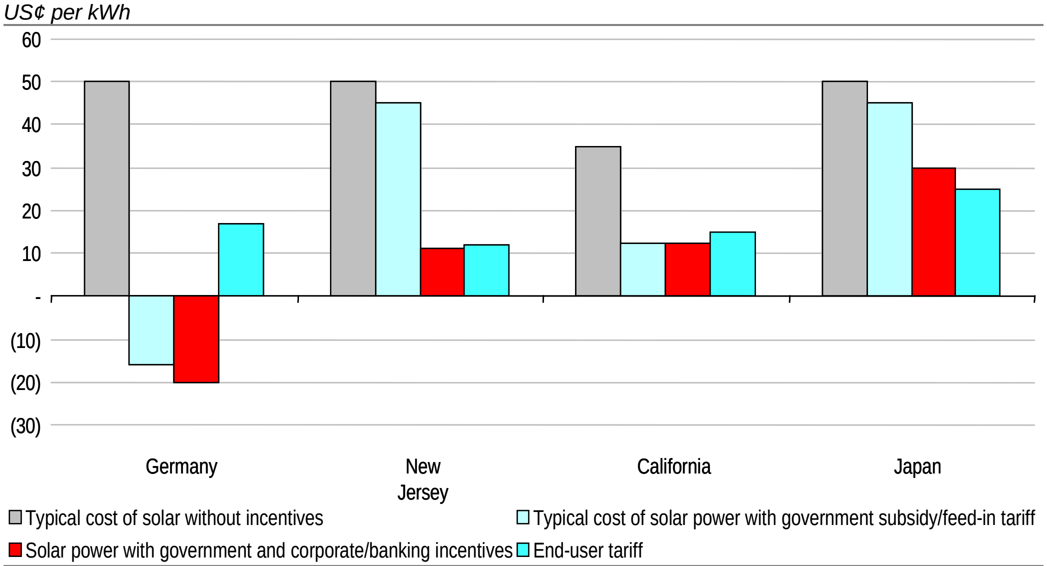
Assuming that solar power will not be economical outside of Japan for many more years, supportive government policies will be critical to promoting deployment of solar power.

Government polices can improve the competitiveness of solar power:

- In the short term, government policies can encourage PV installation by offering rebates or subsidized financing for consumers, while also introducing feed-in tariffs for solar that are higher than conventional power prices. As Exhibit 84 shows, government financial incentives and other incentives from corporates and banks have driven net solar power costs to the consumer below conventional retail power prices in Germany, New Jersey, and California.

Exhibit 81: Subsidized Solar Power Price versus End-User Power Price

US¢ per kWh



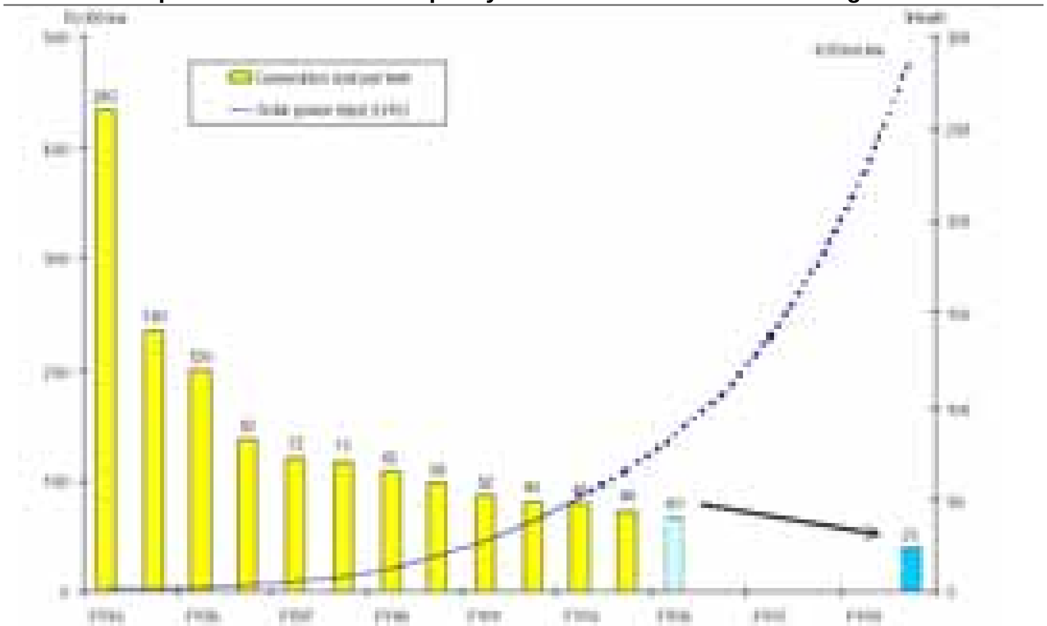
Source: Credit Suisse estimates.

- In the long term, solar power-generating costs should decline as economies of scale are realized, allowing subsidies are to be gradually phased out. The timing of this phase-out, however, is critical—too early a phase-out could lead to the industry stalling or regressing as has happened in the past.

Japan is a good example of a maturing solar power market. Japanese government incentives for residential installations were cut in half in 2005 and eliminated entirely in 2006. Despite this, we believe that domestic Japanese solar installations will continue to grow by over 30% per year through 2010. The reason is that solar is now on the cusp of being stand-alone cost competitive with Japan's (very high) conventional power prices.

As Exhibit 85 shows, Japan's solar power capacity increased by 35 times between 1993 and 2005, and solar power unit cost fell from ¥260 per kWh to ¥40 per kWh by 2005. Solar power unit costs are expected to decline further to ¥23 per kWh by 2009, comparable to Japan's current retail power price of ¥22-24 per kWh.

Exhibit 82: Japan's Solar Installed Capacity versus Solar Power Generating Cost



Source: Credit Suisse estimates.

Japan and Germany are the world's two largest solar markets, accounting for nearly half of global annual installations and half of total global installed solar power capacity. In both markets, the subsidized price of solar power is competitive with the residential grid power price.

This is due to government incentives for end-user adoption. In Germany, the government instituted buyback rates for solar power of $0.69/kWh compared with normal grid rates of $0.17/kWh. The current law guarantees this tariff for 20 years, with 5% annual decreases in the buyback rate.

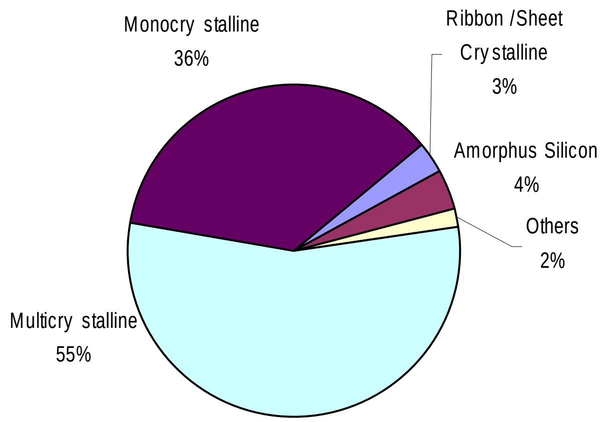
In Japan, the national government provides cash payments of around $500/kW (about 7% of the system's total cost) to individual households that purchase solar systems, and banks offer consumer loans/mortgages with a 1-2-percentage-point interest rate reduction for solar powered homes.

Incentives exist or are emerging in numerous other markets (including Spain, Italy, the U.K., California, New Jersey, New York, and South Korea) that are helping to make solar competitive with grid power prices, despite difficulties in the U.S. with overlapping state and federal jurisdiction in this area and a lack of corporate confidence that a sufficient subsidy will be available to justify the necessary manufacturing investment.

By contrast, Germany displayed a very high level of political commitment to renewable energy that was perceived by the renewable power industry as both consistent and well funded, thus facilitating investment. However, even in Germany the imminent review of the Renewable Energy Act is causing anxiety in that country's solar industry.

Technology Improvement Can Enhance Solar Competitiveness

Exhibit 83: Crystalline Silicon Technologies Currently Dominate the Solar Power Market



Source: Photon International.

As Exhibit 86 shows, crystalline silicon PV cells, either mono-crystalline cells or multi-crystalline silicon solar cells, currently dominate PV cell production.

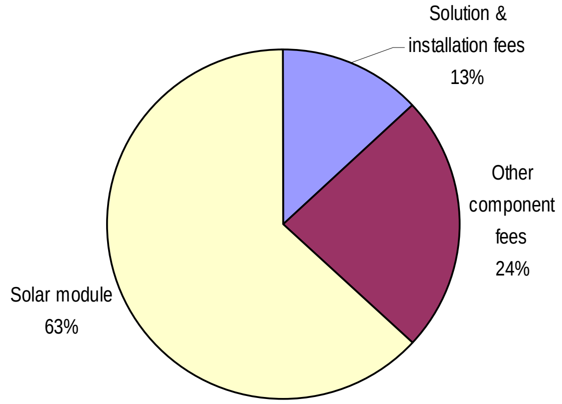
PV modules represent 50% of the total cost of solar power systems, and module cost reduction has been the biggest driving force behind overall solar system cost reduction in recent years.

Exhibit 84: Cost Structure of PV System Cost
'0000 yen per kW, 10000 yen=100 US dollars

	1994	As % of solar Module cost	1999	As % of solar module cost	2005	As % of solar module cost
Solar module price	92.7		60		40	
Solar module cost	*60*		*40*		*25*	
- Material	36	60	24	60	15	60
- Labour	1.2	2	0.8	2	0.5	2
- Depreciation	10	17	3	8	2	8
- R&D	1	2	1	3	1	4
- Others	11.8	20	11.2	28	6.5	26
Inverter and other components (power conditioner)	80.6		21.4		15	
Solution fee	18.6		12.5		8	
Total cost	191.9		93.9		63	

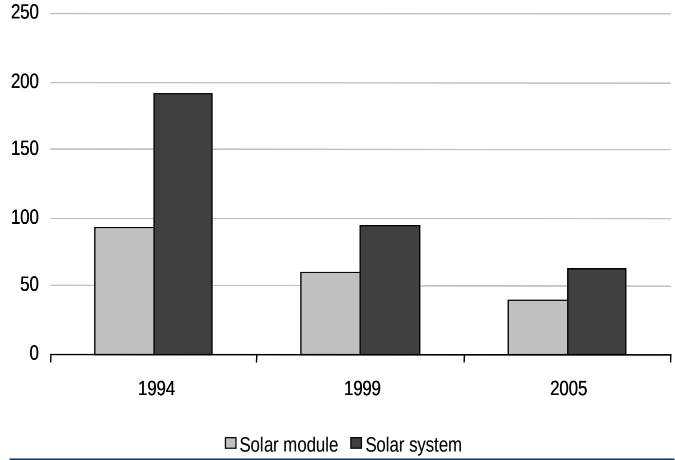
Source: Company data, Credit Suisse estimates.

Exhibit 85: Cost Structure of Solar Systems



Source: Company data, Credit Suisse estimates.

Exhibit 86: Solar (PV) Module Costs versus Solar System Costs



Source: Company data, Credit Suisse estimates.

Silicon wafer costs account for over 90% of the raw material costs of PV cells, making silicon wafer cost reduction the key to driving down solar system costs.

We believe the technology improvements to reduce the cost of PV cell production will come in the following areas:

- *Cell energy efficiency*. Cell energy efficiencies (the proportion of available energy converted to electricity) have increased over the course of last five years from 11-12% to 15-16% today for multi-crystalline silicon PV cells. The highest commercially available mono-crystalline solar cell has a 21% efficiency, while the best laboratory value demonstrated to date is 24.7%. According to Photon International, the theoretical (and unrealizable) limit for single-gap silicon PV cells in standard test conditions is 28%.
- *Thinner wafers*. Most silicon wafers are currently 260-300 um thick. However, wafer thickness of 50 um would be sufficient to absorb most incident light. While silicon wafer manufacturers have been striving to cut wafer thickness, PV cell manufacturers also need to improve their manufacturing process to be able to handle these thinner wafers without increasing breakage. A 10% reduction in wafer thickness would cut a PV system's final price by 0.7%, assuming silicon costs account for 7% of a total PV system's final price.
- *Improvements in manufacturing process*. Improvements in the manufacturing processes can save silicon costs in various respects. Replacing robots with manual labor during the soldering process can decrease the scrap rate of silicon wafers. Texturing technology can increase the sunlight absorbed by silicon wafers, thus increasing the power output of PV cells.

A global silicon supply shortage since 2004 has spurred an acceleration in the development of other PV technologies designed to reduce silicon use in the PV cell. However, so far these alternative technologies have exhibited lower energy conversion efficiencies versus crystalline silicon technology.

The two most important alternative PV technologies to crystalline silicon are string-ribbon technology and thin-film technology:

- *String-ribbon technology.* This technology uses an alternative silicon wafer production processes to avoid the higher cost of the conventional wire sawing process, which results in high losses of silicon. Instead of cutting silicon discs from large blocks or bars, string-ribbon technology crystallizes the wafer discs directly from molten silicon, in the form of thin ribbons. These silicon ribbons need only be then cut to cell format; they are already at the required thinness.

- *Thin-film technology.* In thin-film technology, silicon is applied to a cost-efficient carrier (usually glass) over a large surface area in the form of a thin film. Film applied in this way is much thinner than conventional silicon cells. The thin film is then divided into individual cells isolated from each other by removing material. Through the subsequent vaporization of other layers of materials, the cells are connected to form a module. Copper indium selenide (CIS), gallium arsenide (GaAs), and cadmium telluride (CdTe) are the substances used in addition to amorphous (noncrystalline) silicon and crystalline silicon.

PV cells based on both of these technologies are currently produced on a much smaller scale than the standard crystalline silicon cell technology. However, we believe the penetration of these technologies should will gradually improve if silicon costs stay high relative to historical levels.

Solar Power Demand Outlook

Short-Term Forecast, 2006-07

The global PV market is unlikely to sustain the extremely rapid rates of growth seen recently, e.g., 34% in 2005 and 82% in 2004. We expect global PV demand to grow at a more sustainable rate of 10-12% year over year in 2006 and 2007. Two factors contribute to this moderating demand growth.

- The growth of global PV demand is constrained by the lack of available supply of solar modules due to a global shortage of solar-grade silicon supply. Hence, the 10-12% growth supply estimate is lower than the likely underlying global demand for PV modules.

- Reductions in government subsidies, especially in Germany and Japan—the two largest PV markets in the world—are expected to prevent the global PV market from repeating its 2004 and 2005 performance.

Exhibit 90 revises the global PV demand estimates projected by Marketbuzz 2006. Given the decisions by European and U.S. governments to continue the commitment on renewable energy set by prior administrations, the forecast for 2006 global PV demand is revised to 1,550-1,650 MW (from 1,361 MW). In addition, according to the PV installation plans of the California Solar Initiative program, most of the PV capacity additions will happen after 2008 as a result of silicon supply shortage, which is expected to ease only later in 2007.

Responding to the increasing demand, silicon manufacturers are currently expanding their production capacities, expected to be completed by 2007. The shortage of solar-grade silicon supply is expected to ease marginally in 2007, allowing higher growth in global PV demand. As such, the forecast for 2007 global PV demand is lifted from 1,720 MW to 1,795 MW.

Exhibit 87: Marketbuzz 2005 versus Marketbuzz 2006 Estimate on Global PV Demand, (2005–07)

	2004	2005 (E)	2006E	2007E
Initial estimates (in MW)	1,086	1,097	1,361	1,720
Revised estimates (in MW)	1,086	1,460	1,550-1,650	1,750-1,850
Change (%)	0	33	14-21	1.7-7.5

Source: Marketbuzz 2005, 2006, Credit Suisse estimates.

Exhibit 88: Our Estimate versus Marketbuzz 2005 Estimate on Global PV Demand Growth Rate

(%)	2004	2005	2006E	2007E
Our estimates	82	34	10	12
Marketbuzz estimates	82	34	5	6
Change	0	0	-5	-6

Source: Marketbuzz 2006, Credit Suisse estimates.

Medium-Term Solar Demand Outlook

CAGR of 18% for PV installation in 2005-10

According to Solarbuzz, annual PV installations are likely to reach 3.25 GW by 2010, implying a CAGR of 18% between 2005-10. This forecast implies a total capacity addition of 11.2 GW in 2005-10. We therefore expect installed capacity to increase to 16.2 GW by the end of 2010, including the 5 GW of capacity that was installed by the end of 2005.

Solarbuzz's forecast is conservative compared with the 28% CAGR forecast by EPIA Greenpeace and the 45% forecast by Sharp, the largest supplier of PV cells/modules. A 18% annual growth rate in PV installations until 2010 would imply that global solar power generation would account for 0.06% of total global power generation by 2010 as shown in Exhibit 92, compared with 0.01% of total global power generation in 2004. According to the Energy Information Administration of the U.S. Department of Energy, the global net electricity consumption is to grow at an average 2.6% per year in 2004-2025. Total global power generation is predicted to reach 23,330 TWh in 2010 from 20,000 TWh in 2004.

Exhibit 89: Solar Power Generation as Percentage of Total Power Generation by 2010

2004 global electricity demand (TWh)	20,000
Average annual growth rate in electricity demand (%)	2.60
2010 global electricity demand (TWh)	23,330
2010 global solar power installed capacity (GW)	16.2

Source: Company data, Credit Suisse estimates.

Exhibit 90: PV Market Forecast in 2010

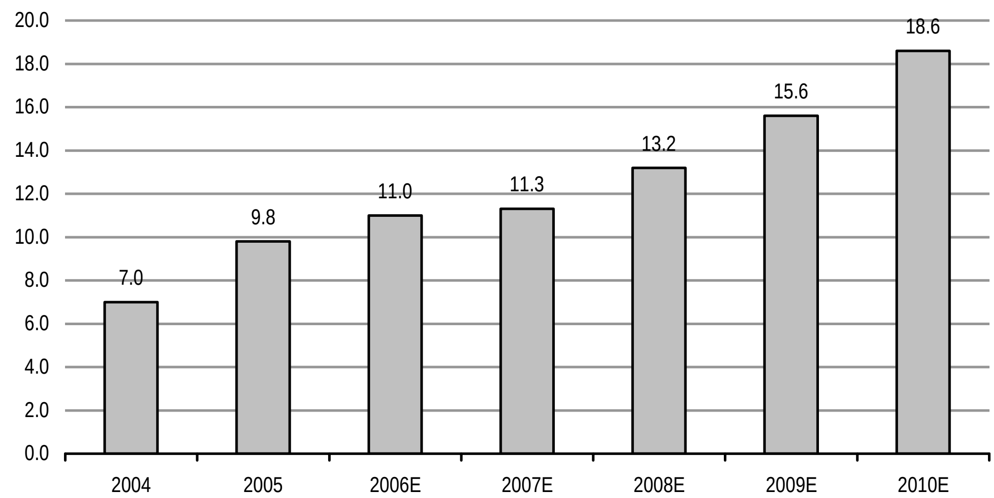
Global solar power generation (assuming 1,000 sun hrs annually (TWh)	16.2
% of total power generated by solar energy (%)	0.06

Source: U.S. Energy Information Administration, Solarbuzz.

Solarbuzz predicts that global sales revenues in the PV market will almost triple from $9.8 billion in 2005 to $18.6 billion in 2010. In the medium term, the international PV industry is expected to employ 2 million people.

Exhibit 91: Global Revenues in PV Market

US$ billions



Source: Marketbuzz 2006.

Sharp's PV forecast for 2005–10

Sharp forecasts that the global market for PV installations will grow at a CAGR of 45% in 2005-10, with China seeing an annual growth rate of 70%, making it the fastest-growing PV market in the world.

Exhibit 92: Forecast on Solar Power Capacity Installations

megawatts

Area/country(MW)	2005	2006	2007	2010	2005-10 CAGR (%)
Japan	291	327	410	1,400	36.9
U.S.	123	185	335	1,200	57.7
Europe	555	893	1,250	3,450	44.1
China	60	90	135	860	70.3
Asia	95	105	120	340	29.0
Global total	**1,129**	**1,600**	**2,250**	**7,250**	**45.1**

Source: Sharp.

Sharp estimates that solar power generation will account for 0.09% of total global power generation by 2010, assuming 45% CAGR in the PV market during 2005-10 and 1.1% CAGR of global power demand. (See Exhibit 96.) In the longer term, solar power is expected to account for 30% of total global power generation in 2040.

Exhibit 93: Forecast on Solar Power Generation versus Global Power Generation

TWh

	2004	2010	2020	2030	2040
Demand	20,000	21,322	28,950	37,228	45,043
Solar	2.2	20	328	3,199	13,540
Solar share (%)	0.01	0.09	1.13	8.59	30.06

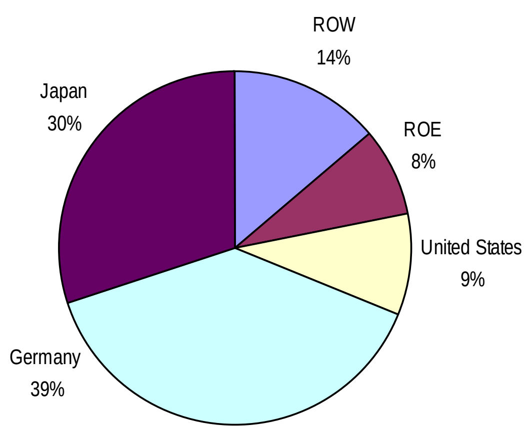
Source: Sharp.

PV Market Growth in Different Markets Between 2004-10

According to the forecasts by Marketbuzz 2005, Japan, Germany and the U.S. are to continue to dominate the world market, but their combined share is estimated to decline to 76% of the world total in 2010 from 78% in 2004. We expect substantial demand from Spain, China, South Korea, and India. We believe the level of government support by each country will determine ultimate demand growth in each of these markets.

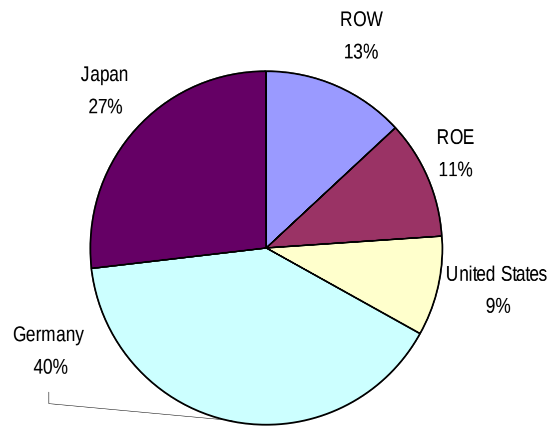
The market shares taken by the emerging PV markets, including Spain, South Korea, and China, are expected to become more substantial beyond 2010, due to support by governments plagued by surging conventional fuel prices and energy demand.

Exhibit 94: PV Market Share by Country, 2004



Note: ROE= rest of Europe, ROW=rest of world.
Source: Solarbuzz.

Exhibit 95: PV Market Share by Country, 2010E



Note: ROE= rest of Europe, ROW=rest of world.
Source: Solarbuzz.

Solarbuzz estimates the German PV market growth rate is likely to slow from 2006. The price rises in the market and the feed-in tariff premium over the retail power tariff could be used by the government to make the New Renewable Energy Act (NREA) less attractive, either by lowering unit subsidy rates or by controlling available funding support. The current feed-in tariff under the 2004 NREA program will decline by 5% every year for new installations from 2006.

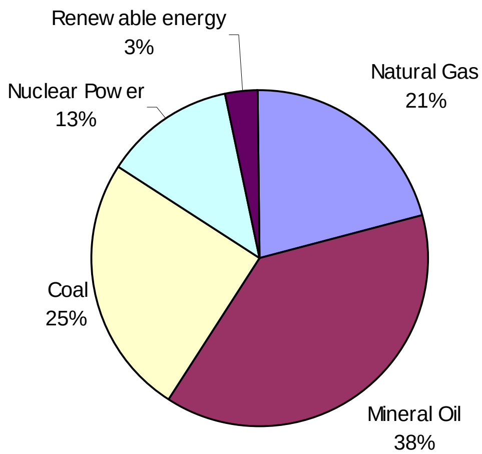
Germany Solar Outlook

Germany is currently the highest growth market for photovoltaic energy. In 2004, the installed capacity of photovoltaic systems increased by 152% to 366 MW and exceeded that of Japan. To encourage the development of the solar industry, the government has made investment in photovoltaic systems economically attractive.

The German government has been looking at ways to decrease dependence on fossil fuels, partly to meet its obligations under the Kyoto Protocol. To date the government has set a target for total energy from renewable sources of 12.5% by 2010 and 20% by 2020. This compares with only 3.1% in 2003.

Within this, Germany aims to procure 6% of its renewable energy from solar power in 2010; solar power represented 0.1% of total German energy production in 2004.

Exhibit 96: Germany: Breakdown of Energy Production, 2003



Source: Federal Ministry for Environment, Nature Conservation and Nuclear Safety.

These targets appear extremely challenging, but in 2004 the German parliament passed the Renewable Energy Act, which fixed favorable feed-in tariffs for solar power. The feed-in tariff for new PV installations is €0.57 per kWh, compared to the peak utility price of €0.1 per kWh. Starting from 2005, the feed-in tariff for new PV systems will decline by 5% year over year from the base tariff of €0.57 per kWh.

These feed-in tariffs are the tariffs at which the electricity grid has the obligation to acquire solar electricity. Q-Cells, a leading manufacturer of solar cells, estimates that the regulation and feed-in tariffs enable a risk-free return on investment of 4-7% per annum, assuming that the photovoltaic installation lasts 20 years.

The current feed-in tariffs will support wind energy systems for 10 years, while solar energy systems have a longer support period of 20 years. The tariffs decline each year to take into account the lower cost of photovoltaic installation over time.

Exhibit 97: Germany: Feed-In Tariffs

Application type	Euro cents/kWh 1 Jan–31 Dec 2004	Annual decline thereafter
Ground-mounted systems in undeveloped areas	45.7	6.5%
Rooftop (<30kW)	57.4	5.0%
Rooftop (for that part >30kW, but <100 kW)	54.6	5.0%
Rooftop (for that part >100 kW)	54	5.0%
Facades (<30kW)	62.4	5.0%
Facades (for that part >30kW, but <100 kW)	59.6	5.0%
Facades (for that part >100 kW)	59	5.0%

Source: Solarbuzz.

As a result of government policy, a relatively significant solar industry has emerged in Germany, including such enterprises as Q-Cells, SolarWorld, Solar-Fabrik, Solon, and Conergy.

The Renewable Energy Act is due for a review later in 2007, and the current grand coalition government may yet reduce feed-in tariffs for solar power or change current governmental policies toward solar power.

However, the solar industry is one of the few in Germany to have created new jobs in the last few years, making any sudden reduction or elimination of subsidies potentially difficult in a political sense.

Spain

Among all other European countries (excluding Germany), Spain was the largest PV market, with 35 MW of new installations in 2005 compared with 40 MW of total installed capacity as of the end of 2003. Spanish government has established a target of reaching 400 MW of installed PV by 2010, a CAGR of 39.7% in 2006-10.

Spain is expected to experience a similar PV boom as Germany in 2004. Even though the Spanish feed-in tariff is lower (€0.42 per kWh below 100 kW) than in Germany, the conditions in Spain are considerably more attractive for two reasons: (1) the tariff is guaranteed in full for 25 years, then at a level of 80% thereafter, in comparison with a 20-year guarantee in Germany with nothing specified thereafter. (2) Spain is a much sunnier country than Germany, with an average of 1,500 sun-hours per annum in comparison with 1,000 sun-hours in the southern parts of Germany. Sunlight adjusted, the Spanish feed-in tariff would correspond to €0.63 per kWh in Germany.

BP Solar, Isofoton S.A., Suntech, and Energías Alternativas SOLARIG are the major players in the Spanish solar market.

Japan: A Maturing Market

Japan's emergence as the long-time leading world PV market in terms of total installed PV capacity (overtaken by Germany in 2005) came about by a market incentive program run by the government for over a decade, a program that has been the key contributor to Japan's long-term plan to install 4.82 GW of PV generation capacity by 2010 and that was responsible for PV installations on over 200,000 houses.

The (Japanese) Agency for Natural Resources and Energy's report *Outlook for Energy Supply and Demand through 2030,* published in October 2004, established a target to raise the output of energy from new energy sources from the equivalent of 7.64 billion liters of oil in fiscal year March 2003 to 19.1 billion liters by fiscal March 2011. This would raise the proportion of total primary energy supplied from new energy sources from 1.3% in fiscal year ending March 2003 to 3.0% by fiscal year ending March 2011. As part of this project, the agency is aiming for 28.8% annual growth in solar power generation capacity, and it expects total installed capacity to expand to around 4.82 billion oil equivalent liters by fiscal 2011.

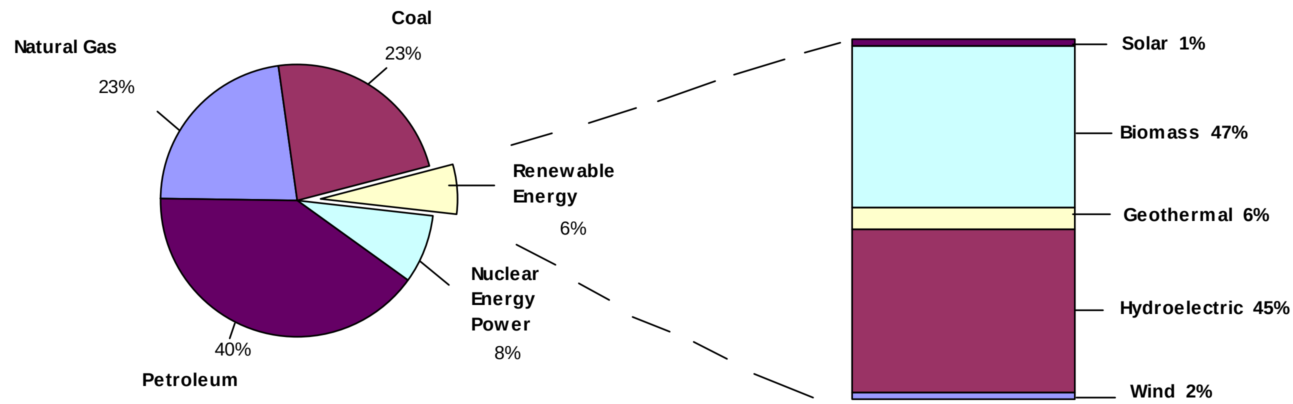
Past incentive programs and high-end-user electricity prices have made solar energy increasingly competitive and self-sustaining in Japan, and the government in 2006 eliminated direct subsidies to end users of solar power.

Despite this removal of subsidies, the PV market in Japan is expected to continue to grow albeit at a slower rate than in the past. The "PV 2030" roadmap implemented by the Japanese government has established the target of solar power becoming fully self-sustainable for householders in 2010 and for businesses in 2020.

The U.S.: California Leads the Way

The U.S. has strong growth potential in solar, we believe, particularly given the likely implementation of a national renewable portfolio standard (RPS) in the next several years. The most common assumption is that a national RPS would target 10% of total electrical energy provision from renewables (not counting existing hydro or nuclear) by 2020. While wind is likely to account for a large chunk of this, solar power will have its place and currently represents only 1% of the total U.S. power provision.

Exhibit 98: U.S. Renewable Energy Consumption, 2004



Source: EIA.

Photovoltaic installations in the U.S. represented only 7% of global installation in 2005, far behind that of Japan or Germany. In 1997, President Clinton set an ambitious target of "one million solar roofs" by 2010. According to the Earth Policy Institute, the number of solar roofs reached only 229,000 at the end of 2003.

More recently, President Bush has issued repeated calls to reduce the nation's dependence on foreign energy sources and is aiming for a 75% reduction in U.S. oil imports from the Middle East by 2025.

Despite the lofty talk however, there is currently no dedicated federal funding of PV installation in the United States. Financial incentives vary by state, as each state has an independent electricity policy. However, several states *have* implemented a number of measures and incentives to develop PV installation.

As usual, California leads the charge, with Governor Schwarzenegger proposing a $2.9 billion 10-year California Solar Initiative (approved in January 2006), which provides, among other things, a 30% rebate to consumers of the cost of a PV rooftop installation. The goal of the Solar Initiative is an increase of 3,000 megawatts of installed PV capacity by 2017. According to Solarbuzz, 84% of the total U.S. PV installations are currently in California.

Colorado, Connecticut, and New Jersey are adopting similar rebates and tax measures to promote photovoltaic installations. The incentives in the U.S. focus mainly on subsidizing the system's installation cost. A sampling of the incentive program for several states follows in Exhibit 102.

Exhibit 99: Incentive Program Sampling by Selected U.S. State

California	Rebate	Customer receives rebate of $2.50/Watt of capacity installed for systems up to 1MW, which reduces over time. In Dec 2005, the California Public Utilities Commission approved $300mln in state wide-solar rebates in 2006. In Jan 2006, $2.9bln in funding via the California Solar Initiative (CSI) program was approved. Solar rebates under the program drop ~10% annually under the CSI program. for systems greater than 100kW, monthly incentives are provided, for systems less than 100kW, up-front incentives are provided. One third of all CSI funds are apportioned for residential solar installations.
Colorado	Various Incentives	The state's RPS requires renewable energy of 3% by 2007; 6% by 2011; 10% by 2015 with 4% from solar-electric generation technologies. Net metering is provided to commercial, industrial, and residential customers with a cap on system size of 2 MW. Rebates and low interest loans are also offered.
Connecticut	Rebate	The states RPS requires 10% renewable energy by 1/1/10. Also, the Connecticut Clean Energy Fund's (CCEF) solar photovoltaic (PV) program offers rebates supporting residential, non-profit, and governmental installations. The rebate level for residential systems is $5/W (PTC) for the first 5 kW and $4.30 for the next 5 kW. Governmental and non-profit installations are eligible for a $5/W (PTC) rebate.
Nevada	Rebate; Renewable Portfolio Standard	The Nevada Solar Generations Program provides rebates of $3.00/Watt for solar systems up to 300kW in size for a max solar capacity of 3MW in 2006. The 2005 Nevada Legislature increased Nevada's RPS to 20% by 2015, and for 2006 not less than 6% of the electricity generated by regulated utilities must come from renewable sources. Of the RPS total, not less than 5% must come from solar renewable energy systems.
New Jersey	Rebate; Grants; Low Interest Loans; Renewable Portfolio Standard	The New Jersey Clean Energy Program (NJCEP) targets 90MW of installed solar generation capacity by 2009 and provides rebates from $3.80-2.00/Watt to the private sector in 2006, based on the size of the system (up to a max of 700kW). Under the Renewable Energy Project Grants & Financing Program, a 20% grant and long term low interest project financing are offered for projects up to 1MW. The NJCEP program also provides a means for Solar Renewable Energy Certificates to be created, verified and sold to electric suppliers who are required to invest in solar energy purchase under New Jersey's Renewable Portfolio Standard.

Source: DSIRE, First Solar, Credit Suisse estimates.

The future of solar power in the U.S. will now be driven by how individual states and ultimately the federal government formulate policy regarding renewable energy. The debate is a live one, and legislation is expected in 2007 or 2008.

China

China's Renewable Energy Law was implemented in January 2006. Solar and wind power are the preferred alternatives to conventional energy sources, which are expected to decline in China's energy mix as a result of surging coal prices and growing concern about environmental pollution. China has established a renewable energy consumption target of 10% in 2020 compared with 3% as at the end of 2003.

According to the solar market study conducted by the China National Development and Reform Commission (NDRC) and the World Bank, the installed capacity of PV systems in China could reach 600 MW in 2010 and could rise to 30 GW in 2020, representing a CAGR of 41% during 2003-10 and a CAGR of 48% during 2010-20.

Off-grid PV systems are expected to constitute the major source of demand in China's solar market, as solar power systems have been set up mainly as part of China's rural electrification campaign. The feed-in tariffs and other financial incentives to install solar systems required for the development of on-grid PV systems are not expected to be established in the near future.

South Korea

South Korea has an ambitious target of 1.3 GW of PV installed capacity by 2011, compared with 15 MW at the end of 2005. This target is part of the government's plan to generate 5% of total energy from renewable sources by 2011. The South Jeolla provincial government plans by April 2006 to start construction of the world's largest solar power facility in partnership with Kore Group, a wholly owned local subsidiary of U.S.-based High Quality Marketing. The project will be partly funded by $150 million of foreign investment. Under the agreement, Sharp will provide components for the 17 MW facility, which will be designed and installed by SunPower and Geothermal Corporation.

Current incentives for solar power in South Korea include investment subsidies and feed-in tariffs. South Korea essentially copied Germany's renewable energy law, but made an addition: newly built houses are required to generate 50% of their energy requirements from renewable energy. This has led to a rapid increase in demand for PV, demand for which currently cannot be satisfied.

The Philippines

The PV market has been driven by a number of programs that target rural electrification using solar power, and these have led to annual installations of 1.5 MW.

The Expanded Rural Electrification Program started in April 2003, aiming to strengthen and integrate all rural electrification efforts of the government and the private sector.

Solar power projects in Philippines include the following:

- The Solar Home Distribution Project, run by the Philippine National Oil Co., is scheduled to run from 2002-07. The whole project entails the installation of a total of 15,100 solar home systems, corresponding to some 0.75 MW of installations. It is being funded by a €5.6 million grant from the Netherlands, plus some counterpart funding from the PNOC. As at November 2004, PNOC had installed solar home systems (SHS) to some 3,526 households in 475 villages not served by the main power grids.

- The provision of electricity in remote and unviable areas that the power grids are unable to serve is open to the private sector or Qualified Third Parties (QTP). Among the first QTP projects is the Philippine Rural Electrification Service (PRES) project. The PRES project has received financing through the French-Filipino Loan Protocol amounting to €22.5 million to provide electricity to a total of 18,000 households located in 128 remote villages.

- The Solar Power Technology Support project, designed to improve the socio-economic conditions of agrarian reform beneficiaries (ARBs) in the 16 provinces of Mindanao, was launched in 2004. The project aims to address rural poverty in the off-grid agrarian reform communities (ARCs) by targeting specific PV applications to increase agriculture productivity and promote livelihood development. The project is supported through a 1997 Memorandum of Understanding (MOU) between the Philippine and Spanish governments.

- The 1 MW grid-connected PV system aims to maximize the efficiency of the 7 MW Bubunawan hydroelectric facility that has recently been put into service. The PV installation is designed to meet peak power needs during the day and allow the dam, which has insufficient water flow, to store capacity for evening use. According to studies, there are approximately 360,000 MW of potentially suitable hydroplants in high solar isolation regions in developing countries that could benefit from combined hydro/PV projects.

Malaysia

Malaysia set a target to achieve 5% power from renewable sources by 2005, but it is currently still a long way short of its goal, and the target has now been pushed out to 2010.

The Malaysian government has put most emphasis on biomass energy in its renewable energy development plan. To encourage the generation of energy using biomass that is renewable and environmentally friendly, companies that undertake such activities are eligible for Pioneer Status, or ITA. Activities located in the promoted areas are eligible for higher exemptions/allowances under Pioneer Status, or ITA. Companies must implement their projects within one year from the date of approval. For the purpose of this incentive, "biomass sources" refer to palm oil mill/estate waste, rice mill waste, sugar cane mill waste, timber/sawmill waste, paper recycling mill waste, municipal waste, and biogas (from landfill, palm oil mill effluent, animal waste and others), while energy forms refer to electricity, steam, chilled water, and heat.

The incentives listed above are also extended to solar power (and to hydropower not exceeding 10 megawatts).

India

India aims to reach full electrification by 2012, mostly through extension of the existing grid, but also including a certain component of PV. India could become an interesting solar growth story in the future. However, a two-year-old policy mandates that Indian PV producers sell their modules domestically at $2.5/W, which is the reason that most Indian produced solar modules are currently exported. This policy will need to change before a domestic installed base of solar power can become viable in India.

Thailand

The government aims to have renewable energy account for 8% of the total by 2011, up from 0.5% in 2002. Its target for solar energy usage is 250 MW by 2011.

The Power Development Plan (PDP) 2004 enforces the new power plant to generate 5% by the renewable energy for the electricity produced from 2001 on. Electricity Generating Authority of Thailand has estimated that in 2015, Thailand will have 630 MW of power capacity produced from the renewable energy.

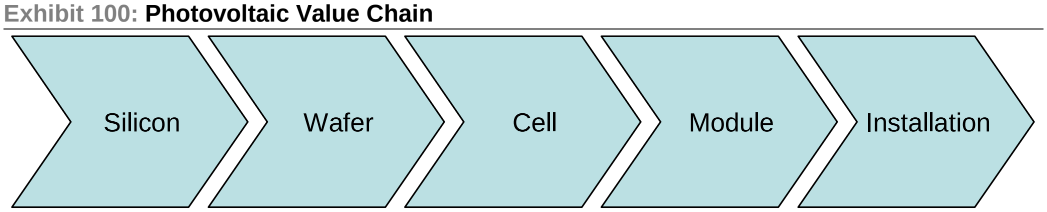
Solar will form some part of this renewables target, and Thailand is well supplied with sufficiently sunny locations. However, further policy development is still needed.

The Photovoltaic Value Chain

The photovoltaic value chain is a useful tool for structuring the analysis of the industry's technologies, economics, and competitive environment. It comprises five steps, from raw materials to completed solar generators.

1. *Silicon.* The transformation of metallurgical-grade silicon into solar-grade polysilicon (also called "silicon feedstock").
2. *Wafer.* The creation of multi-crystalline or mono-crystalline silicon wafers from the silicon feedstock.
3. *Cell.* The manufacture of a photovoltaic cell (able to generate electricity when exposed to sunlight) from each silicon wafer.
4. *Module*. The assembly of multiple cells (often 36) on a solar panel, along with electrical connections.
5. *Installation*. The building of a fully functioning solar-power generator from modules and various electrical components (inverter, meter) and connections.

Exhibit 100: **Photovoltaic Value Chain**



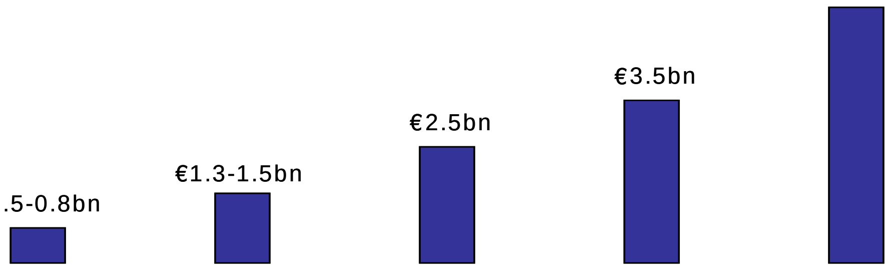
Source: Credit Suisse research.

There is virtually no service component to this value chain after the installation, as the modules are very robust and are usually covered by 20-plus year warranties—their surface simply needs to be kept clean.

We believe the most attractive segment of the value chain in the near term is upstream in the silicon and wafer stages, as a strong acceleration in end demand has driven the upstream to critical undersupply, a situation that is likely to last through 2008, reflecting long lead times (24-36 months for polysilicon capacity, 15 months for wafer capacity).

Exhibit 101: Steps of the Photovoltaic Value Chain

	Silicon	Wafer	Cell	Module	Installation
Market size	€0.5-0.8bn	€1.3-1.5bn	€2.5bn	€3.5bn	€5.5bn
Selling price (€ per watt)	na	1	2	3	5
Supplier concentration	<10	~10	~50	~400	~5,000
Capital intensity (€m/100MW)	80	55	45	25	0



Source: Company data, Credit Suisse research.

In the long run, we would expect the "sweet spot" of the industry's value chain to lie in the cell-making step—away from the bulk chemical/mechanical processes of silicon and wafer manufacturing, where large chemical groups could gain competitive advantage from scale and potential cross-subsidization from other businesses, and away from the low-value-added module assembly stage and labor-intensive, local-presence-driven installation market.

We believe the cell stage offers an attractive combination: barriers to entry (moderate capital intensity and technical intensity), geographical flexibility (cells can be produced away from end-users) and large opportunities for value-creation from R&D (through increased efficiencies).

Polysilicon Expansion to Support PV Growth

Growth in the solar industry is also a function of the quantity of available solar-grade silicon used in the manufacturing of crystalline wafers, which are then used in the production of solar cells. The photovoltaic industry has only recently started to expand quickly, and investments into solar-grade silicon production capacity have been limited in the past few years. The silicon used in solar cells is mainly a by-product of electronic-grade silicon material, which is of a higher the purity than solar silicon.

In our view, a key challenge of the photovoltaic industry will be to expand capacity rapidly to meet a constant and ever-growing demand for silicon in the future. Five Tier 1 companies (Hemlock, Tokuyama, Wacker-Chemie, MEMC, and REC Silicon), are responsible for the bulk of the world's production of solar-grade silicon.

Owing to the recent strong growth in demand for photovoltaic systems, sporadic shortages of silicon have occurred, leading to significant swings in pricing. Contracts for silicon were signed in 2005 at around \$35-45/kg versus \$25/kg in 2004. For 2006, we estimate that long-term contracts were signed at around \$60/kg.

Our bottom-up silicon supply model is shown in Exhibit 105. Feedback from the 2006 Solar Power conference held in the U.S. suggests that pricing remains strong and that there may be some delays to some of the polysilicon projects announced recently. These delays (due mainly to the complexity of new polysilicon plants) suggest that our polysilicon supply assumptions may be too high.

Exhibit 102: Credit Suisse Silicon Model—Year-End Capacity
NKr in millions, unless otherwise stated

Polysilicon Suppliers	2005	2006E	2007E	2008E
Tier 1 Suppliers				
Hemlock Semiconductor	7,700	10,000	14,500	19,500
Wacker Polysilicon	5,500	6,500	10,000	10,000
REC	5,300	6,000	8,000	11,000
Tokuyama	5,200	5,400	6,000	8,400
MEMC	3,800	5,000	6,000	8,000
Tier 1 Supply	**27,500**	**32,900**	**44,500**	**56,900**
Tier 1 Growth y/y	*8.7%*	*19.6%*	*35.3%*	*27.9%*
Tier 2 Suppliers				
AE Poly Silicon	0	0	0	2,500
ARISE	0	0	0	0
China CSG Holdings	0	0	1,500	2,000
Chisso Japan	0	0	0	0
Crystal	0	0	0	0
DC Chemical				3,000
Dow Corning	0	0	0	0
Elkem Solar	0	0	0	5,500
French Consortium	0	0	0	0
Girasolar	0	0	0	0
Global PV Specialists	0	0	0	0
Hoku Materials	0	0	0	1,500
Isofoton	0	0	0	0
JFE Steel	0	0	0	100
JSSI	0	0	0	850
Luoyang Silicon	450	700	1,000	1,000
M Setek	0	0	0	0
Mitsubishi Material	1,600	1,600	1,600	1,600
Mitsubishi Polysilicon	1,260	1,200	1,500	1,500
Photovoltaik Holding (Kazakhstan)	0	0	0	0
Sichuan Xinguang	0	0	0	1,250
SolarValue Ag	0	0	0	5,300
Sumitomo Titanium	700	900	900	900
Tier 2 Supply	**4,010**	**4,400**	**6,500**	**27,000**
Tier 2 Growth y/y	*14.6%*	*9.7%*	*47.7%*	*315.4%*
Total Tier 1 + Tier 2 Supply	**31,510**	**37,300**	**51,000**	**83,900**
Total Supply Growth y/y	*9%*	*18%*	*37%*	*65%*

Source: Credit Suisse research.

We currently forecast year-end 2008 capacity of 83.9 thousands tonnes of poly (electronic and solar combined). This suggests there would be around 36.7 thousand tonnes of polysilicon available for solar in 2008.

Exhibit 103: Polysilicon Available for Solar
tonnes in millions, unless otherwise stated

Year	2004*	2005	2006E	2007E	2008E
Semi poly demand	20,000	21,500	24,510	26,961	29,657
% change y-o-y		*7.5%*	*14.0%*	*10.0%*	*10.0%*
New poly for solar	8,800	8,655	9,895	17,189	37,793
Reject semi poly	2,000	2,150	2,451	2,696	2,966
Poly inventory drawdown	4,000	6,450	4,250	0	-4,000
Total solar poly	**14,800**	**17,255**	**16,596**	**19,885**	**36,759**
% change y-o-y		*16.6%*	*-3.8%*	*19.8%*	*84.9%*
Net efficiency factor		1.00	1.08	1.16	1.24
Top-down PV production estimate (MW) CS	**1,246**	**1,800**	**1,784**	**2,298**	**4,567**

Source: Company data, Credit Suisse estimates.

Beyond 2008, it remains difficult to measure if the supply constraint will continue and for how long. On the one hand, a number of silicon plant projects are due to come on line over the next few years, which should hugely increase solar grade silicon output. On the other hand, favorable legislation through feed-in tariffs or tax cuts continues to be introduced, increasing solar's end-use market.

Finally, the development of thin film technology, which requires much less polysilicon, needs to be taken into account.

Our Preferred Solar Power Stocks

There are many publicly listed companies involved in many different aspects of the solar business.

Our current favorite plays on solar power are:

- REC and Q-Cells in Europe,
- Sunpower in the U.S., and
- Sino-American Silicon Products in Asia.

REC: An Integrated Player

REC is a fully integrated player active across the entire value chain of the photovoltaic industry. We believe REC is currently in the "sweet spot" of the industry, with significant production capacity in upstream solar-grade silicon and crystalline wafers—an area where most of its key competitors are generally undersupplied. REC is also actively developing its downstream solar cell and solar module business, and we believe this is wise should the value chain of the photovoltaic industry evolve in the coming years. In our view, the company appears hedged to a potential redistribution of profits along this value chain through its fully integrated model and provides an attractive way to play the growing development of renewable energies such as solar power.

On the back of solid fourth quarter 2006 earnings, we revised up our revenue forecasts for 2007 and 2008 by 14.3% and 22.1% to NKr6.81 billion and NKr9.57 billion, respectively. We also increased our margin forecasts, as we believe management is keeping costs under control while increasing pricing substantially. We forecast EBITDA margins for 2007 and 2008 of 45.2% and 44.3%, respectively, and EPS of NKr3.78 and NKr5.03.

We believe that earnings growth for REC will be dictated by production ramp-up. Now that REC management has released the full details of its investment plans and ramp schedule in all three of its divisions (silicon, wafers, and solar cells and modules), we believe that the company can generate an EPS of NKr7.67 in 2009.

Given the growth that we foresee in the solar sector, driven notably by the desire to promote renewable energies, we believe that this company should trade at current P/E multiple of 25, which is conservative in regard to solar valuations. Applying 25 times our 2009 earnings estimate of NKr7.67 and discounting that back two years to 2007 leads us to a new 12-month target price of NKr168.0.

Q-Cells: A Pure Play Producer of Cells with Access to Silicon

Q-Cells, based in Germany, is the leading European producer of solar cells and number 2 worldwide, with a production of 166 MWp in 2005. We estimate the company has a global market share of around 10%. In 2006, production reached 255 MWp. The company develops, manufactures, and markets mono- and multi-crystalline solar cells, which are used in the production of solar panels.

Exhibit 104: **Production of Solar Cells in 2005**
MWp

Producer	Production
Sharp	428
Q-Cells	166
Kyocera	142
Sanyo	125
Mitsubishi	100
Schott Solar	94
BP Solar	88
SunTech	73
Motech	60
Shell Solar	59

Source: Solarbuzz.

Q-Cells is a pure play producer of solar cells. These cells are used in the production of modules, which are used in the assembly of photovoltaic installations. The company sells its products to module manufacturers such as Solon, SMD, and Siliken. It is not active in other steps of the value chain (excluding the 17.9% stake the company owns in REC). This is a deliberate choice that management believes will help Q-Cells grow faster than its peers, which are often more integrated.

Management expects 30% sales growth in 2007, higher than our initial estimate of 24%. In 2008, management sees sales of €1 billion compared with our initial estimate of €840 million. Management confirmed its previous EBIT margin guidance of 20%. We detail our estimates below. We recently increased our 12-month DCF-based target price to €58.5.

Exhibit 105: **Q-Cells: New Estimates**
€ in thousands, unless otherwise stated

	2005A	2006E	2007E	2008E
New sales	299,369	539,500	709,782	979,396
New operating profit	63,161	129,129	149,712	191,318
Margin (%)	21.1	23.9	21.1	19.5
EPS	**0.63**	**1.18**	**1.18**	**1.57**

Source: Company data, Credit Suisse estimates.

Securing a sufficient supply of silicon is key in this industry owing to the current shortage of solar grade silicon. The company purchases its crystalline wafers from a number of manufacturers including REC Corporation in Norway. Q-Cells and REC have privileged links, in our view.

SunPower: The Highest Efficiency Solar Cell Producer

SunPower produces the highest energy conversion efficiency (22%) solar cell currently available in the global market . With the company's recent acquisition of PowerLight, the company moved further into the downstream supply chain. PowerLight's focus has always been on large-scale customers including commercial, government, power plants, and large homebuilders. With the acquisition of PowerLight, the combined entity is more balanced between residential, commercial, and large power plants. The company is currently split 70% Europe/30% North America.

SunPower's results continue to be driven by the ramp-up in capacity, by strong demand across all regions, and by pricing leverage. While silicon procurement remains a constraining factor for most of the industry, SunPower has already secured 100% of the silicon required for its 2007 and 2008 production (110 MW and 250 MW of capacity, respectively).

After the company's fourth quarter 2006 earnings release, we updated our estimates to reflect the integration of PowerLight. For the combined SunPower-PowerLight entity, we adjusted our 2007 revenue estimate to $655 million from $365 million and our GAAP EPS estimate to $0.02 from $0.72. For 2008, we increase our revenue estimate to $1.2 billion from $800 million and maintain our GAAP EPS estimate of $1.67. Our $47 12-month target price is based on a 28 P/E multiple on our 2008 GAAP $1.67 EPS estimate.

Sino-American Silicon Products: Our Preferred Asian Solar Play

We believe Sino-American Silicon Products (SAS) is well positioned to improve profitability and increase its market share. SAS is one of Asia's smaller-sized semiconductor wafer suppliers, and is now switching to the solar field: solar accounted for around 60% of 2006 sales.

With the completion of its ChiuNan manufacturing plant in March 2006, SAS's total solar wafer output reached 4.3 million units in 3Q06. The company is expected to expand its solar wafer capacity to 120 MW by June 2008 from 26 MW in 2Q06. Improving relationships with Hemlock and Sharp (SAS is a supplier) give us confidence in the growth story: Hemlock and Sharp are among the world's largest polysilicon and solar cell makers.

Similar to Renesola, SAS had had success in solar recycling technology, which enables SAS to use scrap silicon wafers to produce solar wafers. Its extensive experience of being a semi wafer supplier enables it to source scrap feedstock supply of silicon scrap, sourced from most Taiwan semiconductor companies. With its proprietary technology, we expect SAS' current scrap feedstock supply can provide 10-20% of its 2007 polysilicon needs. This also enables SAS to improve its product mix toward high-margin non-OEM business.

SAS is currently trading at 13 times our 2007 estimate, far below global peers' 20 times-plus. The current constraint in solar wafer capacity and tight polysilicon supply also provide a good business environment.

Suntech: The Largest Asian Cell and Module Manufacturer

Suntech is currently the largest solar cell and module manufacturer in Asia. With its locked-in long-term fixed-price wafer purchase contracts, we believe Suntech is well positioned to expand its production capacity, and leverage on its acquired building-integrated-PV technology from MSK Japan to expand its global sales.

Suntech's emphasis on R&D means it is well positioned to enhance profit margins from deploying semiconductor finger technology (aiming to improve energy conversion efficiency by 1% each year), lower-cost wafers, lower purity wafers (which could reduce unit wafer consumption costs by 50% without impacting the energy conversion ratio), and potentially from crystalline silicon on glass thin film technology in a few years time if this technology becomes commercially viable.

To enhance its profitability, maintain product ASP and protect distribution channels, we believe Suntech will vertically integrate downstream into systems integration in China and elsewhere as the company continues to ramp up production capacity.

We believe Suntech is more likely to invest in silicon production joint ventures instead of going into polysilicon production itself. Suntech is scheduled to commission its new cell and module production factory in Wuxi in second-half 2007.

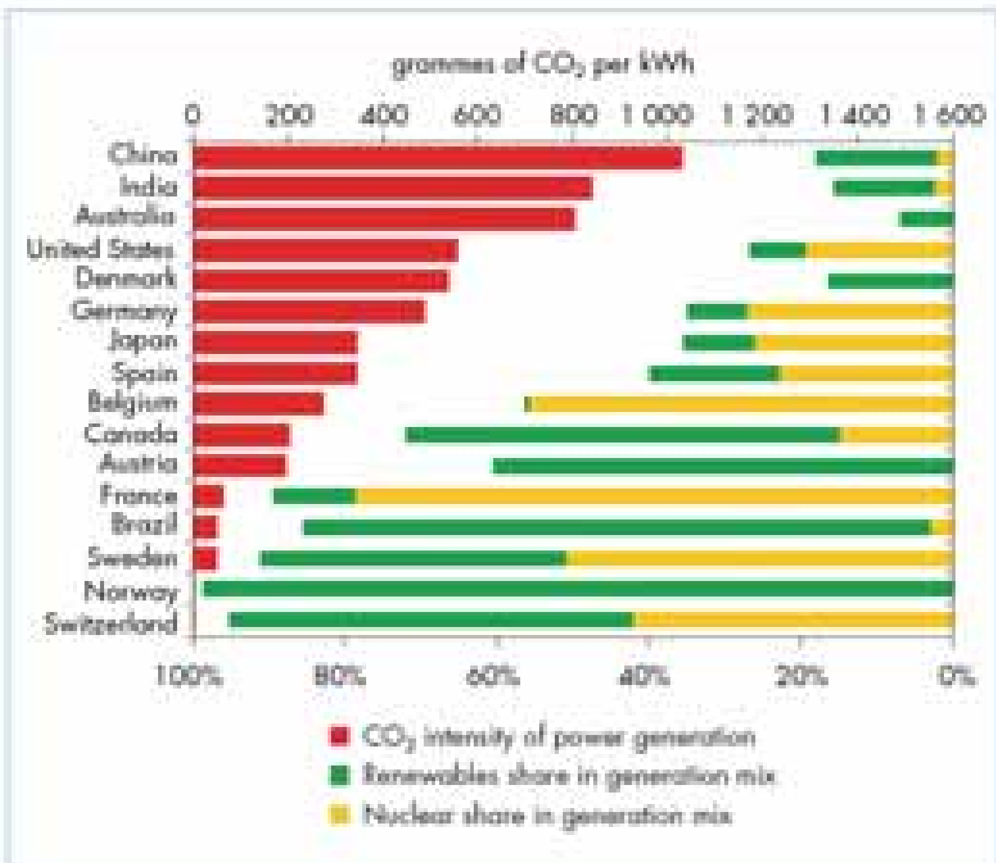
While Suntech currently guides to 250 MW of output in 2007, we expect it to add more capacity in second-half 2007 and deliver output of around 295 MW. We expect Suntech to add 2x30 MW PV cell production lines in February in Luoyang (we assume commercial operation starting in March), and another 2x30 MW lines in second quarter 2007 (we assume commercial operation starting July). We assume Suntech will add another 2x30 MW production lines starting in October 2007.

The Nuclear Alternative

Ralph Profiti

Nuclear power is essentially a renewable source (i.e., derived from a resource that is regenerative or infinite), although it is often argued otherwise, and rarely as such. The rationale behind exclusion may lie in the controversy over environmental damage from waste deposits and its eligibility for development aid, were it classed as renewable (which some people disagree with due to the fears over its radiation safety). Hence, it is legally not included under the "renewable" umbrella term; however, it is still viewed as an alternative to traditional thermal fueled capacities. It represents approximately 18% of Europe's installed capacity (see Exhibit 110) and around 10% on a global level.

Exhibit 106: Power Sector CO_2 Emissions per kWh and Share of Nuclear and Renewables in Selected Countries, 2004



Source: IEA.

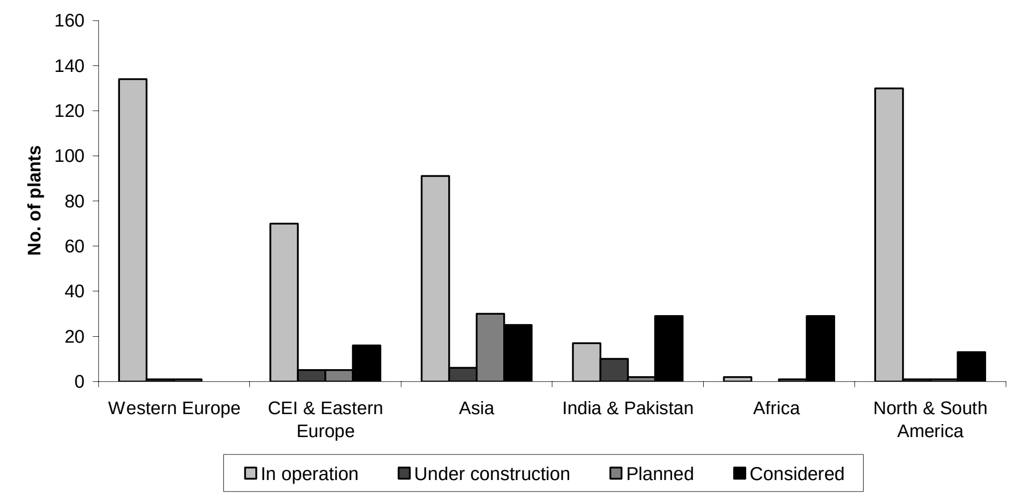
Exhibit 107: Nuclear Installed Capacity
GW, unless otherwise stated

Nuclear installed capacity (GW)	2002	2003	2004	2005	2006E	2007E	2008E	2009E	2010E
North America	113	114	115	118	118	118	120	123	128
Growth	1%	0%	1%	3%	0%	0%	2%	2%	4%
Latin America	4	4	4	5	6	7	7	8	9
Growth	0%	1%	1%	13%	16%	14%	12%	11%	10%
W Europe	128	129	132	131	130	128	128	128	127
Growth	0%	1%	2%	0%	-1%	-1%	0%	0%	0%
E Europe, CIS	48	49	51	52	54	57	60	63	66
Growth	-2%	3%	4%	2%	4%	6%	5%	5%	5%
Middle East, Africa	2	2	2	2	2	2	2	3	3
Growth	0%	0%	6%	5%	5%	5%	7%	6%	6%
China	5	6	7	7	9	10	11	13	14
Growth	150%	20%	10%	6%	22%	15%	14%	14%	10%
India	10	10	12	13	14	14	15	16	17
Growth	11%	0%	20%	8%	5%	5%	5%	5%	5%
Other Asia	55	58	61	63	65	67	72	74	77
Growth	-6%	6%	4%	2%	3%	3%	8%	4%	4%
Total	**366**	**373**	**383**	**390**	**397**	**403**	**416**	**428**	**440**
Growth	**0%**	**2%**	**3%**	**2%**	**2%**	**2%**	**3%**	**3%**	**3%**
% of installed capacity (GW)									
North America	31%	31%	30%	30%	30%	29%	29%	29%	29%
Latin America	1%	1%	1%	1%	1%	2%	2%	2%	2%
W Europe	35%	35%	34%	34%	33%	32%	31%	30%	29%
E Europe, CIS	13%	13%	13%	13%	14%	14%	14%	15%	15%
Middle East, Africa	0%	0%	0%	1%	1%	1%	1%	1%	1%
China	1%	2%	2%	2%	2%	2%	3%	3%	3%
India	3%	3%	3%	3%	3%	4%	4%	4%	4%
Other Asia	15%	16%	16%	16%	16%	16%	17%	17%	17%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Source: Areva, EIA, Siemens, Credit Suisse estimates.

In spite of the many environmental concerns that people may have, the nuclear industry is evidently showing no signs of a decline in build-out. As shown in Exhibit 111, in a recent presentation by French nuclear company Areva (96% state owned), despite a large base of plants, plans to develop nuclear sources are still being encouraged in many of the developing regions.

Exhibit 108: Number of Nuclear Plants in Operation, Under Construction, Planned, and Considered

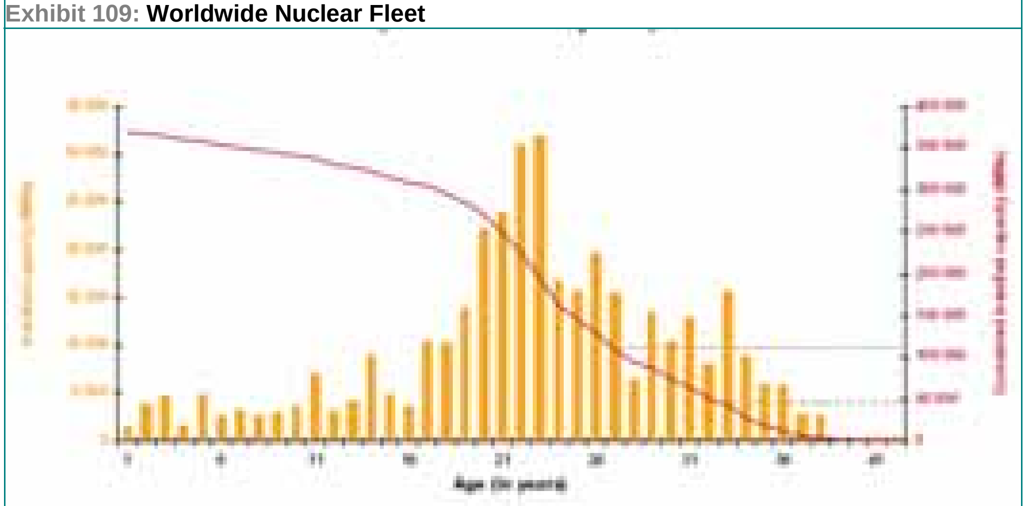


Source: Areva.

China, for example, is one nation with a particularly large appetite for nuclear. In 1993, its self-sufficiency ended when it was forced to become a net importer of oil to meet accelerating economic growth. Alongside coal, this had long-term impacts on the degradation of the environment, so much so that under its 11th five-year plan (formally adopted in March 2006), the government announced that it would try to diversify away from the polluting fossil fuels that had pushed its economic development.

Part of these plans included the Chinese ambition to increase nuclear energy production sixfold by 2020 to reach a total installed capacity of 40 GW (or 4% of the country's total, a share that is some way below its present share owing to the overall strong ramp-up in power generation capacity in the next few years). This alone represents a level of two new generators to be installed annually and in addition the likely implications on uranium sourcing. (Despite China's large land mass and resource capabilities, it has insufficient uranium to meet its energy demands.)

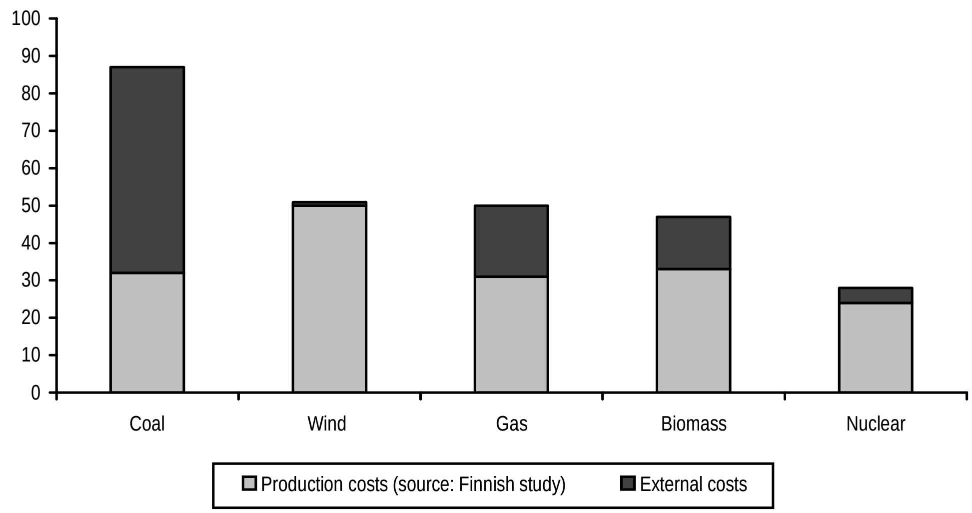
Exhibit 109: Worldwide Nuclear Fleet



Source: Areva.

Much in evidence is the shift toward an older fleet of nuclear-powered plants, which in our view could invoke more investment. Although it would be ideal to rely on one source of energy, a diversified portfolio of generation technologies is more likely, given restrictions on land, fuel, regulation, demand, and supply. As studies have shown nuclear energy to be cheaper in production costs as well as external costs when compared with thermal and many other renewable energies, many governments (such as the Japanese, U.S., French, Indian, and Russian) are keen to include it in their energy mix.

Exhibit 110: Internalized Costs



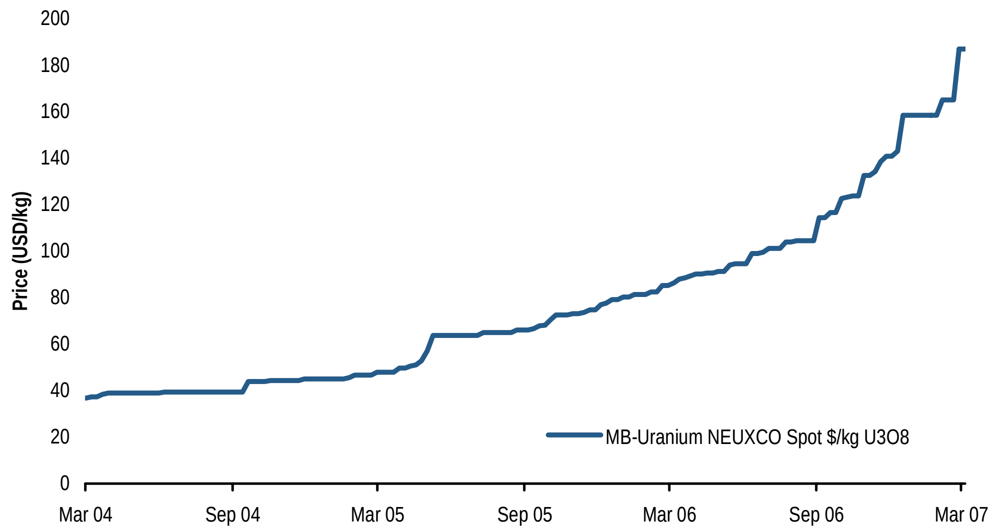
Source: Areva.

Since 2001, uranium prices have been on the rebound, owing to increasing nuclear electricity generation capacity, increasing reactor fuel requirements, and falling inventories of uranium.

The uranium production industry is relatively focused, with a small number of companies operating in relatively few countries. In 2005, eight producers provided approximately 80% of the estimated world production of 108 million pounds of U_3O_8. However, production from world uranium mines supplies only 62% of the requirements of power utilities. Twenty percent of demand is sourced from recycling and producer/consumer inventory (likely to be depleted over the next few years) and the other roughly 20% comes from highly enriched uranium (HEU) derived from the dismantling of Russian nuclear weapons. (The HEU treaty ends in 2013.)

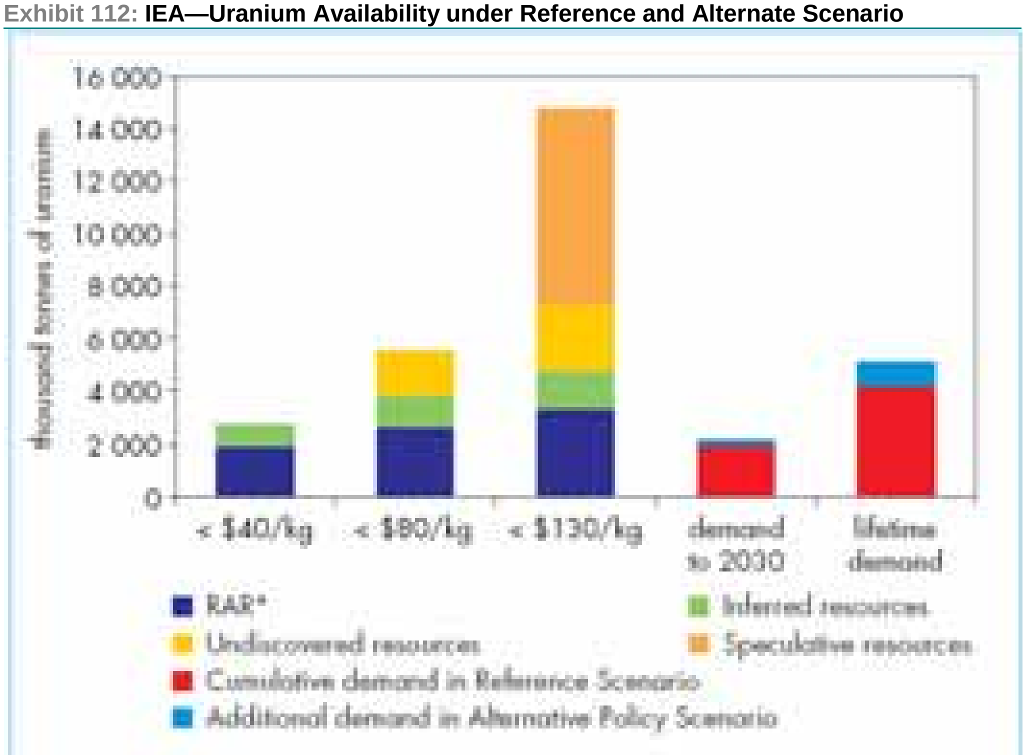
High prevailing prices reflect two decades of underinvestment. Although, there are enough resources in the ground, our Global Mining Team does not expect the market to return to balance for some time (5-10 years).

Exhibit 111: Uranium Price
USD/kg



Source: Datastream.

Exhibit 112: IEA—Uranium Availability under Reference and Alternate Scenario



**RAR = reasonably assured resources.*
Source: IEA.

Cameco Corp.: The World's Largest Publicly Traded Uranium Producer

Cameco's involvement in the uranium mining and nuclear business consists of exploring and developing new deposits, mining and milling uranium ore to produce uranium concentrates (U_3O_8), supplying uranium refining and conversion services to produce uranium dioxide (UO_2) and uranium hexafluoride (UF_6), purchasing uranium from third parties, and selling produced and acquired uranium to utilities. In addition CCO holds a 31.6% interest in Bruce Power Limited Partnership, which operates four of the Bruce Power Limited's "B" nuclear reactors.

CCO offers unique exposure as a vertically integrated player in the nuclear fuel cycle, from uranium mining to nuclear power generation. A focus on its dominant market share in uranium production and a continuing shift in investor base from mining to energy and international should translate into investors getting more comfortable with the CCO story and help drive relative outperformance in the shares.

CCO's realized prices and sensitivity to stronger uranium prices are limited in the near-term by ceiling prices in many of its contracts. These contracts were signed in recent years when spot prices, and related ceiling prices, were at much lower levels. About 25-30% of these contracts roll over every year and are replaced with prices that are more reflective of current market conditions. Over the next three to four years, the current portfolio mix will be replaced with a greater proportion of contracts related to market prices that provide downside protection. CCO is currently targeting a mix of fixed and market-related prices for its contracts, specifically targeting about 40% of volume that is fixed pricing escalated by inflation (3-5 years in duration) and 60% of volume that has pricing related to market prices (10-year duration).

CCO expects to complete its phase-one drilling program and complete the sealing off of water inflow at Cigar Lake (represents 20% CCO contained metal) by second quarter 2007, which suffered development setbacks in third quarter 2006. At full production, we estimate Cigar Lake will represent approximately 5% of global uranium production. A technical report for Cigar Lake is now expected in late March 2007, which should include an updated reserve and resource estimate, capital cost estimate, and production plan. Reserve reclassification remains a key concern. Supply deliveries for 2007 have been deferred; with amounts under base-load contracts deferred to the end of the various contracts while balance of contracts under supply interruption language are deferred over a five- to seven-year period. The pricing mechanism under these contracts remains the same regardless of the uranium price environment

Uranium price forecasting continues to focus on the mine supply issue, whereby the current mine production rate is about 62% of global demand (the balance being filled mainly from the down-blending of enriched uranium). The catalysts for the rise in uranium prices are more structurally related—the wearing off of legacy contracts being replaced with contracts that have base price with escalators, protecting the downside and participating in the market-price upside potential. The scheduled expiration of U.S.-Russian HEU agreement in 2013 has led to an increase in market fear, mostly from utilities for longer-term supply. This led to a pickup in market activity; and finally the technical and regulatory hurdles in bringing a uranium mine into production even with the significant uranium prices increases.

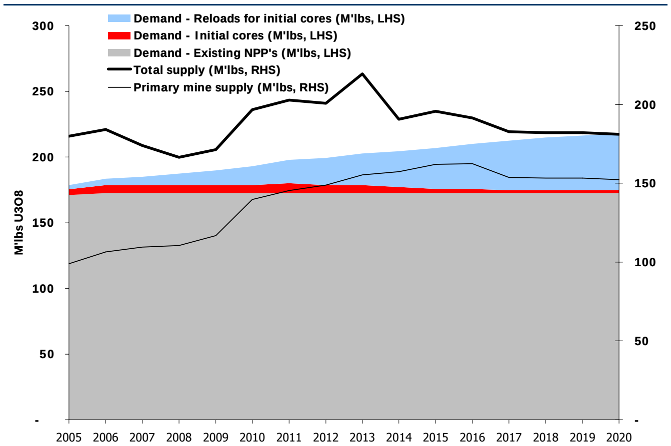
We continue to see strong fundamentals for the uranium market, and we estimated that the resources need to be mined to meet future demand will involve an increased level of underground mining at a long-term price of $40/lb. According to the IAEA, the cost of nuclear power generation has been dropping over the past decade, owing partly to declining fuel costs (including enrichment), operating and maintenance costs, and lower financing costs. In general, the construction costs of nuclear power plants are significantly higher than those for coal and gas-fired plants because of the need to use special materials and to incorporate sophisticated safety features and backup control equipment.

Together, these factors contribute much of the incremental cost of building a nuclear reactor.

The relative attractiveness of nuclear power becomes clearer when measured in the context of electricity-generation costs among competing commodities in the global electricity mix—oil, gas, uranium, and coal. It is in this respect that the relative usefulness of nuclear looks most interesting. Despite the substantial rise in the uranium price over the past year, the electricity-generating cost derived from nuclear power is not expected to rise significantly because of its relatively lower composition as part of the total generation cost of about 25%, compared with natural gas (about 91%), oil (about 88%), and coal (about 76%).

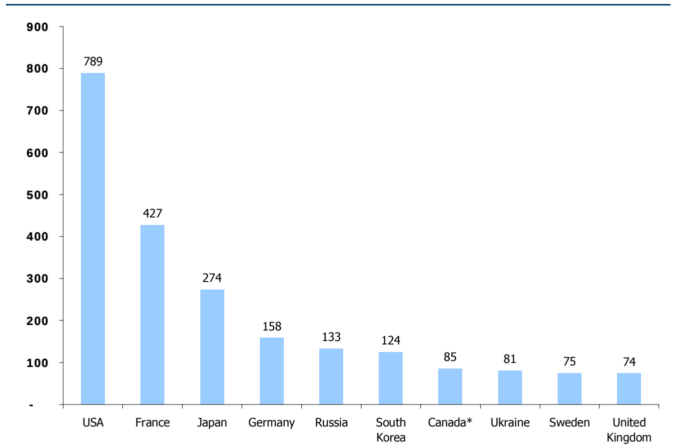
The demand for uranium concentrate (U_3O_8) is directly linked to the level of electricity generated by nuclear power plants. Therefore, our long-term growth assumption for uranium demand is roughly the same as our assumption of nuclear-electricity-generating capacity: roughly 2-3%. Our assumption attempts to take into account changes in the factors that can affect the characteristics of uranium production requirements such as reactor design, load factors, enrichments levels, fuel burn efficiency, and cycle length. We estimate that total global uranium demand will be about 180 million pounds in 2006, rising to 195 million pounds by 2010 and to 225-230 million pounds by 2020.

Exhibit 113: Uranium Supply and Demand



Source: World Nuclear Association, Credit Suisse estimates.

Exhibit 114: Top 10 Nuclear Electricity Generators
kWh



Source: World Nuclear Association, Credit Suisse estimates.

According to data from the World Nuclear Association, China plans to increase its nuclear power capacity to 32 GW from 6.6 GW currently. By our estimate, China will need 50-60 million pounds of equivalent uranium concentrate for its initial core and 14-15 million pounds thereafter as its maintenance requirement. This amount compares with current production capacity of only 2 million pounds. China's "backbone" of uranium mining and metallurgy has historically been located in its Guangdong, Jiangxi, and Hunan provinces. However, in recent years, uranium exploration has been focused on northwest and north China, where there is potential for expansion of uranium mining.

Biofuels: Eat It or Burn It?

Trina Chen

Mark Flannery

Edward Westlake

Turning agricultural products into transportation fuel is big business once again, and appears to offer the appealing combination of lowering dependence on foreign crude oil while supporting domestic agriculture businesses—two outcomes dear to the hearts of politicians in many areas of the world. Political support for biofuels is therefore increasing as oil prices remain high. Exhibit 118 shows already enacted policies for biofuels in selected markets.

Exhibit 115: Overview of World Biofuels Policies

US	Renewable Fuels Standard (RFS) mandates annual use of 7.5bn GPY of renewable fuels by 2012
	Various US states have separate targets and mandates
EU	Goal of attaining 5.75% of transportation fuel needs from biofuels by 2010 in all member states
Brazil	Mandated 20-26% ethanol blend in all gasoline
Canada	Intention for all gasoline to contain minimum 5% ethanol by 2010
Colombia	Mandated 10% ethanol blend in all gasoline sold in cities with populations exceeding 500,000
China	Mandated 10% ethanol blend in gasoline in some provinces
India	Mandated 5% ethanol blend in gasoline in a number of regions
Japan	Intention for all gasoline to contain 10% ethanol by 2030

Source: Credit Suisse research.

However, biofuels are not a free ride for politicians or for consumers. Many biofuels still require government subsidies of some description, and the diversion of increasing amounts of the world's agricultural output into fuel production is already having affect on crop prices.

We believe economic returns from biofuels in some areas (U.S. corn ethanol) have already peaked; most advantage accrues to the first movers in biofuels, particularly where government subsidies are involved. Barriers to entry in the current biofuels industry are limited; a new biodiesel plant can be built within 12-14 months. Ethanol capacity can be added within 18-24 months.

Government incentives for biofuels are starting to be reduced in certain countries, though this process is not uniform and support for second-generation biofuels (cellulosic ethanol, for example) is *increasing*.

Strong demand from the biofuel sector has coincided with recent weak global harvests, and this has pushed up agricultural input prices (vegetable oils, corn, grains). The future of feedstock prices is unclear and depends on the ability of the agricultural sector to respond to the higher price signal with more supply.

There are currently two main types of biofuels: bioethanol and biodiesel.

- Bioethanol (ethanol) comes from the distillation of starch and sugars into a pure ethyl alcohol, which is typically blended into the conventional gasoline pool. The U.S. and Brazil dominate the ethanol industry, accounting for 90% of global production.

- Biodiesel comes from the chemical reaction of vegetable or animal fats with alcohol to produce a vehicle-ready diesel fuel, again normally blended into the conventional pool, although capable of being used directly in existing diesel engines. Biodiesel is a much smaller industry than ethanol and is currently dominated by Europe.

Biofuels are not a low-cost solution to energy supply. Without the current blending tax credit, and at corn prices of $3/bushel (corn is currently $4 per bushel), U.S. corn ethanol would break even, including a return on capital, at a crude oil equivalent price of around $55/bbl, we estimate. Unsubsidized (European) biodiesel based on rapeseed would require around $75-80/bbl, though increased use of palm oil feedstock could reduce this break even toward $60/bbl over time. European ethanol breaks even at around $70-75/bbl. Only Brazilian ethanol is robustly economical at oil prices below $50/bbl; we currently estimate that the Brazilian industry breaks even at $35/bbl.

Ethanol

Ethanol is pure ethyl alcohol produced from fermenting and distilling various crops (corn in the U.S., sugar cane in Brazil, wheat in Europe). In the U.S. it is currently blended into the conventional gasoline pool, but can function as an alternative transportation fuel in modified vehicle engines, as it does in Brazil.

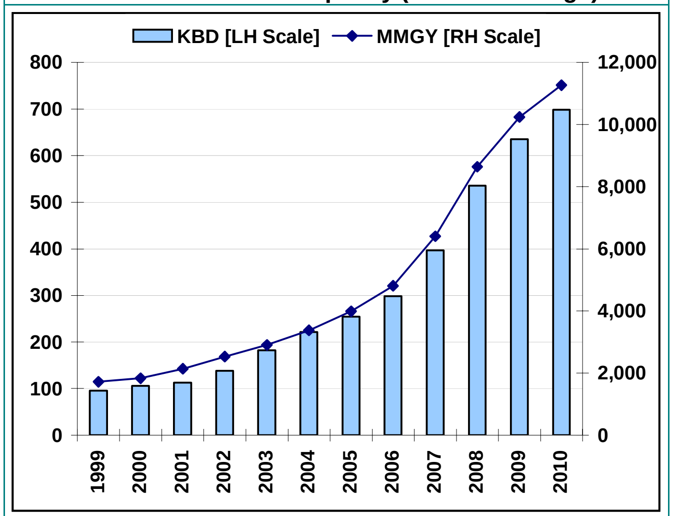
Given that the two largest markets are very different in composition, we treat them separately below.

U.S. Ethanol

The United States is one of the two largest global ethanol producers (with Brazil), and current annualized monthly production is around 5.4 billion gallons per year (350 KBD). On current expansion plans, the U.S. industry would reach 600-650 KBD by the end of the decade, although this is not a foregone conclusion.

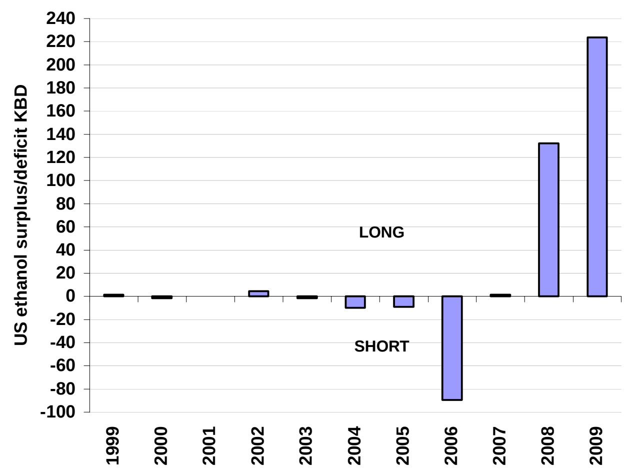
In 2005, the U.S. federal government enacted a mandate for renewable fuel use in gasoline, calling for 7.5 billion gallons per year by 2012. Some individual states have their own more extensive minimum usage mandates.

Exhibit 116: U.S. Ethanol Capacity (Annual Average)



Source: DOE, RFA, Credit Suisse estimates.

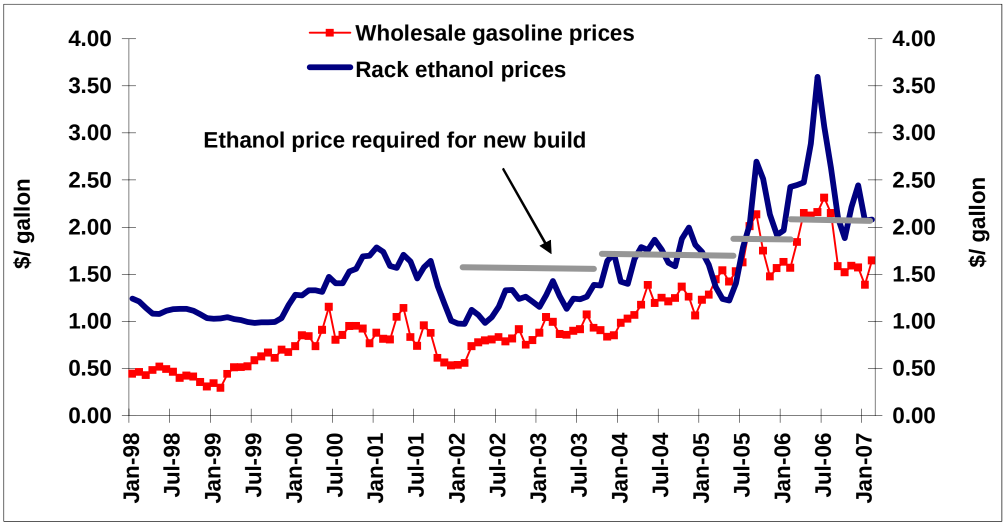
Exhibit 117: U.S. Ethanol Balance (Static Market Share)



Source: Credit Suisse estimates.

Ethanol currently represents around 3.5% of the U.S. gasoline pool and could represent the single most important source of additional U.S. gasoline supply in the next four years. We do not anticipate any problem with blending ethanol up to 10% of the gasoline pool.

Exhibit 118: U.S. Gasoline and U.S. Ethanol Prices



Source: Bloomberg.

Ethanol has priced at parity with gasoline in recent years *plus* the existing $0.51 per gallon federal tax credit for blenders. The 2006 phase-out of the gasoline additive MTBE produced a sudden surge in demand for ethanol as a replacement, but the resulting price spike proved temporary, as seen in Exhibit 121.

New-Build Economics for a U.S. Ethanol Plant

New ethanol plants in the U.S. are quick to build (18-24 months) and generally face no local opposition (unlike conventional refineries). Before the recent sharp rise in corn prices, a new ethanol plant could return its cost of capital (10%) at an ethanol price of around $1.60 per gallon, assuming a construction cost of $1.60 per annual gallon. However, with corn futures now at $4 per bushel for much of 2007, the economics of a new-build plant have changed. (See Exhibit 119.) The break-even ethanol price using $4/bushel corn and $1.75 construction costs is now just above $2 per gallon, we estimate.

Exhibit 119: New-Build Economics for a U.S. Ethanol Plant (Various Corn Price)

IRR (%)		Ethanol price ($/gallon)							
		1.40	1.60	1.80	2.00	2.20	2.40	2.60	2.80
Corn price ($/bushel)	4.50			-6%	3%	11%	18%	24%	31%
	4.00			0%	8%	15%	22%	28%	35%
	3.50		**-3%**	5%	13%	20%	26%	32%	38%
	3.00	-6%	2%	10%	17%	24%	30%	36%	42%
	2.50	-1%	7%	15%	22%	28%	34%	40%	46%
	2.00	5%	12%	19%	26%	32%	38%	44%	49%
	1.50	10%	17%	24%	30%	36%	42%	47%	53%

Note: assumes construction cost per annual gallon of $1.75.
Source: Credit Suisse estimates

The rising cost of construction, while not as meaningful as the corn input price, is another factor in the industry's economics. Construction costs per annual gallon of capacity have been rising, and we estimate are now around the $1.75 mark, with further upside risk. The impact of higher construction costs is shown in Exhibit 120.

Exhibit 120: New-Build Economics for a U.S. Ethanol Plant (Various Construction Cost)

IRR (%)		Ethanol price ($/gallon)							
		1.40	1.60	1.80	2.00	2.20	2.40	2.60	2.80
Construction Cost (per annual gallon)	2.00	-6%	2%	9%	15%	21%	27%	32%	37%
	1.90	-6%	2%	9%	16%	22%	28%	34%	39%
	1.80	-6%	2%	10%	17%	23%	29%	35%	41%
	1.70	-7%	2%	11%	18%	25%	31%	37%	43%
	1.60		3%	11%	19%	26%	33%	39%	46%
	1.50		3%	12%	20%	28%	35%	42%	48%
	1.40		4%	13%	22%	30%	37%	44%	51%

Note: assumes corn input cost per bushel of $3.00.
Source: Credit Suisse estimates.

With the current $0.51 per gallon blending tax credit, U.S. ethanol prices (averaging over $2.20 for fourth quarter 2006) are close to the level needed to justify new capacity expansion. Assuming that corn prices stay around $4 per bushel, however, the investment decision for less well positioned plants is now marginal, and we would expect to see some delays or cancellations in the near future.

U.S. Ethanol Capacity Is Growing Faster Than Required Demand

For now, the U.S. ethanol industry plans to add capacity much faster than we expect U.S. gasoline demand to grow. If this turns out to be reality, then ethanol will at some point need to price at a discount to conventional gasoline in order to ensure sufficient uptake.

The ethanol price is a function of the gasoline price plus or minus any premium reflecting ethanol's own surplus or deficit to *required* demand, i.e., the ethanol needed to ensure finished gasoline meets environmental specifications or to meet federal or state usage mandates. The average ethanol premium to gasoline over the past five years has been close to zero (after adjusting for the $0.51 tax credit).

Exhibit 121: Ethanol General Pricing Assumptions

		1Q06A	2Q06A	3Q06A	4Q06E	2005A	2006E	2007E	2008E	2009E	LT
x	WTI ($/bbl)	63.3	70.5	70.5	66.0	56.5	66.1	62.5	62.5	62.5	62.5
y	US Gulf Coast (PADD III) 3-2-1 $/bbl	9.15	18.56	12.56	7.00	11.92	11.82	12.00	10.00	9.00	8.00
	Implied wholesale gasoline $/bbl [x+y]	72.5	89.0	83.1	73.0	68.4	77.9	74.5	72.5	71.5	70.5
a	Implied wholesale gasoline $/gl	1.73	2.12	1.98	1.74	1.63	1.85	1.77	1.73	1.70	1.68
b	Blending tax credit $/gl	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51
c	Ethanol premium/(discount) $/gl	0.09	0.33	0.12	0.10	(0.33)	0.16	(0.09)	(0.25)	(0.22)	0.00
	Rack price of ethanol $/gl [a+b+c]	2.28	2.99	2.60	2.35	1.80	2.53	2.20	1.98	1.99	2.19
	US Natural Gas NYMEX $/mcf	8.94	6.80	6.53	5.50	8.70	6.94	6.50	6.25	6.00	6.00
	Chicago corn spot price $/bushel	2.05	2.29	2.20	2.81	1.97	2.34	3.00	2.70	2.60	2.47

Source: Credit Suisse estimates.

The rising supply of ethanol could act to back-out imported gasoline blendstocks from Europe, though some of these imports are subject to *supply push* as gasoline demand in Europe is falling. This ethanol-on-imported-gasoline competition could weaken light oil prices in future years, we think, by increasing light product deliverability.

Cellulosic Ethanol—Coming Soon?

Our discussion of U.S. ethanol above has concentrated on the active and commercial part of the industry—namely, corn-derived ethanol. However, there is currently much research and development work, and much talk, in the area of cellulosic ethanol.

Corn ethanol takes the grains of corn and grinds them in a mill to release the carbohydrates and sugars contained within the grain.

Cellulosic ethanol attempts to access the carbohydrate and sugar content of plant material without employing the milling process. This would potentially enable a much wider range of ethanol feedstocks, everything from switchgrass to wood chips or corn stalks and stover (waste biomass). The challenge lies in developing powerful (and cheap) enough enzymes to break down the individual plant cell wall (the *lignum*) to permit the fermentation process.

There are several companies that claim to be on the verge of developing commercial cellulosic ethanol plants, and one or two demonstration plants have been built for this second-generation biofuel, but so far there is nothing of commercial scale in existence.

Cellulosic ethanol offers the potential to significantly change the face of the U.S. biofuel industry in the coming 5-10 years, but high capital costs per unit and unproven technology mean that it is still far from a fully commercial proposition today.

U.S. Politics Now the Main Uncertainty in U.S. Ethanol

The main unknown impact on future U.S. ethanol pricing is the potential action of the U.S. Congress and individual U.S. states in potentially increasing the ethanol mandate from the Energy Policy Act of 2006. As mentioned, the current federal mandate calls for 7.5 billion gallons of use by 2012, a level that we expect to be easily surpassed by supply.

Should the usage mandates be extended, this could have the effect of supporting ethanol prices against conventional gasoline, since a mandated gallon of ethanol does not have to compete on price with gasoline. However, the eventual impact (weaker prices for light refined products) will be the same, just via a different transmission mechanism.

There are some logistical constraints to the speed of the build-out of U.S. ethanol, mainly in transportation; ethanol cannot be transported in petroleum pipelines, and non-RFG markets lack ethanol blending infrastructure. Over time some of the economic rent in the industry will need to be diverted from producers into logistics and infrastructure providers.

As for imports to the U.S., Brazil, the world's other main producer of ethanol, would seem well set to supply more. Brazil's lower production costs help offset the current import tariff of $0.54 per gallon for most ethanol into the U.S. However, given the expected capacity boom in domestic U.S. ethanol, plus an uncertain U.S. political scene and Brazil's own logistical issues, it seems unlikely that Brazilian ethanol producers will be investing explicitly for export to the U.S. any time soon.

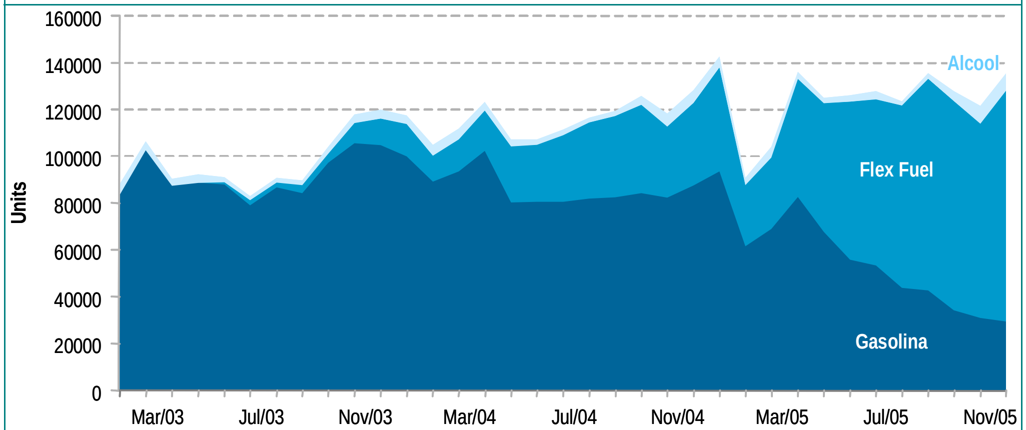
Brazilian Ethanol

Brazil was the first country to introduce and use ethanol on a large scale, initially as a gasoline additive, then later as the main fuel for much of its national vehicle fleet. By the early 1980s, an impressive 85% of light vehicles were running on ethanol.

Following the oil price collapse of 1985-86, however, subsidies were gradually phased out, and eliminated entirely in 1999, the modern-era low for crude oil prices. Ethanol has since made a strong comeback in the Brazilian market and currently accounts for 20-25% of the total gasoline pool.

In March 2003, Brazil introduced a new type of passenger vehicle: the “flex fuel” vehicle. The flex-fuel mechanism burns hydrous ethanol, gasoline, or any mixed proportion of both fuels. Some 80% of cars sold in Brazil are now flex-fuel vehicles. Those with a very bullish outlook for the U.S. ethanol industry point to flex-fuel vehicles as the means for pushing the ethanol content of the total gasoline pool beyond 10%.

Exhibit 122: **Brazil's Domestic Vehicle Sales**

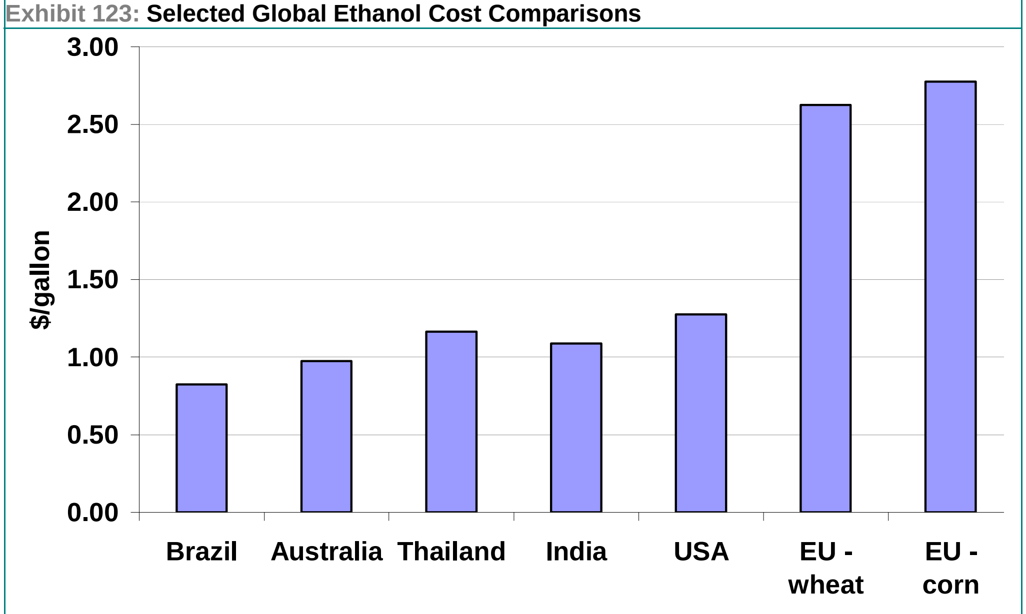


Source: Anfavea, Credit Suisse research.

Brazil's unique position in ethanol stems mainly from its very low sugar production costs, and the favorable cost advantage that sugar has over corn and others as a feedstock for ethanol production.

Brazil's sugar production cost of around US$0.073 per pound is significantly below that of Thailand (the second lowest-cost producer) at US$0.10 per pound and Australia at US$0.11 per pound. The main reason is that Brazil produces sugar from sugar cane, which is a far more efficient crop than the sugar beets in use in much of the rest of the world. In addition, Brazil's favorable climactic and soil conditions allow sugar cane to be harvested six or seven times before it needs to be replanted, compared with India where sugar cane needs to be replanted every two harvests, on average.

Exhibit 123: **Selected Global Ethanol Cost Comparisons**



Source: FO Licht, Credit Suisse research.

Further development of the Brazilian ethanol industry will depend on further penetration of flex-fuel vehicles (a trend that is likely to start to slow in the coming years) and on the possibility of exporting ethanol production to the U.S. or elsewhere.

Brazil's low cost of production and abundant arable land mean that expansion of the domestic ethanol production industry for export is an economically sensible proposition, even with the current $0.54 per gallon import tariff to the U.S. However, Brazil will need to make significant multi-year investments in port and handling infrastructure if it is to grow its ethanol exports. With U.S. domestic production growing very rapidly, Brazilian ethanol producers are currently exhibiting some caution over making these investments.

Cosan

Cosan is Brazil's largest sugar and ethanol producer and the second largest in the world, with 40.0 million tonnes of crushing capacity, representing roughly 10% of Brazil's milling capacity. Since 2000, the company has grown through several acquisitions, and we believe it is well positioned to continue to consolidate Brazil's sugar industry.

Recently, Cosan failed to acquire the second largest Brazilian sugar and ethanol producer (Vale do Rosario), which, in our view, could signal that competition for existing assets has increased. Moreover, recent news flow regarding Russia and Indian sugar production has been exerting downward pressure on sugar prices.

Despite the more challenging scenario, we think that the long-term investment case on Cosan remains positive. We believe there is still a lot of room for Cosan to implement its consolidation strategy in the Brazilian sugar and ethanol market, since currently there are more than 300 different sugar producers in the country, most of which are less-efficient and less-capitalized players. Furthermore, we still see no reason for sugar prices to remain below the $0.12/pound level for a sustainable period. Our long-term model for a sugar plant in Brazil suggests a minimum price of around $0.115 cents/pound to remunerate invested capital. We also highlight that although we have seen several articles mentioning the risk posed by production expansion in India, the country runs at a production cost of $0.13/pound, above current market prices.

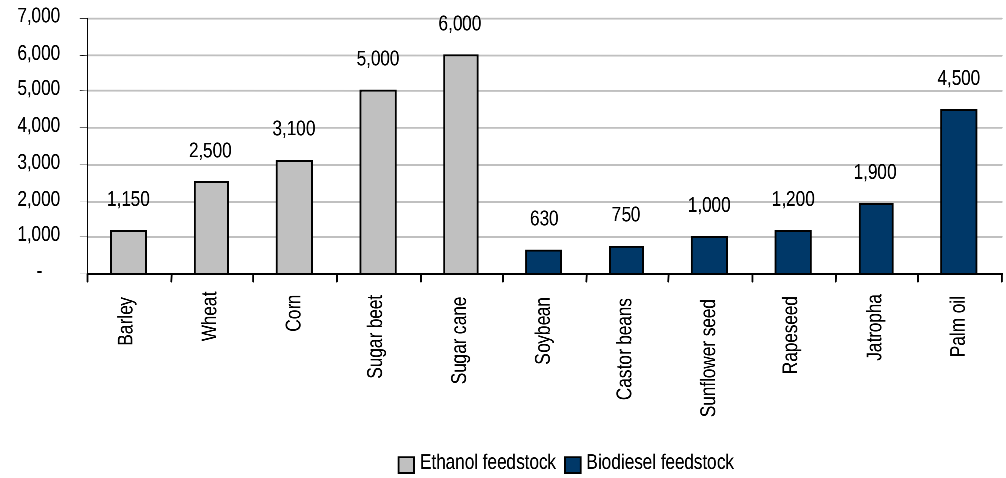
Therefore, we reinforce our OUTPERFORM rating and R$55/share target price on Cosan, yielding 42% upside potential from present levels. According to our estimates, the stock is trading at 8.9 times our 2007E EV/EBITDA and 2007E P/E of 19.2x, in-line with its international peers despite higher earnings growth.

European Ethanol a More Marginal Business

The main difference between European, U.S. and Brazilian ethanol lies in the feedstock. In Brazil, the feedstock is predominantly sugar cane, in the U.S. is it corn, and in Europe it is wheat or rye. European feedstocks are considerably more expensive, with lower yields per acre and E.U. crop price supports. Energy costs, which are a meaningful percentage of the overall cost of ethanol production, are also higher in Europe.

Offsetting these economic disadvantages for European ethanol is a €0.192 per liter ($0.55 per gallon) import tariff on ethanol, originally designed to offer protection to domestic E.U. *alcohol* producers, though it benefits the ethanol industry as well.

Exhibit 124: Comparison of Yields Among Different Feedstock
in liters per hectare

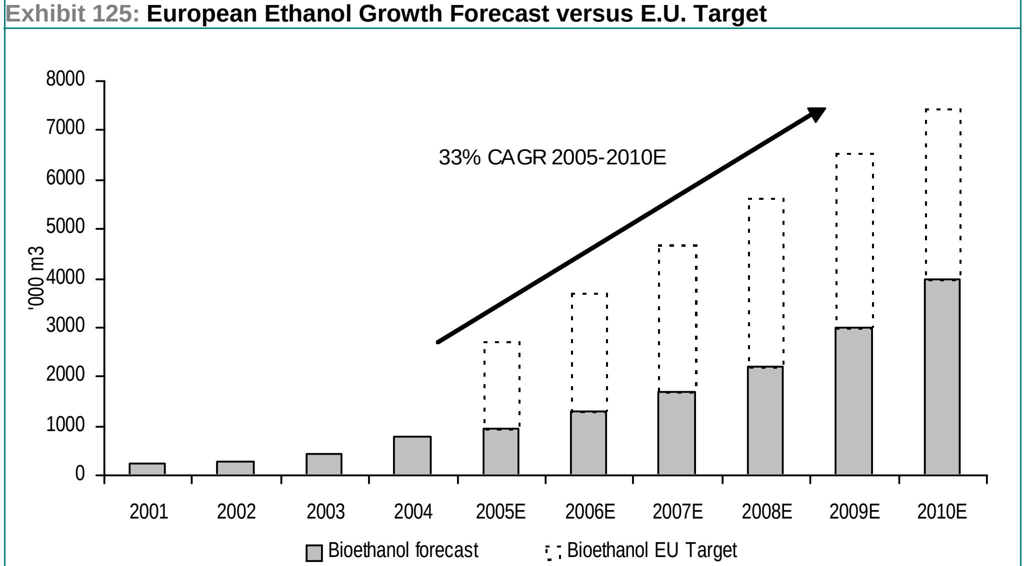


Source: International Federation of Agriculture Producers.

Equally as important as the feedstock price disadvantage is the lack of a natural market for ethanol in Europe. Declining consumption of gasoline in Europe and a rising need to export the conventional gasoline surplus have made oil companies resistant to including ethanol in their sales mix. We do not think this is likely to change in the near future. If European ethanol production is to reach anything close to the E.U.'s targets, more concrete policy or legislation will be needed.

For example, ethanol could help replace MTBE as a gasoline-blending component should MTBE be phased out as it has been in the U.S.

Exhibit 125: European Ethanol Growth Forecast versus E.U. Target



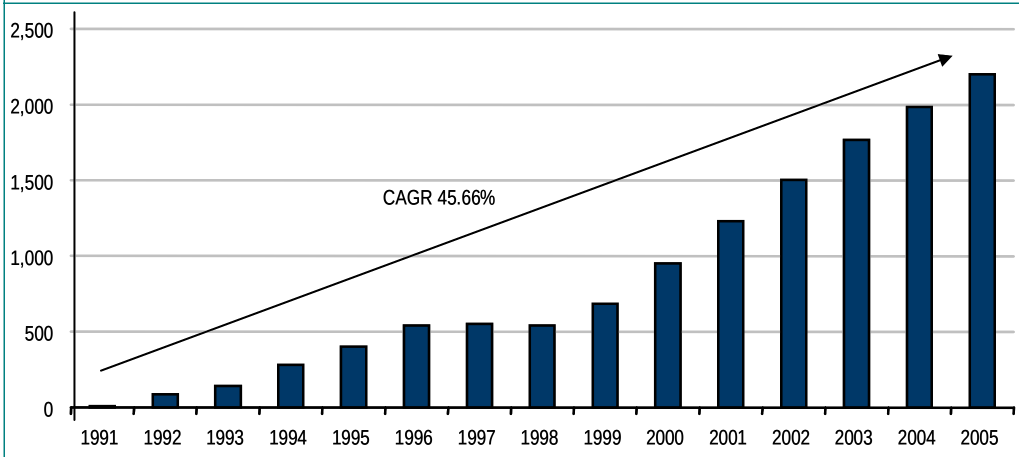
Source: Frost & Sullivan.

Biodiesel

Biodiesel is a car-ready alternative diesel fuel made by the reaction of vegetable (or animal) fats with alcohol to produce *fatty acid alkyl ester,* with glycerine as a by-product. On average, 100 pounds of most feedstock oils or fats plus 10 pounds of methanol will produce 100 pounds of biodiesel and 10 pounds of glycerin.

Commercial production of biodiesel did not begin until the late 1990s, many decades after the world's first ethanol plants entered service. Since then the biodiesel market has grown rapidly. Worldwatch Institute has reported that global production of biodiesel increased from 11.4 million liters (less than one thousand barrels of oil equivalent per day) in 1991 to 2,200 million liters in 2005, a CAGR of 46%.

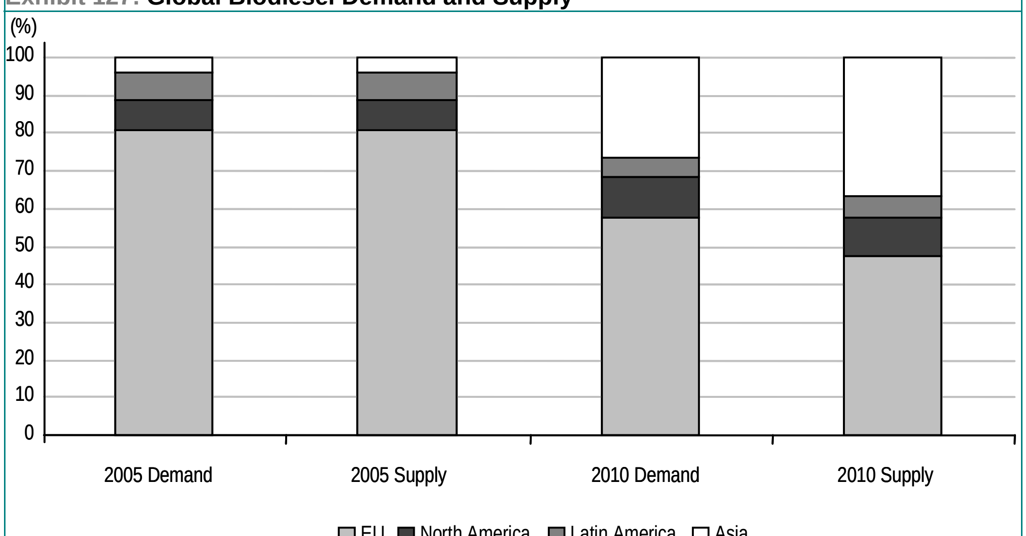
Exhibit 126: Global Biodiesel Production
in million liters



Source: Worldwatch Institute, Credit Suisse research.

Europe currently dominates the global biodiesel market, with 80% of supply and demand, but we expect a gradual globalization of this biofuel, with strong growth expected in China and India, in particular.

Exhibit 127: Global Biodiesel Demand and Supply



Source: Company data, Credit Suisse estimates.

Biodiesel is typically sold as a blend with conventional diesel in Europe, as B5 (5% biodiesel), B10 (10% biodiesel), and so on.

Relative to conventional fossil diesel, biodiesel exhibits much lower emissions and meets the requirements of European fuel standards II and III. It can be operated in any diesel engine with little or no modification. However, engine manufacturers currently provide warranties only for engines that run on a 5% blend (B5).

Unlike refineries, which require a considerable planning approval process and construction time, biodiesel plants are relatively quick to build. Industry examples suggest a construction time of around 12 months for biodiesel, with around one month for start-up. This compares with ethanol plants that typically take 18 months to construct and 4 months to reach full utilization.

High returns on capital are available for existing producers in the European market, while payback on new projects is around two to three years. These returns should fade over time, we believe.

We believe the key drivers of returns in the biodiesel industry are:

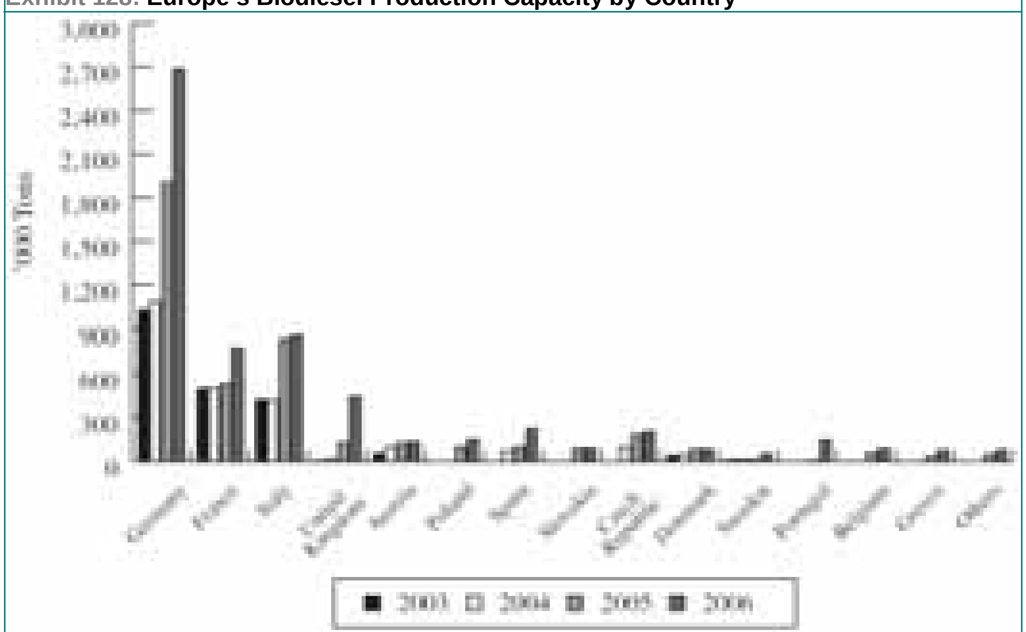
- the level of the oil price;
- the level of government support/subsidy;
- the supply/demand for diesel (including biodiesel); and
- the input price of the feedstock.

Although new entrants are eventually likely to compete away the current high returns, the combination of strong growth and attractive returns is available for the first movers.

European Biodiesel

Europe is currently the largest biodiesel market in the world and looks set for considerable growth into the next decade. The European biodiesel industry is dominated by Germany (the largest biodiesel producer in the world), with France and Italy in second and third place, respectively, and everyone else a long way behind.

Exhibit 128: **Europe's Biodiesel Production Capacity by Country**

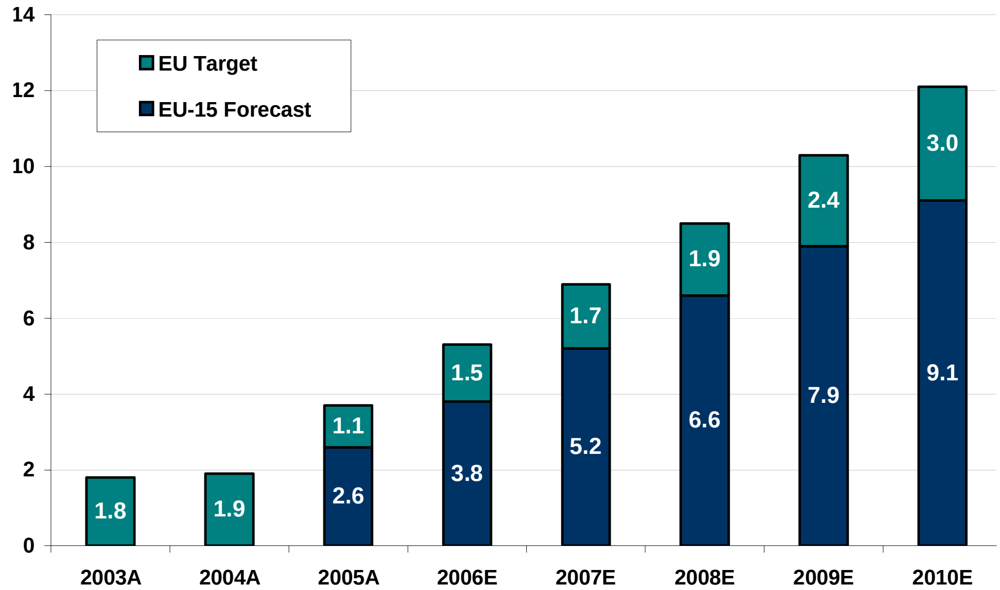


Source: Frost & Sullivan, Credit Suisse research.

In a bid to reduce greenhouse gas emissions and promote the general "greening" of the energy mix, the E.U. is promoting the use of biofuels via various directives.

Under the 2003 E.U. Biofuels Directive, by the end of 2010 5.75% of energy content of all gasoline and diesel used for transport purposes must originate from renewable sources. Some E.U. countries have said they are considering mandating up to a 10% blend of biodiesel by 2015; Germany, for example, is aiming for 8% by 2012.

Exhibit 129: **E.U. Biofuel Targets**



Source: European Commission, Credit Suisse estimates.

Full achievement of the E.U.-wide 5.75% target would imply biodiesel consumption of around 11-12 million tonnes per annum or 70-85,000 barrels of oil per day by 2010. If one assumes that European consumption breaks down in accordance with the E.U.'s directive (a big "if"), then consumption by France, Germany, Spain, Italy, and the U.K. would represent around 70% of Europe's total biodiesel market in both 2006 and 2010.

Are the European Biofuels Targets Sensible?

The principal E.U. regulation governing biodiesel is Directive 2003/30, which sets a general target of 5.75% market share by energy content for biofuels by 2010. However, the industry's trade association, European Biodiesel Board (EBB), has identified a number of obstacles to the achievement of this goal:

- *E.U. legislation has not been harmonized in national legislation.* This has led to the absence of a pan-European internal market for biofuels.
- *5% limit.* The fact that only 5% biodiesel by volume can be blended into conventional diesel without voiding vehicle engine warranties is an obvious constraint on reaching the E.U. directive target of 5.75% market share by energy (equivalent to 6.5% on a volume basis).
- *Consistent pan-European vehicle warranties.* The fact that vehicle and engine warranties with respect to the use of biofuels are inconsistent across various European countries is limiting the take-up of higher biodiesel blends.
- *The perceived reluctance of the Oil Majors to promote biofuels*, which compete with their existing refinery output, particularly ethanol. While certainly true of ethanol, which competes with a product (gasoline) already in surplus in Europe, the attitude of the Oil Majors to biodiesel is neither negative nor entrenched, we think.

Despite these existing barriers, the EBB is already lobbying for the Europeans to adopt a more aggressive target of 8% by 2015, and some countries have said they are considering 10% (e.g., Poland).

The E.U. Biofuels Directive has prompted governments to introduce varying degrees of tax exemptions for biofuels. (See Exhibit 130.) This means that returns on new capacity investment are currently very country specific. Other factors such as logistical integration with suppliers and customers and energy costs are also important to European biofuel economics.

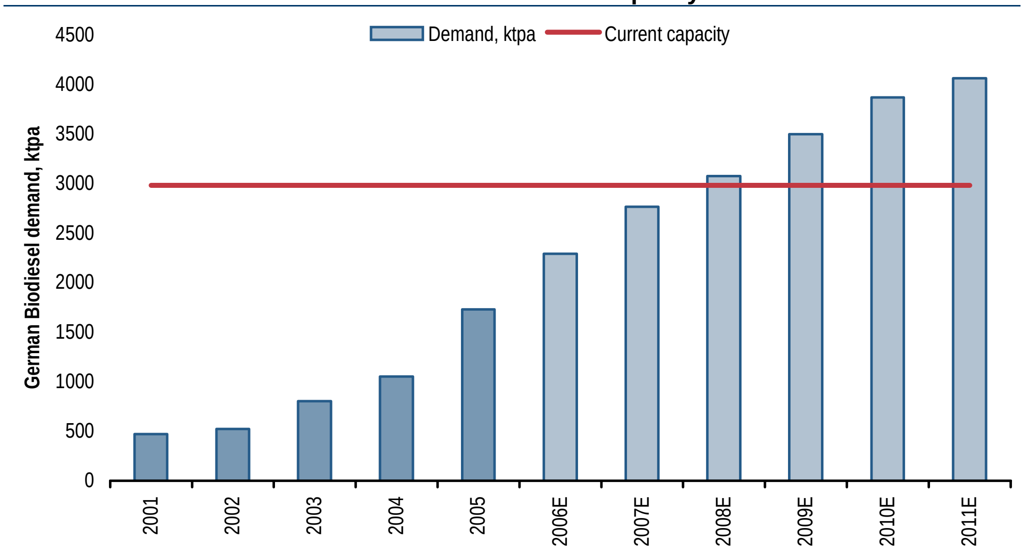
Exhibit 130: European Biofuel Legislation Snapshot

Country	Tax regimes	Blending Targets
Austria	Full exemption for pure biodiesel and blends up to 2%	2.5% April 2005, 4.3% April 2007, 5.75% April 2008
Belgium	Discussions to introduce full exemption underway	
Denmark	No measures currently in place	Some local opposition
Finland	No measures currently in place	Mainly ethanol, target only 0.1% biofuels due to high local crop costs
France	Tax exemption formula depends on price of oil vs. rapeseed	2% target in 2005, quota will likely rise with domestic production levels
Germany	Tax subsidies will be slowly reduced by 2012	4.4% biodiesel, 1.2% ethanol from January 2007
Greece	No measures currently in place	
Ireland	Looking at quota of 8m liters (7 kt) biofuels tax exemption	
Italy	Full exemption up to a quota of 300 kt. Pure biodiesel used for heating (rather than transport) can also qualify	Quota system
Netherlands	Discussions to introduce full exemption underway	Discussions underway on target of 2%
Portugal	Discussions underway on incentives for up to 1% fuel consumption	Limited local feedstock limits enthusiasm
Poland	€0.37/litre for 2–5% biofuels component	Discussing 10% blends in longer term
Spain	Zero duty, depending on the spread between feedstock costs and mineral oil prices	3% ethanol use already, limited biodiesel crop availability
Sweden	80% tax break for E85 fuelled cars	Mainly ethanol, partly due to cold climate properties of biodiesel
UK	Exemption of £0.20 per liter on ethanol and biodiesel	Low % volume target—0.7% diesel sales in 2005. Mineral diesel tax is already highest in EU

Source: Company data, Credit Suisse estimates.

The future of European biodiesel is underpinned by the rising shortage of domestic conventional diesel. However, given the relatively high break-even oil price ($80/bbl) and the lack of a realistic coordinated policy approach, we think the industry's progress is likely to occur in fits and starts. There is even risk of oversupply in local markets such as Germany.

Exhibit 131: German Biodiesel Demand and Current Capacity



Source: EBB, Credit Suisse estimates.

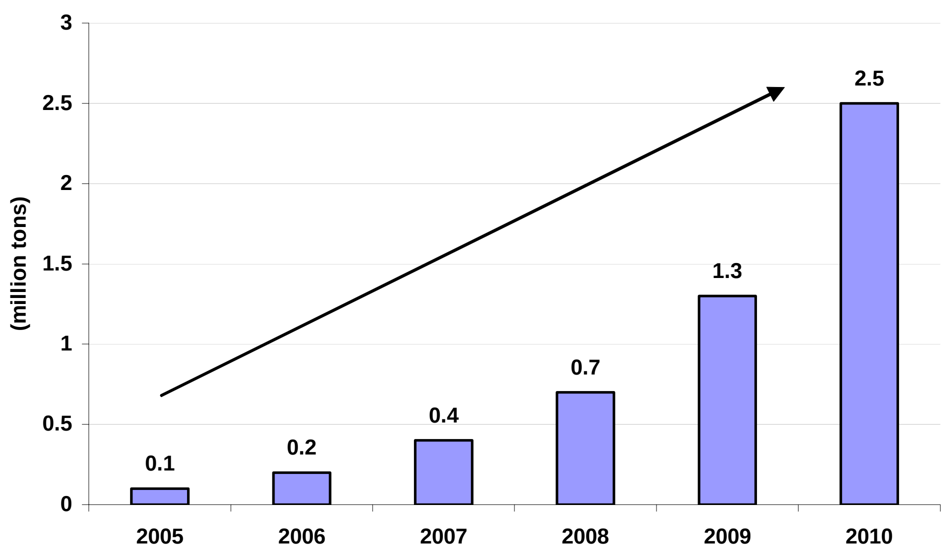
Asian Biodiesel

There are obvious benefits to Asia from a push into biodiesel, mainly in the strong end-user diesel markets of China and India, and there are indirect beneficiaries too, such as the Malaysian palm oil producers that are benefiting from rising palm oil prices and increased demand for their product.

Asia currently consumes more than 2 billion tonnes of fossil oil per year (40 million barrels of oil per day), and consumption could double again by 2025. Certain Asian countries are facing rapidly worsening air pollution and greater reliance on imported oil. This is particularly true for Asia's two largest countries: China and India.

The recent increase in oil prices has spurred a boom in Asian biofuels production. Bio-era estimates that Asia's biodiesel demand will increase from 100,000 tonnes (2,000 barrels of oil per day) in 2005 to 2.5 million tonnes (50,000 barrels per day) by 2010, representing a CAGR of more than 90%. These numbers do not appear to take into account recent developments in the Chinese biodiesel market, however, and are therefore likely to be too low.

Exhibit 132: **Asia's Demand for Biodiesel**



Source: Bio-era.

China

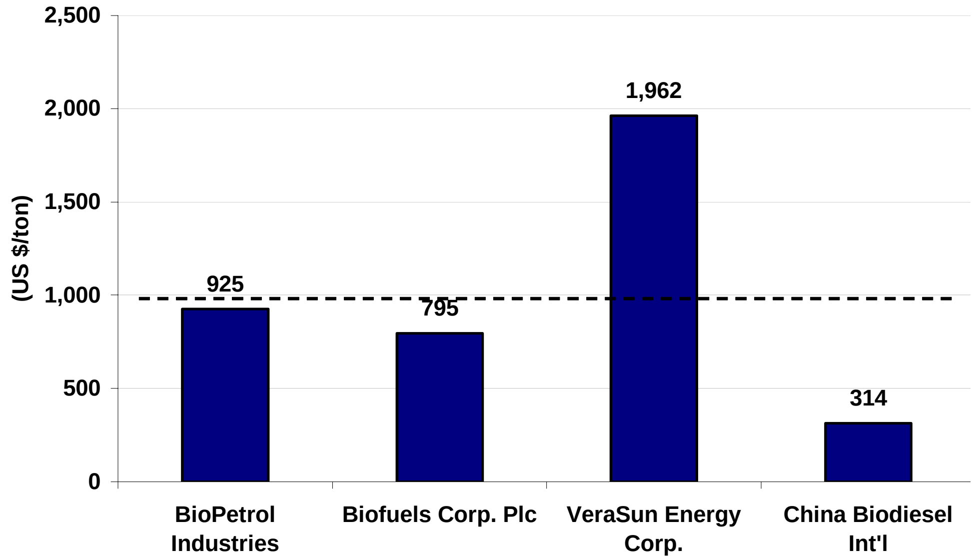
On July 24, 2006, Zhu Zhigang, vice minister of China Ministry of Finance, said that China was formulating a mid-/long-term development plan for biomass energy. He mentioned that the government was aiming for the consumption of biomass energy to account for 20% of oil consumption by 2020. Specifically, the government hopes the liquid biofuels capacity can reach 20 million tonnes/year by 2020, of which bio-ethanol should reach 15 million tonnes/year and biodiesel should reach 5 million tonnes/year.

The newly established Renewable Energy Promotion Law and, since February 2005, the CO_2-emissions trading system, are thought to stimulate the introduction of liquid biofuel in the transport sector. Since January 2005, in order to share less fossil fuel among more vehicles, the Chinese automobile efficiency standard defines that all new cars must adhere to limitations on their fuel consumption ranging from a maximum of 6.2 liters per 100 kilometers for small vehicles to 15.5 liters per 100 kilometers for small trucks.

We estimate China's 2006 biodiesel production capacity to have been around 600,000 tonnes per annum (11.5 thousand barrels per day) and this is expected to grow to 1.8 million tonnes per annum (34.5 thousand barrels per day) by 2010. While these are tiny numbers in the context of the Chinese oil market, the growth is nonetheless impressive.

Unlike the U.S., Europe and Brazil, China has very limited cultivable agricultural land available, and it requires almost all of this for food production. However, China is one of the largest *consumers* of cooking and vegetable oils, and this is likely to provide the main feedstock for the development of the Chinese biodiesel industry.

Exhibit 133: Unit Total Cost Comparison, 2005



Note: The unit total cost for VeraSun is for ethanol production, unit total cost = (COGS + operating expense)/production volume.
Source: Company data, Credit Suisse research.

Recycled cooking oil is a very low-cost feedstock compared with traditional biodiesel inputs (rape seed oil, palm oil), and this currently allows Chinese biodiesel producers to enjoy margins of 30-40%, before considering government subsidies. The cost of feedstock in Europe accounts for 80% of the value of the end product, while in China this is more like 40-60%.

This margin advantage should support the further rollout of biodiesel into the Chinese market. In fact, China is the only major biodiesel manufacturing country where biodiesel (from waste cooking oil) represents a cheaper alternative than conventional fossil diesel.

The barriers to further expansion of the Chinese biodiesel market include the absence of national quality standards, but the industry's entry barriers are low and we expect capital investment in Chinese biodiesel for some years to come.

Most biodiesel producers in China are currently privately owned. Of the major Chinese oil companies, only Sinopec has a pilot plant with 2,000 tonnes per year of capacity. The parent company of CNOOC Ltd. (China's offshore oil producer) has signed an agreement with a private Malaysian research company, Bio Sweet, to develop a 120,000-tonnes-per-year joint-venture biodiesel plant on Hainan Island. CNOOC has also indicated its interest in pursuing further biodiesel opportunities around China.

Some Chinese provincial governments have set up so-called gasohol offices to promote high blends of ethanol in gasoline. Local governments, state-owned enterprises, and other governmental organizations use gasohol as a transport fuel, further steps of the strategy to phase out pure gasoline until mandatory E10 can be supplied for the whole country at some point in the future.

India

India's current biodiesel policy provides for the purchase of biodiesel by oil marketing companies at a reasonable price from some 20 purchase centers in 12 states.

The short-term target is to introduce a 5% biodiesel blending into fossil diesel, with the aim of increasing this to 20% by 2020 (although this seems very ambitious to us). A 5% blending would represent 2.5 million tonnes (48 mbd) of demand for biodiesel, whereas a 20% blend would represent 16 million tonnes (306 mbd).

There are many biodiesel initiatives under way, but most are at the field trial/study stage. These include field trials of biodiesel by vehicle manufacturing companies and Indian Oil Corporation's (IOC) trials of biodiesel on bus fleets in Haryana and Mumbai. IOC is also conducting trials on railways with biodiesel.

Studies of biodiesel blends of up to 20% are being conducted to analyze the feasibility of biodiesel as an automotive fuel. Furthermore, specifications for biodiesel (B20) have been drafted by the Bureau of Indian Standards (BIS) and circulated to all stakeholders for comments, and are likely to be finalized soon.

ON the supply side, Indian biodiesel feedstock plantations are under consideration by companies and by the government.

India exhibits significant potential for jatropha cultivation, a crop that requires minimal attention and can easily be intercropped. A U.K. company, D1 Oils, estimates that around 20 million hectares of India's 60 million hectares of waste and marginal land currently lying barren or underutilized could be used for jatropha cultivation.

D1 Oils has formed a joint venture with Mohan Breweries and Distilleries, and has begun large-scale jatropha cultivation in Tamil Nadu, Andhra Pradesh, and Chattisgarh.

In February 2006, Southern Online Biotechnologies, a Hyderabad-based company, began a 10,000-tonnes-per-year biodiesel project in Chautupal, Nalgonda district, Andhra, Pradesh, with technology provided by Lurgi of Germany.

The Philippines

The Philippines Department of Energy (DOE) has mandated the use of 1% coconut-based biodiesel in all government diesel vehicles. The DOE also plans to implement a 5% biodiesel blend nationwide at some point.

Tax exemptions will also be extended to pioneers in biodiesel production and for the purchase of related foreign capital equipment. In addition, fiscal and nonfiscal incentives are envisaged alongside high priority for financial assistance.

A Biofuels Bill is also being debated currently in the Philippines senate. This mandates the a 5% minimum ethanol blending with gasoline (E5) by 2008 , which would require 220 million liters per year of ethanol, rising to an E10 blend by 2010, which would require 480 million liters.

Thailand

Thailand aims to make a 10% biodiesel blend available by 2012. Ethanol blended at 10% in gasoline (E10) is currently available at more than 4,000 retail stations in Thailand. A 10% ethanol blend for gasoline has been mandated from 2007, with a ban on MTBE imports. Higher blends are expected (E20 and E85) once domestic ethanol production increases sufficiently.

Korea

South Korea has no domestic oil reserves and is the world's seventh largest oil consumer and fifth largest importer of crude oil, with one of the world's largest domestic conventional refining industries relative to the size of the domestic market.

B0.5 biodiesel for private vehicles has been on sale in Korea since July 1, 2006. The low percentage of blending (Europe is at 5% biofuel-blended diesel) appears to be a compromise between the conventional refiners and the government.

There is currently a lack of adequate local supply of vegetable oil, the raw material used in biodiesel production, and a lack of preparedness by the South Korean automotive industry.

Nevertheless, the government still claims that it wants conventional refiners to implement a B20 blend in two years' time, although this appears unfeasible today.

In a bid to encourage the use of biodiesel, the government has offered fiscal benefits, but due to the meager percentage of blending, the price of biodiesel is only W2/liter lower than that of conventional diesel.

Japan

There are currently no proposals on the table regarding the use of biodiesel in Japan.

There have been various schemes proposed to increase the use of ethanol, but the availability and stability of biofuel supply has been a major problem in Japan. In May 2005, Japan signed a $578 million loan agreement with Brazil to finance infrastructure, which should result in increased exports of ethanol to Japan.

In order to encourage the uptake of ethanol, the Japanese government proposed an E3 standard in 2004 as a prelude to a national E10 blend standard by 2010. The E3 initiative began in April 2005. However, due to insufficient of ethanol supply, the scheme failed. The Ministry of Economy, Trade, and Industry plans to sell the biofuel at special gas stations in 2008, and it estimates that by 2010 around 10% of gasoline in Japan will be blended with ethanol, but supply concerns remain.

Asian Biodiesel—the Palm Oil Feedstock Angle

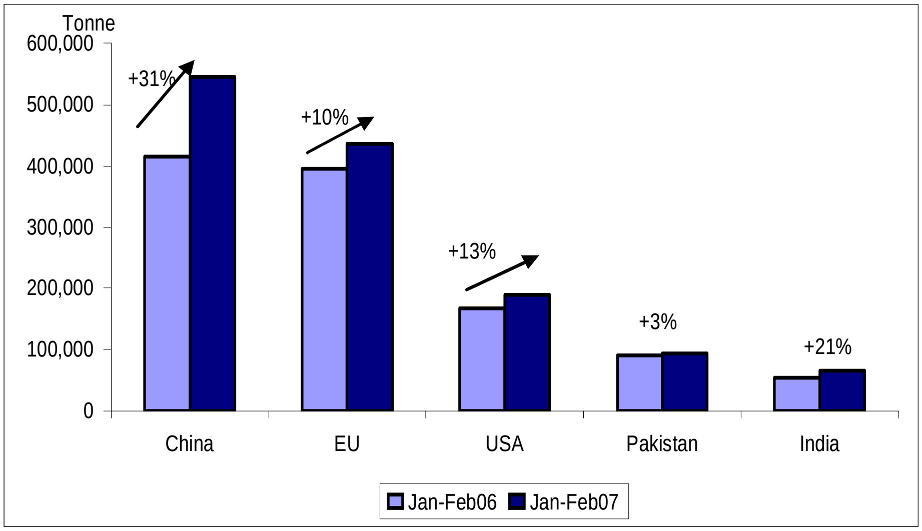
In Asia there is more than one way of playing the emerging biodiesel business. One of the standard feedstocks expected to be used for biodiesel production in the future is palm oil, the production of which is concentrated in plantations in Malaysia and Indonesia.

Malaysia

The outlook for palm oil plantations in Malaysia remains relatively strong, and the political background somewhat benign, meaning that the sector is essentially a play on the increasing demand worldwide for fuel crops. Malaysian palm oil is likely to form a good part of the feedstock for emerging biodiesel industries in Asia, in Europe, and on the West Coast of the U.S.

In addition, as demand for U.S. corn has been rising very quickly, pushing up corn prices, it is likely that in 2007 and 2008 U.S. farmers will shift production from soybeans to corn. This will leave palm oil in a relatively good position, as soybean oil competes with palm oil both for food and nonfood (biodiesel) uses.

Exhibit 134: Malaysian Palm Oil Exports



Source: Company data, Credit Suisse estimates.

Exports of Malaysian palm oil have increased significantly in early 2007 versus early 2006, particularly to China, and we expect that capacity expansion plans by plantations will be absorbed by rising global production of biodiesel in the coming three to five years.

Malaysia is in the midst of reformulating its domestic biofuel policy and is likely to launch Envo B5, (a blend of 5% refined olein and 95% mineral diesel) in late 2007, delayed from the original plan of early 2007.

Four Malaysian government ministries are currently testing the Envo B5 blend. In Miri, Sarawak, three bus companies have volunteered for the trial, allowing their buses to use this B5 bio-fuel. If the Malaysian government were to commercialize B5 fully for domestic use, we estimate that some 0.5 million tonnes of palm oil would be used as biofuel in Malaysia.

Indonesia

The outlook for the Indonesian palm oil plantation sector is less certain, mainly due to the changeable political background.

Mari Pangestu, Indonesian trade minister, has stated that the country is looking for ways to increase the downstream value-added and processing of raw materials including palm oil. “Banning raw material exports is one instrument, but there are many other instruments. You could use incentives,” said the minister recently.

Indonesia’s broader energy plans drawn up by the Ministry of Energy and Mineral Resources (MESDM) calls for a 2% biofuel mix in 2005-10, or an estimated annual domestic usage of 720,000 kiloliters, rising to 3% in 2011-15 (1.5 million kiloliters/) and 5% in 2016-25 (4.7 million kl).

Besides the tax breaks, the Indonesian government has required Rp100 per tonne to be invested in various feedstocks in order to develop this biofuel energy. Around Rp30 million/hectare is estimated to be invested in palm oil plantations and Rp3 million/ hectare in Jatropha, an alternative bio fuel source.

In the meantime, the minister for state-owned enterprises, Sugiharto, said that state-owned banks are able to extend Rp24 tonne of credit from the Rp100 tonne expected to be extended by commercial banks for the development of biofuel, especially for investment in palm oil plantations. Moreover, the government is looking to revoke 213 plantation licences where logging has taken place but no effort to do any replanting has been initiated.

Genting from Malaysia has expressed interest in investing in 1 million hectares of oil palm and Jatropha plantations, while some Chinese investors are looking to invest in 0.5-1 million hectares of sugar cane and cassava plantations. Of the 17 licences approved for biodiesel plant development, 12 are held by foreign investors.

To encourage domestic demand for biofuels, the government is imposing a requirement on Pertamina and PLN to be the standby offtaker of 21.5 million kiloliters biofuel of the expected 23.432 million kiloliters produced by 2010. The move is intended to curb the nation's reliance on imported oil.

As for ethanol, the National Energy Planning is targeting for consumption to reach 550 million liters, 850 million liters and 1,500 million liters in 2010, 2015, and 2020, respectively. Further details are limited.

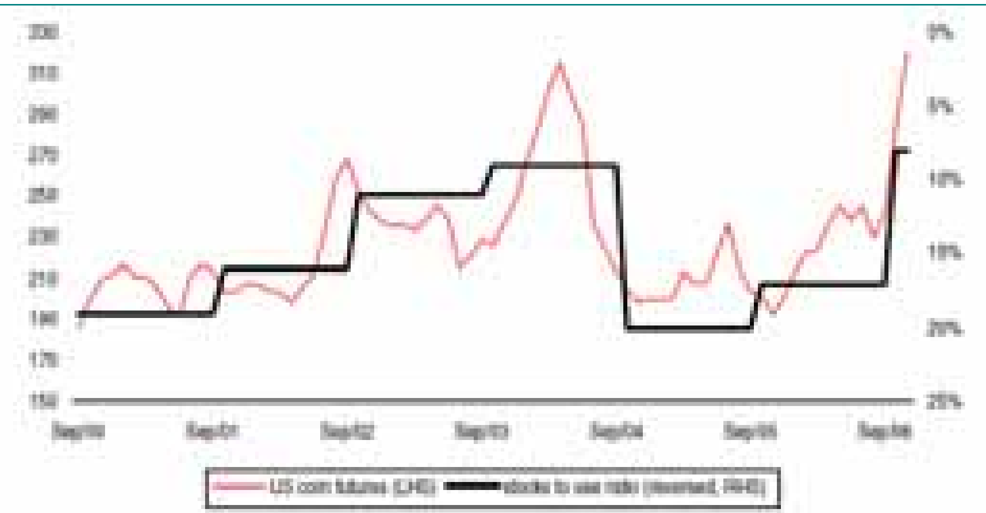
Press reports, including those in TEMPO and Bloomberg, indicate that the Indonesian government has formed a committee of representatives from the ministries of trade, agriculture, industry, and finance as well as the Investment Coordinating Board (BKPM) to formulate a policy with respect to the palm oil industry. With the Minister for Industry having already voiced his support for favoring the downstream industry, the trade minister's comments could lend more weight to prioritizing *domestic* industry requirements over exports, something that would not be positive news for Indonesian palm oil plantations, we believe.

The Crop Conundrum: Biofuels Push Up Crop Prices

The prices of the main agricultural commodities used in biofuels (corn, rape seed oil, sugar cane) have all increased significantly in recent months, highlighting an important and growing interconnect between the oil market and the agricultural markets.

If we add new demand from biofuels to coincidental bad global harvests in many crops, the stage is set for several "interesting" years in global food prices.

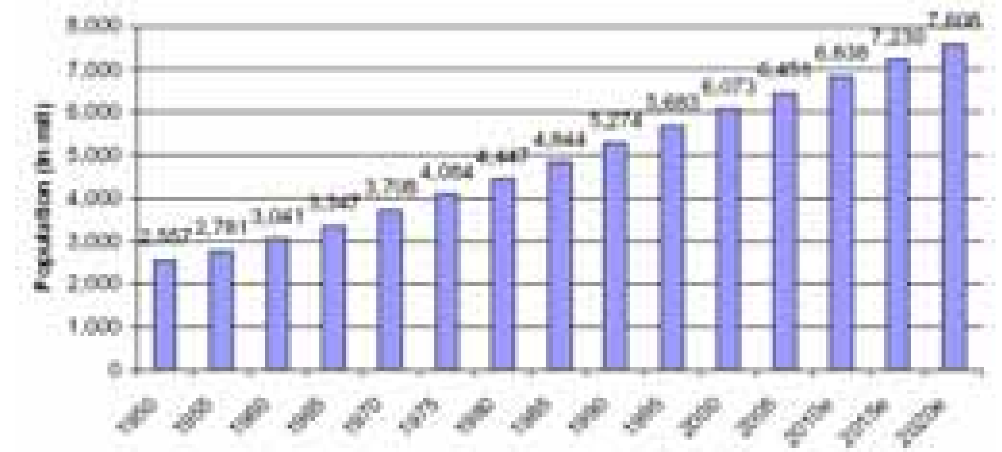
Exhibit 135: U.S. Corn Futures and Stocks-to-Use Ratio



Source: USDA, Reuters.

We believe that annual crop demand growth for food will continue near the 2.3% level (grain growing near 2%, oilseeds near 4%), as economic growth offsets lower population growth. This equates to about 40 million tons of grain and 16 million tons of oilseeds per year.

Exhibit 136: World Food Needs to Continue to Grow
world population in millions



Source: U.S. Census Bureau.

The emergence of biofuels is set to accelerate demand for crops from these historical growth levels. For example, U.S. ethanol is driving corn demand up by about 550 million bushels, or about 14 million tons per year, and we estimate that a growing biodiesel industry could accelerate demand for oilseeds by 3-6 million bushels per year.

Total crop demand including biofuels looks set to rise by just over 3% per annum, putting strain on the global agricultural business.

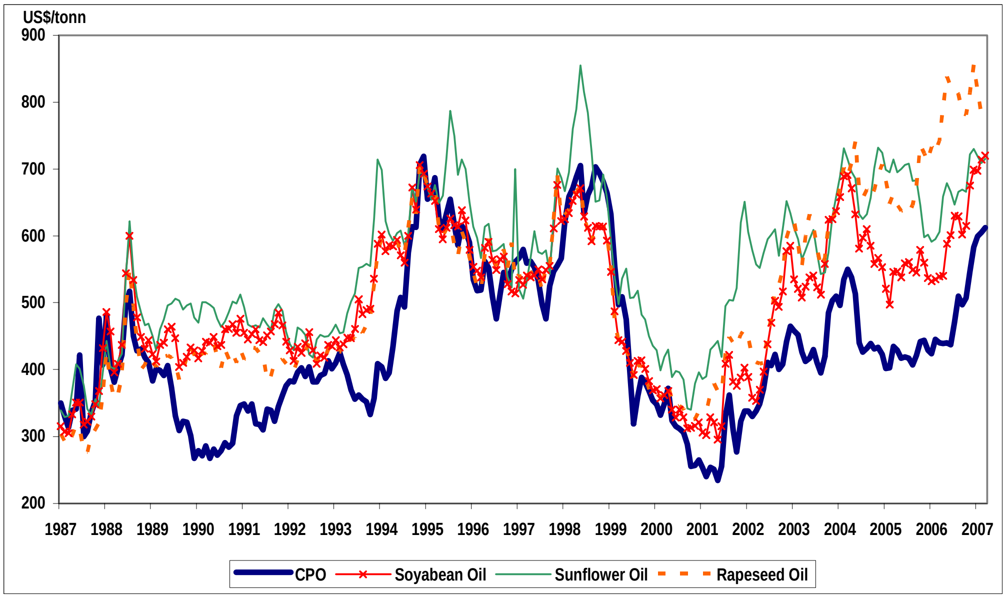
On the supply side, production yields continue to improve as technology advances, and global productivity can grow faster than technological advances as existing technology spreads to developing countries.

Vegetable Oil Prices Are Also Rising

The primary component of biodiesel is vegetable oil feedstock. A study commissioned by Piedmont Biofuels estimated that the cost of feedstock can reach up to 90% of total biodiesel production costs, and typically accounts for 80%, in the European market at least. European feedstock is typically rapeseed oil or soybean oil, though cheaper palm oil is also possible in theory.

Exhibit 137: **Raw Material Cost Comparison**

€ per ton



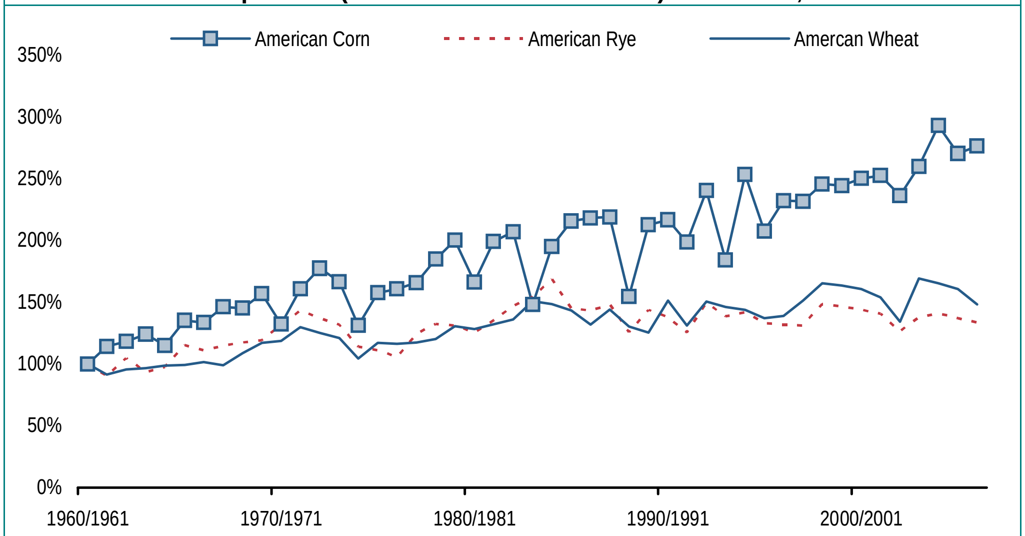
Source: Reuters.

Just as rising ethanol capacity is pushing up demand for U.S. corn, biodiesel demand for these edible oils is likely to underpin strong prices for several years to come.

Crop Yields Should Continue to Rise

Crop yields have been rising over time in the United States. Crop yields are higher in the U.S. than elsewhere (partly a function of climate but also due to technological innovation, we think). Higher land use and yields combined should allow incremental grain output over time. Biofuel profitability will depend on relative capacity constraints in land use, biofuel conversion capacity, and oil production capacity.

Exhibit 138: **U.S. Crop Yields (Production/Area Harvested) Since 1960, Rebased**



Source: USDA.

For further useful analysis please see *Crop Conundrum* by Credit Suisse food analyst, David Nelson, published on November 2, 2006.

There Is Land in Europe (and the U.S.) to Bring Back into Cultivation

We could also see some alterations in land use, particularly in Europe where 20% of cultivable arable land is currently designated for "set-aside," i.e., is left deliberately fallow in order to support European agricultural commodity prices. This amount is forecast by the European Commission to rise by 11.2% by 2013.

However, some of the land classified as set-aside is for growing nonfood oil seeds (for biodiesel feedstock). Adjusting for this, we estimate that the amount of set-aside land would fall to 8.9% in 2006 and to 10.1% in 2013.

Not all this land will be employed to grow crops in the future. However, we expect that high crop prices (if sustained) would attract some of the land that is currently in voluntary set-aside to enter production. Current estimates by the European Commission state the amount of voluntary set-aside to be 3.2 million hectares (equivalent to 5.0% of arable land currently used). Should half of this land be planted in the long term, it would produce an extra 4.4 million tonnes of wheat or 8.4 million tonnes of rye, enough to supply around 3.0 million liters of ethanol (versus current productive capacity of around 1 million liters).

Exhibit 139: Additional Crop Available for Varying Restart of Voluntary Set-Aside, 2013E
in million tonnes

Crop	25%	50%	75%	100%
Corn	6.3	12.6	19	25.3
Wheat	2.2	4.4	6.6	8.8
Rye	4.2	8.4	12.5	16.7

Source: European Commission, USDA .

Some Things to Watch for as Biofuels Consume More Food

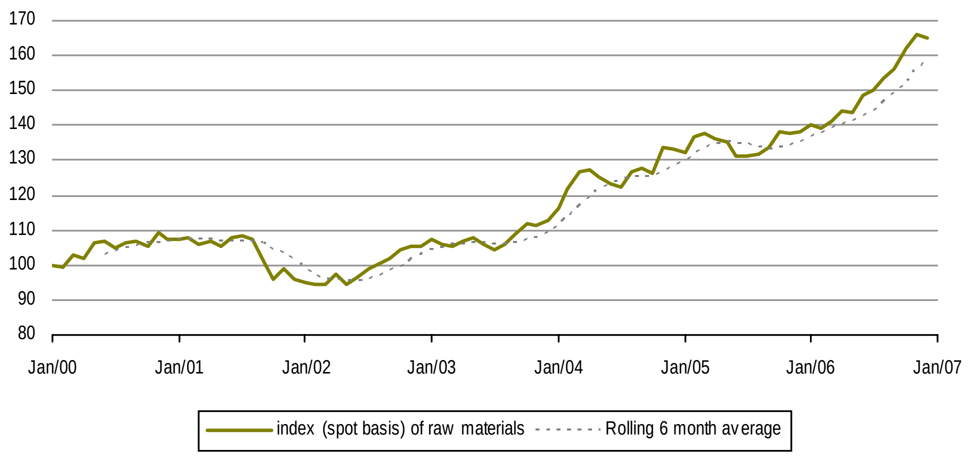
- The big near-term risk is that of a crop-supply shortfall, such as could be brought on by a multiyear drought, during the period when crop supply is racing to catch up with structurally higher demand growth. We believe crop prices will not only be materially higher for the foreseeable future, but much more volatile.
- Meaningfully higher crop prices—particularly for an extended period of time—could reduce the public's enthusiasm for biofuels if it leads to food price inflation, which it is likely to do.
- The lower fuel efficiency of ethanol compared to conventional gasoline is another area of possible consumer reaction against biofuels. Ethanol is 25% less efficient than gasoline (in miles per gallon) and biodiesel is 5% less efficient than fossil diesel.
- A longer-term risk comes from the environmental impact of putting much more land into crop production. There are costs or implications to everything. Right now, the public is not weighing any cost on the environment, but eventually, it may.

Biofuels' Negative Impact on the Food Industry

Grain forms the primary raw material in the food industry: 60% of the cost of raising meat is the feed cost, 75% of the cost of flour is wheat, etc.

The increased U.S. demand for corn to make ethanol is encouraging farmers to switch from other crops (e.g., soya) to grains. As a result, while corn prices have risen sharply, so too have the prices of other crops. This has brought unprecedented input cost inflation to the food processing industry. Agri-product prices have also risen substantially, and so too have packaging costs (PET, paper, board, tin, aluminum).

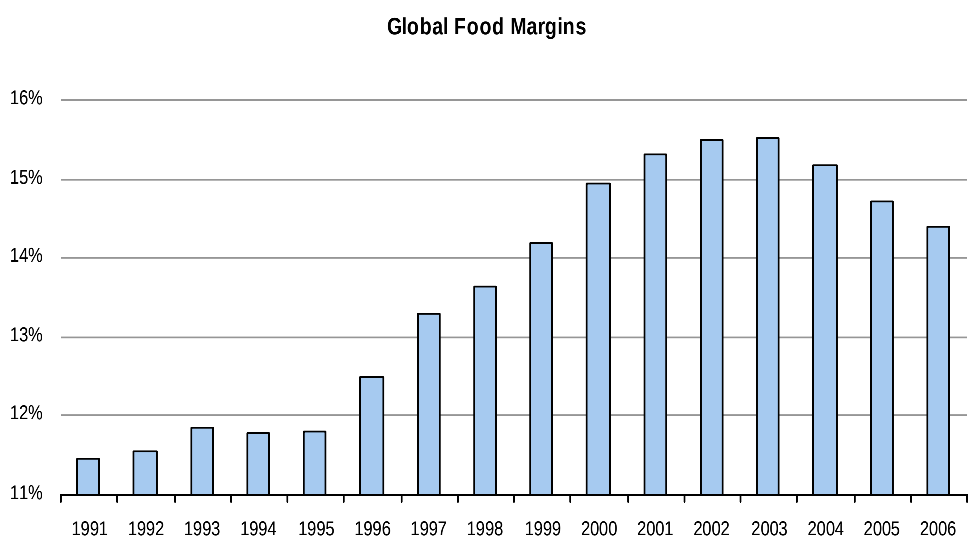
Exhibit 140: Index of All Raw Material Costs for the Food Processing Industry



Source: Credit Suisse Food Team.

This inflation has been more than industry margins can bear. After a decade of widening margins, we have seen global food margins go into reverse for the last three years, entirely the result of input cost inflation.

Exhibit 141: Global Food Processing Industry Margins



Source: Aggregated results of top 11 food companies.

The continuing trend toward greater incentives for biofuel uses of grain and vegetable oil versus food usage seems to suggest no immediate reversal of these input cost pressures.

The European paper industry is suffering from high energy costs as some pulp and papermaking processes are highly energy intense. However, an increasing amount of investments are now poured into more energy-efficient production processes and also into more efficient use of the residues from pulp and paper manufacturing (e.g., noncellulose wood material, bark) for energy recovery/electricity production.

While recovery boilers (where wood residues from the pulping process is burned and used chemicals are recovered for reuse) have been in use for a long time, new modern facilities are more efficient. High energy prices have prompted investments to install modern turbines to maximize generation of bio-fueled electricity. Following such investments, an energy efficient pulp mill is today net long electricity and in colder climes the low value steam that cannot be used for electricity generation can be sold (and is sold) to local municipalities for central heating purposes. Energy in the form of heat and electricity is developing into a significant revenue generator for chemical pulp mills.

UPM-Kymmene, Europe's second largest paper company, is at the forefront of energy investments and is planning to take its energy investments one step further. Not only does the company actively pursue investments to more efficiently use waste from its production processes as a source of energy, the company has also started a process with the aim to become a large-scale biodiesel producer with wood as the primary raw material. The company intends to develop bio-diesel as a separate, complementary business unit with the intention to locate bio-diesel plants adjacent to current pulp and paper operations. Not to cannibalize on its need for fiber for wood products and pulp and paper manufacturing, UPM plans to make more extensive use of logging residues, small wood, and stumps in its endeavor to explore biodiesel production. These additional wood sources are currently left in forests, as they have no use.

UPM sees biodiesel as a natural extension for a company whose core business is adding value to wood raw material. As a forest company, UPM has a strong role in the value chain; it owns forests; it has advanced wood procurement systems in place and has significant production of various end products, which generates wood residues suitable for energy production. In addition, logistics and infrastructure to and from its already existing production sites are well developed, minimizing investments in infrastructure when building up this new business line.

Our Favorite Biofuel and Derivative Stocks

With input costs rising due to the crop conundrum, we prefer lower-cost operators such as Cosan and Asian plantation stocks. For sentiment toward higher-cost OECD biofuel producers to improve, we would need a convincing agricultural supply response.

Cosan

Cosan is Brazil's largest sugar and ethanol producer and the second largest in the world, with 40.0 million tons of crushing capacity, representing roughly 10% of Brazil's milling capacity. Since 2000, the company has grown through several acquisitions, and we believe it is well positioned to continue to consolidate Brazil's sugar industry.

Recently, Cosan failed to acquire the second largest Brazilian sugar and ethanol producer (Vale do Rosario), which, in our view, could signal that competition for existing assets has increased. Moreover, recent news flow regarding Russia and India sugar production has been exerting downward pressure on sugar prices.

Despite the more challenging scenario, we think that the long-term investment case on Cosan remains positive. We believe there is still a lot of room for Cosan to implement its consolidation strategy in the Brazilian sugar and ethanol market, since currently there are more than 300 different sugar producers in the country, most of which are less efficient and less capitalized players. Furthermore, we still see no reason for sugar prices to remain below the US$0.12/pound level for a sustainable period. Our long-term model for a sugar plant in Brazil suggests a minimum price of around US$0.115/pound to remunerate invested capital. We also highlight that although we have seen several articles mentioning the risk posed by production expansion in India, the country runs at a production cost of US$0.13/pound, above current market prices.

Therefore, we reinforce our OUTPERFORM rating and R$55/share target price on Cosan, yielding 42% upside potential from present levels. According to our estimates, the stock is trading at 8.9 times our 2007E EV/EBITDA and 2007E P/E of 19.2x, in-line with its international peers despite higher earnings growth.

In the U.S. sector, we are generally cautious regarding prospects for the corn ethanol stocks, although share prices have generally corrected to a point where companies are trading closer to our estimate of fully built-out replacement cost, rather than at several multiples of replacement cost as they were during mid 2006.

We Remain Overweight the Malaysian Palm Oil Sector

Synergy Drive via Sime Darby and Golden Hope

Sime Darby and Golden Hope offer a natural "put" as their downside is protected by Synergy Drive's cash options of RM6.46 and RM5.46, respectively. As Synergy Drive is expected to derive more than half of its earnings from upstream plantations, it is a proxy to rising palm oil prices. Based on Synergy Drive's pro forma P&L, Sime Darby and Golden Hope are trading at P/Es of 12.4x and 12.3x, our 2008 estimates, respectively.

IOI Corp.

IOI Corp. is the best managed plantation company in Malaysia and has exemplary capital management (e.g., cancelling treasury shares, rising dividend payout, U.S.-dollar convertible bonds, privatizing undervalued subsidiaries) with a high ROE of about 20%. IOI Corp. has restarted its share buyback program, lending some support to the share price. Its 2008 P/E of 13.6 times is attractive versus a three-year earnings CAGR of 29%.

KLKepong

KLKepong is a beneficiary of rising palm oil prices, as 80% of its earnings are derived from upstream plantations (palm oil and rubber). KL Kepong has a young plantation, with some 20% immature, 19% categorized as young, and about 50% at prime age.

Wilmar

The enlarged Wilmar will be the largest refiner and trader of palm oil in the world. Following the merger with PPB Oil Palms Bhd., Wilmar's presence in China and India will strengthen, as it will control some 60% of China's imported palm oil market and 40-45% in India. China and India are not only very large importers of palm oil, their countries are also some of the fastest growing edible oil markets in the world.

XTL: Feedstocks-to-Liquids

Making Liquid Fuels from Other Feedstocks

Mark Flannery

Edward Westlake

XTL refers to the conversion of different feedstocks (X) to liquids (TL). Today the two most common inputs are coal and natural gas while the output is mainly high-quality diesel, petrochemical feedstock, and specialty products like lubricants.

In this section, we overview the XTL concept, look at the economics of current technologies, discuss drivers of competitive advantage, and outline where future technology may take the industry. Our conclusions:

- XTL looks set to have a small but growing role in global transport market, particularly in urban markets, where its lower NOx and particulate emissions and its lower greenhouse gas contribution will be valuable.
- However, XTL is suffering from chronic capital cost inflation. Limited access to conventional resources is pushing oil companies to consider such pricey alternatives as XTL, but it is not clear to us that all such plants clear the cost of capital hurdle at below $50/bbl oil prices.
- We estimate that the average oil price needed to deliver a 10% IRR from a gas-to-liquids (GTL) plant is in the $40-45/bbl range, assuming gas input costs of $2.50/mcf and capital costs of around $45,000 per barrel of daily capacity.
- We believe coal-to-liquids (CTL) may require a slightly higher oil price of around $50/bbl in Western markets, assuming a coal input price close to the ex-mine mouth price. The CTL break-even oil price in China, a major CTL market, is likely to be lower than this.
- In future, XTL could come to encompass biomass-to-liquids, and the industry is progressing in research and development in this area.

For now, GTL offers lots of potential with relatively little near- or medium-term impact likely on global oil markets. Natural gas liquids (NGL), liquefied natural gas (LNG), and general oil substitution by gas remain more powerful factors in the oil market.

Rising Demand for Liquid Fuels, Particularly Diesel

Over the medium term, liquid transportation fuel demand has been rising steadily at a faster rate than crude oil demand, mainly due to falling demand for residual fuel oil (which is being substituted by natural gas).

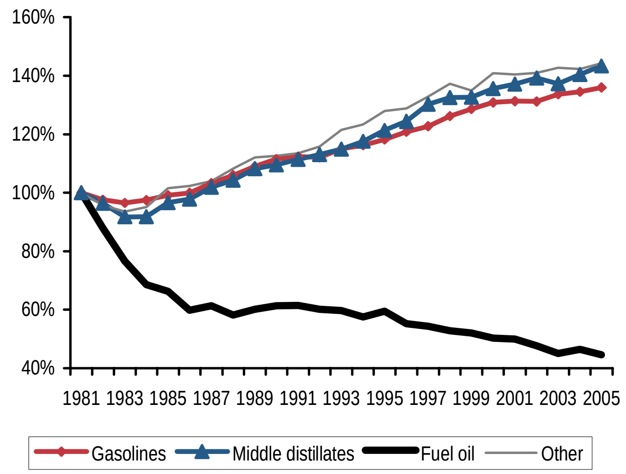
Within the mix, diesel has been the global transportation fuel of choice (at least outside the U.S.), and we believe it should continue to outstrip gasoline in growth terms for the foreseeable future.

This presents two problems:

- how to meet the growing diesel demand, and
- how to minimize diesel emissions over time, particularly in urban areas.

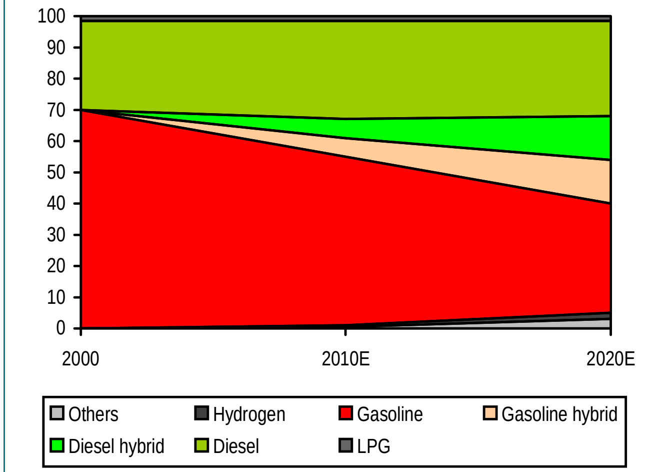
XTL can help with both of these problems, and should be a useful addition to the global diesel supply mix.

Exhibit 142: Long-Run OECD Demand Trends by Product
index, 1981 = 1



Source: BP Statistical Review.

Exhibit 143: Possible Distribution of Car Fleet by Fuel Type

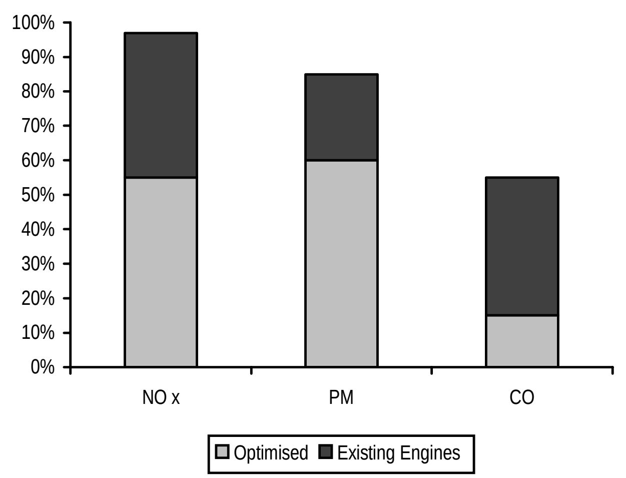


Source: RDS.

Gas-to-Liquids Diesel Cuts Emissions

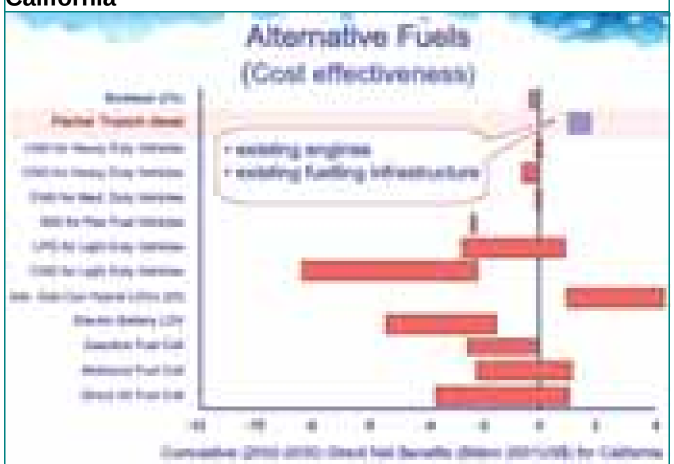
GTL diesel has very low sulphur content (less than 5 ppm), a high cetane number (at least 70 versus 45–55 for most diesels), low aromatics (less than 1%), and good cold-flow characteristics (very handy on a winter's day).

Exhibit 144: Emission Savings from GTL Engines
100% = fossil diesel



Source: RDS.

Exhibit 145: Cost Effectiveness of Alternative Fuels in California



Source: Sasol presentation.

Exhibit 144 shows potential emission benefits using GTL diesel in existing and optimised engines. Exhibit 145 shows the cost effectiveness to motor fuel end-users of various alternative fuels available in the Californian market.

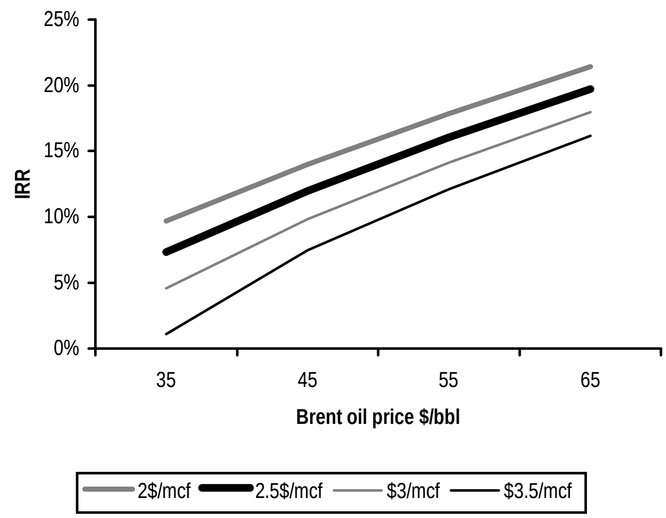
GTL diesel *can* be used directly in a vehicle, but its very high quality means that in practice it will be blended into the conventional pool. GTL diesel requires no additional investment in retail fuels distribution or auto technology, unlike ethanol at higher blend percentages and unlike LPG, CNG, fuel cells, or battery-powered light vehicles.

GTL's Economic Framework Is Less Clear

GTL plants should be able to deliver a positive project IRR, depending on the host country's fiscal terms, although in most cases an LNG plant continues to look more attractive, mainly due to LNG's lower capital costs. GTL's capital costs are increasing rapidly, with the Escravos project recently hiking its estimates by 20%.

Exhibit 146 shows the returns of GTL projects on the basis of $45,000 per daily barrel of capacity at varying input gas price costs versus oil prices. At an input gas price of $2.50/mcf, an oil price of around $40–45/bbl would be required to generate a 10% IRR.

Exhibit 146: Typical GTL IRR at Various Gas and Oil Prices



Note: Legend refers to the input cost of natural gas.
Source: Company data, Credit Suisse estimates.

Note we calculate $2.50/mcf as the typical alternative sales price for natural gas into an LNG scheme for sale into U.S. markets at $6/mcf Henry Hub.

For CTL, we conclude that investment returns will be more dependent on host-nation incentives than for GTL, particularly regarding the input cost of coal, the tax rate, the cost of associated utilities (particularly water), the cost of mitigating carbon emissions, and the real capital cost of projects (rather than the initial estimate).

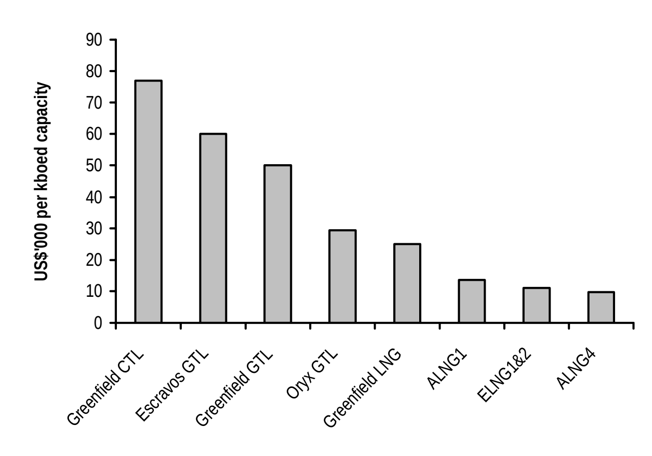
For those involved in integrated CTL projects enjoying discounted ex-mine mouth prices, IRRs could exceed those we present above.

Relative GTL/LNG Economics

Although cost inflation is an issue for both GTL and LNG plants to date, LNG capital costs have been significantly cheaper than GTL. Natural gas resource holders have a choice of monetizing their reserves using LNG targeting the power/heating end markets or converting the gas into liquid transportation fuels using GTL.

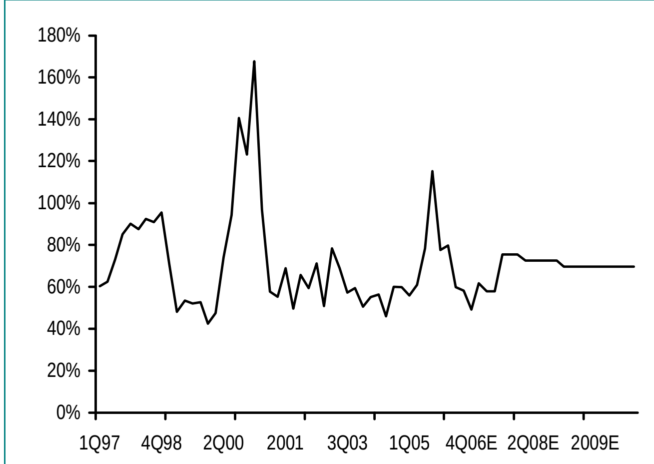
GTL's higher capital costs are partly compensated by the fact that gas prices have typically traded below oil prices (at a 5.8:1 ratio) and that the diesel cut of the GTL product slate should trade at a premium even to expensive ultra low sulphur diesel (at 15 ppm).

Exhibit 147: Selected Capital Costs per Barrel of Capacity
$000 per kb/d capacity



Source: Company data, Credit Suisse estimates.

Exhibit 148: Henry Hub U.S. Gas Price as % of WTI
converted at 5.8:1 mcf/bbl



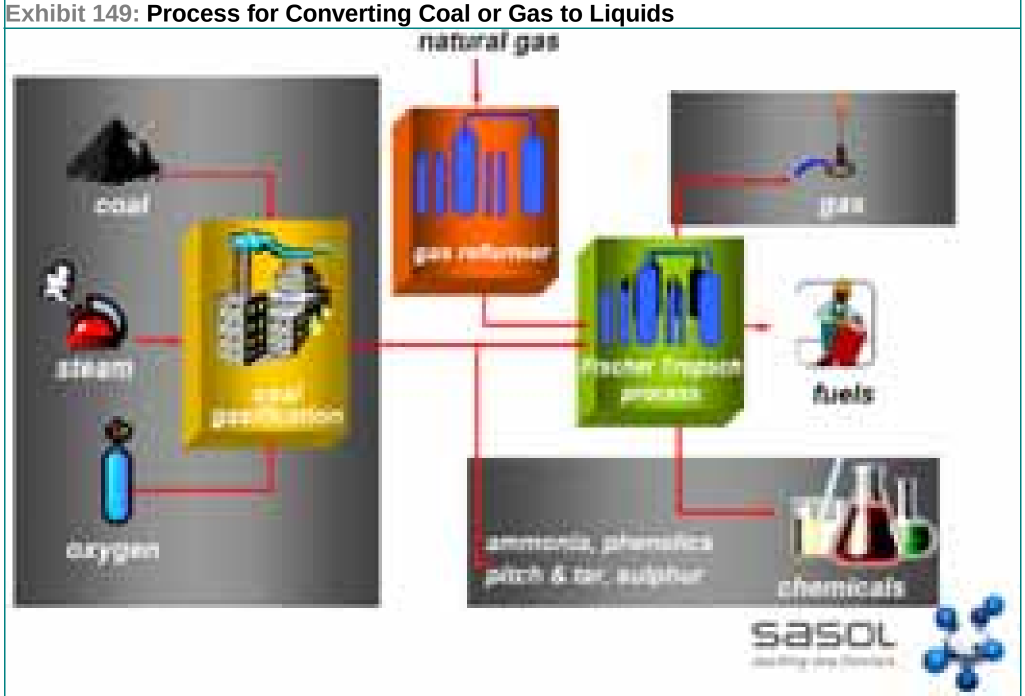
Source: Company data, Credit Suisse estimates.

How GTL Works

Natural gas is passed into a reformer. This converts it into synthesis gas (syngas), which is a carbon monoxide-hydrogen mixture. This syngas is then fed into a unit that uses the Fischer-Tropsch process to convert the gas mixture into liquid hydrocarbon with the help of a catalyst. The resulting liquid fuel is then refined into finished fuels, normally diesel. Coal-to-liquids is essentially the same technology except that the coal needs to be gasified first then fed into the Fischer-Tropsch unit.

Exhibit 149 shows a basic schematic of the process for converting coal or gas to liquids.

Exhibit 149: Process for Converting Coal or Gas to Liquids



Source: Sasol.

This is not a new technology, but only a handful of companies (ExxonMobil, Sasol, Royal Dutch Shell, PetroSA, and Chevron) have invested enough time and funds to develop a sufficiently commercial set of processes and skills needed to build full-scale GTL plants.

GTL Has Lots of "Potential"

Given the amount of stranded gas around the world (gas with no obvious future as piped supply), the potential for GTL is large. However, the contribution of real projects to actual global oil supply is likely to remain limited in the near term.

To date, most host nations have understandably preferred to go with LNG, given its lower capital costs. The contribution of NGLs to global supply and the substitution of oil demand by natural gas will both likely have a more substantial impact on the global oil market than GTL.

Even Qatar has announced a moratorium on new GTL projects until the existing tranche of LNG and GTL projects has been completed.

We also highlight that future locations for GTL projects (Kazakhstan, Colombia, Iran, Australia, and Nigeria) are very likely to have higher costs or local market risk than in Qatar.

Exhibit 150: **Global GTL Projects**

Project	Country	Capacity b/d	Ownership	Status
Bintulu	Malaysia		RDS	On-stream
ORYX	Qatar	34,000	Sasol	Q107 start-up
Escravos	Nigeria	34,000	CVX/Sasol/NNPC	Startup 2009E
Pearl	Qatar	140000	RDS	FID 2006
XOM	Qatar	154000	XOM	Heads of Agreement
COP	Qatar	160000	COP	Postponed
MRO	Qatar	>100000	MRO	Postponed
Oryx II	Qatar	66000	Sasol/CVX	Postponed
CVX/Sasol	Qatar	100000	Sasol/CVX	Postponed
Base Oils	Qatar	8500	Sasol/CVX	Postponed

Source: Credit Suisse research.

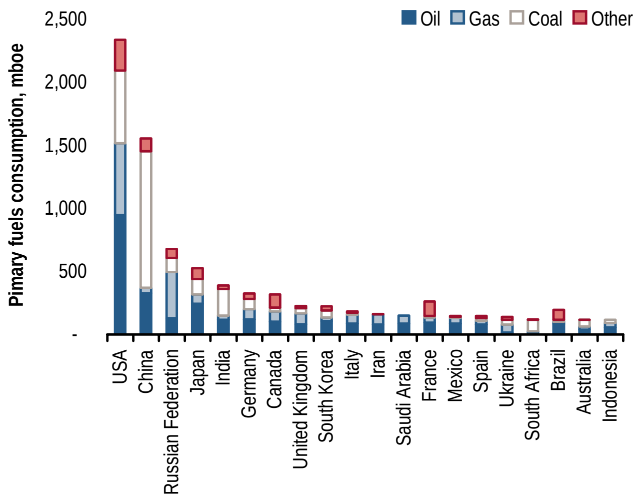
Coal-to-Liquids

For further details on the potential of the global and Chinese CTL industries, see our report *Asia Regional Coal Sector: Coal to Liquids—a Clean and Bright Future*, dated July 6, 2006.

Coal: Still an Important Role to Play

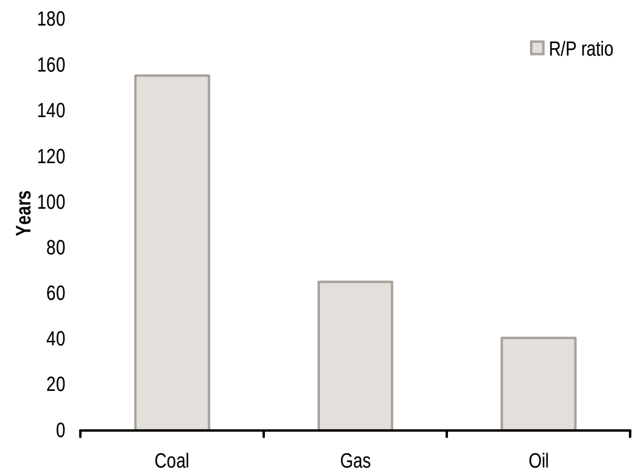
Coal's continuing role in the global energy sector comes from the length of its reserve life (150 years) versus the known reserve life for oil (40 years) and natural gas (60 years). These reserve lines for oil and gas do not include upside from unproved reserves or from improving recovery factors, etc.

Exhibit 151: Primary Fuel Consumption
in mboe



Source: BP Statistical Review.

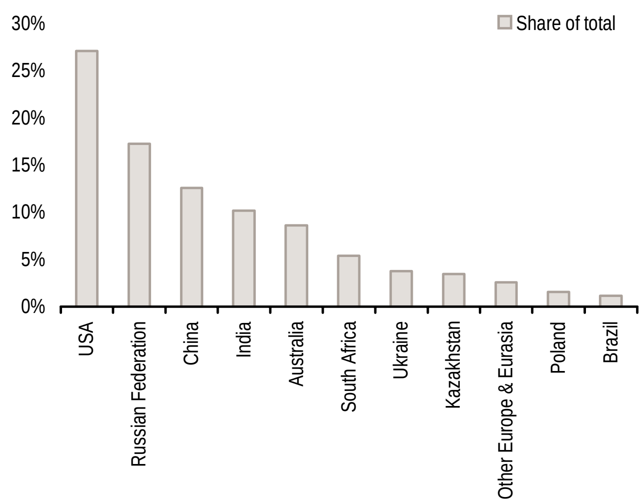
Exhibit 152: Global R/P Ratios for Key Energy Sources



Source: BP Statistical Review.

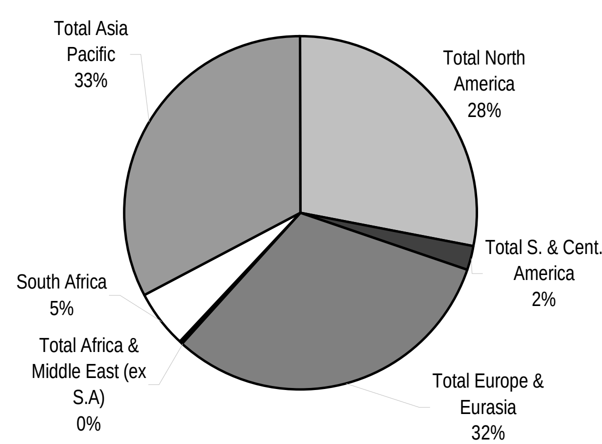
The distribution of the world's coal reserves suggests that CTL has potential in a handful of countries, notably the U.S., China, and India. Russia does have extensive coal reserves but also has vast reserves of oil and natural gas that are likely to attract the bulk of investment dollars. As a huge energy exporter, Russia has no strategic imperative to develop a CTL industry.

Exhibit 153: Proved Coal Reserves by Country, End-2005



Source: BP Statistical Review.

Exhibit 154: Proved Coal Reserves by Region, End-2005



Note: Includes anthracite, bituminous, and lignite coal.
Source: BP Statistical Review.

The same cannot be said of either the U.S. or China. Both are significant energy importers, with particular growing dependence on foreign oil. CTL could play a meaningful role in both countries. Given emissions constraints and marginal economics in the U.S., however, it seems to us that China is the most likely market for a broad rollout of CTL technology. We think other possibilities for significant CTL industries include India and Indonesia.

How CTL Works

Coal liquefaction is similar in nature to the gas-to-liquids process, and centers on adding hydrogen to the coal (carbon) feedstock to create a hydrocarbon.

This can be done either by subjecting pulverized coal to high temperatures and pressures to cause hydrogenation (the direct method), or by first gasifying the coal and turning the resulting gas into synthesis gas (syngas), which may then be transformed into a liquid via the Fischer-Tropsch method.

The direct method of conversion is not currently in use commercially, and all existing CTL plants use the indirect method. The cost of turning coal into syngas for liquefaction via the Fischer-Tropsch process is currently around twice the cost of turning natural gas into syngas. Consequently, much of the CTL industry's R&D is focused on improving the economics of the first stage of the indirect method, as well as on overall cost reduction in the direct method.

The basic processes of coal-to-liquids conversion outlined above were developed more than 60 years ago. However, there are other technical/economic aspects to consider when evaluating individual projects.

Above and beyond the normal regulatory constraints, capex inflation, etc., there are two principal environmental issues associated with CTL plants: water handling and carbon dioxide emissions.

- *Water consumption.* Each barrel of oil product output from a CTL plant requires 5-18 barrels of water during the production process. Depending on where the plant is located, this can cause significant problems. For example, in China, most CTL plants are located near coal mines where water shortages are already a problem. In the U.S., the most likely location of future CTL plants is close to the large coal deposits in the western states where water allocation is now a serious political issue.
- *Carbon dioxide release.* Synthetic liquid fuel production methods release carbon dioxide in the conversion process, usually at 7-10 times the amount that is released in the extraction and refining of conventional petroleum liquid fuels. A CTL plant sponsor will therefore need to consider in great detail the likely direction of carbon emissions regulation in the proposed location. It is likely that a CTL plant will incur additional capital expenditures in carbon sequestration or in the purchase of carbon credits to offset these emissions. Both of these could be significant additional costs once the regulatory framework settles down.

CTL Economics Are More Challenged Than GTL

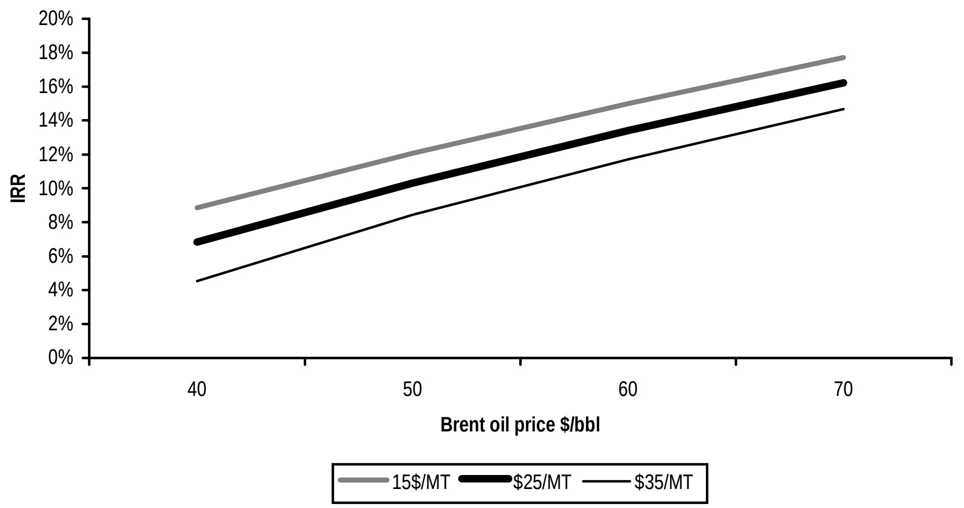
At a ratio of 0.56:1 (the energy content equivalence of coal to oil), coal has priced $10-30 per barrel of oil equivalent below oil as far back as 1990, due mostly to coal's high cost of conversion to energy.

At current oil prices of $65/bbl, however, the gap between ex-mine mouth coal prices in China and international oil prices has reached $55/bbl, opening the possibility of a positive returns spread for new CTL plants.

On the other hand, however, CTL capital costs have been rising fast, as they have been in other XTL projects and in the energy industry generally.

Exhibit 155 shows the estimated IRR of CTL projects at varying input coal costs, assuming a 30% tax rate and capital cost of $77,000 per daily barrel of capacity.

Exhibit 155: Sensitivity If CTL IRRs to Different Oil Prices (and Coal Prices)



Source: Company data, Credit Suisse estimates.

China's Coal-to-Oil Projects

We estimate there are currently 27 projects in China subject to detailed planning or undergoing feasibility studies, adding up to a total of over 600,000 barrels per day of liquid oil output through either direct or indirect liquefaction technology.

Should they all move to completion, this output would represent 10% of China's current oil demand and add an incremental 100 million tonnes, or 5% per annum, to China's domestic coal demand.

Nearly one-third of the projects listed in Exhibit 156 are either already under construction or in the detailed planning stage and thus can be regarded as highly probable. We would expect these to come online in the next two to three years. The remaining plants are undergoing feasibility studies and should move forward if the oil price outlook remains strong.

Exhibit 156: Major Coal-to-Oil Projects Under Construction and Planning in China

	Projects	Province	Technology	Annual capacity (mn tonnes) Phase I	Post Phase I	Status
1	Shenhua	Inner Mongolia	Direct liquefaction	1	2	Under construction
2	Xianfeng	Yunan	Direct liquefaction	1	0	In detailed planning, 4 yr construction
3	Liupanshui	Yunan	Direct liquefaction	0.5	0	Feasibility completed
4	Yilan	Heilongjiang	Direct liquefaction	1	0	Feasibility completed
5	Shuangyashan	Heilongjiang	Direct liquefaction	1	0	Feasibility completed
6	Qimei Group	Heilongjiang	Direct liquefaction	0.5	0	In planing, 3 yr construction
7	Xilinguolei	Inner Mongolia	Direct liquefaction	1	0	Feasibility completed
8	Feicheng Mine	Shandong	Direct liquefaction	0.5	0	Feasibility completed
9	Yanzhou Coal	Shandong	Direct liquefaction	3.2	6.4	unclear
10	Tengda Northwest	Gansu	Direct liquefaction	0	0	Feasibility completed
11	Shuicheng Mine	Guizhou	Direct liquefaction	1.08	0	In feasibility study
12	Kaiyuan Xiehua	Yunnan	Direct liquefaction	0.5	0	Trial completed
13	Shenhua	Shannxi	Indirect liquefaction	3	12	Project approved
14	Ningxia Coal Group	Ningxia	Indirect liquefaction	3	0	Project approved
15	Kaiyuan Xiehua	Yunnan	Indirect liquefaction	1.5	0	In Feasibility study
16	Henan Coal Liqf	Henan	Indirect liquefaction	1.5	0	Feasibility completed
17	Pingmei Group	Henan	Indirect liquefaction	0.5	0	In detailed planning, 3 yr construction
18	Shanxi Shuozhou	Shanxi	Indirect liquefaction	1.4	0	In detailed planning
19	Datong Coal Chem	Shanxi	Indirect liquefaction	0.8	0	In detailed planning
20	Yanzhou Coal	Shandong	Indirect liquefaction	1	1	in construction
21	Nuneng Group	Shandong	Indirect liquefaction	3.2	6.4	
22	Xuzhou Mining	Jiangsu	Indirect liquefaction	1	0	In detailed planning
23	Jincheng Qihe Coal	Shanxi	Indirect liquefaction	1	0	Negotiation w SASOL
24	Luan Coal Group	Shanxi	Indirect liquefaction	0	0	Feasibility completed
25	Changzhi	Shanxi	Indirect liquefaction	0.15	0	In detailed planning, 2 yr construction
26	Huating Coal Elec	Gansu	Indirect liquefaction	2	0	In detailed planning
27	Yitai	Inner Mongolia	liquefaction	0.16	0.48	in construction
	Under construction			**2.16**	**3.48**	**Under construction**
	High probability			**8.15**	**12**	**Under construction/detailed planning**
	Probable			**13.78**	**0**	**Planning/feasibility study**
	Total			**31.49**	**28.28**	**All listed**

Source: China Association of Social & Economic System Research Company data, Credit Suisse estimates.

U.S. CTL Outlook

With significant domestic coal reserves and a growing oil import bill, the U.S. would seem to be an attractive place to roll out a CTL industry. However, adoption of CTL technology has so far been very slow, with only eight individual CTL projects under discussion, together representing around 350,000 barrels per day. The U.S. National Coal Council recently conducted research from which it advocates use of an additional 475 million tons of coal annually (nearly half the U.S. market) to enhance U.S. liquid fuel supply by 10%.

The main problem in the U.S. is the enormous capital cost of the CTL plants, and the fear of generating first-mover disadvantage. While discussions around CTL have recently gained some momentum, it is likely that the U.S. federal government will need to give some sort of lead if CTL is to catch on in a significant way over the next five years.

Indonesia CTL Outlook

Over the years, the Indonesian government and coal-mining companies have sporadically sought to develop coal conversion projects, though almost none of the initiatives to date has moved off the drawing board. Some of the avenues explored include coal-bed methane production, coal gasification, and CTL technologies. The reasons for the lack of progress range from capital constraints, (previously) lower oil prices, and a ready export market for thermal coal production.

In the current high oil price environment and given Indonesia’s increasing net oil import position, there is once again renewed interest in CTL technology. Bumi Resources recently announced its intention to develop a CTL project using South African or Japanese technology. The company suggests that the project size will be between 13,500 and 80,000 barrels of diesel per day.

India and the Philippines CTL Outlook

The governments of India and the Philippines are also pursuing CTL initiatives. Headwaters Technology Innovation Group, a subsidiary of Headwaters, Inc., has entered into an agreement with Oil India Limited to prepare an economic and technical feasibility for coal liquefaction projects in India. Headwaters has also signed an agreement with the Philippines' Department of Energy to evaluate, develop, and promote coal liquefaction projects.

India's large domestic reserves make it a potentially attractive place for CTL rollout, but the energy policy framework in India may be too weak to support the marginal economics.

Conclusion: and the Winners Are . . .

In our view, the winners in the XTL industry will fall into two categories: (1) those companies with global downstream networks that can extract the full quality premium for XTL diesel, and those that can execute multi-billion-dollar global projects in gas-rich areas such as the Middle East, Nigeria, North Africa, and Australia, and (2) those companies that can harness favorable regulatory regimes to capture economic value from a large technology deployment.

- The first category includes ExxonMobil, Royal Dutch Shell, and the joint venture between CVX and Sasol. Other global oil Super Majors such as Total and BP should be able to compete over time, but have historically placed emphasis on other extraction/conversion technologies, and are consequently some way behind.
- The second category appears to be confined to China at present, and includes China Shenhua Energy and Yanzhou Coal, both of which are primarily coal producers with small but growing CTL businesses.

Micro-Generation

Turning the Electricity Industry Upside Down?

Note: This Micro-Generation section was written by Jon Slowe—Director, Delta Energy & Environment

Defining Micro-Generation

The U.K. government defines micro-generation technologies as those that *"provide heat and/or electricity on a small scale from a low carbon source."* This definition encompasses a number of technologies:

- micro-combined heat and power (micro-CHP, sometimes known as domestic CHP or dCHP);
- Small-scale wind turbines, supported by free-standing poles or poles mounted on buildings;
- solar thermal (solar radiation to heat);
- micro-hydro (small-scale hydropower);
- biomass heating (boilers and stoves fueled by wood pellets or logs); and
- photovoltaics (solar radiation to electricity);

The Energy Act (2004) defines micro-generation as having capacities up to 50 kW electric and 45 kW thermal and explicitly mentions geothermal sources, biofuels, and fuel cells (which Delta views as a micro-CHP technology) technologies. 45 kW thermal capacity encompasses all residences and some small businesses (although larger businesses could use a micro-generation heat technology to meet some of their thermal demand). To help visualize this, residential boilers typically have thermal capacities between 15 kW and 35 kW. The 50 kW electrical limit encompasses all residences and a larger number of business. Most households will typically use an electricity-generating micro-generation product of less than 5 kW, and in many cases just 1 kW.

Can Utilities Ignore a Potential Micro-Generation Mass Market?

According to an Energy Saving Trust report for the U.K. Department of Trade and Industry, "30-40% of the U.K. electricity demand in 2050 could be met by micro-generation technologies." Under this scenario, micro-generation would certainly be at the top of utility agendas. Today, it is a wholly insignificant part of power markets and energy services market. For future strategic decisions, utilities need to determine (1) the rate at which micro-generation markets are likely to develop, and (2) how large micro-generation markets are ultimately likely to become. They can then decide how to secure stakes in the value chain.

Implications for Utilities

Electricity-generating micro-generation technologies that have mass market potential—primarily micro-CHP (and, to a lesser degree micro-wind and photovoltaics)—could have major impacts on the electricity value chain.

Increasing generation in households and small businesses will reduce demand in wholesale power markets, potentially reducing the profitability of large central power plants. Micro-CHP could, however, be intelligently dispatched (as a virtual power plant) to reduce peak demand, reducing the cost of meeting these peaks.

Micro-generation results in a lower flow of kilowatt hours down networks. As the majority of distribution network operators' (DNO) revenue is currently linked to throughput, this results in lower DNO revenue. A number of responses are possible, such as increasing the variable part DNO charges or decreasing the proportion of revenue dependent on throughput and increasing fixed charges. Micro-generation will also likely alter DNO costs. It may drive cost down by reducing peak demand on the system (as micro-CHP units will be running during these peaks), although additional costs may be required for active network management or resetting voltage levels at transformers. Initial studies have examined the benefits and costs, but there is no general consensus on the magnitude of each.

Micro-generation will reduce retail electricity sales without reducing fixed costs (cost to serve); for most retailers, this will have a negative impact on their retail business. This may be offset in a number of ways, including the following:

- a reduced winter peak demand requiring less purchase (or generation) of expensive peak power on the wholesale market;
- using micro-generation to deepen the customer relationship, reducing customer churn;
- using micro-generation packaged with an energy supply package to acquire new customers;
- increasing the fixed proportion of retail tariffs;
- profit on the purchase of micro-generated electricity sold by the customer back to the utility;
- profit on micro-generation product sales and related service contracts;
- owning the micro-generation asset and selling electricity (and in some cases heat) to the customer;
- increased gas sales, increasing profit for gas distributors and retailers (assuming gas retail itself is profitable).

Heat-only micro-generation technologies, where they displace natural gas heating, will have a negative effect on gas distribution and retail businesses. However, they may bring some of the same values, as detailed above. Where they displace electric heating, they will likely bring negative impacts on the power sector; where they displace oil or LPG heating, there will be no negative impacts on the power sector.

The impact of micro-generation on utility businesses is clearly varied and complex, with different models of how utilities take micro-generation products to market bringing different outcomes. The utility industry is, in the main, in the early (and, in some cases, very early) stages of understanding and exploring these impacts. In the long term, innovative arrangements such as recouping a micro-generation investment through high distribution use of system charges for a particular property are possible.

In addition to this varied and uncertain impact, different micro-generation technologies and products will bring different levels of impacts due to different levels of generation and the timing of when they generate power. For example, for a household with annual demand around 3,500 kWh:

- A 1 kW micro-wind turbine may only generate 500-1000 kWh, with little correlation between when this is generated and residential demand.
- A 1 kW Stirling engine-based micro-CHP product may generated around 2,000-2,500 kWh, with a stronger match between when this is generated and residential electricity demand.
- A 1 kW solid oxide fuel cell micro-CHP product may generate 5,000 kWh or more (due to its higher electrical efficiency, meaning it produces less heat than a Stirling engine and therefore runs for more hours), again with a relatively strong match between when this is generated and residential electricity demand.

Finally, if micro-generation is to supply 30-40% of U.K. electricity demand, this will require diverting a proportion of future capital investment in power generation capacity away from utility investment in central power plants to investment (from utilities and/or homeowners) in micro-generation. As well as affecting utility investment in power generation capacity, this will likely raise a number of tax issues.

Ultimately, if micro-generation is to supply a significant proportion of U.K. electricity demand, utilities will have to have stakes in the micro-generation value chain and will have to have service divisions capable of installing and servicing micro-generation products.

Utilities will have to adapt their business models if they are to successfully navigate the emergence of a micro-generation mass market.

Micro-Generation Technologies

Micro-generation technologies can be segmented in a number of ways. Exhibit 157 identifies those technologies that provide electricity or heat or both: those that are mature and those that are finding their feet in the market; those that show significant potential for long-term cost reduction; and finally, in Delta's view, those that offer the potential to penetrate the mass market.

Micro-CHP offers the most significant mass-market potential, with the major caveat that products are only just emerging. The performance of micro-wind is not well enough understood to firmly evaluate its mass-market potential.

Exhibit 157: Segmenting Micro-Generation Technologies

Technology	Electricity	Heat	Maturity	Potential for significant cost reduction	Mass-market potential	Potentially cost competitive before 2020
Micro-CHP	✓	✓	Residential scale just emerging—larger products mature	Yes	Yes	Yes
Micro-wind	✓		Free-standing mature—building mounted immature	Yes	Not yet clear	Not yet clear
PV	✓		Mature—but technology developing rapidly	Yes	Only in the very long term	No
Micro-hydro	✓		Mature	No	No	Only in small no. of attractive sites
Solar thermal		✓	Mature	No	Possibly	No
Biomass		✓	Matured in recent years	No	No	In off-gas grid areas
Heat pumps		✓	Mature	No	No	In off-gas grid areas

Source: Delta Energy & Environment.

Below, we examine these technologies one by one. We concentrate on micro-CHP, given the mass-market potential of this technology and the variety of technologies being developed. Like biomass and heat pumps (and potentially solar thermal if packaged with a boiler), one advantage of micro-CHP is that it is sold into the existing boiler market, and thus does not have to create a new market.

Micro-CHP

Micro-CHP is (and, for a few years, has been) a “nearly” product in the U.K. Product is not yet widely available, but is likely to be so from 2008 onwards.

Micro-CHP is best explained as a boiler that also produces electricity. The box will contain a power generator, from which waste heat is recovered. A supplementary burner will usually add to this waste heat, with the system providing all of a building’s thermal needs. The “micro” in micro-CHP has different definitions. Products for individual homes are typically rated between 1 and 3 kW. Higher capacity products are suitable for larger buildings such as apartment buildings, nursing homes, and small hotels.

There are five power generation technologies being used and/or developed for micro-CHP application.

- Internal combustion engine—a mature technology, but only since the late 1990s available for micro-CHP applications.
- Stirling engine—an external combustion engine, with a heat source driving mechanical movement (which then generates power) within a sealed unit.
- Fuel cells—based on a chemical reaction usually between hydrogen (often derived from natural gas) and oxygen. Solid oxide and PEM (polymer electrolyte membrane) are two main fuel cell technologies being developed for micro-CHP applications.
- Rankine and steam cycle engines—like Stirling engines based on external combustion, using steam or an organic fluid to drive a mechanical generator.
- Pico-turbines—a miniature high-speed gas turbine that is incorporated into a boiler, with the hot exhaust replacing the flame in a boiler.

The characteristics of these technologies are summarized in Exhibit 158. Cost is not included, as a number of technologies are not yet commercialized or are being manufactured in low volumes.

Exhibit 161 focuses on micro-CHP products that are being manufactured or developed for individual households (with electrical capacity less than a few kilowatts), as this represents the mass-market opportunity for micro-CHP.

Exhibit 158: Micro-CHP Technologies Characteristics

Micro-CHP technology	Electrical efficiency (%)	Number of leading developers targeting micro-CHP applications	Commercialisation status
Stirling engine	10—25	7	Market introduction in U.K. is likely from 2008
Rankine/steam cycle	9—15	4	One developer targeting market introduction around 2009
Internal combustion engine	23	2	Over 30,000 units installed in Japan, but market introduction in Europe uncertain
PEM Fuel cell	30-35+	>10	Market introduction in 2008 in Japan, after 2010 in Europe likely
SOFC Fuel cell	30—45+	>10	Some developers targeting thousands of installations in 2009, but as only a handful of units are in field tests this may be optimistic
Pico-turbine	10—20	2	Commercialisation unlikely before 2010

Notes—Excluding Hexis, which placed around 100 units in field tests in 2001-3. Hexis has now gone back to improving the fundamental fuel cell technology, planning to deploy just tens of units over the next two years.
Source: Delta Energy & Environment.

Current Market Players

E.ON U.K. is leading the micro-CHP field in the U.K., with its partnership with Whisper Tech, a New Zealand-based Stirling engine manufacturer. It has installed around 200 WhisperGen units and has placed an order for 80,000 units, with Whisper Tech working to secure a manufacturing partner to fulfill this order. E.ON U.K. installs the WhisperGen unit for a marginal cost of around £600 above a boiler (£3,000 installed). Two other Stirling engine developers are planning to bring product to U.K./European markets in 2008. Microgen, a subsidiary of BG Group, had invested more than £70 million in developing a Stirling engine micro-CHP product, but BG Group shut down the business in January 2007. At least one organization is considering acquiring this technology. Fuel cells lie at the other end of the efficiency spectrum. Commercialization efforts for micro-CHP applications have largely been focused in Japan, where over 1,000 systems have been installed as part of a well-funded government demonstration program. Gas utilities, together with major corporations such as Toyota, Toshiba, Kyocera, Sanyo and Matsushita, are investing heavily to bring product to market from 2008. A number of companies are focusing on the European opportunity, although only two companies have yet installed more than ten units in field tests (both of which have since retreated back to fundamental technology development). One of the more aggressive companies targeting the European market is Ceramic Fuel Cells, which plans to introduce product into the market in 2009.

All in all, micro-CHP product, based initially on Stirling engines and steam/Rankine cycle engines, is likely to enter the European market in 2008-09. The U.K., the Netherlands, and possibly Germany are expected to be at the forefront of market development.

Fuel cells will follow after introduction of the above technologies—very soon after according to some developers, but some time after in the views of other analysts. The high electrical efficiency of fuel cells is attracting many players to the product development race. If products can be made at low enough cost and with long lifetimes, fuel cells may dominate micro-CHP markets.

Micro-Wind

Small wind turbines have been sold for years for a variety of applications, such as battery charging on yachts, to provide power to remote telecommunication stations and to power farmhouses and other buildings. In Mongolia, well over 100,000 systems are used to provide power to yurts. Virtually all products to date are mounted on free-standing poles, with the conventional sitting methodology calling for wind turbines to be placed as far from buildings as possible due to the distortion buildings cause to wind flows. The market leader (outside of China and Mongolia) for small wind turbines, Southwest Windpower, shipped over 10,000 units in 2005.

Only in the last few years, however, has there been a concerted effort to bring small wind turbines to the mass market by designing them specifically for building mounting, with the market currently at very early stages. Over 20 companies are developing product for such applications. The U.K. has been the main focus of these efforts, with Scottish companies Windsave and Renewable Devices leading the pack. The 1 kW Windsave product sells for £1,500 through retail outlet B&Q, with the 1.5 kW “SWIFT” Renewable Devices product selling for £3,500 through Scottish & Southern (which has a stake in the company).

Although a wind turbine is a simple machine in principle, there are many challenges to developing a mass-market building-mounted product. Noise must be low, vibrations must be isolated from the building, the products must be maintenance free, and installation must be straightforward.

The major unresolved issue is a detailed understanding of the wind resource over buildings. As the output of the wind turbine is proportional to the cube of the wind speed, there are very wide estimates of how much energy a rooftop wind turbine will produce. Optimists expect a 1 kW rated machine to produce 1,500 kWh or more, whereas others expect less than 800 kWh. The surrounding environment around the wind turbine and precise sitting on the roof top is critical. All in all, these issues are very poorly understood. An Energy Saving Trust and Carbon Trust initiative has been launched, in 2007, to better understand these issues.

Solar Thermal

Solar thermal water heating uses the sun's radiation to heat water, which is then stored in a hot water tank and used to meet domestic hot water demand. In the U.K., this can supply most of a home's hot water needs during summer months and over a year about half of all hot water demand. Systems can also be used for swimming pools or commercial buildings.

There are two main technology types. Flat plate systems contain a dark absorber panel that absorbs solar radiation, with tubes carrying water adjacent to this panel. Evacuated tube systems have vacuums around each glass tube, reducing heat loss from the water inside the tube, and an absorber built around each tube.

The technology is relatively mature. Most major boiler manufacturers now offer their own (or OEM) solar water heating products. Currently, China, Germany, Japan, Australia, and many Mediterranean countries all have large markets.

Biomass Stoves and Boilers

Biomass heating systems for households and small businesses, fueled by wood pellets or logs, are rapidly gaining in popularity in parts of central Europe, Scandinavia, and Italy. There are essentially two types of systems:

- *Stoves.* These are best described as room heaters. With a glass panel showing an aesthetically pleasing flame, they are typically placed in a home's main living area, and provide heating to that room.
- *Boilers.* These are designed to provide all of a home's domestic hot water and space heating needs (in a similar manner to a conventional natural gas or oil boiler).

Pellets are easy to handle, and can be delivered either by tanker or in sealed bags. For boilers, there are two main storage methods used. If room is available, the simplest solution is to use a sealed storage unit in a room next to the wall on which the boiler is installed against. An automatic feeder system then carries pellets to the boiler. A separate solution is to use an outside store (similar to an oil storage tank for oil heating systems). In this case pellets are "sucked" along pipes to the boiler.

Significant advances in biomass stove and boiler technology have been made in recent years. Manufacturers report efficiency as high as 93%, and many products have fully automatic operation, including automatic start-up and shutdown and programmable operation. Long maintenance intervals are possible—only once a year servicing, emptying of ash as little as a few times per year, and filling of pellet storage tanks as little as a few times a year.

The most important European markets for biomass heating are Germany, Austria, Italy (around 100,000 stoves a year), Denmark, and Sweden. Biomass heating is most viable in off-gas grid areas, where it competes against fuel oil, LPG or electric heating. The European market has grown at 30-40% per annum in the last two to three years.

Micro-Hydro

The potential for micro-hydro (which is typically defined as up to 100 kW capacity) is highly location specific. Potential can be divided into larger schemes in hilly and mountainous areas, and smaller schemes often developed at old mill buildings. The U.K.'s Energy Saving Trust estimated that in 2005 there were no more than 100 schemes less than 50 kW capacity across the U.K.

Heat Pumps

In simplified terms, heat pumps take low-grade heat from a source (the earth, a body of water, or the air) and "concentrate" this heat into higher grade heat using a compressor, supplying this heat in the form of hot water or warm air (a refrigerator run in reverse). Heat pumps are relatively simple, containing an outdoor heat exchanger and evaporator, a compressor, and a condenser and indoor heat exchanger. They are usually categorized by the source of outdoor heat (air or ground) and whether they supply warm water or warm air. They do use electricity to power the compressor, but for every unit of electricity used, typically three to four units of heat are supplied.

There are two types of heat pumps: ground and air sourced. Ground-sourced heat pumps extract heat from the ground either from long, shallow trenches or from a deep drilled borehole. The high cost of civil works means ground sourced heat pumps are best suited to new build properties. Air sourced heat pumps, on the other hand, can more easily be retrofitted to existing homes, but are less efficient currently.

Ground-sourced heat pumps compete well, on life-cycle costing, against oil, LPG and electric heating in off-gas grid areas, although their capital cost is higher than these alternatives.

Half of all new homes in Switzerland use heat pumps; the technology is extremely popular in Scandinavia, and in Japan high-efficiency air sourced heat pumps now sell in volumes of hundreds of thousands of systems a year, in many cases displacing natural gas water heaters.

Selected International Micro-Generation Highlights

- *PV in Germany.* 750 MW of PV capacity was installed in Germany in each of 2005 and 2006. Supported by an attractive feed-in tariff (currently €0.49/kWh), over 300,000 systems have been installed in total.
- *Solar water heating in Germany.* Germany also has a very large market for solar water heating, with 140,000 systems installed in 2006 alone, representing an increase of 58% on the previous year. There are close to one million solar water heating installations in Germany.
- *Heat pumps in Switzerland.* Half of all new homes in Switzerland are heated by heat pumps. A coordinated effort among electric utilities, heat pump manufacturers, and the government has helped this market develop.
- *Micro-CHP in the Netherlands.* The three leading Dutch utilities—Nuon, Essent and ENECO Energie—joined together with gas wholesale company GasTerra to develop a micro-CHP market. They have a commitment to install 10,000 micro-CHP units over the next three years as long as a suitable product is available. Three major boiler manufacturers in the Dutch market have affirmed their interest in developing a micro-CHP market in the Netherlands.

- *Heat pumps in Japan.* Electric utilities in Japan have aggressively introduced high-efficiency air-water heat pumps as part of a drive to all-electric homes. They are succeeding in grabbing a significant share of the water heating market from the gas industry. Sales of heat pump water heaters, branded EcoCute, have risen from less than 20,000 in 2002 to more than 150,000 units a year.

- *Micro-CHP in Japan.* Partly to counter the above, Japanese gas utilities are pushing micro-CHP markets. Osaka Gas led the introduction of the ECOWILL micro-CHP system in 2003. With all major gas utilities now selling the ECOWILL system, over 17,000 units were sold last year. Heavy government investment in fuel cell demonstrations, together with gas utility pull, have attracted major corporations into fuel cell micro-CHP product development in Japan.

Exhibit 159: U.K. Utility Micro-Generation Engagements

Company	Micro-Generation Engagement
Centrica	Existing home services business through which micro-generation products can be rolled out. Trialling micro-wind turbines• Working with Ceres Power to develop fuel cell micro-CHP product Had previously signed heads of terms agreement to take the Microgen Stirling engine micro-CHP product to market Introducing solar water heating products to the mass market • Won DTI tender for Phase 2 of LCBP to install solar water heating, micro-wind, heat pumps, photovoltaics and biomass boilers
E.ON U.K.	Recently developed home services business covering a significant proportion of the U.K. Installing WhisperGen micro-CHP products and placed order for 80,000 units Trialling building mounted wind turbines and selling free-standing wind turbine Installing ground source heat pumps • Plans to offer solar water heating and photovoltaics
EDF Energy	Watching brief—some home services capability focussed around conventional heating products. Parent company EDF testing and active with a number of micro-generation technologies.
RWE nPower	Developing home services business. Installing ground source heat pumps Parent company RWE testing and evaluating some micro-generation technologies and products.
Scottish Power	Watching brief only
Scottish & Southern	Rolling out home services business Invested in Renewable Devices and installing their roof top wind turbines Invested in Solar Century and installing photovoltaics • Installing ground source and air source heat pumps

Source: Delta Energy and Environment.

Wave Power

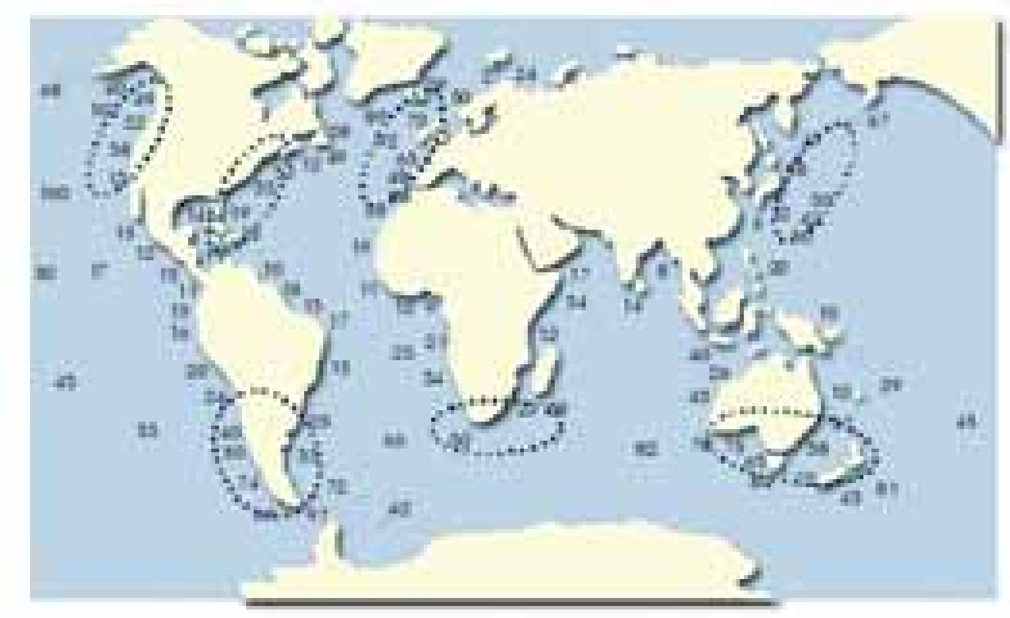
Global Market Potential Is Vast

Colin Pollock

Wind-generated ocean waves are a vast and largely untapped source of energy, Industry sources cite the potential global market could exceed 2000 TWh per annum, requiring >£500 billion of investment.

Wave energy converters (WECs) are designed to extract and convert energy from ocean waves into electricity. Good sites to position these machines (typically to be arranged in clusters called "wave farms") are near coastlines open to ocean swells. Regions of high wave power density are found typically in deep water (>50 m) between 20-60 degrees latitude north and south of the equator. For example, power density reaches as high as 65-70 kW per meter of wavefront near the western coastlines of the U.K. and Portugal in the Atlantic Ocean.

Exhibit 160: Overview of Global Wave Energy Density



Source: Company data.

Seasonal variation in wave power density broadly matches customer demand patterns—i.e., the sea state tends to be rougher in winter months.

Conceptual Proposals for WECs Abound, but Few Are Commercially Exploitable

Numerous proposals have been pursued over the last 30 years, many of which remain conceptual only. A few designs have been able to secure sufficient funding for R&D and fewer still have demonstrated any real prospect of reaching commercial development.

In order to be commercial, a device must be designed to withstand (1) severe weather conditions and extreme waves of up to 30 m in height and (2) be able to efficiently capture and deliver power across the wide range of wave heights and periods found in different sea states.

WECs can be divided into three broad categories:

- *Shoreline systems*: 0-10 m water depth, 0-100 m from shore or built into shore. Machine types include the oscillating water column (OWC) (e.g., Limpet project on Islay, Scotland), pendulum flap and overtopping devices (e.g., Tapchan in Norway).

- *Nearshore systems*: 10-25 m water depth, 100-500 m from shore, bottom standing (e.g., Osprey, Energetech systems).
- *Offshore*: 50-plus m water depth, 2-20 km from shore, free-floating or subsea configuration. Numerous machine types exist. Power output ranges from 10 kW-5 MW with hydraulic, water/air turbine or direct electrical power take-off. Surface/floating examples include Pelamis WEC (Ocean Power Delivery), OPT PowerBuoy, AquaEnergy, and Wave Dragon. Subsea examples include AWS and the Bristol cylinder.

Large-Scale Commercial Exploitation Is Some Time Off

There are a large number of devices in the conceptual phase of development with several large-scale prototypes under test or in build phase. However, only a proportion of these technologies are likely to be commercially viable at utility scale. For the leading technologies, we see several barriers yet to overcome.

- *Financing.* Capital starvation could (or in some cases has) prevented viable designs from emerging from the early phases of development. Successful projects to date have been equity financed by private investors and venture capital funds. Private equity, early-stage public flotation (such as OPT on AIM), and strategic investment are the likely sources of financing in the next phase.
- *Utility investment or off-take support.* Necessary to ensure wave projects attract financing. Certain projects have gained traction, e.g., Ocean Power Delivery's Pelamis have won utility support through contracts with SPW and Enersis to construct machines.
- *Grid connection.* Sufficient incentive must exist for transmission companies to incur substantial capex to extend or re-inforce grid connections necessary to connect wave farms.
- *Permits and approvals.* Schemes will require local and national consent. Externalities such as impact on marine life and existing users of the sea must be managed.
- *Political support.* Projects will require financial support through subsidies or tariff recovery mechanisms until they achieve scale and further reduction in capital costs in order to be genuinely competitive with other types of generation. More advanced projects are at the stage of requiring a *feeder market* for wave power similar to those that drove development of wind energy in Denmark and Germany in the 1980s, and currently in place to support solar in Germany and California. This will require political support through the introduction of new legislation, e.g., through inclusion in the ROC mechanism in the U.K. The first such scheme was introduced in Portugal in 2004; this has been followed up by a similar scheme in Scotland, which is due to be adopted into formal legislation this month. The potential fillip to the manufacturing and offshore sector from a large-scale rollout of WECs is a lever used by some wave developers to encourage political backing of the sector.

Some wave power projects have begun to reach the end of their R&D phase and are becoming increasingly derisked from a technology and construction perspective but increasingly face a dilemma without political support in creating a market and the appropriate economic incentives for the further development of wave power:

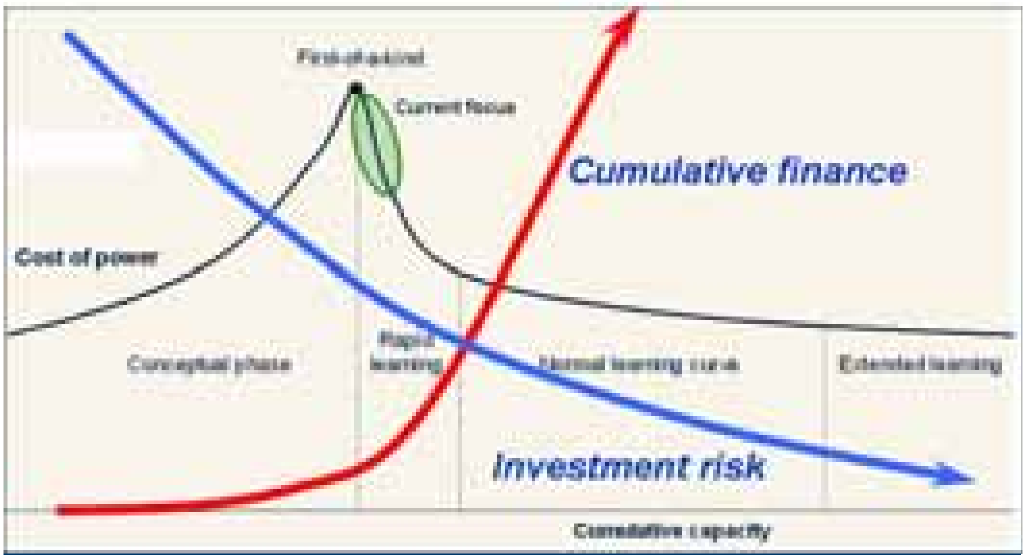
- A market is necessary to achieve financing support as companies must be able to demonstrate strong growth potential to justify the high equity return targets typically demanded by early-stage equity financing.
- Without financial support, however, there is a risk that proven designs will be insufficiently developed to enter the potential market within the range of acceptable capital costs.

Assuming the nascent market for wave power does develop apace, it is conceivable that only the strongest (perhaps one or two) technologies receiving sufficient financial support will be taken forward for full commercial exploitation on a utility scale. Capital cost reductions that follow further innovations to improve existing designs could further increase barriers to entry thereafter.

Capital Costs Are High but Should Reduce After Further Development

We believe capital costs for the first "full scale" WECs are now in the region of £2500/kW versus costs of £2000/kW based on initial estimates during the conceptual development a decade ago. This opening cost compares favorably with starting costs of all previous renewable technologies, and indeed with the current costs of solar PV technologies. Up-scaling and improved technical efficiency and component standardization should permit further major cost reductions as the sector matures.

Exhibit 161: Wave Power Remains in "Rapid Learning" Phase of Development



Source: Company data.

Capital Goods and Alternative Energy

Patrick Marshall
Julian Mitchell
Nicole Parent

Renewable energy is a high growth area that we believe will soon impact on the global portfolio of power generation. Clear winners in this drive will not only include the utilities but also capital goods and construction companies, which supply the major equipment and components necessary to outfit plants. On the other side, high energy prices and concern over GHG emissions will drive a renewed focus on the demand side, that could perhaps in the longer term be more important.

Demand-Side Drivers

Theoretically, lowering energy intensity will cost less than developing new energy sources. As discussed, the IEA's alternate energy scenario from 2004-2030 would result in some $560 billion of lower capital costs by focusing upon lower energy consumption. There are a multitude of examples of lower energy consumption providing quick payback for the associated capital cost. For example, paybacks of around two years can be achieved in commercial lighting retrofits or generally buying compact fluorescent lamps as opposed to incandescent bulbs. Using high-efficiency industrial motors and irrigation pumps in most developed countries can save electricity at a cost in the range of $5-30 per MWh.

Energy Efficiency in Transportation

There are three principal ways of improving energy efficiency across the transportation sector;

- *The provision of products and systems to the automotive OEM sector, which results in improved fuel consumption.* Note that over the past 15 years the U.S. light-duty vehicle fleet miles per gallon has actually fallen from 22 MPG to 21 MPG (primarily due to the increased popularity of SUVs). This, in turn, can be provided by a number of mechanisms: the development of hybrid vehicles, increased diesel penetration, or the provision of products that result in higher mileage per gallon for existing vehicles such as lighter materials (e.g., powdered metallurgy components in powertrain). A number of companies provide products in this manner such as Tomkins (power transmission systems, powdered metallurgy components), SKF (bearings, hub units) and GKN (CVJs, powdered metallurgy components).

- *Indirect measures to reduce energy consumption* through governmental policies attempting to switch the populace to move away from their light vehicles (10-12% of man-made CO_2 emissions) toward other less emission producing forms of transport such as trains. Beneficiaries of such policies would be the main rolling stock manufacturers (Alstom, Siemens, Bombardier) as well as those exposed to rail signaling (the prior three plus Invensys).

- *In aviation the cost of improving energy efficiency is arguably high* with respect to the environmental benefits gained. According to the IEA, while the capital cost of improving aviation efficiency would account for about 20% of total transport related investment, this spend only delivers 11% of the expected benefits. Companies exposed here would be both engine OEMs (Rolls-Royce, GE, UTX, MTU, Snecma) but also airframe and other component companies (SGL Carbon).

Energy Efficiency in Industry/Commerce

With regard to potential energy savings in industrial markets, the IEA estimates that there are twice as much savings to be derived from non-OECD countries when compared with OECD countries. Indeed, potential savings from China alone would be as much for the OECD.

Exhibit 162: **Change in Industrial Energy Demand by Region and Sector**

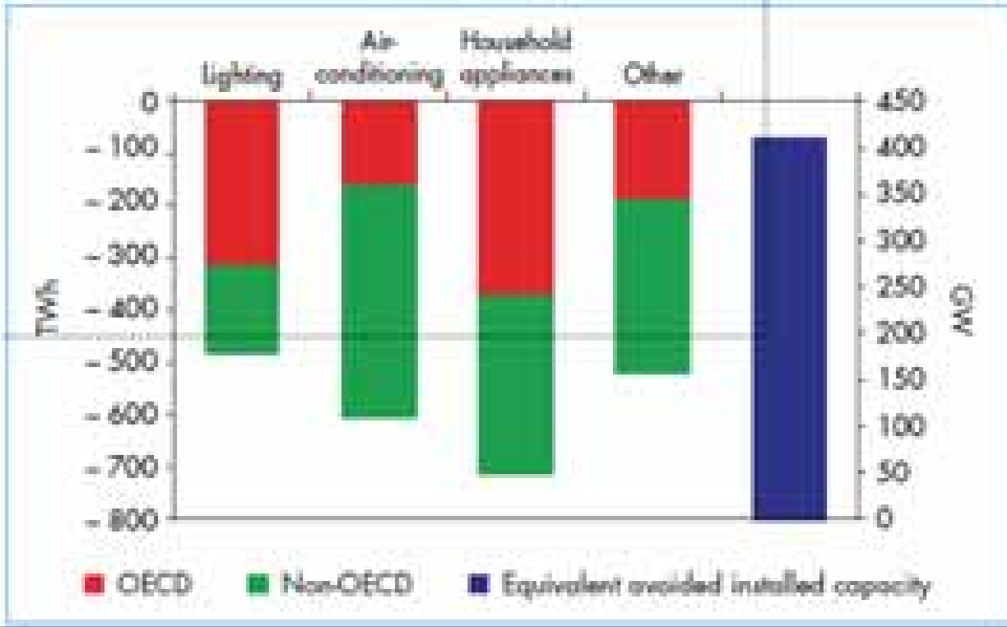
Source: IEA.

Note that the energy intensity across the steel and cement industries in Japan is 50% lower than in China. The main product area is industrial and infrastructure markets where energy consumption can be made is in electric motors, which account for 60% of electricity usage. The most efficient electric motors today are some 20-25% more efficient that the installed capital stock. The penetration of efficient motors is around 70% in Canada and the U.S. (driven by regulation), but in selected European countries the market share of efficient motors can be as low as 15%. Products such as variable speed drives, automation solutions, power metering, and energy management systems can reduce energy consumption in an average facility by 10-20%. In commercial buildings there are three main areas to improve energy efficiency: HVAC control, lighting control, and building management systems. However, with regard to higher energy efficiency there are numerous products and services provided by our capital goods universe such as electrical motors, pumps, compressors, valves, controls, instrumentation, bearings, heat exchangers, and automation systems. Not surprisingly there are numerous companies across our capital goods universe that are essentially selling payback to end users in the form of lower energy costs, such as Schneider, ABB, Invensys, Sulzer Weir Group, IMI, Spirax-Sarco, Atlas-Copco, Honeywell, Ingersoll-Rand, Emerson, GE, SKF, Alfa Laval, Enodis, Schindler, Kone, UTX, GEA, and Metso.

Energy Efficiency in Consumer Markets

In residential markets, improved energy efficiency in lighting (19% of global electricity demand), heating ventilation and air conditioning and household appliances drive most of the potential energy savings. The savings in electricity overall would avoid the installation of around 400 GW of new generation capacity. (See Exhibit 163.)

Exhibit 163: Change in Electricity Demand in Residential and Services



Source: IEA.

We summarize the corporates exposed on the supply side of alternative energy in the Exhibit 164.

Exhibit 164: Corporates Exposed

Supply Side Application	Corporates Exposed
Transportation	SKF, NSK, NTN, Tomkins, GKN, Valeo, Continental, Alstom, Siemens, Bombardier, Invensys, GE, UTX, , MAN, Honeywell
Industry/Commerce	SKF, NSK, NTN, JTEKT, Komatsu, Miura, Hisaki Works, Alfa Laval, Schneider Electric, Atlas Copco, Invensys, ABB, Alfa Laval, Enodis, Spirax-Sarco, IMI, Tomkins, Metso, Weir Group, Sulzer, Schindler, Kone, Rockwell, Emerson, UTX, ASD, Siemens, Bucher Industries, Komax SPX
Consumer	Daikin Industries, Electrolux, Whirlpool, Siemens, Philips, GE, Zontobell, IMI, Tomkins,UTX, ASD, LII, , Hitachi, GGL

Source: Company data.

In Exhibit 165, we highlight our coverage universe and how companies are exposed either from a supply or a demand supply perspective.

Exhibit 165: Individual Company Exposure within Capital Goods Sector

Company	Product Area	Comments
ABB	Power T&D for wind-farms, wind turbine components	50% of sales exposure
Alfa Laval	Capital Equipment For Ethanol/Bio-Diesel Plants and LNG/GTL plants	In 2006 ethanol/bio-fuel plants accounted for 4% of group order intake. Average size of order for ethanol plant is €1-€2m.
Alstom	Hydro leader, Bio-mass, Clean Coal, equipment retro-fit for coal plants, leader for conventional 'island' nuclear plants	Power generation overall is 60% of sales, around one quarter of this is related to hydro, clean coal, nuclear
Areva	Nuclear mining and reactor leader, #3 in global power T&D, which is exposed to wind build-outs	Nuclear + power T&D is 100% of sales
Atlas Copco	Gas compressors	4% of group sales derived from gas and process compressors with high LNG exposure.
Bucher Industries	Farm Equipment - fodder harvesting machines	Benefit from US ethanol subsidies - higher corn crop prices. This market accounts for estimated 4-5% group sales
Chiyoda	LNG plant construction	LNG plant construction consists of 61% of order backlog as of December 31 2006.
Cookson	Crucibles used for production of solar-cells	Solar crucibles account for 2% of Ceramics division and 1% of group sales.
FKI	Generators for Gas, Hydro and Nuclear Fuelled Power generation	Brush Generators accounts for 11% of group sales with very strong medium-term growth outlook.
GEA	Turn-key bio-diesel, bio-ethanol and bio-gas plants as well as capital Equipment (decanters, dryers etc)	c9% of group sales from ethanol/bio-fuels but will be c2% of sales once sale of Plant Engineering is concluded.
General Electric	Wind, Nuclear JV, Solar, Clean Coal power generation	Alt energy accounts for <6% of GE's revs, but diversified infrastructure portfolio is well-positioned in most alt energy markets
Halma	Components for Fuel-Cells	<1% of group sales
Hitachi	Nuclear Power	
Ishikawajima-Harima HI	Tank, Nuclear Equipment	
JGC	LNG Plant Construction	LNG plant construction consists of 18% of order backlog as of September 30 2006
John Deere/Agco	Farm Equipment Producer	Beneficiary from higher crop prices particularly corn in North America used for ethanol production
Kitz	Valves	
Komax	Photovoltaic (solar power)applications	Provide automation applications for the production of solar panels. Accounts for estimated 5% of 2006 sales.
Kubota	Farm Equipment	Beneficiary from higher crop prices
MAN	Bio-Ethanol plants	<3% of group sales
Meisei Industrial	LNG Insulation	
MHI	Solar Panel, Wind Turbine, Nuclear Power	
Morgan Crucible	Fuel-Cell Components	Morgan develops graphite products and bi-polar plates for fuel-cells. c2% of group sales
Quanta Services	Contractor for power T&D	Quanta provides services to the construction of power infrastructure with exposure to the gas, nuclear and wind markets
SGL Carbon	Fuel-Cell Components	<1m revs, more R&D exposed
Shinko Plantech	Plant Construction	
Siemens	Wind turbine manufacturer, a leader in hydro power generation, global top 2 power T&D and clean coal overall	Power business area overall is around 26% of sales, around half of this is related to T&D and clean power generation
Sulzer	Pumps (oil&gas, LNG)/Surface coatings/Separation columns	Power/Oil & Gas and Power generation accounts for around 50% of group sales

Exhibit 166: Individual Company Exposure within Capital Goods Sector continued

Company	Product Area	Comments
Toshiba	Nuclear Power	
Toyo Kanetsu	Tank Equipment	
United Technologies	UTC Power Fuel Cells	$70mm of revs annually will ramp if successful w/ commercialization
Vestas	Wind-Power	100% of sales
Weir Group	Pumps/Valves/Fuelling for Nuclear Power Stations, LNG Carriers/Wave Power JV	Power/Oil & Gas accounts for 37% of group sales
Demand-Side Exposed:		
ABB	Low voltage electrical equipment, components into the rail industry	
Alfa Laval	Plate Heat Exchangers	Plate heat exchangers are more efficient than shell and tube heat exchangers. 50% of group sales derived from heat exchangers.
Atlas Copco	Industrial Compressors	Energy efficient production of compressed air. 70% of life-cycle cost of industrial compressor is energy costs.
Bucher Industries	Farm Equipment - fodder harvesting machines	Benefit from U.S. ethanol subsidies - higher corn crop prices. This market accounts for estimated 4-5% group sales
Cooper Industries	Broad range of products across T&D system including automation technologies for monitoring, metering, and energy management	General beneficiary of increased infrastructure spending assocaited with alt energy sources
Electrolux	Energy Efficient Kitchen Appliances	
Emerson	Inbound power systems, energy consumption monitoring, electrical testing, diesel generation	Helps customers control and improve manufacturing and production processes
Enodis	Energy Efficient Appliances For Commercial Kitchens	
IMI	Thermostatic radiator valves, Balancing Valves	Products reduce energy consumption in residential and commercial buildings. TRVs statutory across residential market in Germany. 12% of group sales derived from Indoor Climate division.
Invensys	Automation Systems	
Komax	Photovoltaic (solar power)applications	Provide automation applications for the production of solar panels. Accounts for estimated 5% of 2006 sales.
Legrand	Low voltage electrical equipment	Increased residential automation
MAN	More environmentally-friendly truck engines	
Metso	Automation Systems	
Philips	Lighting	
Rockwell	Automation systems	Helps customers control and improve manufacturing and production processes
Schneider	Energy Management	In unique position given positioning in electrical distribution, industrial control, building control (need control of installation to deliver energy efficiency), critical power. 9% of group sales derived from building automation and energy management.
Siemens	Low voltage electrical equipment, lighting, rail transport	
SKF	Bearings	Reduced friction in bearings lowers energy consumption in a multitude of end-markets. Bearings/after-market service
Spirax-Sarco	Steam-Traps, Valves, Controls, Instrumentation	85% of group sales exposed to products result in lower energy use as steam does not condensate into water

Exhibit 167: Individual Company Exposure within Capital Goods Sector continued

Company	Product Area	Comments
SPX Corporation	Transformers, high voltage substations, switchyards, transmission lines	General beneficiary of increased infrastructure spending assocaited with alt energy sources
Sulzer	Pumps (oil & gas, LNG)/Surface coatings/Separation columns	Power/Oil & Gas and Power generation accounts for around 50% of group sales
Tomkins	HVAC Components/Powertrain Auto Systems	

Source: Company data, Credit Suisse estimates.

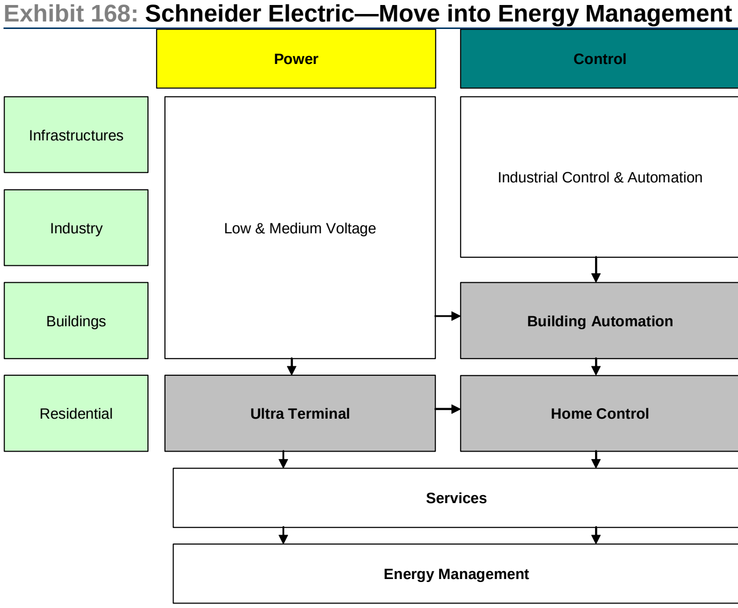
With regard to investment opportunities for alternative energy plays across the capital goods universe, we inevitably ask ourselves why should investors pay a very high multiple of earnings (or even sales) for a "pure-play" on alternative energy supply when there are equally a multitude of companies just as potentially exposed on the "supply side" of alternative energy at a fraction of the respective valuations. Indeed, beyond the secular drivers of the industrialisation and infrastructure growth of emerging markets (the industrialization and urbanization of the two most populated countries in the world) and a return to trend levels across global corporate capital spend, higher energy prices are driving demand for many products and services across our universe.

Attempting to highlight the most exposed companies is a difficult process given that most of our corporates have some sort of exposure in one way or another. However, below we highlight three case studies all of which we believe are attractive (short and long-term) investment propositions.

Schneider Electric

Arguably the company within our coverage with the best exposure to energy efficiency is Schneider Electric, the global leader in low voltage and final low voltage electrical distribution and the global number 2 in industrial control and automation. The two fields of electrical distribution and control are increasingly converging and in order to deliver energy efficiency at an installation (such as a factory or office building) that installation first needs to be controlled. (See Exhibit 168.)

Exhibit 168: Schneider Electric—Move into Energy Management



Source: Company data, Credit Suisse estimates.

Over recent years Schneider has expanded its product and service offering into activities such as energy management, building automation, and critical power that are strategically related to its core power and control activities. In particular, Schneider believes that the market for energy efficiency is growing at 15-20% at present, with the group being able to provide 10-30% of energy savings from its complete range of products and services. Schneider has witnessed rising demand for systems and services to enhance energy management and process control. In addition, Schneider is enjoying demand for new distribution solutions that are required for renewable energy sources. Schneider can provide customers through a combination of products and services:

- enabling products such as variable speed drives, motor control, metering, etc.;

- offering supervision and control systems/software; and
- offering high-value services such as customer audits in order to help customers take the right decision in energy efficiency installations and suppliers.

With regard to energy consumption in the developed worlds of the E.U. and the U.S., we note that residential/consumer markets account for 25% of total demand, commercial buildings 40% of total demand, and the residual 35% from industry and infrastructure.

- In industrial and infrastructure markets, motors account for 60% of electricity usage. Through a combination of variable speed drives, power metering, energy management systems, and automation solutions, Schneider Electric believes that an average facility can reduce its energy consumption by 10-20%.
- In commercial buildings (the largest end user of electricity), Schneider is focused on three main areas to improve energy efficiency: HVAC control, lighting control, and building management systems. Renovation of an existing facility can yield up to 30% of energy savings.
- In residential applications, markets for energy efficiency are more fragmented but through products such as lighting control, heating monitoring and shutter control, Schneider believes that using energy efficient products may save 10-40% of electricity.

Schneider addresses the needs for greater energy efficiency through its TAC building automation subsidiary and other specialized subsidiaries—namely, Power Measurement Inc.

In building automation, Schneider provides increased comfort, security, and lower operating costs in commercial and industrial buildings through open systems technology. Schneider provides solutions for optimising energy consumption with two businesses: PowerLogic and Power Measurement Inc. PowerLogic is the global leader in providing energy reduction and reliability solutions. Power Measurement is a leading designer, manufacturer, and provider of enterprise management systems for energy suppliers, service providers, and energy consumers to optimize the delivery, measurement, and consumption of electricity and electrically powered equipment and systems. These two businesses have combined annual sales of €300 million, or some 2% of group sales. These two businesses combined (building automation and energy management) had combined annual sales of €1.2 billion for fiscal 2006, or some 9% of group sales. Integral within this offering for Schneider is its secured power activities, which have recently been enhanced with the acquisition of American Power Corporation (APC). Specifically within the field of energy consumption monitoring, Schneider Electric is the global leader.

The valuation of Schneider relative to its European capital goods peer group appears quite compelling at this juncture. Schneider trades at a 15% EV/EBITA discount to its peer group. Schenider Electric is trading at a P/E of 11.3 times based on our 2008 EPS estimate.

Spirax-Sarco

Spirax-Sarco provides knowledge, service, and products worldwide for the control and efficient use of steam and other industrial fluids. The business of Spirax-Sarco is concentrated upon the industrial and commercial-steam-using market and is widely spread across the world and across all manufacturing industries. (No industrial sector makes up more than 10% of group sales while no individual customer is more than 1% of group sales.) The global steam-using market is very fragmented and while Spirax-Sarco is the leading supplier to the market, the group still has a relatively small market share (10% of global market).

Steam is the natural choice as a heat medium in many industrial processes because of its high heat-carrying capacity, controllability, sterility, and efficiency as a heat transfer medium. The expertise in Spirax-Sarco is in applying the group's products to improve the efficiency of customers' process heating and reducing running costs, most notably energy consumption. Spirax-Sarco makes this knowledge available through extensive training programs and through its own trained 1,000-plus direct sales engineers and service engineers worldwide (30% of group employees), which build long-term partnerships with the group's customers. Spirax-Sarco's sales engineers are trained to analyze customer problems and to supply the solution through the application of the group's products (boiler controls and systems, flow metering, control systems, pumps and energy recovery systems, humidifiers, steam traps, etc.). In recent years, Spirax-Sarco has expanded its offering through the provision of services such as energy audits and steam trap surveys to identify potential improvements to customers' systems.

With rising energy prices affecting production costs, the industry is increasingly looking for ways in which to save energy costs while reducing maintenance and production costs. Below we highlight a number of examples where Spirax-Sarco has reduced energy costs for end customers:

- A Spirax-Sarco flash steam recovery system will cut visible plumes of flash steam from an industrial site, which can allow a boiler to be taken off-line. With the remaining boilers working toward optimal capacity utilization, these will result in energy savings of 10% on top of the 10% saved directly by the waste heat recovery.
- In a Finnish pulp mill, Spirax-Sarco carried out a survey in order to rectify problems with its dryer. Spirax-Sarco installed a steam trap on each steam heater battery that removed condensate in a controlled way and resulted in reduced steam consumption and no corroded batteries.

More than 80% of group sales for Spirax-Sarco are focused upon steam specialities and lower energy usage. Spirax-Sarco is trading at a P/E of 15.5 times based on our 2008 EPS estimate.

Alstom

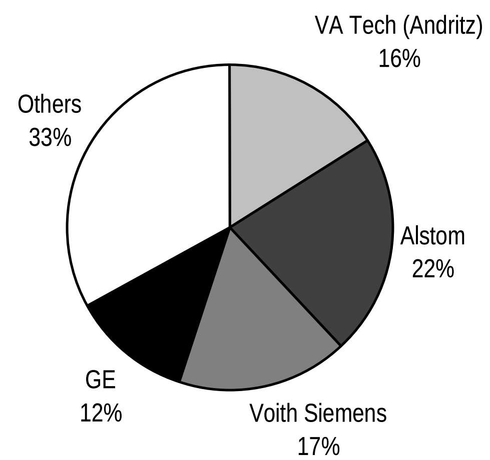
Following substantial portfolio changes in recent years, Alstom's current product offering is well exposed to demand as well as to supply considerations in terms of the need for emissions reduction, in our opinion. Sixty percent of group sales accrue from the power generation market (and more environmentally friendly ways of producing electricity), with the remaining 40% accruing from rail transport, which is likely to benefit from efforts to reduce the consumption of fossil fuels in private vehicles. In terms of market positions worldwide, Alstom is a number 1 in power markets such as the conventional "island" surrounding the nuclear "core," number 1 in hydro power globally, number 1 in emissions control technology for coal-fired power stations, and number 3 in gas turbines globally.

Power Generation

We see four main areas in which Alstom has good exposure to supply-related considerations for cleaner electricity production worldwide:

- *Leading position in nuclear and hydro*. Alstom is a leader in the hydroelectric power generation equipment market, with around 22% market share. This is a fairly consolidated industry, and Alstom has participated in many of the largest projects worldwide, including the Three Gorges project in China, which the company took investors to see at its Capital Markets Event in mid-March 2007. Although Alstom does not provide the core nuclear reactor for nuclear power plants, it is the leader in the conventional equipment surrounding this core, such as the generators, steam turbines, etc. (In September 2006, Alstom won an order from EDF to build the biggest ever steam turbine for a new EPR plant in France.)

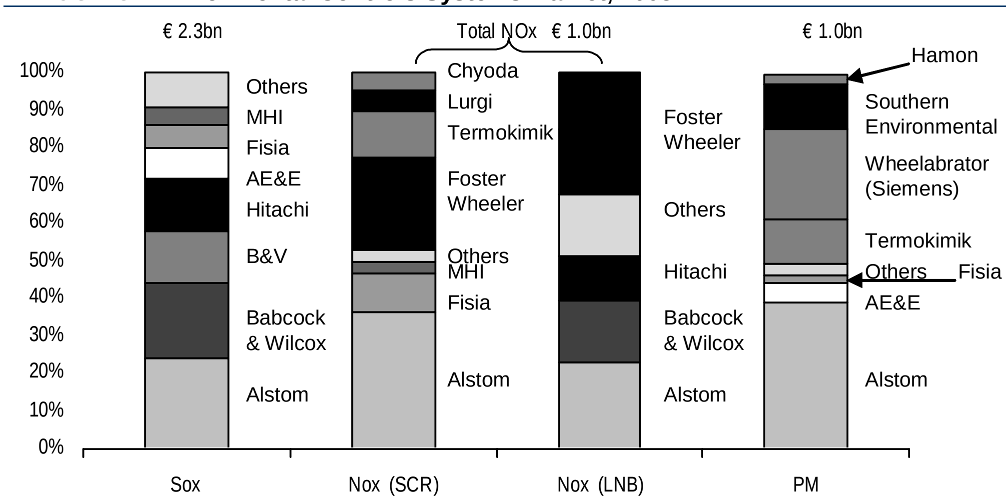
Exhibit 169: Hydroelectric Power Generation Equipment Market Shares



Source: Andritz.

- *Leader in pollution control equipment for coal-fired power plants*. Alstom's environmental control systems business is a clear leader in a fairly disaggregated market, and it is a business that is growing at double-digit rates, with above-group average operating margins. Key offerings from this business include flue gas desulphurizers (dry, wet and seawater based, to reduce sulphur dioxide emissions), electrostatic precipitators (to reduce ash from coal boilers), fabric filters (ash-laden gas is sieved, in order to collect submicron-sized particulates), mercury-emissions-reduction equipment, and selective catalyst reduction (SCR) systems to reduce nitrogen oxide emissions.

Exhibit 170: Environmental Controls Systems Market, 2005

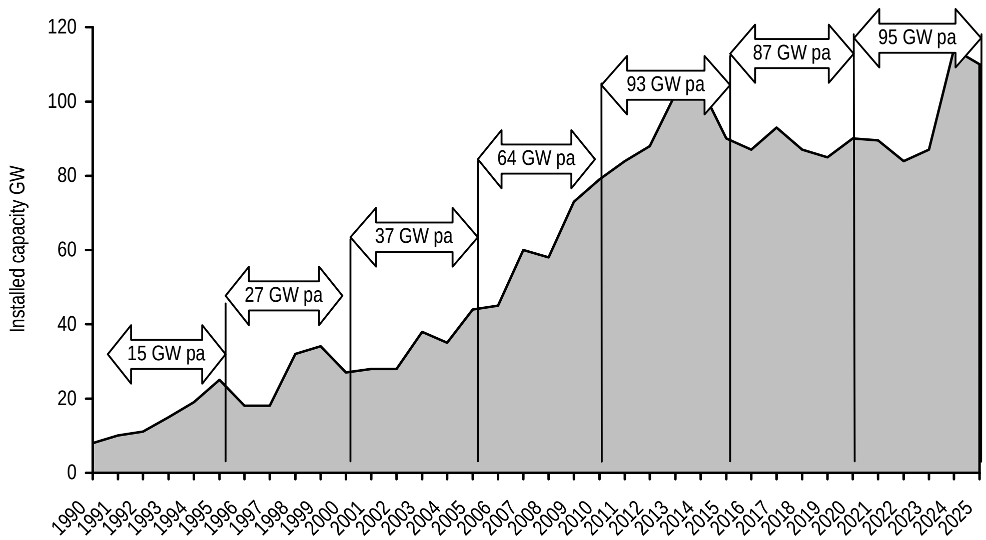


Source: Alstom.

- *Leader in leading-edge clean coal technology*. Alstom is a leader in several key areas that are likely to lead to much cleaner coal-fired power plant generation. One of these is co-firing bio-mass, which burns coal together with another fuel (e.g., wood), and is carbon-neutral. Alstom installed biomass technology for Scottish and Southern Energy at the U.K.'s first dedicated coal and biomass co-firing plant. In terms of next-generation technology, there are three areas that the company is focusing on in order to reduce carbon dioxide emissions: oxyfiring technology (which burns coal in a mix of oxygen and recirculated carbon dioxide, rather than air, and enables carbon dioxide emissions capture); chemical looping combustion (CLC)—a calcium-based compound is used to transfer oxygen from the combustion air to the fuel; the lack of direct contact between these two isolates CO_2 from the other flue gases, enabling capture); and chilled ammonia carbon capture. (This captures CO_2 from flue gases from coal fired boilers and natural gas combined cycle plants.) Alstom is due to start construction of a chilled ammonia plant in Wisconsin in the U.S. in early 2007.

- *Power service business should benefit from aging installed fleet*. The proportion of installed power generation capacity worldwide, which is more than 40 years old (deemed a key milestone in the industry in terms of the need for major refitting of equipment), is likely to considerably increase over the next decade. Clearly, much of the aging power plant fleet will have relatively high emissions—closing most of them down is not practical or desirable—so this is likely to require significant investments in retrofitting of more efficient equipment within the plants, and servicing this equipment.

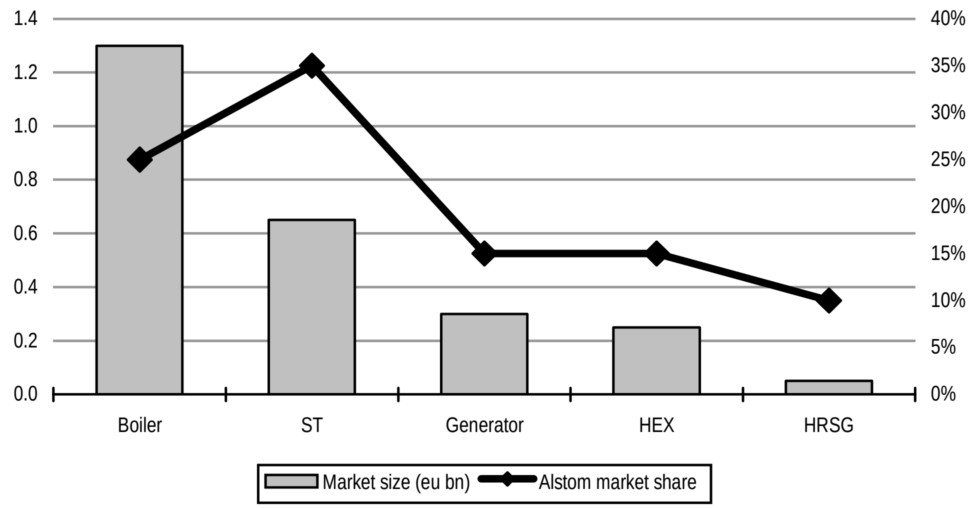
Exhibit 171: Installed Power Plant Capacity Exceeding 40 Years of Age



Source: Alstom, UDI.

Alstom's market share of the retrofit power equipment business is fairly high, as it has the largest installed base of any vendor globally. Note that its power service division is now 20% of sales, with midteens operating margins, and should benefit from increased service requirements from older plants and newer-generation plants that are now moving beyond their equipment warranty periods.

Exhibit 172: Alstom's Market Share of Retrofit Power Equipment Businesses

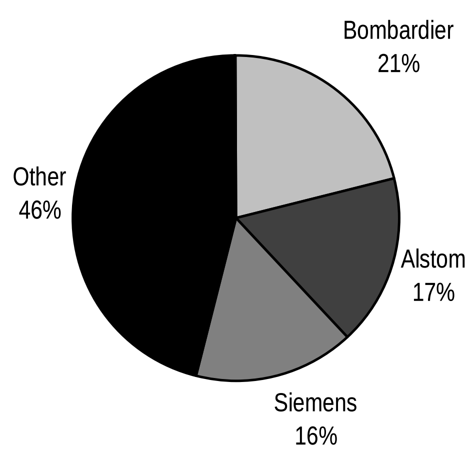


HEX (Heat Exchanger); HRSG (Heat Recovery Steam Generator); ST (Steam turbine).
Source: Alstom NB.

Rail Transport

Alstom is one of the top 3 global providers of rail equipment. Its business has been European focused, with 49% of sales accruing from Southern Europe, 27% from Northern Europe, 14.5% from the Americas, and 9% in Asia in fiscal 2006, but it does have activities in 50 countries. The key product line is rolling stock (58% of sales); Alstom supplies a very broad range of products, including trams, metros, regional trains, high-speed trains, locomotives, and wagons, as well as train life services (18%). Information solutions (13.5% of sales) involves the train control system and passenger information system. The remainder of the business is involved in activities such as electrification (design, manufacture, and installation of the electric power supply) and track laying.

Exhibit 173: Average Rail Market Share Based on Worldwide Orders*, 2003–05



** Note the market excludes markets which Bombardier classify as not accessible to open bid competition, excluding the N. Aerican freight locomotive and wagon markets and electrification.*
Source: Bombardier.

Supply-Side Drivers—Low CO_2 Emission Power Generation Spend (Renewables/Nuclear) Also Rising Quickly

Capital goods companies provide equipment and services for capital formation across the supply for the alternative energy subsector in six main areas:

- *Capital equipment* (pumps, boilers, valves, plant engineering, decanters, heat exchangers, automation equipment, instrumentation, software etc.) used in the manufacture of nontraditional hydrocarbons such as biofuels, gas-to-liquids, coal-to-liquids, coal-to-gas. There are a large number of capital goods companies exposed here, but we would hazard that these markets generally represent a small proportion of the overall sales for these groups: Alfa Laval, GEA, Spirax-Sarco, Sandvik, ABB, GE, Siemens, Schneider, Invensys, MAN, Sulzer, Metso, IMI, and Weir Group.

- *Capital equipment used for nontraditional electricity generation* such as wind turbines, hydro power, solar, biomass, geothermal, and wave. Companies exposed here are Vestas, Clipper Windpower, Siemens, Mitsubishi, Suzlon, Enercon, GE, Gamesa, Alstom, Andritz, Ocean Technologies, and Weir Group.

- *Other alternative energy technologies* such as fuel cells, micro turbines, hydrogen power, etc. Companies exposed here are Ingersoll-Rand, Turbo Genset, Halma, and SGL Carbon.

- Although it is not strictly renewable energy, *capital equipment to reduce emissions* in nonrenewable energy sources such as coal, oil and gas-fueled power plants today represent some 70% of total global installed capacity for electricity generation. The power sector accounts for 40% of the CO_2 emissions from fossil fuel combustion, well ahead of the second largest segment (transport). Companies exposed here include Alstom, Siemens, Foster Wheeler, Mitsubishi, Hitachi, and GEA.

- Although not strictly renewable, the provision of *nuclear-powered electricity* is likely to have an expanded role in future global energy supply. Companies exposed here are Areva, Toshiba, MHI, Hitachi, GE, Weir Group, and IMI.

- *Corporates that are indirectly exposed,* particularly with regards to the industries providing the feedstocks for alternative energy—that is, principally agriculture markets. Companies exposed here are Deere & Co, AGCO, CNH, and Kubota.

We highlight corporate exposure to each of each of these applications in Exhibit 174.

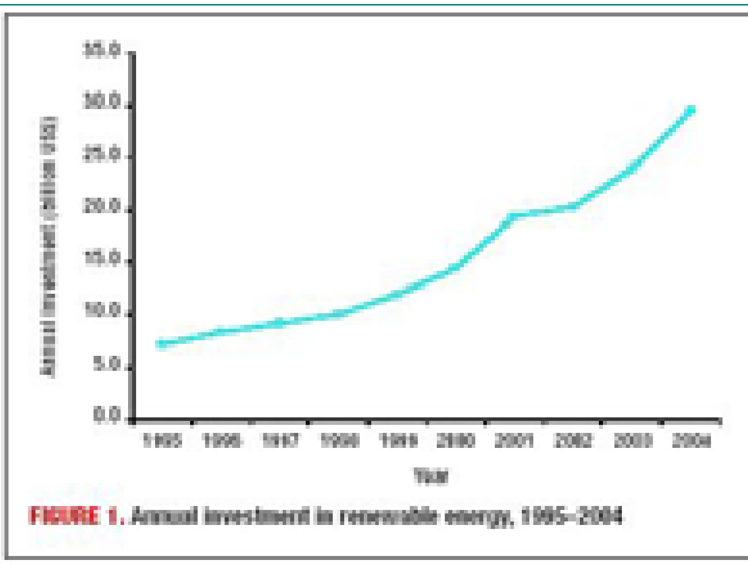
Exhibit 174: Corporate Exposure to Demand in Side Applications

Demand Side Application	Corporates Exposed
Ethanol, Bio-Diesel	Alfa Laval, GEA, Invensys, Toyo Kanetsu, MAN AG,
Coal To Liquids	Shinko Plantech, Toyo Engineering,
Gas to Liquids	Yokogawa, JGC, Chiyoda, Nikkiso, Meisei Industrial, Atlas Copco, Weir Group
Coal To Oils	Shinko Plantech, Toyo Engineering
Hydro	GE, VA Tech (Andritz), Alstom, Voith Siemens, FKI
Wind	MHI, ABB, Vestas, Clipper, Suzlon, Gamesa,
Solar	MHI, Cookson, Evergreen Solar, Sun PowerCorp, Q Cells ,
Geothermal	Alstom
Biomass	Alternative Energy Solutions, Alstom, Babcock-Hitachi, MHI, Advanced Alternative Energy Corp
Wave	Weir Group, Ocrean Power Delivery, Ocean Technologies,
Fuel Cells	Ebara, Halma, SGL Carbon, Morgan Crucible, United Technologies
Micro-Turbines	Ceres Power, ITM Power, Alternate Energy Corp,
Cleaner Coal	Siemens, Alstom, GE,
Nuclear	Areva, Alstom, MHI, Hitachi, Toshiba, Ishikawajima-Harima HI, FKI

Source: Credit Suisse.

According to a report published by the REN21 Renewable Energy Policy Network, investment in renewable energy worldwide was some US$30 billion, excluding hydropower, in 2004. (This is compared with investment in the entire power generation sector of roughly US$150 billion.) The share of capex in renewables (20%) is clearly exceeding the share that renewables hold in existing installed capacity (approximately 7-8%).

Exhibit 175: Annual Investment in Renewable Energy
US$ billions



Source: Renewables 2005 global status report.

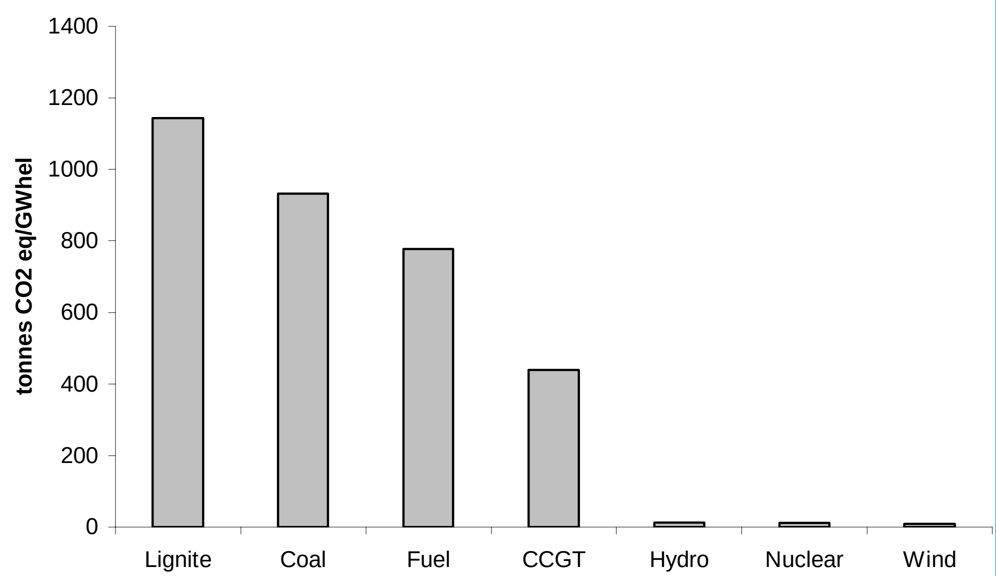
For example, according to market researchers Frost & Sullivan, the European renewable power plant servicing market earned revenues of US$418 million in 2005 and this is estimated to reach US$1.2 billion by 2012. The expanse in power generation will necessarily impact the power transmission and distribution networks, with European companies such as ABB, Siemens, and Areva benefiting, as well as U.S. names such as Cooper, Quanta Services, SPX, Hubbell, and Infrasource. In particular, growth in wind power will most likely have the greatest impact, given the high demand for reliable transmission networks with regard to offshore sites. (We detail the likely impact further ahead in our section on wind-powered generation.)

Renewables

Global regulatory and legislative change in the renewable power segment should create a growing need for improvements in power generation equipment as well as in grid networks and transmission infrastructure.

Driven by the increasingly apparent environmental consequences of thermal-fueled electricity production (see Exhibit 176), we expect spending in the sector to ramp up in the medium term.

Exhibit 176: CO_2 Emission by Energy Source
tonnes eq/GWhel, unless otherwise stated



Source: Areva, WEC.

In Europe, renewable energy is expected to increase significantly as a proportion of European power supply in the coming years, as we discussed.

The E.U. Directive on the Promotion of Electricity (2001) aims to double the share of overall renewable energy production from 6% to 12% by 2010 and further to 20% by 2020. The January 2007 E.U. Commission Energy Policy review noted that the renewable energy share is now unlikely to exceed 10% by 2010. This requires more action to create a credible plan.

The European Commission has announced €1 billion investment between 2007 and 2013 in energy technology research, seeking to lower the costs of renewable energy and to increase the efficiency of energy use. By providing a large cash injection into renewables, the Commission hopes that member states and the E.U. power industry will follow the lead with their own investments.

Exhibit 177: Split of Western Europe Power Generation Capacity
%, unless otherwise stated

% Split	2000	2001	2002	2003	2004	2005	2006E	2007E	2008E	2009E	2010E
Coal	33%	32%	32%	31%	31%	30%	30%	30%	29%	29%	29%
Gas	22%	23%	22%	22%	22%	22%	22%	23%	23%	23%	23%
Hydro	23%	22%	23%	23%	23%	23%	23%	22%	22%	22%	22%
Nuclear	20%	20%	19%	19%	19%	18%	18%	17%	16%	16%	16%
Wind	2%	3%	4%	4%	5%	6%	7%	7%	8%	8%	9%
Solar	0.0%	0.0%	0.0%	0.1%	0.2%	0.3%	0.4%	0.5%	0.6%	0.7%	0.9%
Geothermal	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Other	0.2%	0.3%	0.3%	0.3%	0.4%	0.5%	0.6%	0.7%	0.8%	0.9%	0.9%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Source: Credit Suisse research, Credit Suisse estimates.

While, in our view, many E.U. member states are likely to miss their respective targets, efforts are nonetheless under way

Some countries are achieving more than others. On August 22, 2006, the Italian government body in charge of the renewable energy sector reported that Italy is on track to produce 22% of its electricity from renewable sources in 2010 versus 17% at the end of 2005. This increase will be led by wind projects adding nearly 5 GW in installed capacity in the period.

Exhibit 178: E.U. Targets

E.U. – Country	Share of total power production (%)	Target Value (%)
	1997	**2010**
Belgium	1.1	6.0
Denmark	8.7	29.0
Germany	4.5	12.5
Finland	24.7	31.5
France	15.0	21.0
Greece	8.6	20.1
Great Britain	1.7	10.0
Ireland	3.6	13.2
Italy	16.0	25.0
Luxembourg	2.1	5.7
Netherlands	3.5	9.0
Austria	70.0	78.1
Portugal	38.5	39.0
Spain	19.9	29.4
Sweden	49.1	60.0
E.U. – Total	**13.9**	**22.0**

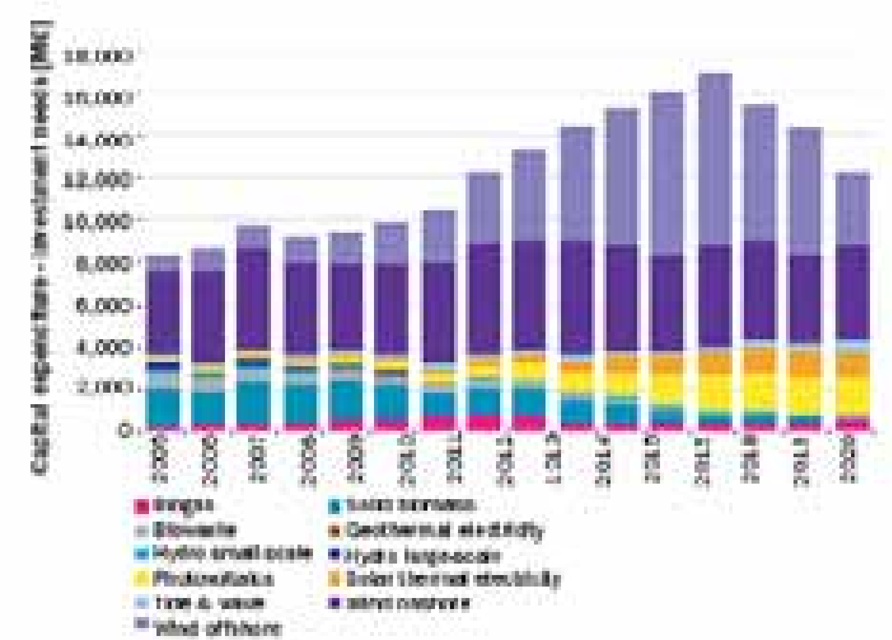
Source: E.U. Commission.

The increased spending outlined above should benefit those capital goods companies that produce power generation equipment, including Siemens (wind turbines, power generation refits, and environmental controls), Vestas and Gamesa (wind turbine manufacturers), and Alstom (hydro and environmental controls).

There should also be positive effects on power transmission and distribution companies.

In Exhibit 179, we highlight the investment needs in various renewable energy sources, as noted by the EWEA under the "BAU-scenario," which assumes a continuation of the current Renewable Energy Source policies up to 2020. As expected, it underlines that of the €9-10 billion total investment required in 2007 and 2008, well over half will likely feed into wind technologies (onshore and offshore).

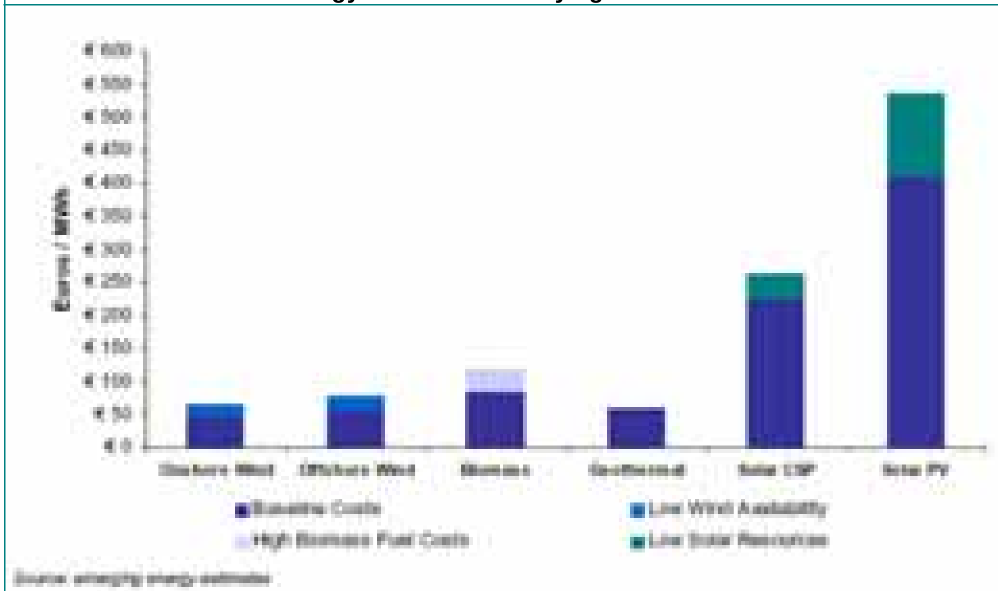
Exhibit 179: Total Investment Needs in the Period 2005-20 within the EU15 in the BAU Scenario



Source: EWEA.

We examine some of these implications for capex and costs in more a detailed breakdown by technology in Exhibit 180.

Exhibit 180: Renewable Energy Costs Under Varying Conditions

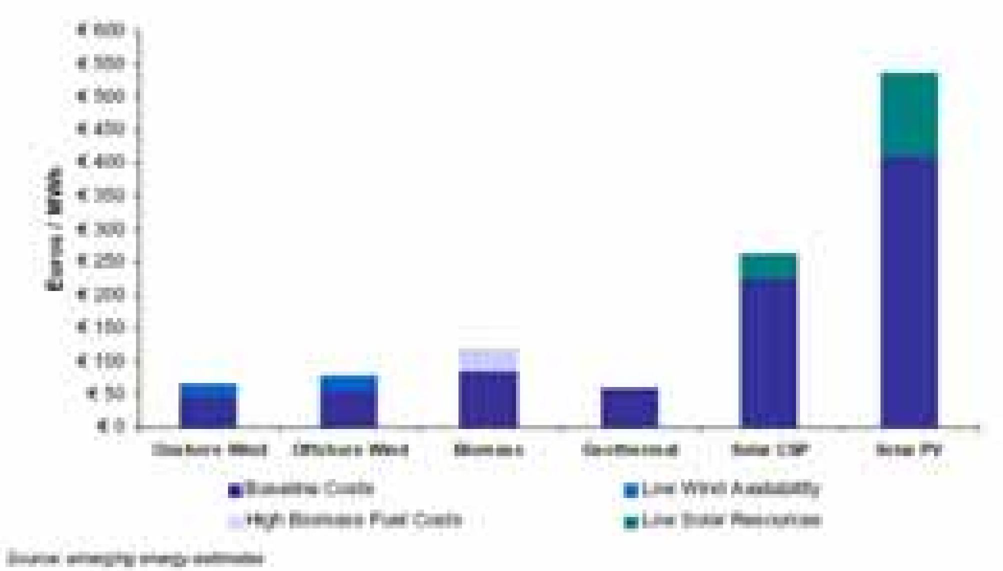


Source: Emerging Energy Research.

Wind Power

Europe constitutes 70% of global installed wind power capacity today, and wind remains the most cost competitive of renewable energy forms, although it still lags some way behind coal and gas—hence the need for some continued regulatory support.

Exhibit 181: Renewable Energy Costs Under Varying Conditions



Source: Emerging Energy Research.

Economies of scale can sometimes be perceived as detrimental to wind as an energy choice; turbines range from 1 MW to 3 MW at the higher end, while coal and gas turbines can reach sizes of almost 300 MW, yet the cost per MW is much higher for wind turbines. The issue of space is also a very pertinent consideration, particularly in crowded areas of Europe. To achieve the equivalent power capacity of a gas turbine, 100 wind turbines could be necessary.

Globally, growth is still expected to trend upwards, with the majority of additions to installed capacity accruing in Western Europe, Asia, and North America.

Exhibit 182: Wind Installed Capacity
GW

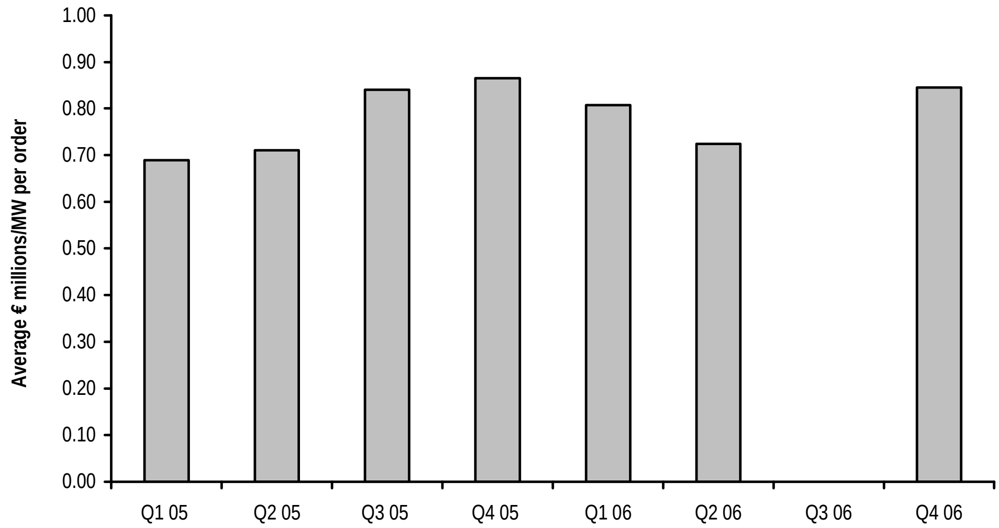
	2002	2003	2004	2005	2006E	2007E	2008E	2009E	2010E
North America	5	7	7	10	12	13	15	16	18
Growth	10%	36%	7%	37%	21%	9%	12%	11%	10%
Latin America	0	0	0	0	1	2	2	2	2
Growth	33%	99%	30%	3%	516%	15%	13%	12%	10%
W Europe	23	29	35	41	47	53	59	65	71
Growth	33%	24%	22%	18%	16%	13%	11%	10%	9%
E Europe, CIS	0	0	0	0	0	0	1	1	1
Growth	41%	10%	5%	12%	52%	68%	46%	35%	31%
Middle East, Africa	0	0	0	0	0	0	0	1	1
Growth	7%	19%	35%	5%	23%	19%	16%	14%	12%
China	0	1	1	1	4	4	5	6	7
Growth	17%	21%	35%	65%	183%	20%	18%	16%	15%
India	2	2	3	4	6	7	8	10	11
Growth	17%	25%	41%	48%	34%	20%	17%	14%	10%
Other Asia	1	1	2	2	2	4	7	10	14
Growth	43%	54%	66%	31%	-19%	132%	74%	51%	42%
Total	**31**	**39**	**48**	**59**	**72**	**84**	**97**	**111**	**125**
Growth	**28%**	**27%**	**22%**	**24%**	**22%**	**16%**	**15%**	**14%**	**13%**
% of installed capacity (GW)									
North America	16%	17%	15%	17%	16%	15%	15%	15%	14%
Latin America	0%	0%	0%	0%	2%	2%	2%	2%	2%
W Europe	74%	72%	73%	69%	65%	64%	61%	59%	57%
E Europe, CIS	0%	0%	0%	0%	0%	1%	1%	1%	1%
Middle East, Africa	0%	0%	1%	0%	0%	0%	0%	0%	0%
China	2%	1%	2%	2%	5%	5%	5%	5%	5%
India	5%	5%	6%	7%	8%	8%	9%	9%	8%
Other Asia	2%	2%	3%	4%	2%	5%	7%	9%	12%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Source: EIA, EWEA, WWEA, AWEA, Credit Suisse estimates.

Using empirical data from wind turbine orders from companies such as Siemens and Gamesa (note that Vestas no longer gives price information of orders, GE does not either, and Siemens gives limited disclosure) over 2005-06, the average price per MW of installed capacity won is around €0.69 million/MW.

Although this price may actually be overstated somewhat by service and maintenance contracts included in the final order prices, we think that pricing has remained fairly stable in recent quarters and that this price would give a potential investment total in Europe alone of €4.1 billion in 2007E, given our estimates of 6 GW worth of additions. (See Exhibit 182.) In the U.S. we would expect US$11.8 billion of wind investments in 2007 (based on estimates of 13GW of expansionary build).

Exhibit 183: Average Price of Orders
€ millions/MW

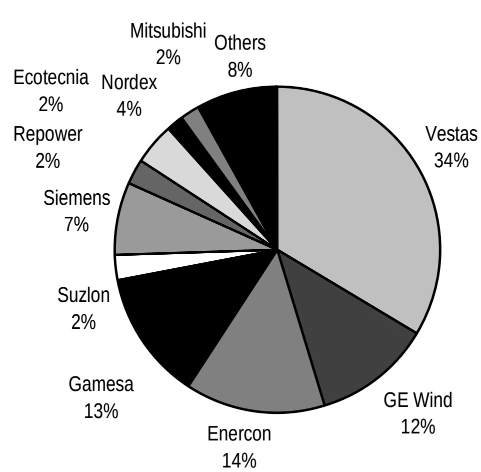


Source: Gamesa, Siemens (NB. No order values available for Q306).

The first point of capture for wind power investment comes in the turbine manufacturers. The market today based on installed capacity (i.e., power potential of wind turbines built) is split, as shown in Exhibit 184.

Vestas is the clear market leader overall and has diverse global market exposure versus other market leaders such as Gamesa (mainly European and Chinese markets) and General Electric (the leading vendor in the U.S.).

Exhibit 184: Installed Wind Power Capacity Split



Source: Gamesa (2005 annual report).

Exhibit 185: Wind Power Market Leaders by Country, 2005

Market leaders by country (2005)	Vendors		
	No. 1	No. 2	No. 3
USA	GE Wind	Vestas	Mitsubishi
Germany	Enercon	Vestas	GE Wind
Spain	Gamesa	Vestas	Acciona
India	Suzlon	Vestas	NEPC
Portugal	Enercon	Vestas	Gamesa
China	Gamesa	Goldwind	GE Wind
Italy	Vestas	GE Wind	Gamesa
U.K.	Siemens	Vestas	Repower
France	Repower	Vestas	GE Wind
Australia	Vestas	Enercon	Repower

Source: Gamesa.

Power Grids and Wind Power—Some Investment Needed

Wind power's intermittent generation nature was previously thought likely to cause problems with existing power grids, but Denmark, with the highest wind penetration in the world, has not seen major problems with its power grid in recent years. Wind energy appears able to meet up to 20% of demand on a large network without causing serious technical problems.

Integrating wind power into the grid appears to be less of a technical problem and more of an economical and regulatory issue. Some investments will be needed, however.

The main issues affecting electricity grids and wind power follow:

- New wind power is generally installed in peripheral regions with below-average power demand. This requires electricity to be transmitted over long distances to areas of higher demand, and this can add to congestion on the existing power grid, requiring extensions.
- A relatively small voltage drop (i.e., grid fault) can lead to a disconnection of a large number of wind generators, and then to a large generation deficit as certain types of turbine cannot control the reactive power output. The risk of voltage instability increases when the fault duration is long and the wind generators are connected to a weak grid. New grid connections must therefore be able to withstand voltage drops of certain magnitudes and durations.
- The lack of control of some types of turbines over their reactive power output means that in order to control the voltage, additional equipment for generating controllable amounts of reactive power is needed.

Several international studies (Austria, Denmark, Germany, France, the Netherlands) have determined the additional grid reinforcement requirements relating to wind power (using load flow simulations, etc.); these studies (taking into account onshore and offshore turbines) indicate, according to the EWEA, that the grid extension/reinforcement costs caused by additional wind generation are in the range of €0.4-4.7/MWh of wind.

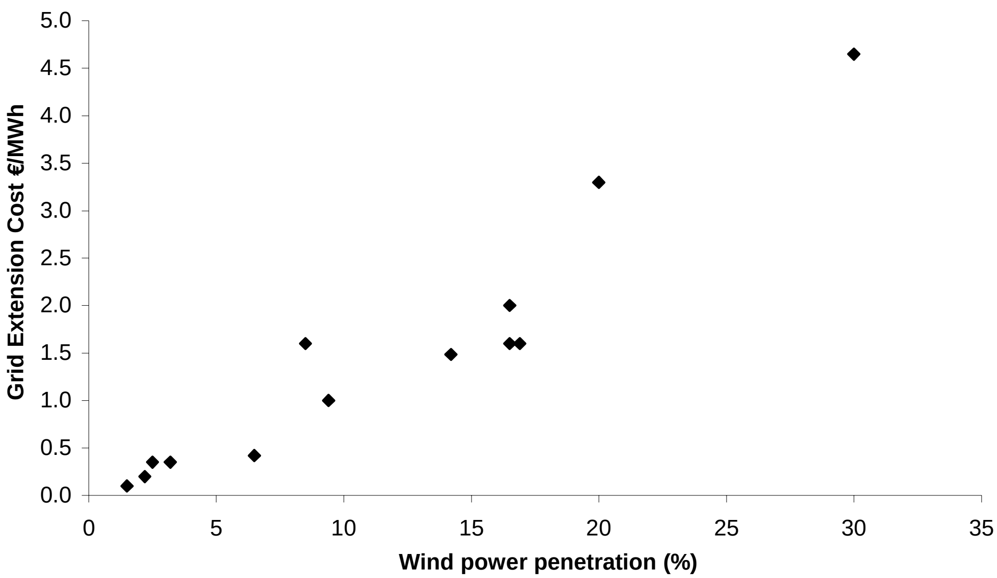
Exhibit 186: Summary of Country Studies on Wind Energy Effect on the Power Grid

Country	Wind scenario	% of gen. capacity	cost for T&D grid	Cost per MWh
U.K.	50:50 offshore/onshore split	20% (30%)	NA	€3.3/MWh (€4.7/MWh)
France	14GW	8%	€800m	€1.9/MWh
Netherlands	6000MW by 2020	NA	€200-500m	€1.1-2.2/MWh
Austria	1700MW by 2020	6%	NA	€0.4/MWh
Germany	36GW by 2015	13%	€1,120m	€0.9-1.0/MWh
Spain	20GW	NA	€500m	€2/MWh

Source: EWEA.

Estimates of the additional grid investment requirements of tying in wind power, depending on the size of the wind power proportion of capacity, are shown in Exhibit 187.

Exhibit 187: Estimated Additional Power Grid Extension Costs from Wind Energy



Source: EWEA.

The EWEA acknowledges that “there is no doubt that transmission and distribution infrastructure will need to be extended and reinforced in most of the E.U. countries when large amounts of wind power are connected.” Overall, it seems clear that wind turbine buildouts will lead to incremental T&D investment in Europe of several billion euros in the coming years against a Western European T&D equipment market of €10 billion in 2005 (i.e., the upgrades could be fairly meaningful).

Note the likely growth of the global T&D equipment market from total global power generation spend below. We forecast capital spending in T&D equipment globally to grow at 11-13% on an annual basis, with more modest growth across Europe (predominantly due to the historical lack of capex in intercountry networks).

Exhibit 188: T&D Market Spend
$ in billions, unless otherwise stated

Equipment (US$bn)	2003	2004	2005	2006E	2007E	2008E
Western Europe	9.4	9.6	9.9	10.2	10.9	11.4
Growth	1%	2%	2%	4%	6%	5%
Eastern Europe	2.2	2.6	3.0	3.4	3.9	4.4
Growth	18%	18%	16%	14%	14%	12%
CIS	4.1	4.4	5.0	5.7	6.3	7.1
Growth	1%	7%	15%	12%	12%	12%
Africa	1.2	1.5	1.7	1.9	2.2	2.6
Growth	19%	23%	10%	15%	15%	15%
Middle East	1.9	2.3	2.6	3.0	3.6	4.3
Growth	9%	18%	12%	17%	20%	20%
China	8.5	10.0	11.7	13.5	15.5	17.8
Growth	13%	18%	17%	15%	15%	15%
India	2.8	3.0	3.3	4.0	4.8	5.7
Growth	5%	8%	10%	20%	20%	20%
Asia ex-China, India	9.0	9.7	10.5	11.6	13.3	15.3
Growth	3%	8%	8%	10%	15%	15%
North America	7.4	7.0	7.1	7.4	8.0	8.8
Growth	2%	-5%	1%	5%	7%	10%
Latin America	3.4	3.6	3.8	4.0	4.3	4.7
Growth	2%	5%	5%	6%	8%	8%
Total	**50.1**	**53.8**	**58.6**	**64.7**	**72.8**	**82.0**
Growth	5%	8%	9%	11%	12%	13%

Source: Company data, Credit Suisse estimates.

Likely beneficiaries of increased spend in T&D include European names such as Siemens, Areva and ABB and in the U.S., Quanta Services, Cooper, SPX, Hubbell and Infrasource. the European vendors dominate the market, holding some 30-40% of global revenues in T&D collectively.

Hydro

Hydro generation can prove to be a sustainable and reliable source of energy, although it is highly capital intensive and limited by site availability. To date the main producers of hydro-based electricity are Brazil, Canada, the U.S., China, France, and the Scandinavian countries.

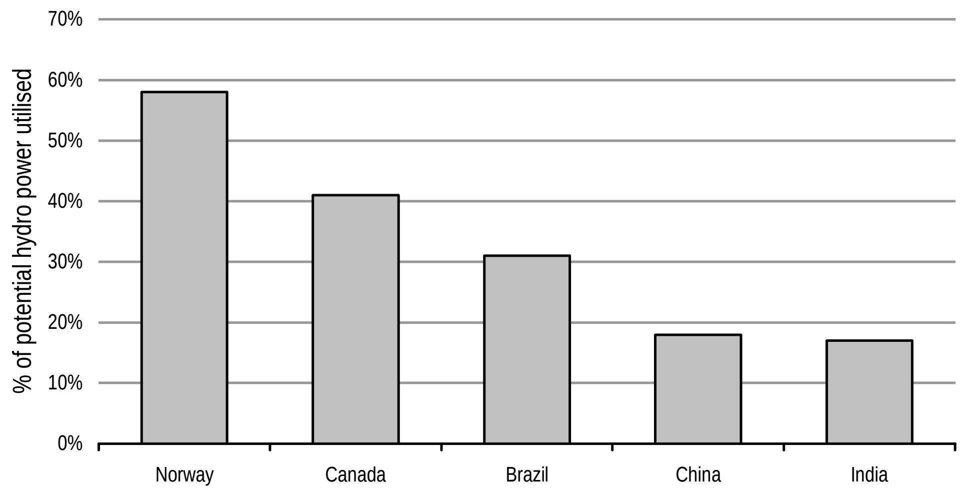
Exhibit 189: Hydro Installed Capacity
GW, unless otherwise stated

Hydro installed capacity (GW)	**2002**	**2003**	**2004**	**2005**	**2006E**	**2007E**	**2008E**	**2009E**	**2010E**
North America	147	149	151	152	153	154	155	156	157
Growth	0%	2%	2%	1%	0%	1%	0%	1%	1%
Latin America	117	120	124	127	128	130	133	135	138
Growth	2%	3%	4%	2%	1%	2%	2%	2%	2%
W Europe	148	153	159	161	164	166	168	171	173
Growth	2%	3%	4%	1%	1%	1%	1%	1%	1%
E Europe, CIS	80	80	80	81	81	82	83	84	85
Growth	1%	1%	0%	0%	1%	1%	1%	1%	1%
Middle East, Africa	26	26	27	27	28	29	29	30	30
Growth	3%	0%	2%	2%	2%	2%	2%	2%	2%
China	86	95	108	124	134	147	161	172	184
Growth	4%	10%	14%	15%	8%	10%	9%	7%	7%
India	27	28	33	34	37	40	43	45	48
Growth	4%	4%	18%	3%	8%	8%	8%	6%	6%
Other Asia	54	48	51	53	55	57	59	61	63
Growth	3%	-10%	4%	4%	4%	4%	4%	4%	3%
Total	**684**	**699**	**733**	**759**	**779**	**805**	**831**	**854**	**879**
Growth	**2%**	**2%**	**5%**	**3%**	**3%**	**3%**	**3%**	**3%**	**3%**
% of installed capacity (GW)									
North America	21%	21%	21%	20%	20%	19%	19%	18%	18%
Latin America	17%	17%	17%	17%	16%	16%	16%	16%	16%
W Europe	22%	22%	22%	21%	21%	21%	20%	20%	20%
E Europe, CIS	12%	11%	11%	11%	10%	10%	10%	10%	10%
Middle East, Africa	4%	4%	4%	4%	4%	4%	4%	3%	3%
China	13%	14%	15%	16%	17%	18%	19%	20%	21%
India	4%	4%	5%	4%	5%	5%	5%	5%	5%
Other Asia	8%	7%	7%	7%	7%	7%	7%	7%	7%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Source: EIA, Credit Suisse estimates.

Significant potential still remains in the some hydroelectricity producers, as shown in Exhibit 190.

Exhibit 190: Significant Hydro Potential Remains



Source: Ministry of Power, Government of India.

One example of such a market is India, which, as part of its target to add 100,000 MW of additional capacity from 2002-2012, recently lowered barriers to entry in the form of capital expenditure limits put in place by the Central Electricity Authority.

To further hasten the process, the central government now also provides equity funds to Central Public Sector Undertakings (CPSUs) specifically for hydroprojects. These can ensure debt financing over a longer period (due to the comparatively larger capital investment necessitated by such projects), and India's central government has also called on state governments to review procedures for land acquisition to move approvals and the implementation of projects along more quickly.

Fifty GW of initiatives have already been launched in India, and in total 162 projects are planned between 2007 and 2017.

Initiatives such as these should help vendors of power-generation equipment. Alstom, for example, has been one beneficiary, receiving an order for a €265 million project with India's National Hydroelectric Power Corporation (NHPC) for the turnkey supply of the largest hydropower scheme in India, the Subansiri Project in Assam (scheduled to come into operation in 2010).

This is encouraging, but we don't expect growth rates in hydroelectrical generation equipment to exceed that of their respective regional or global GDP rates.

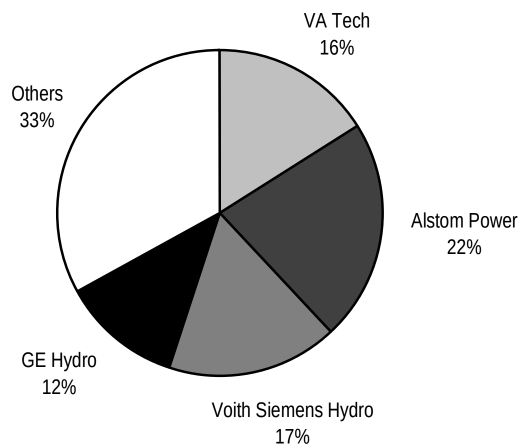
Exhibit 191: Hydro Power Equipment, Global Market Growth

Region	Market volume (€ millions)	Growth rate
Europe	600	2.5%
North America	400	1.0%
South America	400	1.0%
Asia excl China	440	3.1%
China	1,300	5.6%
World	**3,140**	**3.0%**

Source: Andritz.

In terms of vendors, Alstom is the world's leading hydropower equipment vendor, followed by Siemens, VA Tech, and GE. (See Exhibit 192.)

Exhibit 192: Hydro Power Equipment Vendors, Market Share Split



Source: Andritz presentation (VA Tech Hydro).

Geothermal

Geothermal is a comparatively little used renewable source of energy, mainly due to the limited resourcing and available sites.

Capital costs are high, but once running, geothermal power plants occupy comparatively little land area versus wind or hydro plants. Operating costs are very low as in the case of wind and hydroelectric power.

Unlike some other renewable electricity forms, geothermal can be a reliable source of base-load power capacity (i.e., it can sustain the level at which utilities deliver power throughout the day).

The large majority of existing geothermal capacity is used to derive thermal energy as opposed to generating electrical energy, though plants can perform a dual function..

Geothermal capacity is expected to grow at low and stable rates for the rest of the decade.

The main names we would highlight in this sector are on the whole unlisted private companies, although larger power generation companies, such as Alstom, do have minimal exposure to the sector.

Exhibit 193: Geothermal Installed Capacity
GW, unless otherwise stated

Geothermal installed capacity (GW)	2002	2003	2004	2005	2006E	2007E	2008E	2009E	2010E
North America	2.23	2.32	2.39	2.45	2.50	2.54	2.64	2.74	2.84
Growth		4%	3%	3%	2%	2%	4%	4%	4%
Latin America	1.16	1.19	1.23	1.29	1.34	1.38	1.42	1.46	1.50
Growth		2%	3%	5%	4%	3%	3%	3%	3%
W Europe	0.9956	0.996	1	1	1.024	1.0444	1.0544	1.0644	1.0744
Growth		0%	0%	0%	2%	2%	1%	1%	1%
E Europe, CIS	0.02	0.02	0.03	0.06	0.07	0.08	0.09	0.10	0.11
Growth		0%	30%	100%	17%	13%	13%	11%	10%
Middle East, Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Growth									
China	0.029	0.029	0.028	0.028	0.028	0.028	0.028	0.028	0.029
Growth		-0.6%	-3.4%	0.0%	0.0%	0.0%	0.8%	0.8%	0.8%
India	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Growth									
Other Asia	3.48	3.52	3.59	3.62	3.69	3.70	3.77	3.83	3.90
Growth		1.0%	2.0%	0.9%	1.8%	0.5%	1.7%	1.7%	1.7%
Total	**7.92**	**8.07**	**8.26**	**8.45**	**8.65**	**8.78**	**9.00**	**9.23**	**9.45**
Growth		**2%**	**2%**	**2%**	**2%**	**2%**	**3%**	**3%**	**2%**
% of installed capacity (GW)									
North America	28%	29%	29%	29%	29%	29%	29%	30%	30%
Latin America	15%	15%	15%	15%	15%	16%	16%	16%	16%
W Europe	13%	12%	12%	12%	12%	12%	12%	12%	11%
E Europe, CIS	0%	0%	0%	1%	1%	1%	1%	1%	1%
Middle East, Africa	0%	0%	0%	0%	0%	0%	0%	0%	0%
China	0%	0%	0%	0%	0%	0%	0%	0%	0%
India	0%	0%	0%	0%	0%	0%	0%	0%	0%
Other Asia	44%	44%	43%	43%	43%	42%	42%	42%	41%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Source: EIA, International Geothermal Association, Credit Suisse estimates.

Biofuels Capital Investment

Biofuels are renewable fuels that can be used as an alternative to carbon-derived fuels. Biodiesel (one of two biofuels, including bioethanol, a derivative of ethanol) can be used as an alternative to coal, gas or oil, all of which produce carbon dioxide and pollutants, such as sulphur dioxide as by-products. Biodiesel, on the other hand, is a natural hydrocarbon with a negligible sulphur content and when burned also produces a reduced level of carbon monoxide and around a 30% reduction in particulate emissions.

Biofuels are being actively promoted as a credible alternative to oil in transport in the latest review of energy policy by the E.U. Commission on January 10, 2007. (It set a binding minimum target for biofuels of 10% of vehicle fuel by 2020.) In order to achieve this, it aims to replace 2% of petrol and diesel for transport by biofuels by 2005 and 5.75% by 2010, although it should be noted that the 2005 target was not actually achieved, hence the reinforcement of the 2020 target.

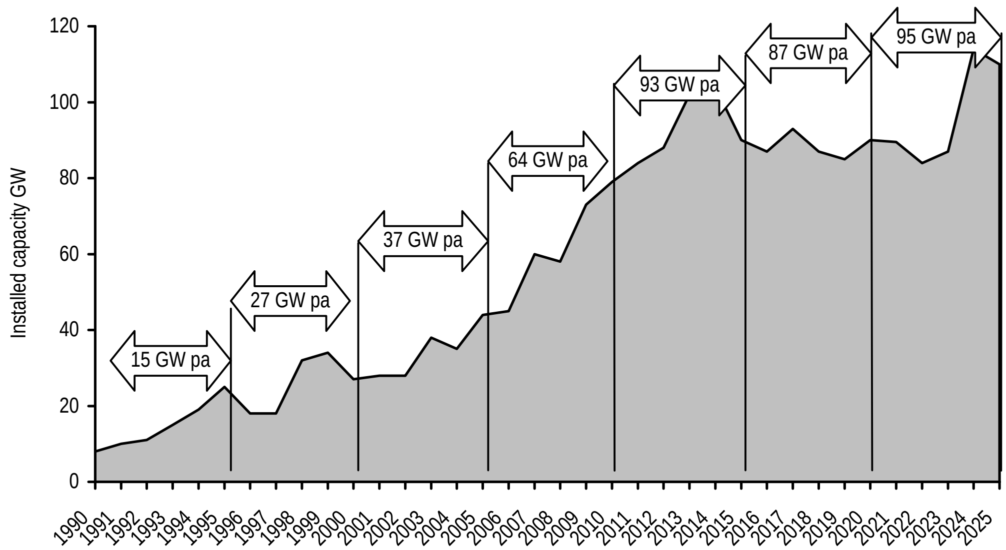
The disadvantages to biofuels lie in the need for government incentives, particularly with regards to plant builds. Most biofuels still require some form of government subsidies and as with oil and gas prices, the diversion of increasing amounts of the world's agricultural output into fuel production is likely to have impacts on certain crop prices. (Biofuels used include rapeseed, and palm and vegetable oils.)

In addition to the suppliers of biofuels themselves, key winners with regard to manufacturers of biofuel equipment include Alternative Energy Solutions, Alstom, Babcock-Hitachi, MHI, and Advanced Alternative Energy Corp.

Nonrenewable Alternatives

The growing acceptance of a need to reduce carbon emissions creates potentially large implications for increased spending on pollution controls and on upgrades to *existing* power plants, many of which are now aging.

Exhibit 194: Installed Power Plant Capacity Exceeding 40 Years of Age



Source: Alstom, UDI.

According to the EIA, the power sector globally in 2002 accounted for around 40% of the carbon dioxide emissions from fossil fuel combustion, well ahead of the second largest segment (transport).

There are several alternatives available to help in this regard.

Nuclear

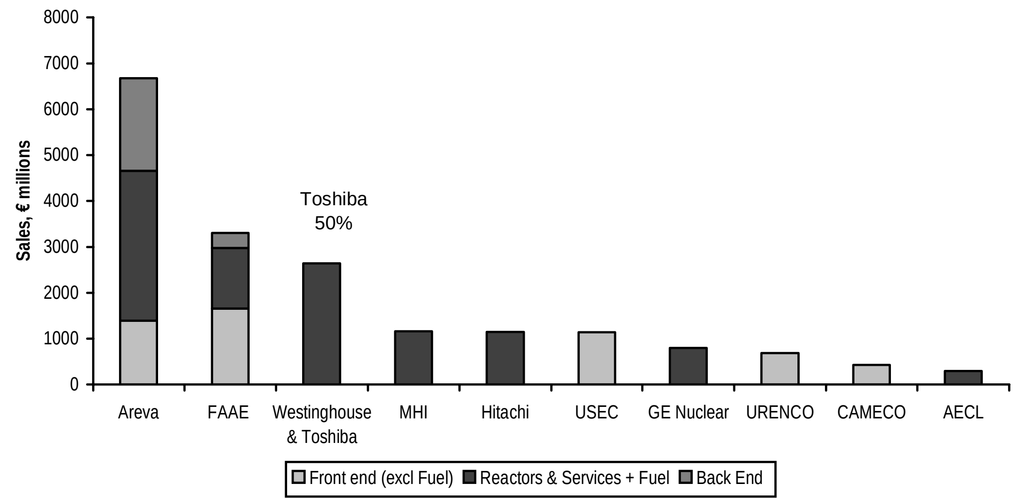
According to the World Nuclear Association, as of January 2007 28 nuclear plants were under construction, 64 plants in planning, and 158 plants proposed. Combined, these new plants total some 215 GW of additional capacity, which represents just under two-thirds of the present installed global nuclear base.

Clearly, this extra demand for nuclear power will have positive implications for nuclear equipment vendors. (See Exhibit 195.)

Areva is currently the largest global player, but the field holds many other participants: GE in the U.S., MHI and Hitachi in Japan, FAAE in Russia, etc.

For further information on nuclear as an alternative source of energy, please see our earlier section, A Nuclear Alternative, where we also discuss the investment thesis for CAMECO.

Exhibit 195: Nuclear Market Sales by Vendor
Eu in million



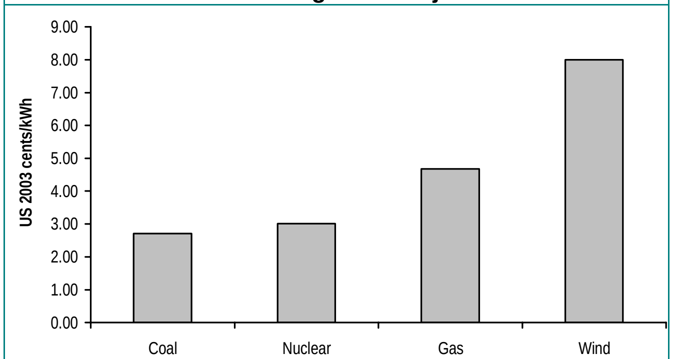
Source: Areva (FAAE = Federal Atomic Energy Agency of Russia, AECL = Atomic Energy of Canada Ltd).

Cleaner Coal

Coal represents an efficient and low-cost power generation fuel, and remains a significant part of installed capacity bases in the U.S., Europe, and China.

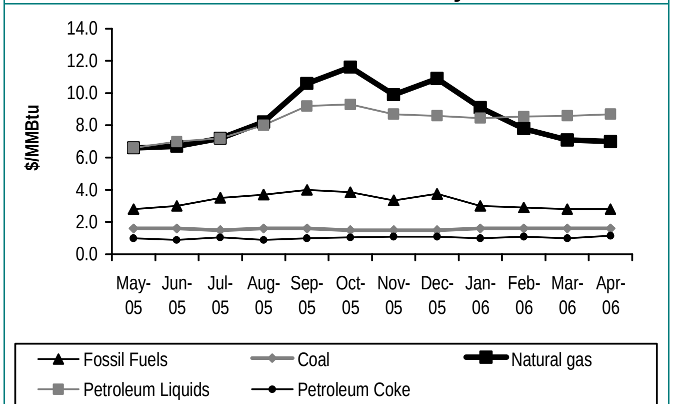
However, the pressure to reduce emissions is growing, and businesses such as Alstom's environmental controls systems division and Wheelabrator (acquired by Siemens in October 2005) address the issue through the development of technologies intended to ensure the capture and/or transformation of air pollutants—in particular, nitrogen oxides, sulphur oxides, and heavy metal emissions. Such offerings include selective catalytic reduction technology, scrubbers, and fabric filters, which are more commonly referred to as environmental controls systems.

Exhibit 196: U.S. Generating Cost Projections for 2010



Source: OECD/IEA NEA 2005.

Exhibit 197: U.S. Electric Power Industry Fuel Costs

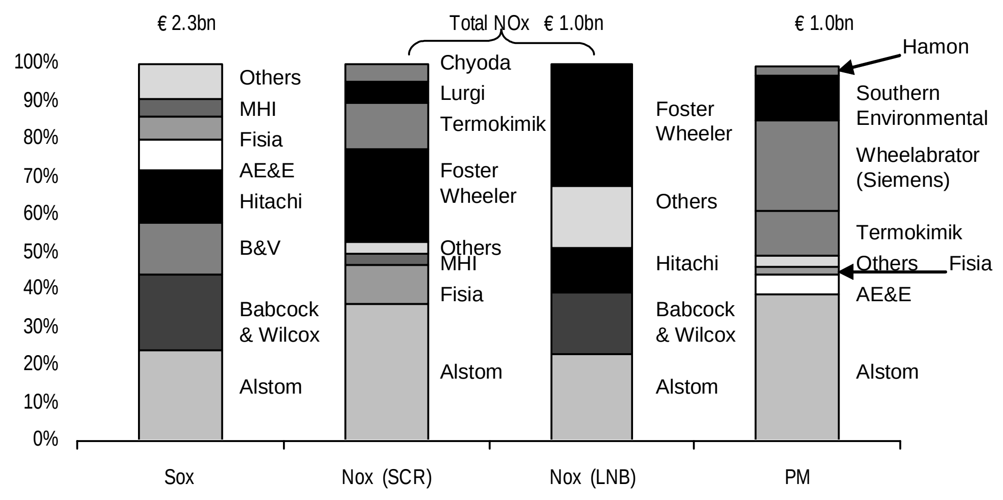


Source: EIA.

As with the E.U. Energy Policy, which specifically targets an increased uptake of renewable energy, the demand for ECS equipment will be driven in Europe by the E.U. implementation of the LCP (large combustion plants) directive, which directs new plants over 50 MW built after November 2002 to comply with emission limit values and also requires significant emission reductions from existing plants to be achieved by January 1, 2008 (to be reached through national emission reduction plans). Exemption from this compliance would only apply were a 20,000-hour limit placed on the operation of combustion plants from January 1, 2008, to December 31, 2015. Evidently, this directive should ensure a rally in demand for emissions control systems by current operation plants, particularly since widespread national compliance is required in all E.U. countries. Companies such as Alstom have also noted that many customers are keen to bundle work on environmental compliance with other upgrades, such as retrofits.

The addressable market is around €4-5 billion (in terms of putting ECS into the installed equipment base).

Exhibit 198: Environmental Controls Systems Market, 2005



Source: Alstom.

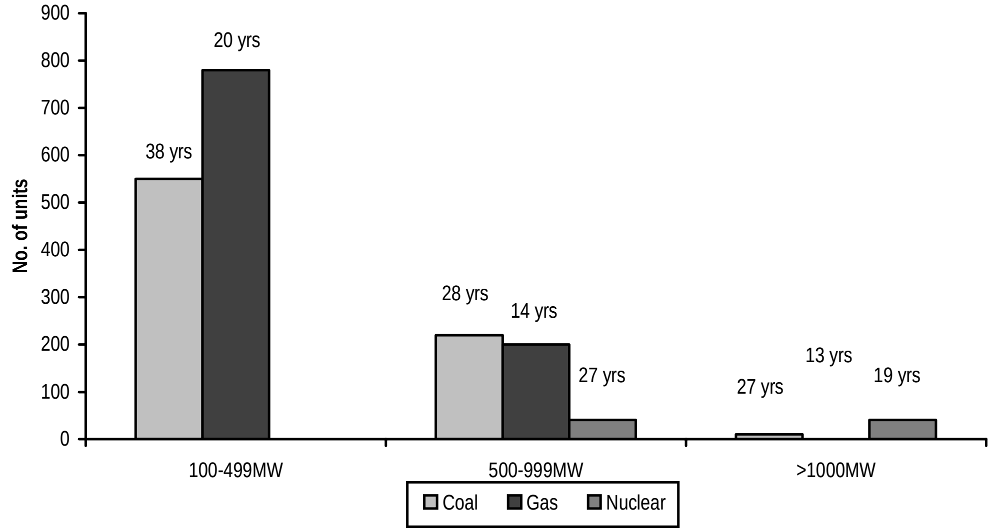
Turning to retrofit equipment, Alstom estimates the global market today is around €2 billion, including turbines and generators, with around one-quarter of this accruing to Alstom (although there is some overlap between retrofit and ECS equipment). There are two main motivations for electric utilities to replace aging power equipment:

- *Increased efficiency.* Added incentive results from the difference in electricity revenue generation that can be achieved through retrofitting a power plant. The cost savings achievable from retrofitting will not be passed on to the customer, since electricity prices are not expected to drop in coming years (given rising fuel prices). Hence the opportunities from retrofits in the form of revenue growth would, in our opinion, outweigh any downside from the fixed-cost investment.

- *Environmental regulations.* As discussed, more stringent regulations for compliance in countries such as the U.S. and Europe, added to the potential for future requirements in developing regions such as Asia and China, will necessarily increase demand for retrofits.

Drivers such as healthy balance sheets of the utilities and the aging state of many thermal plants (most coal-fired plants in the U.S., for instance, are 30-40 years old, since 50% of operational plants went into operation prior to 1970 according to Platts UDI Electric Power Plants Database; see Exhibit 199), further compound the willingness of plant owners to upgrade units.

Exhibit 199: Aging Coal-Based Fleet in the U.S.

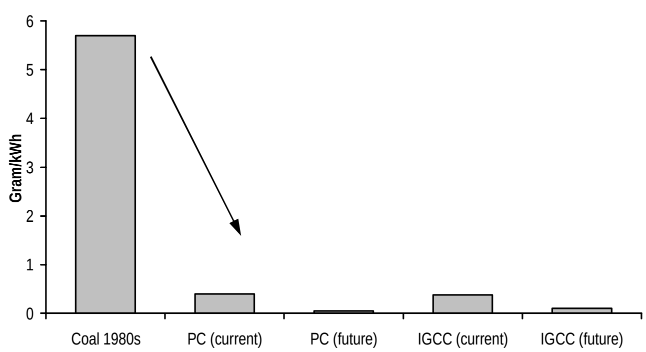


Fleet's average age per class of capacity shown above bars.
Source: Areva.

Emissions Reduction

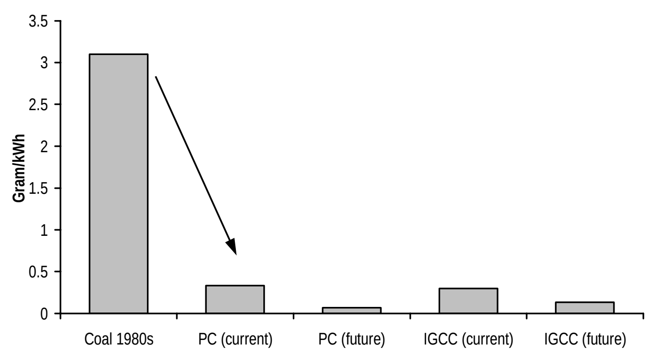
Some of the plants shown in Exhibit 198 have been retrofitted with scrubbers, with only a few equipped with more effective flue gas clean-up systems technology (which is now fitted as standard on new power plants in compliance with the U.S. Clean Air Act Amendments of 1990). The average net energy conversion efficiency of these older plants is about 32%; however, nowadays advanced pulverised coal-fired power plants can achieve net power plant efficiencies of 40% or higher, reducing the amount of coal consumed, CO_2 discharges, and emissions. Exhibit 200 and Exhibit 201 highlight the reductions in emissions that have been achieved since the 1980s through the introduction of new technology in coal-fueled plants (namely, through pulverized coal and coal-to-gas technology), rendering coal a more environmentally friendly technology.

Exhibit 200: Sulphur Dioxide Emissions



Source: Alstom.

Exhibit 201: Nitrous Oxide Emissions



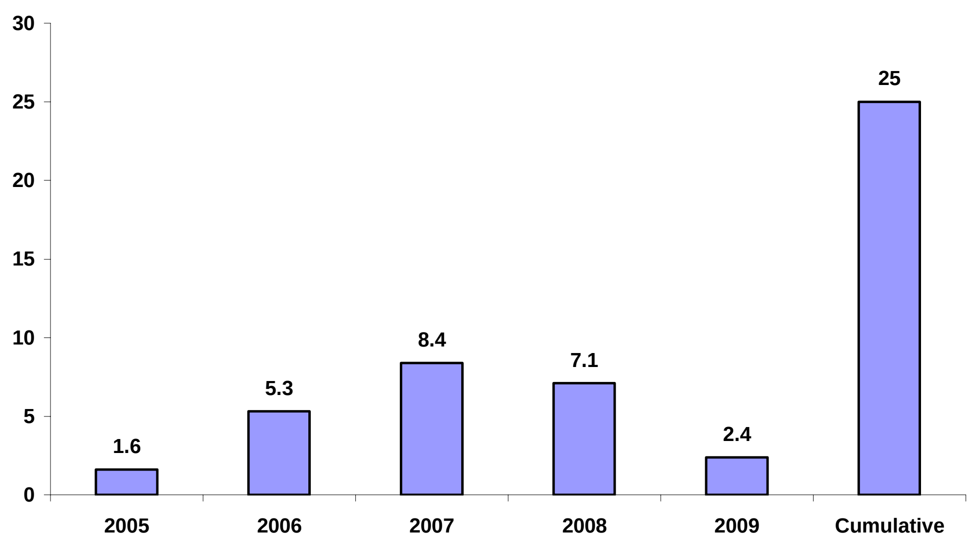
Source: Alstom.

In spite of technology improvements, scrubbers have only been retrofitted on about 25% of coal power plants, and less than 25% of capacity is equipped with selective catalytic reduction (SCR) systems, which reduce the nitrous oxide emissions in flue gas as a secondary control. (Seventy percent of the coal-fired U.S. power plant capacity does, however, have some primary NOx control such as low-NOx burners.) Hence, a substantial opportunity for upgrades remains.

Thus far, existing scrubbers have contributed to a 33% decline in pollution caused by coal plants, and improvements have also been implemented with plants in China and Europe. There is an estimated US$12 billion opportunity in scrubber retrofits, and over 500 scrubber opportunities for existing coal plants through 2010. Additionally, there is an estimated US$8 billion opportunity for mercury emissions control projects, and US$5 billion for SCR. (See Exhibit 202.)

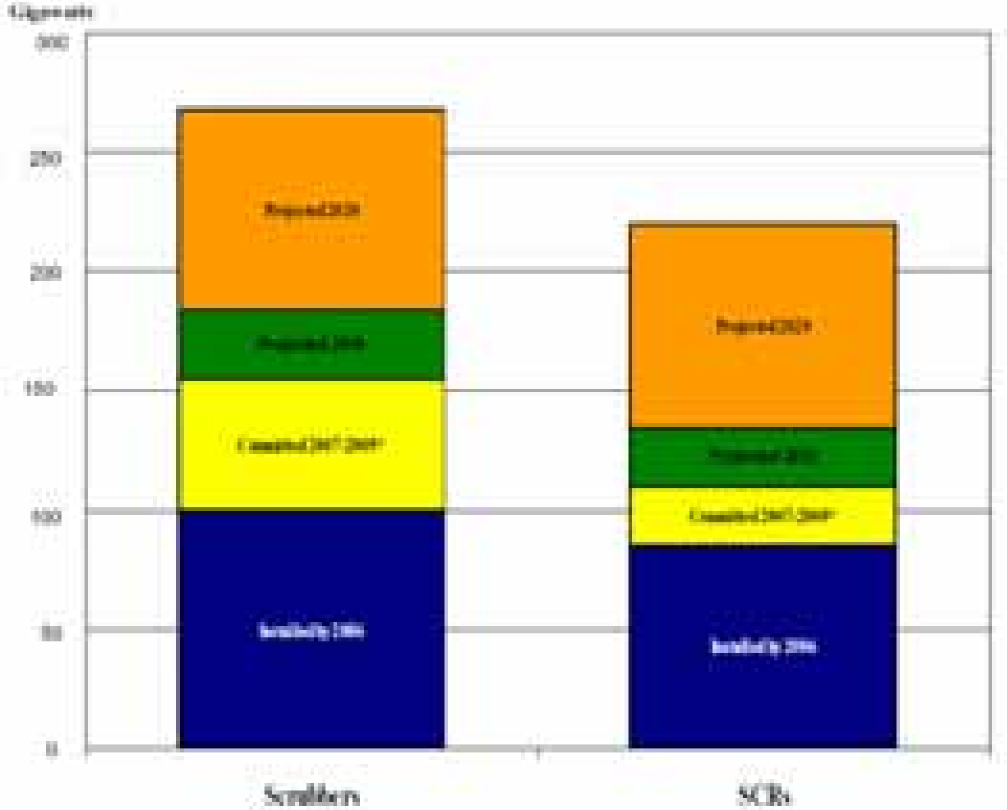
Recent activity involving emissions regulation includes the Clean Air Interstate Rule (2005), which serves to reduce NOx and sulfur emissions by 70% and 60%, respectively (from 2003 levels), in 28 eastern states. The CAMR rule has also been proposed, which would regulate mercury emissions, as well as the CAVR rule, which reduces emissions from older industrial units. The implementation of these rules should bring emissions control costs in the United States to US$47.8 billion from 2007-2025. Additional legislation is expected in 2008. Such prospects could be a positive for Fluor (4% of revenues from power), Shaw Group (36% of revenues), URS Corp. (over 5% of revenues), Washington Group (25% of revenues), and McDermott International (46% of revenues). These percentages represent the companies' total power revenues; therefore, revenues from retrofit technology represent a smaller percentage. Fluor anticipates a high level of scrubber activity in 2007 on new and existing plants given energy requirements in the United States Shaw Group also expects growth in scrubber projects, as it is working on six projects worth about US$1.5 billion, which will be booked into backlog over the next several quarters.

Exhibit 202: Coal-Fired Plant Emission Retrofits, 2005–09
US$ in billions



Source: McIlvaine, Shaw Group.

Exhibit 203: EPA Scrubbers/SCR Forecast
in gigawatts



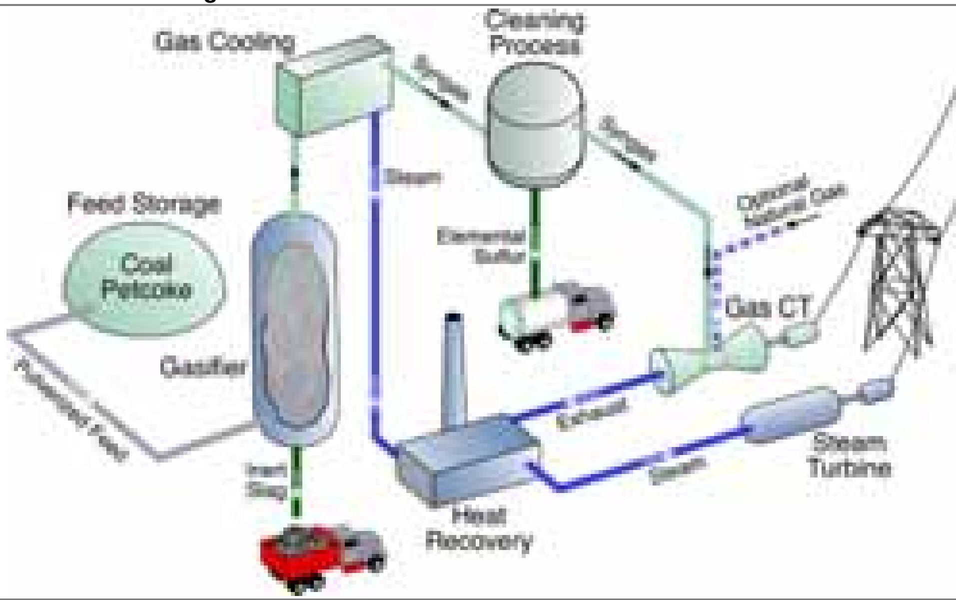
Source: EPA 2006 Base Case.

On a long-term basis, new coal power plants would provide greater benefits than retrofitted plants in terms of efficiency and power conversion, which should mean that the next decade is likely to involve upgrades to old plants, the closure of some of the oldest facilities, as well as investment in new build. Note that much of new plant investment will involve environmental controls equipment; as part of its April announcement to build 11 new plants (which we mentioned earlier), TXU stated that it would spend up to US$2.5 billion on such equipment.

IGCC versus PC

Although one might agree that coal-fired power is due a recovery in investment, one further point to consider for the long term is what kind of coal-fired plants are built. Alstom focuses on pulverised coal-fired boiler technology (PC); one-third of the world's PC plants are located in the U.S. However, there is considerable excitement in the market concerning another type of coal-fired technology: integrated gasification combined cycle (IGCC). There are other types of coal-fired technology, such as pressurized fluidized bed combustion (PFBC), which is used in markets such as Sweden and Japan, but more hype surrounds IGCC plants, largely because GE is pushing this technology. Alstom does not have a presence in IGCC.

Exhibit 204: Flow Diagram for the IGCC Process



Source: Energy Northwest.

The key difference between PC and IGCC concerns two types of technology used within the IGCC process: coal gasification and combined cycle. In the coal gasification stage, coal is combined with oxygen in the gasifier to produce gaseous fuel (syngas), which after cleaning is used in the combustion turbine to produce electricity. In the combined-cycle stage, exhaust heat from the combustion turbine is recovered to produce steam, which then passes through a steam turbine to power another generator, which produces more electricity. In a conventional power plant, coal is pulverised to a very fine powder and burned, and the steam produced spins a turbine, which generates electricity. While there has been much widely aired speculation in the industry that IGCC will become the dominant technology within future coal-fired power plants, we note the following:

- *Cost.* IGCC facilities are more expensive to build than conventional coal plants—around 20% more expensive on some studies. Given the limited experience as regards IGCC facilities (there are only two commercial electricity power plants in the U.S., although there are over 100 small-scale IGCC plants used in chemical manufacturing globally), truly accurate costs for construction and operation remain difficult to ascertain.

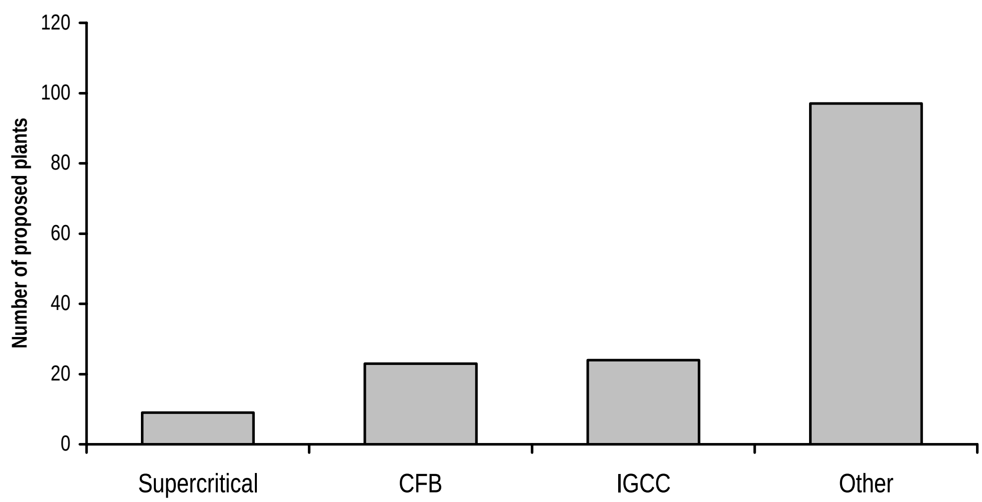
- *Maintenance.* According to Alliant Energy, IGCC technology apparently requires more frequent maintenance with longer maintenance outages, requiring utilities to draw on other sources of power when the IGCC plant is unavailable.

- *Efficiency.* Given the combined-cycle nature of the IGCC plants, they are often perceived to be more efficient than PC, as they convert 40-45% of the energy value of coal into electricity. However, technology at conventional coal plants has improved considerably, such that current plants have a 34-37% efficiency, and newer PC plants under development could allow efficiencies of over 42%.

- *Emissions reduction.* There are certain elements of IGCC plants that do appear to be much more environmentally friendly than PC plants. For instance, it is claimed by proponents of the technology that water requirements are anywhere between 20% and 50% lower, and CO_2 emissions are 20% lower as well. However, in some areas, such as NOx and SO_2, we believe that the current new-generation PC plants offer comparable emissions output versus IGCC plants, and in the long run, the case for IGCC is no clearer. (See Exhibit 205.) A typical new coal-fired boiler PC system now eliminates up to 97% of the combined particulate, SO_2 and NOx emissions. We also note the comments from a spokesperson for TXU earlier this year, who stated that, "New TXU power generating units proposed for Texas will have lower emission rates than the country's IGCC plants."

- *Where are the orders?* Given that IGCC technology made significant breakthroughs in the 1990s and given some claims that next-generation IGCC plants could offer 60% energy efficiency, one might expect to find evidence of large orders for IGCC plants. However, of the 153 plants in the pipeline in the U.S., only 22 are for IGCC largely, we believe, for the reasons outlined above. Below we show that although a large proportion of the new plants planned will be relatively advanced, they do not necessarily take the form of IGCC plants. (CFB or circulating fluidised-bed plants suspend solid fuel particles, which are recycled 10–50 times, on upward-blowing flue gas during the combustion process, aiding effective chemical reactions and heat transfer; supercritical plants describe the thermodynamic state of the fuel, which undergoes high pressures to convert into electrical energy more efficiently; Alstom offers both these types of plant equipment.)

Exhibit 205: IGCC's Share of Proposed U.S. Coal-Fired Plants Is Low



Source: NETL.

Government Support for Coal Projects

The Energy Policy Act of August 2005 showed the commitment of the government, not just to the promotion of renewable energy but also to ensuring more productive uses of domestic energy resources, including coal. Specifically, it recognizes the "importance of coal as America's most abundant energy resource and as the source of more than half of our electricity production." The Department of Energy therefore seems to be actively promoting the use of coal for power generation, and there also seems to be greater government commitment to nuclear energy.

Exhibit 206: Implications of Energy Act for Nonrenewable Energy Sources

Non-Renewable Energy

- 50% cut in cost of capacity-increasing oil refinery investments, which lead to increases of more than 5% in output
- Expanded Fed Authority via the DoE over siting of oil refineries - local & state control effectively eliminated
- Natural gas distribution line depreciation life shortened from 20 to 15 yrs
- FERC gains sole authority to make/overrule decisions on construction, expansion & operation of LNG facilities
- Clean coal tax credit at 20% for industrial or integrated gasification combined cycle projects; 15% for others
- Accelerated depreciation for pollution control equipment - allowance extended for coal fired facilities

Source: EPAct 2005.

This does not represent a marked change in approach; in presenting the National Energy Policy in May 2001, President Bush announced a Clean Coal Power Initiative, which provides US$2 billion over 10 years to advance clean coal technology and aims to help utilities cut sulphur, nitrogen, and mercury pollutants from power plants by nearly 70% by 2018 and boost efficiency.

Focus on U.S. Capital Goods Companies

General Electric

On the U.S. capital goods side, General Electric would likely see the largest benefit from increased spending on alternative energy sources, as its infrastructure segment is a world-leading manufacturer of wind turbines, coal gasification, and other emerging technologies. GE's exposure to alternative energy represents approximately 5-6% of total company revenues, with the largest exposure being in wind. GE is by far the largest wind turbine supplier, with almost double the installed capacity of its closest competitor and a 60% market share of new capacity additions. Outside of wind, management remains bullish on the prospects for alternative energy in general and continues to reposition its portfolio to best take advantage of growth opportunities. Most recently, the company sold its hydro business, noting that it is a solid opportunity, but the largest growth opportunities lie elsewhere. GE also formed a joint venture last fall with Hitachi Nuclear to focus on boiling water reactor (BWR) technology and services. Management believes the joint venture helps improve its global positioning and follows the trend of industry consolidation (Toshiba and Westinghouse; MHI and Areva). Interest in BWR remains high, particularly in India, China, and Eastern Europe, and management expects its nuclear business to triple by the 2008-09 timeframe. The company also continues to invest in other alternative technologies including solar and biomass.

Related Energy Efficiency and T&D Build-Outs Would Broadly Benefit U.S. Capital Goods

U.S. capital goods companies stand to broadly benefit from the trend toward alternative energies. General Electric, as we highlighted above, would likely see the most direct benefit from equipment demand, but we also expect to see our companies benefit from related transmission and distribution upgrade requirements and an increased focus on energy efficiency. We discuss some the companies that would see benefits below:

Cooper Industries (CBE). CBE's Power Systems business should benefit over the long term from transmission infrastructure improvements. Cooper has a broad range of products spanning the entire T&D system, from generation to residential end users and includes a number of well-recognized brand names. Recently, CBE Power Systems announced the acquisition of Cannon Technologies, a provider of automation technologies for monitoring and metering, and energy management by electrical utilities with over 400 North American utility customers.

Emerson (EMR). EMR's network power business has core offerings focused on building a reliable power network and would benefit significantly from increased utility capital expenditures. Specifically, the company's inbound power systems business provides reliable power systems, which transfer critical application loads from utility to emergency generators. The company also has network power service offerings focused on energy consumption monitoring, preventive maintenance, and electrical testing. Emerson also manufactures diesel gen sets.

Rockwell Automation (ROK). Rockwell's integrated architecture and motor control solutions are focused on helping customers improve energy efficiency. Management estimates that in the U.S., motors account for 60% of total energy usage, implying a significant opportunity to save costs by operating pumps and fans at below full speed when peak usage is not required. When pumps and fans operate at 60% speed, 75% less energy is required. Rockwell's electric drive products help customers efficiently manage variable speed requirements. We estimate ROK's intelligent motor controls revenues were about $900 million (about 20% of total revenues) and growing at high-single-digit rates.

SPX Corporation (SPW). SPW would also directly benefit from transmission infrastructure spending. Its Waukesha electric systems business is the market leader in medium transformers and a large supplier of large power transformers. The business is also a supplier of transformer accessories including health products, breaker components, high voltage substations, and switchyards and transmissions lines. In 2006, revenues from SPX's medium-sized transformer business reached $290 million (about 7% of total company revenues).

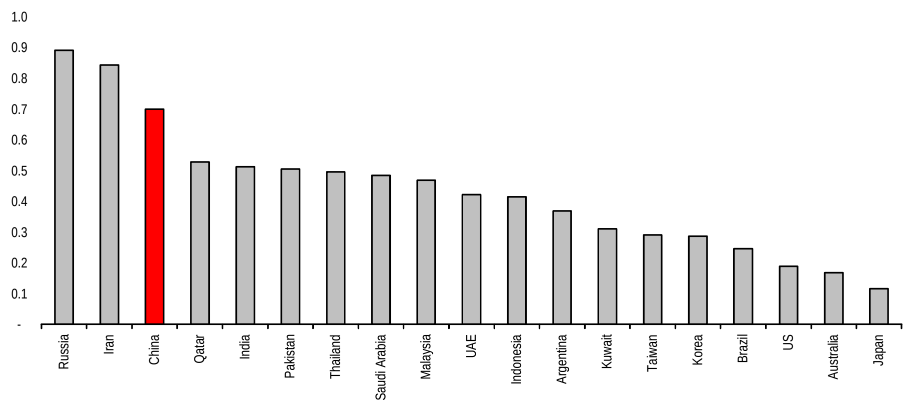
United Technologies (UTX). UTX's benefit would be somewhat smaller, although it could also see incremental revenues from renewable sources. The company's UTC power segment manufactures power generation systems for commercial building applications and light industrial businesses. The segment also manufactures organic rankine cycle devices, which convert waste heat into usable energy and fuel cells for the scientific, transportation, and commercial markets. UTX's fuel cells can already be found on mass transportation bus systems in California and elsewhere. If state and local governments opt to increase spending on cleaner emissions technologies for vehicles, UTX's power segment could see nice growth.

Asia Energy Efficiency Plays

Angello Chan

Energy efficiency improvements in the developing economies will be highly profitable, partly due to the replacement of older existing capital stock and also due to the ability to leapfrog technology development versus OECD countries, which already have high sunk costs.

Exhibit 207: Energy Intensity by Country



Source: Credit Suisse estimates.

Key Plays on Energy Efficiency in Asia

As part of the Chinese government policy to achieve the goal of reducing per unit GDP by 20% by 2010 compared with 2005, the State Electricity Regulatory Commission (SERC) and State Grid Corp. of China (SGCC) have decided to have inefficient, pollutive, small power plants that are under 125 MW in unit size, of which there is over 100 GW installed in China, to be replaced in three years by more fuel-efficient and less pollutive larger 600-1,000 MW units. Such a move will be in-line with two other energy conservation and emissions control statements made by the PRC government in November 2005 and June 2004.

We believe the replacement schedule may take longer than three years, but we see this as a significant milestone for the power equipment manufacturing sector, as the market has been concerned about a slowdown in order deliveries after a significant amount of generation capacity came on line in 2006 and is scheduled to be commissioned in 2007. Replacing 100 GW in five years would translate into 20,000 MW per annum. We believe PRC IPPs will move faster toward deploying advanced and larger-scale power generation equipment, such as 600 MW, 1,000 MW supercritical equipment when they consider building/replacing plants. Only three suppliers are equipped to supply: Harbin, Dongfang, and Shanghai Electric. Split three ways, SEG could win new orders of 7,000 MW per annum that do not add to country total capacity, which the market is concerned about in terms of overcapacity after 2008.

The government recently ordered several small power plants owned by four out of five mega IPP gencos to be shut down, as these units breach the government standard for emissions control. New plant applications by these gencos would be held up if the operators do not comply with the government's emissions policy. This was the first move by the government to show its determination to enforce its environmental policy. We believe SEG's large unit scale power equipment and emissions control systems sales will benefit from the government's emissions control policy.

SGCC officials expect 2007 capacity addition of 95 GW following the 102 GW addition in 2006. Despite the higher-than-expected capacity addition in 2006, SGCC officials do not believe a necessary oversupply would develop, as demand growth also remains higher than expected. Without counting small plant replacement and export orders, SGCC expects capacity additions of around 70 GW in 2008. However, the capacity in some provinces, such as Jiangsu, which is expected to exceed 100 GW in 2006-07 will likely lead to meaningful plant utilization decline, a view shared by Huaneng Power International's senior management. However, a SERC official told us that the government aims to maintain plant utilization hours at around 5,000 by shutting down small plants.

The suspension of the two-tier tariff power polling competition in Northeast China in 2006 was due to slow economic growth in the region, insufficient capacity, and cost increases that led to a rise in the pool bidding tariff. The rise in the pool tariff was counter to the government's initial expectation and hence the government decided *not* to use the higher pool tariff as the settlement tariff but temporarily suspend tariff competition pending further reform measures. For East China, SERC is looking at maintaining government set tariffs by plant for output below 5,000 hours and output in excess 5,000 hours will be subjected to tariff competition. Central China will likely deploy the same model but in 2008, while test pilot areas in East China will roll out this scheme in 2007. According to SERC, North China will be exempt from any competition policy in the foreseeable future as this area is the policy center and will be host to most of the 2008 Olympic Games. As for Southern China, competitive tariff policies will unlikely roll out before the supply shortage is over (maybe 2008 or beyond).

1,000 MW unit equipment consumes 40% less coal and water (for cooling) and hence also helps preserve water resources (also a government priority) versus 100 MW and 135 MW units. Small/old plant equipment replacement is one driver that, in our view, could surprise the market with order book growth for SEG, as China has 120 GW of old/small units to be replaced. (See Exhibit 207, 208, and 209.)

Exhibit 208: Power Plant Coal Consumption Rate Analysis, 2004

Unit Capacity (MW)	100	135	200	300	600
Coal consumption rate for power generation (g/kWh)	393.9	373.6	367.6	338.0	328.4

Source: Huadian Power, Credit Suisse research.

Exhibit 209: Power Plant Self-Use Rate Analysis, 2004

Unit Capacity (MW)	300	600	800
Self use rate (%)	5.21	4.77	4.64

Source: Huadian Power, Credit Suisse research.

Exhibit 210: Power Plant Water Consumption Rate Analysis, 2004

Unit Capacity (MW)	200		600
Water cooling method	Indirect	Direct	Direct
Water consumption rate (cubic m/s. GW)	0.30-0.48	0.38	0.20

Source: Huadian Power, Credit Suisse research.

Civil Aerospace

Will a Tighter Air Travel Emission Limit Drive the Replacement Cycle?

Steve East

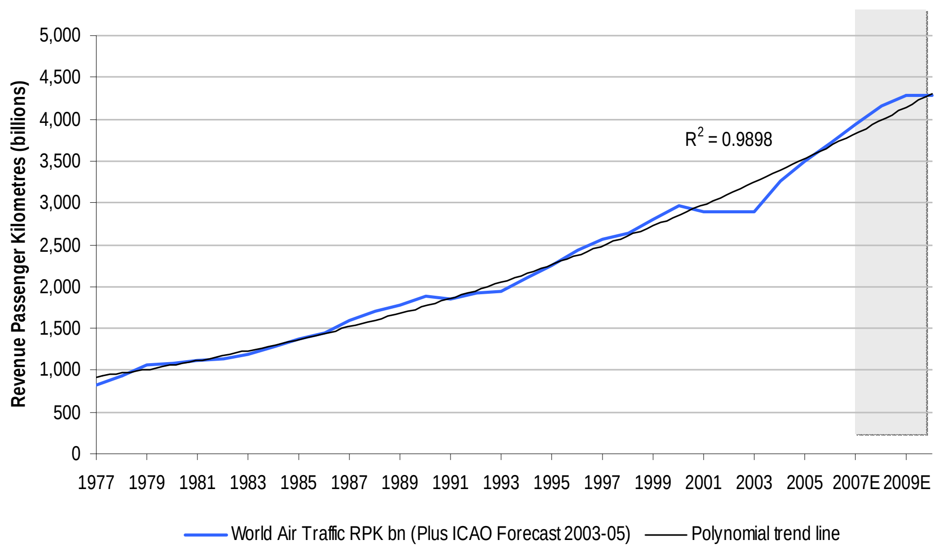
Andre Kukhnin

Air traffic is one of the key areas in the economy where emissions continue to grow strongly in absolute terms and we see potential for regulation to demand improvements. This could create a replacement cycle for aircraft and we believe the key winners of this process would be Boeing and Rolls-Royce.

Air Travel History and Outlook

Exhibit 211 shows the air traffic growth history since 1977. The average rate of growth over that period was 5.4%.

Exhibit 211: Global Air Traffic Growth History
RPKs in billions, unless otherwise stated



Source: Company data, Credit Suisse estimates.

In Exhibit 212 we show Boeing's air traffic outlook for the next 20 years.

Exhibit 212: RPK and GDP Growth Rates by Region, 2004–2025
%

GDP and RPK growth rates	GDP	RPK	Multiplier
China	6.6%	7.9%	1.2
Soutwest Asia	5.4%	7.1%	1.3
Asia-Pacific	3.8%	6.2%	1.6
Latin America	3.8%	6.2%	1.6
Africa	4.4%	5.7%	1.3
Northeast Asia	1.8%	5.6%	3.1
Southeast Asia	4.4%	5.5%	1.3
Middle East	4.1%	5.5%	1.3
Global	3.1%	4.9%	1.6
Europe	2.1%	4.3%	2.0
North America	2.9%	4.1%	1.4
Oceania	2.5%	3.7%	1.5
Global	**3.1%**	**4.9%**	**1.6**

Source: Boeing.

Environmental Lobby Is Picking Up

There has been a significant pickup in the lobbying of governments, particularly in Europe, to try to restrict growth in air traffic emissions. While air traffic only contributes 3.5% of global CO_2 emissions, it remains a GDP-plus growth market and is expected to double over the next 20 years, whereas emissions are being reduced in absolute terms in other areas of the economy.

This has led the E.U. to consider setting carbon emission limits and to introduce carbon trading. While the U.S. remains firmly opposed to this, there have been growing signs that the U.S. is beginning to consider how controls can be introduced over carbon emissions from air traffic.

Carbon trading has even won support from some airlines such as British Airways, which says on its website that it believes "*punitive taxes or constraints on industry growth*" would lead to "*extremely negative social and economic effects for the European economy.*" It believes "*a well-designed emissions trading scheme is a cost-effective and environmentally beneficial policy instrument.*"

Furthermore the airline say that while an international approach "*must be the ultimate objective . . . some regions may need to move faster.*"

Progress on Aero Engines

Much of the efficiency we see in the aerospace industry comes from advances in aero-engine technology. Fuel burn on a new-generation engine is around 20% better than the average of the installed base and there has been an average of slightly more than 1% per year improvement in this over the past 20 years. Rolls-Royce believes the improvement in emissions matches or likely beats the fuel burn gains on new engines compared with the installed base.

Clearly, the older aircraft in the fleet will be the ones to be retired first if emission requirements step up. The potential fuel burn and pollution gains against these are probably closer to 30%.

Looking forward, there is a European-wide program to improve products further, with some E.U. funding. The Advisory Council on Aeronautics Research in Europe (ACARE) is overseeing a joint program with the industry to improve emissions. The target is to reduce emissions by more than half by 2020 and a 50% reduction fuel burn, a 50% reduction in CO_2, and an 80% reduction in NOx by 2020.

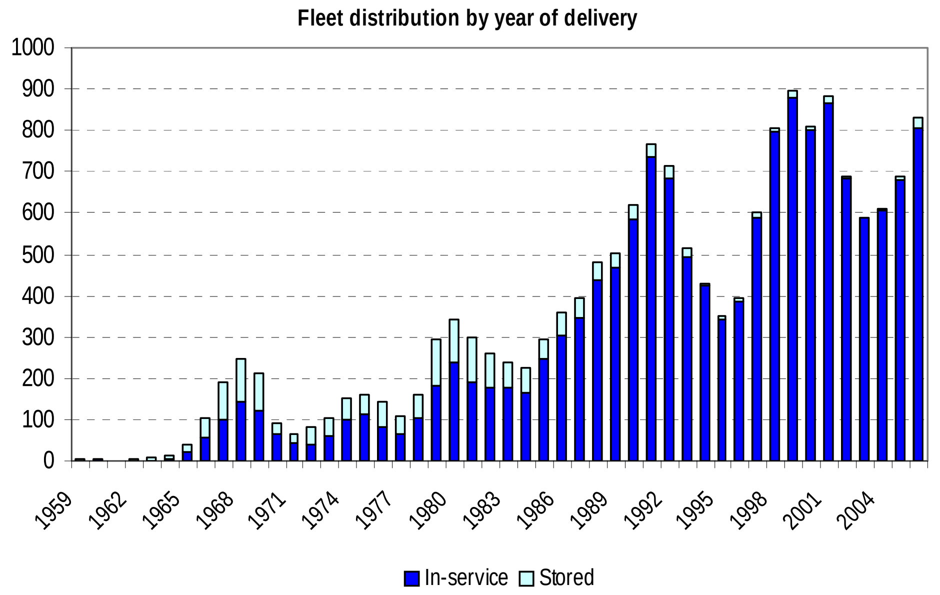
Also, there are very aggressive manufacturing targets for industry to reduce energy consumption and waste. Between 2007-09, the target is a 10% reduction in energy in consumption, a 10% reduction in solid waste, and a 50% recycling rate. From 1998-2005, Rolls-Royce already cut energy consumption by 42% and greenhouse gas emissions by 52% to meet industry targets.

Replacement Cycle for New Aircraft

Some aircraft over 40 years old continue to fly in service. Rather than immediately scrap assets, airlines continue to use older aircraft on less frequent routes, where the higher intensity (and time consumption) of maintenance has less impact. Exhibit 213 shows the age of the global aircraft fleet (including aircraft in storage).

After this, the aircraft can either be sold to a lower utilization airline (in developing countries) or to a freight operator that can convert the aircraft for freighter use for a further 10-15 years. A last alternative is storage, or full retiral.

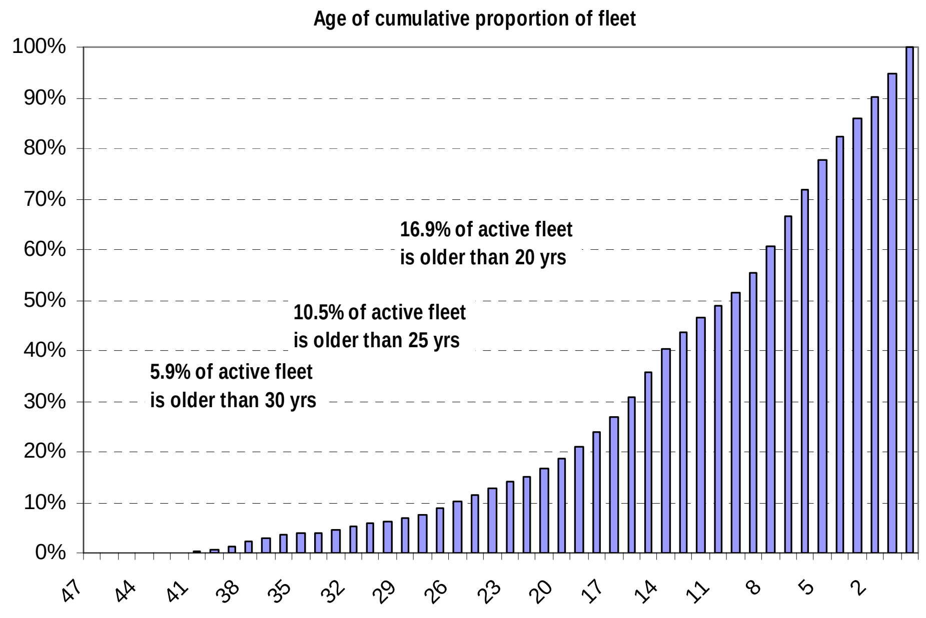
Exhibit 213: World Fleet by Year of Delivery, December 2006
aircraft, unless otherwise stated



Source: CASE, Credit Suisse research.

Rather than show the absolute numbers of aircraft in service, as in Exhibit 213, Exhibit 214 shows the percentage of the world fleet still in service at a certain age.

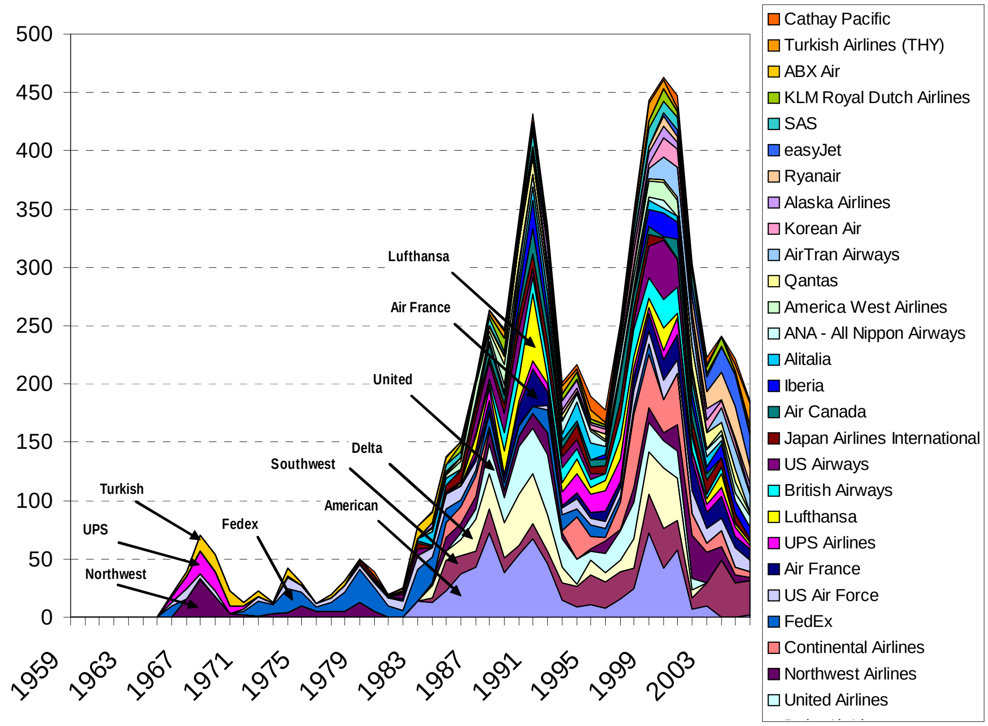
Exhibit 214: Cumulative Proportion of the Commercial Aircraft Fleet by Age
% aircraft, unless otherwise stated



Source: Airclaims.

Currently 16.9% of the global commercial aircraft fleet is over 20 years old, 10.5% of the fleet is over 25 years old, and 5.9% over 30 years old. We see potential for a pickup in the retirement of older aircraft driven by tighter emissions requirements, and we believe we may see some of the major airlines (which have so far sat out the latest order cycle because of challenges on their cash flows) stepping up to start buying new aircraft.

Exhibit 215: Top 25 Airlines: Fleets by Year of Delivery
aircraft, unless otherwise stated

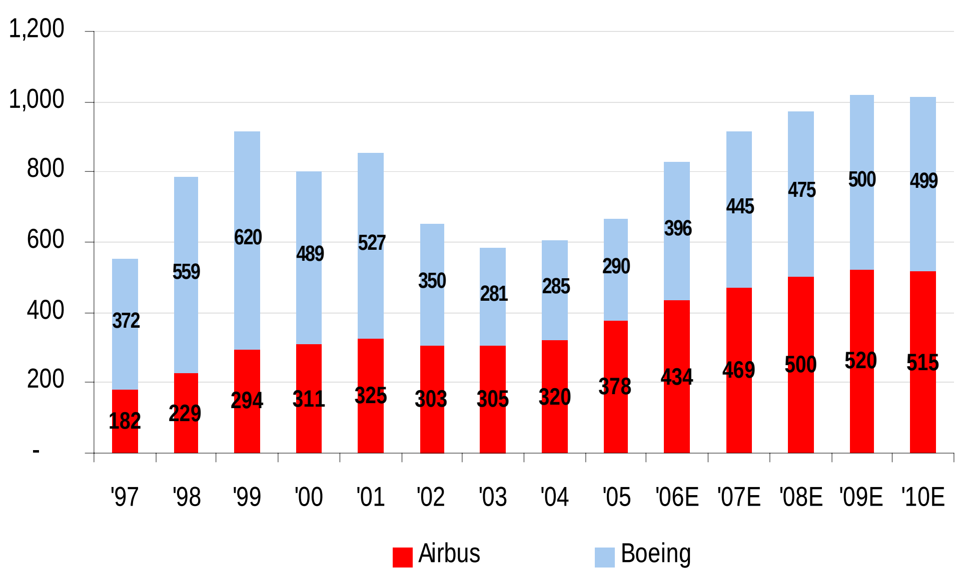


Source: CASE database, Credit Suisse research.

Implications for Equipment Suppliers

The obvious beneficiaries of any replacement cycle would be Airbus and Boeing since such demand could elongate the equipment production upcycle. (See Exhibit 216.)

Exhibit 216: Airbus and Boeing: Aircraft Production
aircraft, unless otherwise stated



Source: Company data, Credit Suisse estimates.

Between Airbus and Boeing, we would prefer to play Boeing rather than EADS (which owns Airbus) because Boeing has a superior product portfolio, in our view (backed up by a major swing in market share in new orders from Airbus to Boeing).

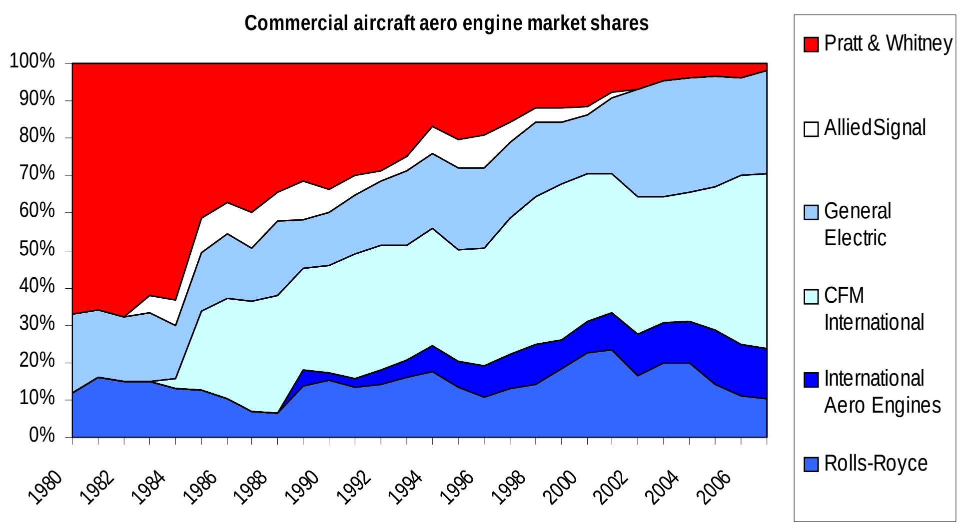
Boeing is also leading in the technological innovation by launching an all-composite (rather than aluminum) aircraft, the B787. The B787 is planned to enter service in 2008 and represents a major technology leap forward, giving significant operating savings and reductions in emissions. Airbus is now following Boeing with its A350XWB, but this is not planned to enter service until late 2013. Boeing is also well positioned to launch an all-new composite narrow-body aircraft much earlier than Airbus if the market demands better emissions and fuel efficiency from high-volume short-haul aircraft.

The other way we would play this theme is through the aero-engine suppliers, specifically with Rolls-Royce or General Electric. On one hand, the aero-engine manufacturers are losers out of any fleet replacement cycle because they potentially lose high-margin spares revenues from engines that would otherwise have needed overhauls and new spares. However, for companies that have a small installed base of older equipment but which have strong positions on new aircraft, a replacement cycle has two benefits:

- It accelerates the installed base growth where new engine deliveries exceed scrap rates and we see the spares annuities that come from installed bases as the key driver of cash and return for these businesses.
- While original equipment (OE) deliveries are low margin, the parts are the same for new engines or for spares and these are operationally geared manufacturing businesses. Strong OE volumes do give aftermarket margin benefits.

Both Rolls-Royce and GE have strongly grown their market shares over the past 30 years and have little to lose if we see a pickup in the scrapping of aircraft 20 years old.

Exhibit 217: Global Aero Engine Market Shares (Deliveries)



Source: Company data, Credit Suisse estimates.

Rolls-Royce and its narrow-body engine joint venture International Aero Engines (a partnership with Pratt & Whitney) has grown its market share over the past 25 years. GE and its narrow-body engine joint venture CFM International (with SAFRAN) have also grown strongly over this period. If a new narrow-body aircraft is launched, we see more upside for Rolls-Royce because it has no position on the B737 (a monopoly CFM product).

Energy Efficiency Drives Growth in Advanced Building Materials

Harry Goad

When analyzing the issue of energy efficiency from a building materials perspective, there is one stand-out product: insulation. Although insulation has, quite obviously, been an important component of construction activity for a considerable period of time, the ever-increasing focus on the reduction of carbon emissions, from a legislative and a sentiment perspective, has heightened the emphasis on this product. Put simply, the better insulated a building is, the less central heating is required, with the desired consequence being a decline in carbon emissions.

As a consequence of the Kyoto Protocol's target to reduce carbon emissions by 20% by 2010, the building industry has been affected by associated legislation. The E.U. introduced the Energy Performance of Buildings Directive in 2003, which will be implemented by the member states individually but should underpin the goal of cutting CO_2 emissions by 20% by 2010. A key aspect of this directive will be the introduction of a Building Energy Rating (BER) certificate, which will detail the energy efficiency of any given property. Such a certificate would allow potential home buyers or tenants greater visibility on prospective energy performance and costs. It is expected to be fully implemented by the end of 2008, and would form part of a surveyor's report.

Thus it is clear that increasing the energy efficiency of new buildings is a very live issue, although for the time being it will vary somewhat from one E.U. member state to another. Ultimately one can increase the insulating ability of any given property in two ways—by using a greater volume of product or using a higher quality insulant (better "U" value).

Within our Credit Suisse European coverage list there are three stocks that manufacture insulation products; Saint Gobain, CRH, and Kingspan. However, for the first two companies mentioned, insulation is a relatively small part of what are broader "construction conglomerates," while for Kingspan insulation is the core business, accounting for about 65% of group profit.

Traditionally insulation products have consisted of either fibers, such as glasswool or rockfiber, or polystyrene. Kingspan has moved the development process forward by developing a foam-based product. The advantages of this product are (1) its improved insulation efficiency (the foam product reduces air leakages), and (2) the board is thinner than the traditional fiber- or polystyrene-based product. The width of the product is very significant; the thinner board allows the builder to construct a house with the same (or better) insulation ability as the traditional product, but it reduces the square footage of the plot taken up by external and internal walls. As building regulations focus on ever-increased use of insulation, this issue is only going to become more important, in our view, as builders look to maximize available square footage.

This foam-based product is used in the manufacture of two types of Kingspan product: insulated panels and insulated boards. The former is where the foam is injected between two sheets of steel to create a cladding-type panel that could be used as an alternative to traditional wall or roof building materials, it would typically be used in retail, leisure, and industrial buildings. An insulation board is a similar product to an insulated panel, but serves a different end market (residential rather than commercial and industrial) and hence is produced in a different style. The insulation board uses the same insulation material as in the panel (i.e., it does not use traditional fibers), but it is manufactured in a board form, so that it can be placed either underneath the tiles in a roof or underneath a concrete floor. Thus the opportunity for the insulation manufacturers is clear. Aside from the legislative-driven change, we also expect the building industry to find itself increasingly responding to the demands of a society, particularly within the commercial sector, that pays greater heed to environmental issues.

U.S. Auto Trends

The Future Is Smaller

Chris Ceraso

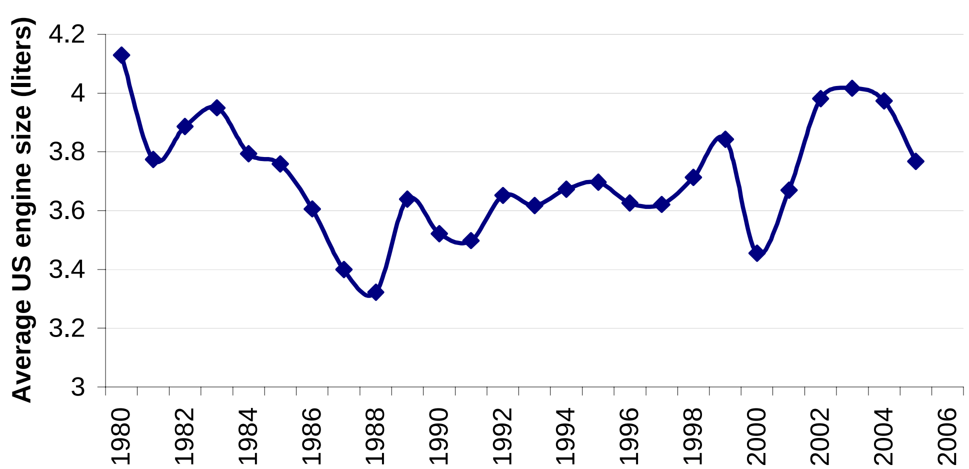
There is much discussion about how to improve energy efficiency in the U.S., and a significant target area is the low mileage per gallon (MPG) of the U.S. vehicle fleet. In the following section, we discuss the potential for hybrid vehicles and for diesel-powered vehicles in Europe and the U.S. In this section, we look at some trends already in place in the U.S. market.

The U.S. Auto Market Really Matters

What happens in the U.S. auto market really matters to global energy distribution. The U.S. gasoline market is the largest single refined product market in the world, and U.S. gasoline demand growth has been one of the major underpinnings of the global oil market over the last 10-15 years. During the demand-led upcycle in oil prices from 2002-06, U.S. oil demand growth accounted for around 25% of global demand growth, and a large proportion of this was gasoline. Medium-term trends in the U.S. gasoline market therefore have serious implications for global oil prices.

Aside from the normal drivers of underlying gasoline demand (population growth, wealth increase, and total miles driven), another factor played a significant part in recent strong U.S. gasoline demand growth: the rising size of the average U.S. vehicle engine over the last 15 years or so.

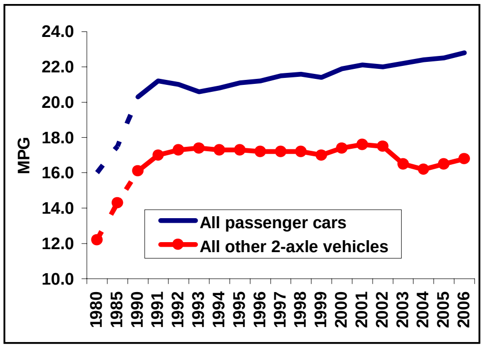
Exhibit 218: **Average Size of U.S. Vehicle Engines**
liters



Source: Wards, Credit Suisse.

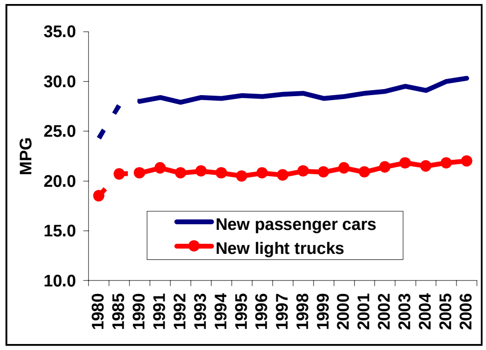
Average annual U.S. gasoline demand growth over the last 15 years was around 2%, of which 0.3-0.4% can be attributed to the impact of larger engines. Over the last 15 years, the MPG efficiency gains from better engine technology, better automotive materials, etc., in the U.S. have been largely offset by larger engine size and vehicle weight, as Exhibit 219 and Exhibit 220 show.

Exhibit 219: U.S. Existing Vehicles MPG



Source: U.S. Highway Administration.

Exhibit 220: U.S. New Vehicles Average MPG



Source: U.S. Highway Administration.

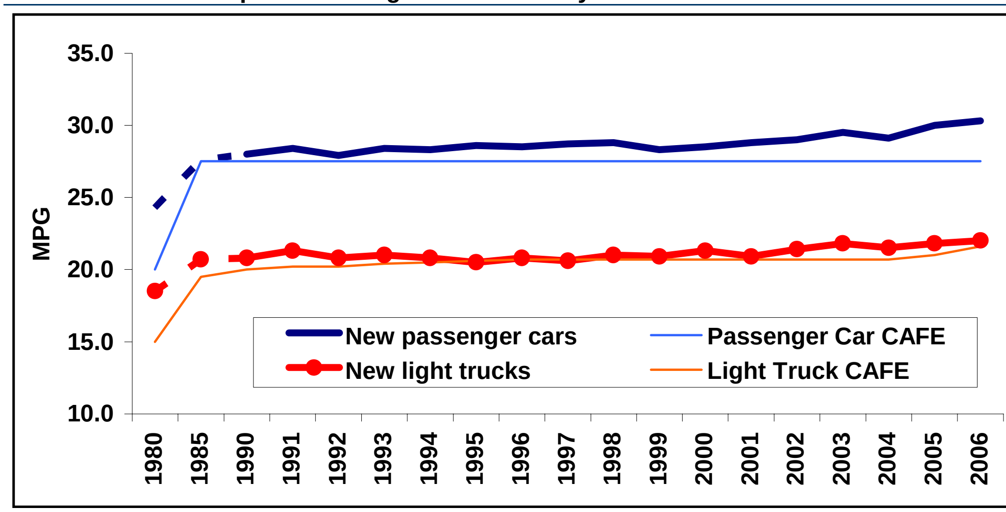
Modest gains in the fuel efficiency of U.S. passenger cars have not been replicated in the light truck segment, where until recently customers continued to solve their own *cost of motoring* equations in favor of larger engines where possible.

However, times are changing in the U.S., in the marketplace and potentially in the legislature.

New Vehicle Mileage Legislation (CAFE) Is Likely

The average mileage per gallon of the U.S. vehicle fleet has barely increased over the past 15 years, as we have just seen. However, there is existing legislation in place that mandates minimum MPG standards for U.S. vehicles. The Corporate Average Fuel Efficiency legislation (known as CAFE) was first enacted in 1975 as a reaction to the 1973 Arab Oil Embargo.

Exhibit 221: U.S. Corporate Average Fuel Efficiency Standards



Source: U.S. Highway Administration.

CAFE was initially a notable success, lifting average MPG of passenger cars and light trucks by 5-8 MPG each. However, the standards have remained virtually unchanged for over 20 years, while the U.S. vehicle fleet shifted dramatically in favor of the light truck segment over the same period. (SUVs are light trucks, not passenger cars.)

Truck penetration is now falling slightly partly under the influence of higher gasoline prices (see below), but there is renewed political impetus building for an increase in the CAFE standards, and even some talk of "closing the SUV loophole."

Several of the Democratic candidates for the 2008 U.S. presidential election are proposing to raise the CAFE standards, and even President Bush in his 2007 State of the Union speech called for an increase in the average MPG of the U.S. vehicle fleet, while leaving the specifics vague.

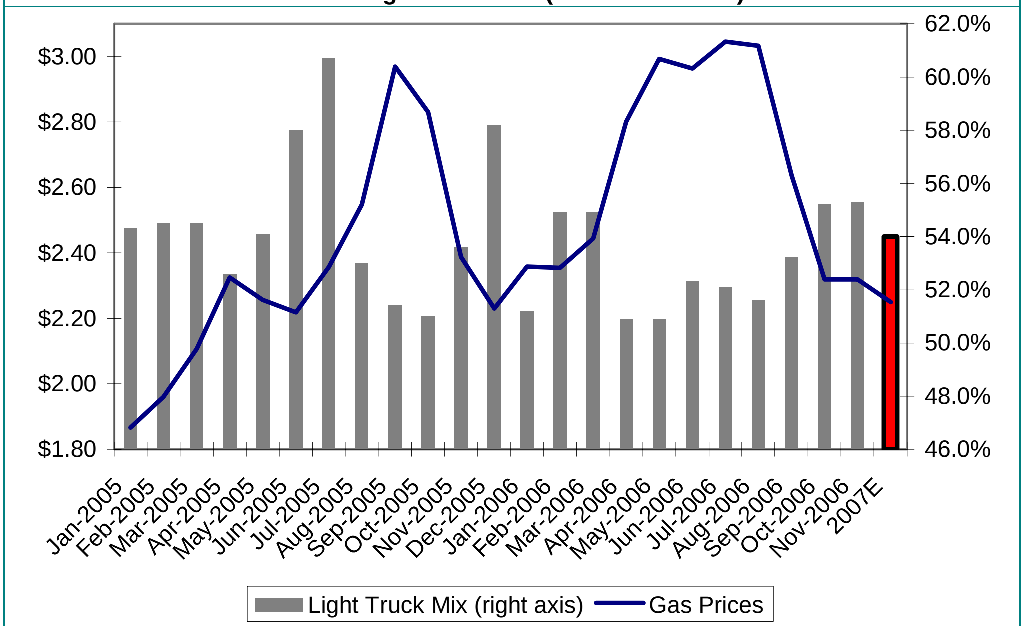
Raising vehicle fuel efficiency by government mandate remains controversial in the U.S., but it seems likely that the political stars are lining up to make some change possible or even likely within the next two years.

Whether this alone will be enough to achieve the desired goal of reducing U.S. gasoline consumption is another matter entirely.

U.S. Consumer Preferences Are Already Changing

Short-term spikes in gasoline prices create soft-patches of demand for larger-engine SUVs, as Exhibit 222 shows. The percentage of total vehicle sales comprising light trucks (which includes pickups, SUVs, minivans, and crossovers) plunged to a low of about 51% in April and May 2006, when U.S. gasoline pump prices surged past $3.00 per gallon. As gasoline prices receded over late summer, the truck mix rebounded back to 55-56% of new vehicles sold.

Exhibit 222: Gas Prices versus Light Truck Mix (% of Total Sales)



Source: Autodata, DOE.

Our U.S. Autos Team projects truck mix to stabilize at around 54% in 2007, up from an average of about 53% for full-year 2006 but down from the 58% seen in 2005. Lower pump prices would suggest a higher penetration rate, but consumer tastes are changing.

There's More to the Story Than the Car/Truck Split

One of the most damaging trends for the Big 3 U.S. automakers in 2005 and 2006 was consumers' shift away from traditional body-on-frame midsize SUVs and toward more fuel-efficient car- and minivan-based crossovers, or CUVs, a category dominated by non-U.S. automakers.

As we show in Exhibit 223, CUVs have recently been one of the fastest-growing segments in the U.S. market, up more than 30% in the past three years, while midsize SUVs have been among the worst performing segments, dropping almost 18% in 2006 (first 11 months) on top of a 9% decline in 2005. We expect the shift away from midsize SUVs and toward CUVs to continue in 2007.

Exhibit 223: **Year-on-Year U.S. Segment Sales Performance**

	CY 04	CY 05	YTD 2006*
Small SUV	18.1%	8.9%	34.4%
Sport Wagon / Crossover	12.8%	11.1%	6.8%
Small Car	-2.2%	4.9%	4.3%
Mid-Size Car	-1.5%	2.5%	1.8%
Full-Size SUV	-6.4%	-18.4%	0.0%
Full-Size Van	6.2%	5.3%	-1.0%
Luxury Light Trucks	-1.3%	5.2%	-1.7%
Large Car	-25.6%	-26.8%	-2.7%
Luxury Car	4.1%	4.6%	-4.1%
Full-Size Pickup	7.4%	0.5%	-9.1%
Minivan	3.0%	-0.1%	-11.7%
Small Pickup	-10.9%	-2.1%	-13.1%
Mid-Size SUV	0.3%	-9.2%	-17.6%
Total Passenger Cars	-1.9%	2.5%	1.2%
Total Light Trucks	3.6%	-0.5%	-5.6%
Total Light Vehicle Market	***1.1%***	***0.8%***	***-2.5%***

**YTD thru November*

Source: Autodata.

Full-Size Pickups: New Products versus Macro Headwinds

Full-size pickup sales fell by an estimated 9% in 2006, as higher gasoline prices, rising interest rates, and a tumble in the housing market all put pressure on this important (and fuel-thirsty) category, where roughly 75% of vehicles are used for business purposes.

The full-size pickup segment will see a number of new product introductions from Ford and General Motors in 2007, which should stimulate some incremental demand versus 2006. However, we remain concerned that softness in the U.S. housing market in 2007 will weigh down on full-size pickup sales.

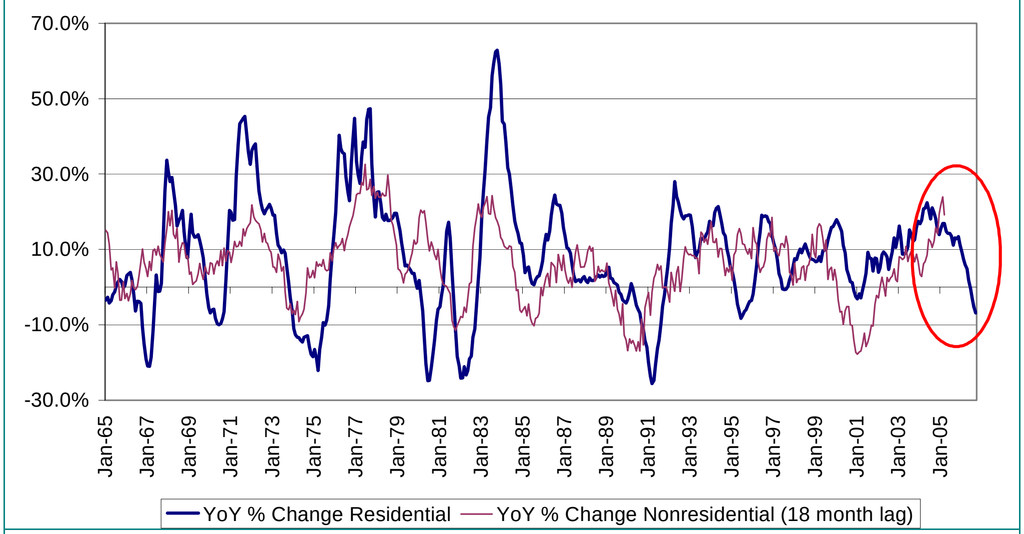
In our March 21, 2006 report, *Back to the Future*, we reviewed the strong positive correlation between full-size pickup sales and existing home sales and other housing-related measures. Weakness in the U.S. housing market emerged as one of the major issues for full-size pickup sales in 2006 and will remain a headwind in 2007, in our view.

For 2007, it is important to focus more broadly on total construction spending—both residential and nonresidential—where the correlation with full-size pickup sales is even more robust than the existing home sales relationship we highlighted in March 2006.

Exhibit 224 shows that *total* construction spending growth looks like it began to roll over in 2006, with the residential market falling hard and the nonresidential market still in growth mode.

The fact that pickup truck sales turned down more sharply than total construction in 2006 implies that high gasoline prices are playing some part in the mix decisions. We think it also suggests that the construction-related headwind for pickup sales may become even more difficult in 2007, particularly if the nonresidential market follows the pattern set by the residential market.

Exhibit 224: Value of Private Construction Put in Place: Residential versus Nonresidential

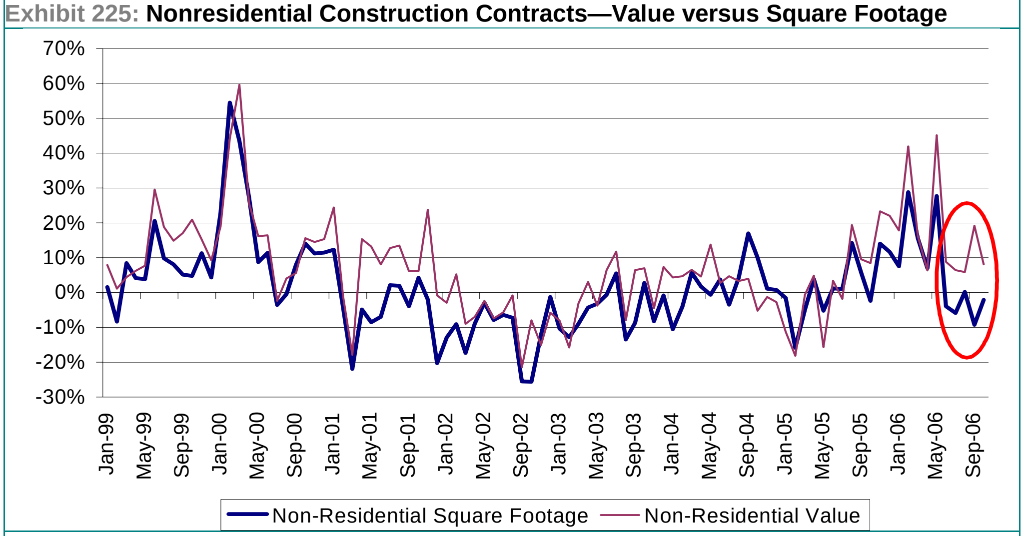


Source: Census Bureau, Haver Analytics.

In fact, the turn in nonresidential construction may already be under way. Exhibit 225 shows the year-on-year value of nonresidential construction contracts versus the square footage represented by those contracts. The total square footage under contract has recently been falling, while total contract value is still rising. This suggests that the recent increase in the value of construction is being driven by cost inflation rather than strong demand.

If nonresidential construction does roll over, this will likely exacerbate the decline in demand for full-size pickups that we have already seen.

Exhibit 225: Nonresidential Construction Contracts—Value versus Square Footage



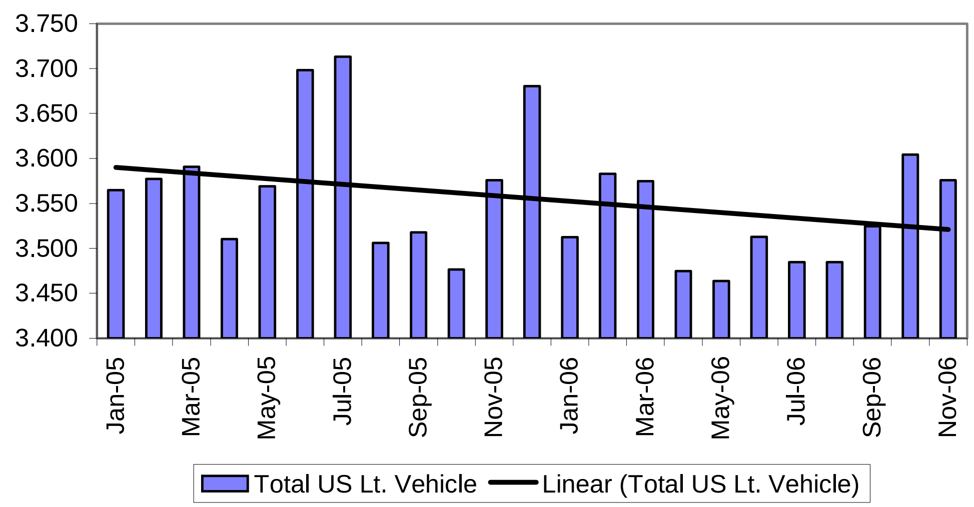
Source: McGraw-Hill Dodge Construction data.

The Mix within the Mix

Average Engine Size Is Declining

We believe our data show that the medium-term trend in higher gasoline prices has produced a medium-term trend toward smaller engine sizes. Engine sizes have clearly come under downward pressure in response to rising fuel prices and higher interest rates.

Exhibit 226: Average Engine Size, New U.S. Light Vehicles, January 2005–November 2006



Source: Credit Suisse estimates.

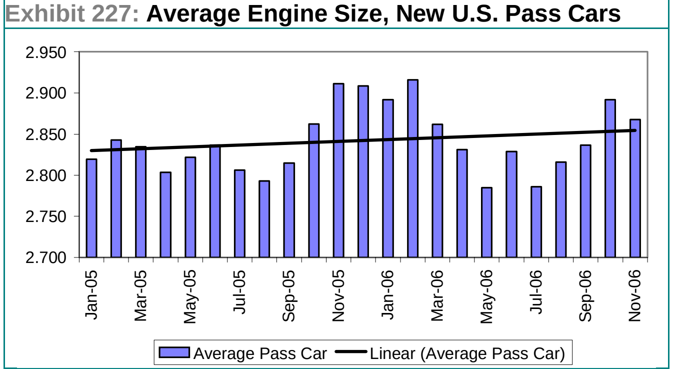
Smaller Engines Are Mainly a Truck Phenomenon

Looking at Exhibit 227 and Exhibit 228, we see that average engine sizes for passenger cars have actually *risen* somewhat over the past two years. (See Exhibit 228.) In fact, the downtrend in average engine size is wholly attributable to the light truck category. (See Exhibit 227.)

Rising consumer preferences for greater fuel economy and for lower total vehicle cost (the cost of motoring) are part of the story, but smaller light truck engine sizes also likely reflects a higher proportion of CUVs versus SUVs.

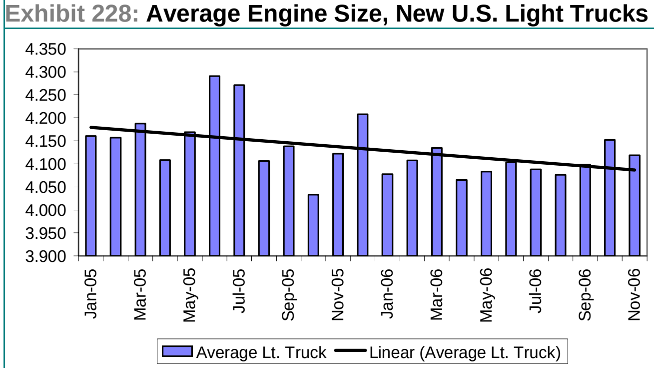
Because of their unibody architecture and resulting lighter weight, CUVs generally have smaller engines than midsize or full-size SUVs. And as this category grows, it looks to be dragging down average engine sizes for the light truck segment as a whole.

Exhibit 227: Average Engine Size, New U.S. Pass Cars



Source: Credit Suisse estimates.

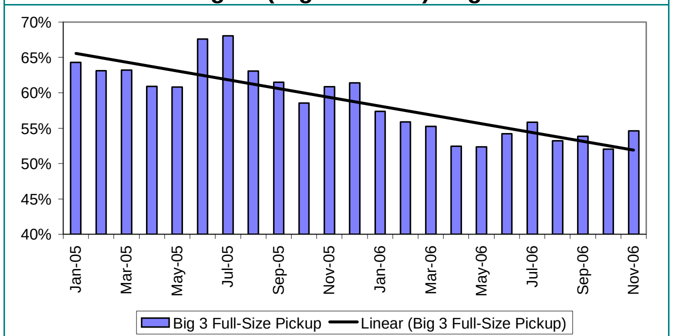
Exhibit 228: Average Engine Size, New U.S. Light Trucks



Source: Credit Suisse estimates.

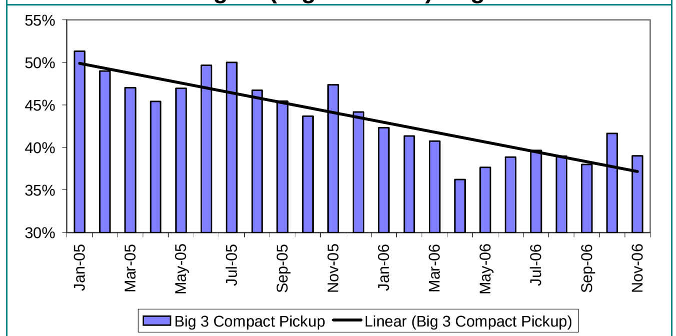
But it's not only the CUV effect pushing down average engine size in the light truck category. In Exhibit 229 and Exhibit 230, we show the penetration of larger-engine models in the full-size and compact pickup truck segments where there tends to be a large array of powertrain (i.e., bigger engine) options, and where the data suggest there is sensitivity to gasoline prices.

Exhibit 229: Big 3½ Ton Full-Size Pickups
Penetration of Largest (High-Volume) Engine Size



Source: Credit Suisse estimates.

Exhibit 230: Big 3 Compact Pickups
Penetration of Largest (High-Volume) Engine Size



Source: Credit Suisse estimates.

The compact pickup category offers a cleaner example of the pressure that higher gasoline prices and interest rates can exert on engine size. This category has not seen a new product introduction in the U.S. in a couple of years, which helps eliminate noise in the mix data. In addition, compact pickups are among the least expensive vehicles in the industry and attract buyers that are particularly price sensitive.

A clear example of the CUV-for-SUV trade-off can be seen at Ford. The company's new Edge CUV has enjoyed relatively strong initial sales, but the company reports that a high proportion of Edge buyers are switching out of its traditional truck-based Explorer SUVs.

As it relates to our discussion on engine size and fuel economy, we note that the Edge is equipped with a 3.5-liter V-6, rated at 18 MPG city and 25 MPG highway. The Explorer, by contrast, is offered with two engines: a 4.0-liter V-6 or a 4.6-liter V-8, both of which are rated at 15 MPG city and 21 MPG highway. Thus, consumers switching out of the Explorer and into a new Edge are contributing to the downward pressure on average engine size and (driving habits equal) are using less gasoline in the process.

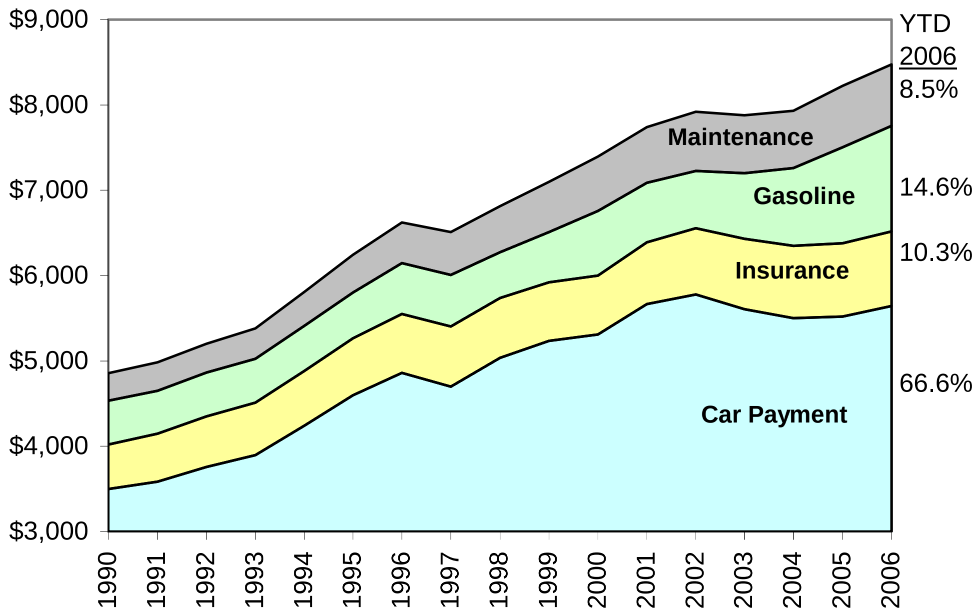
Don't Forget about Interest Rates

Rates Are a Major Driver of Mix Decisions

While interest rates are less frequently cited than gasoline prices as a factor in consumer engine size decisions, they are actually a critical part of the decision framework.

In Exhibit 231, we show a time series of the major cost components of owning and operating a vehicle: vehicle payment, insurance, gasoline, and maintenance. Although gasoline, now at 14.6%, has recently risen significantly as a percentage of the total cost of motoring; the vehicle payment is still far and away the largest cost component at 66.6%.

Exhibit 231: Cost of Motoring—Average Annual Expenditure



Source: Ward's, BLS, Federal Reserve, Credit Suisse estimates.

In the short term, existing vehicle owners can react to higher gasoline prices in a variety of ways—for example, driving less (carpooling, buses) or driving the more fuel-efficient family vehicle. However, the only way a *new* vehicle shopper can reduce his or her car payment (or even hold it steady) in a rising interest rate environment is to buy a cheaper vehicle, and this normally comes with a smaller engine, with higher fuel efficiency.

This is consistent with our research findings that higher interest rates result in U.S. consumers buying *less* vehicle rather than *fewer* vehicles. Therefore higher interest rates generally pose a threat to those vehicles with high-priced vehicle options, such as larger engines, all-wheel-drive, and leather seats. (See our June 30, 2004 report, *The Cost of Motoring*, for more details on the correlations between interest rates and engine size.)

The above analysis suggests to us that the U.S. consumer is moving into a different medium-term phase in vehicle-buying habits. Higher gasoline prices and potentially higher interest rates are likely to take their toll on high-priced mix in the U.S. vehicle fleet, and this essentially means smaller engines on average, dragging down gasoline demand growth.

Hybrids or Diesel, or Both?

Chris Ceraso

Mark Flannery

The section above outlined some of the factors at work in setting average fuel efficiency in the U.S. vehicle market. That analysis focused mainly on consumer-driven engine size choices and legislated mileage per gallon standards. However, there is another way to improve fuel efficiency in the U.S. and around the world: alternative vehicle propulsion.

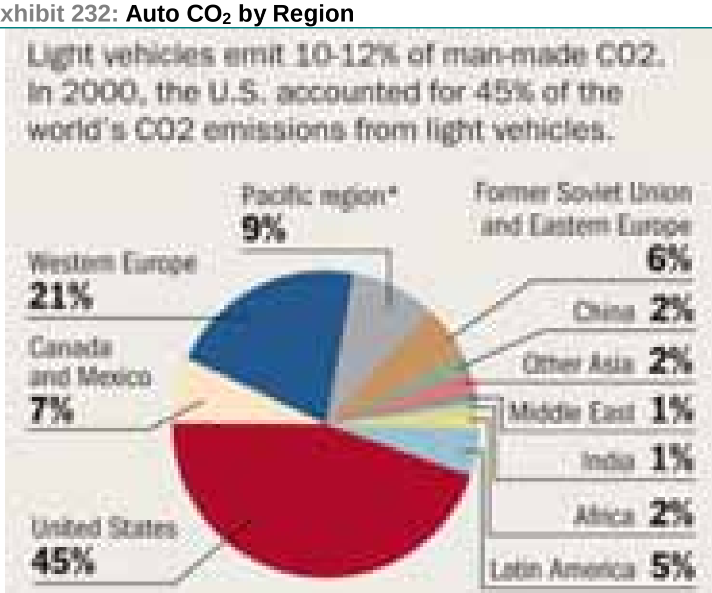
Here we are not talking about fuel cell- or hydrogen-powered vehicles, both of which remain some years away, but rather about two choices available to most consumers today: gasoline-electric hybrid vehicles and diesel engine vehicles.

Gasoline-electric hybrid engines have a traditional gasoline internal combustion engine that is supplemented by a battery-powered electric motor, mainly recharged with the energy generated from braking. These are a proven technology and achieve 20-40% higher MPG than a traditional gasoline engine, with particular savings in lower-speed urban driving where the electric motor component delivers more of the power. Diesel engines are another high MPG option, and diesel has made enormous market share gains in Europe in the last 15 years, though penetration in the U.S. is still extremely low.

Hybrid Vehicle Growth

So far, U.S. automakers have succeeded in avoiding most types of government mandates, and the legislature has allowed a voluntary market-driven approach. This period may be coming to an end, however, as the issue of global warming gains significant political traction, even with a supposedly skeptical U.S. electorate.

Exhibit 232: **Auto CO_2 by Region**



** Japan, S.Korea, Australia and New Zealand.*

Source: Environmental Defense.

While the auto industry is not the largest emitter of CO_2 (this honor belongs to the power generation industry), it is nevertheless a very visible industry and one likely to be subject to some form of control or legislation as the issue of global climate change climbs higher up the political ladder.

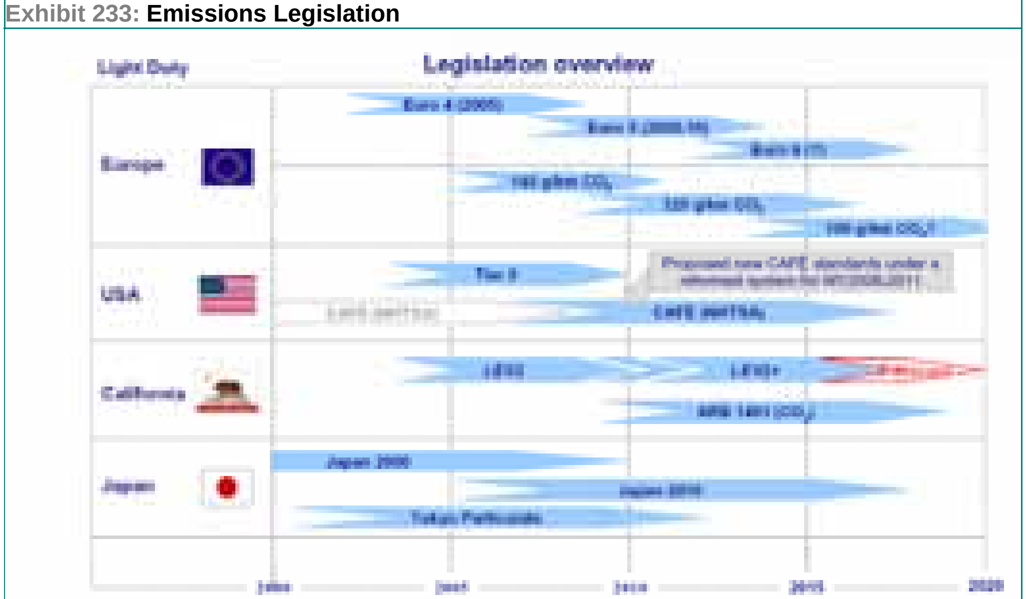
Among recent key developments:

- For the first time in 12 years, Democrats control both houses of Congress. Proposals for dramatic reductions in greenhouse gases have surfaced, and hearings already are under way.
- President Bush, long a lukewarm proponent of voluntary fuel economy improvements, surprised the industry in his 2007 State of the Union address when he called for tougher fuel economy standards that would save 8.5 billion gallons of gasoline by 2017. This would effectively raise the fleet average requirement of cars and trucks by nearly one-third, to 34 MPG, by that year. Such action, he said, "will help us confront the serious challenge of climate change." Details on the implementation mechanism were few.
- In early 2007 a coalition of 10 major U.S. companies, including General Electric, DuPont and Alcoa, formed a high-profile coalition with environmental groups to call for substantial cuts in carbon dioxide emissions. The U.S. automakers were noticeably not part of this coalition.
- Two major court cases, one in the U.S. Supreme Court and one in California, will have a major impact on the powers of states and the EPA to regulate greenhouse gas emissions. The auto industry argues against both state and federal regulation.

In Europe, there are signs of a legislative push into this topic. The European Union's new stated strategy is to reduce carbon dioxide emissions per kilometer travelled from the current average of 161 g down to 120 g per km by 2012. The E.U. is also set to reduce further the proportion of sulphur in diesel oil, to set mandatory minimums on biofuel usage as well as improving the fuel efficiency of transmissions and tires.

Recent heads of government negotiations on this topic suggest some sort of Europe-wide deal is possible or even likely in 2007.

Exhibit 233: Emissions Legislation



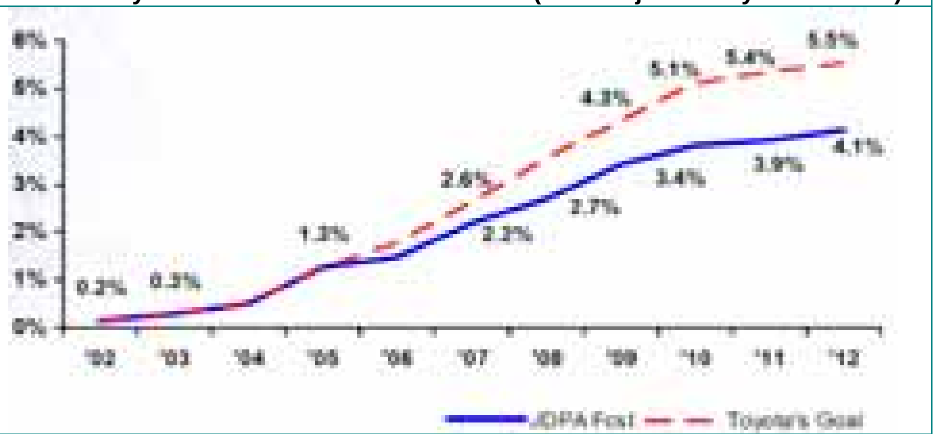
Source: KGP.

Hybrids in the U.S., Diesels in Europe

Hybrids currently account for less than 0.5% of global vehicle sales, 69% of which are sold in North America, 24% in Asia, and 7% in Europe. JD Power forecasts that hybrid vehicle sales will account for 4% of global sales by 2012, while Toyota suggests that the figure will be 5.5%. The U.S. is expected to remain the largest consumer of hybrid vehicles for the near future: around 254,000 hybrids were sold in the U.S. in 2006, up 28% from 2005.

In Japan, hybrid penetration is only around 1% despite the fact that this technology has been available for longer and on more models than in the U.S.

Exhibit 234: Hybrid Vehicle Penetration Forecast (with Projected Toyota Increase)



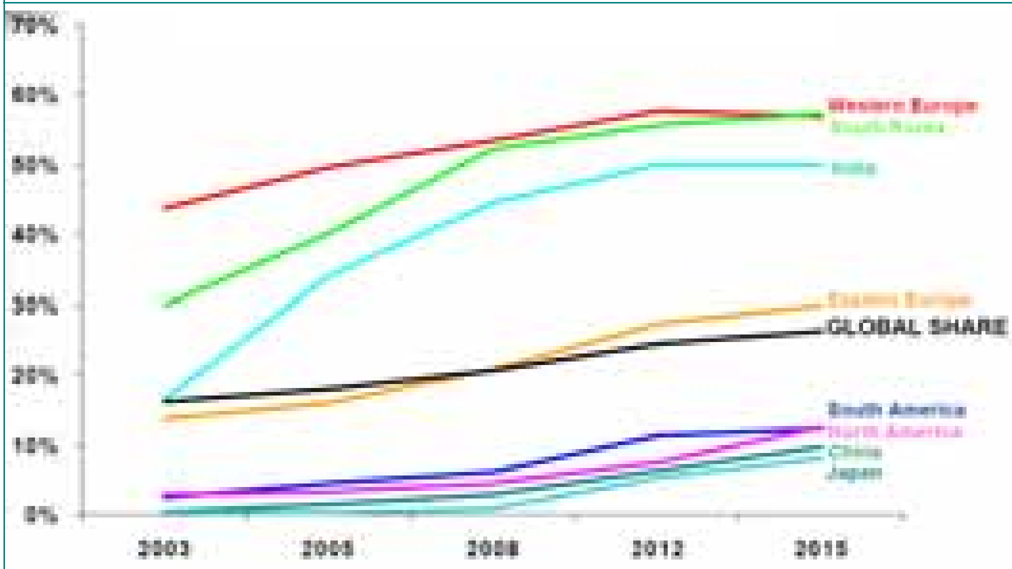
Source: JD Power.

The European consumer's reception of hybrids has been cool so far, mainly as diesel cars represent a much more compelling economic proposition. The main economic benefit from hybrids comes in congested city driving (of which there is plenty in Europe). If local city or other governments decide to offer incentives for hybrids in an attempt to reduce urban smog and improve air quality, then consumers may respond. Until then, it seems unlikely that hybrids will make much of an inroad in Europe.

Diesel Is the "Alternative" Fuel of Choice in Europe

Europe remains the largest consumer of diesel-powered light vehicles, and penetration has now reached almost 60% of new vehicles sold. Europe's diesel sales growth rates are now slowing, and North America and Asia are likely to experience faster percentage growth between now and 2015, but diesel penetration is expected to remain below 10% in both China and the U.S.

Exhibit 235: Global Diesel Sales—Diesel as Percent of Personal Vehicle Sales



Source: JD Power.

Changing fuel specification requirements has proven challenging to diesel vehicle manufacturers recently, as Western governments have become tougher on particulate emission levels and other aspects of diesel fuel use. Diesel technology is currently keeping up with planned emission standards, however, and a growing number of global engine manufacturers claim they will shortly meet the very exacting U.S. requirements.

Currently Volkswagen is the world's largest supplier of diesel-powered light vehicles, with Ford in second place. Toyota is the fastest growing diesel vehicle producer.

Consumers Are Making Rational Economic Decisions

Automotive consumers in the U.S. and Europe are generally very sophisticated in regard to their own calculations of what we call the cost of motoring equation. So far consumers have not been willing to pay a premium for a more efficient vehicle that cannot demonstrate a clear economic payback.

In a 2005 survey by JD Power, when asked what were the "most important factors considered while selecting a vehicle purchase" the top consideration for reader was reliability/durability at 61%, gas mileage was middle of the wish list with 33%, and environmental impact was at the bottom with 7.5%.

Exhibit 236: Industry total: "Most important Factors Considered While Selecting Vehicle Purchase"

Reliability/Durability	61.49%
Interior comfort	51.11%
Exterior styling	47.17%
Quality of workmanship	47.12%
Dealer was convenient/Liked dealer in my area	41.54%
Performance	41.10%
Like the image this vehicle portrays	35.79%
Gas mileage	33.29%
Safety	32.77%
Passenger capacity	30.62%
Advanced technology of the vehicle	28.35%
Low price or payment/Ability to obtain financing	27.08%
AWD/4WD capability	26.13%
Low maintenance costs	25.53%
High resale value	24.21%
Cargo capacity	23.31%
The "deal"	18.73%
Better warranty	11.40%
Environmental impact	7.56%
Other	4.66%

Source: JD Power.

Since 2005 there has been a rapid increase in consumer awareness of climate change and environmental issues, along with a growing acceptance that higher fuel prices might be here to stay for a while. This suggests that customer responses may be different in an equivalent survey taken today. However, we believe that to ensure widespread market penetration, more fuel-efficient cars need to be backed by an obvious economic proposition for the consumer.

In Europe, the rise of the more fuel-efficient diesel vehicle was spurred by ever increasing fuel taxes, taking end-user fuel prices to a level two to three times higher than those in the U.S. In addition, there were some government tax incentives for diesel fuel in the early days of the market. The economic savings from owning a diesel vehicle in Europe have been clear and demonstrable for some years, especially as diesel vehicles rarely cost considerably more than their gasoline equivalents, and as the performance gap between gasoline and diesel vehicles has shrunk to almost zero in the last 10 years.

The Diesel Benefit Is Immediate in Europe, Not in U.S.

The economic benefits are evident today when it comes to diesel cars, even in the U.S., as the following examples make clear.

In Exhibit 237, we show the relative economics of owning and operating a diesel vehicle in the U.S. and in the U.K. (our European example country).

Exhibit 237: Assumptions Behind Gasoline versus Diesel Comparison

	E350 Sedan - gasoline			***E320 Sedan- diesel***		
**assumes 55% city, 45% highway*						
	City	Highway	Comb*	City	Highway	Comb*
Fuel Economy (MPG)	19	26	22	27	37	32
Miles driven per annum US			14000			14000
Miles driven per annum UK			9000			9000
Fuel use per annum US (gallons)	737	538	648	519	378	444
Fuel use per annum UK (gallons)	474	346	416	333	243	286
Fuel cost $/gallon US			2.38			2.55
Fuel cost $/gallon UK			6.39			6.68
Annual Fuel Cost US ($)	1,754	1,282	1,541	1,322	965	1,133
Annual Fuel Cost UK ($)	3,027	2,212	2,660	2,227	1,625	1,909
MSRP US $	54,405			55,465		
MSRP UK $	78,507			74,734		

Source: Company data, Credit Suisse estimates.

Our example uses the Mercedes Benz E-Class saloon, with the U.S. MSRP grossed up by 6% to account for average sales taxes. There are some very significant market differences between the U.K. and U.S.: fuel is drastically more expensive in the U.K. (high rates of government taxation) while the average U.K. car owner drives fewer miles per annum than his or her U.S. counterpart.

Exhibit 238: Comparative Economics of Diesel versus Gasoline Ownership

	City	**Highway**	**Comb**
Fuel Savings US ($/yr)	$431	$317	$408
Fuel Savings UK ($/yr)	$800	$587	$752
Fuel saving as % of vehicle premium US	41%	30%	38%
Fuel saving as % of vehicle premium UK	N/A	N/A	
Years to return investment US	2.5	3.3	2.6
Years to return investment UK	Immediate		

Source: Company data, Credit Suisse estimates.

In the U.K., the economic benefit of owning a diesel vehicle is immediate, as the car costs no more than its gasoline equivalent (it actually costs less in this case), and although diesel fuel is priced at a premium to gasoline in the U.K. (as in the U.S.), the efficiency benefits overwhelm the small price differential. In this example, the average U.K. consumer would save just over $1,000 per annum on fuel costs by buying the diesel-powered E320 versus the gasoline-powered E350.

In the U.S., the fuel savings are more modest at $371 per annum, but this would pay back the premium cost of the diesel vehicle in just over 2.5 years. It is likely that diesel vehicles in the U.S. could be priced in the future on a par with gasoline vehicles if they were sold in greater numbers, although the emissions control equipment required to make diesel vehicles “50-state legal”’ is more expensive than the European equivalent.

The benefits of diesel ownership diminish somewhat when comparing lower-priced vehicles in the U.S. where vehicle price premiums for diesel are a larger proportion of the total cost. In Europe, this phenomenon is not visible, and diesel vehicles are fully competitive in terms of vehicle price all the way down to entry-level cars.

Hybrids Are Not Economically Attractive Today

As we have just seen, the economics of diesel vehicles in Europe are compelling, and in the U.S. are at least nonpunitive.

However, for consumers on both sides of the Atlantic, the economics of hybrid ownership are much less attractive. This is because the vehicle price premium for the hybrid engine system is higher than the existing diesel vehicle premium, and likely to remain higher as it requires more engineering and parts than a diesel engine. (The hybrid’s battery power storage and delivery mechanism is a whole new vehicle system.)

Exhibit 239: Assumptions Behind Gasoline versus Hybrid Comparison

	Lexus RX 350- gasoline			***Lexus RX 400- Hybrid***		
***assumes 55% city, 45% highway**						
	City	Highway	Comb*	City	Highway	Comb*
Fuel Economy (MPG)	20	25	22	32	27	30
Miles driven per annum US			15,000			15000
Miles driven per annum UK			9,000			9000
Fuel use per annum US (gallons)	700	560	629	438	519	471
Fuel use per annum UK (gallons)	450	360	404	281	333	303
Fuel cost $/gallon US- mid grade			2.48			2.48
Fuel cost $/gallon UK- mid grade			6.39			6.39
Annual Fuel Cost US ($)	1,736	1,389	1,580	1,085	1,286	1,175
Annual Fuel Cost UK ($)	2,876	2,300	2,617	1,797	2,130	1,947
MSRP US $	40,402			44,409		
MSRP UK $	60,772			70,883		

Source: Company data, Credit Suisse estimates.

The example in Exhibit 238 uses the Lexus RX series as the comparison model, and keeps most other assumptions unchanged from the earlier gasoline-diesel comparison.

Exhibit 240: Comparative Economics of Regular Gasoline versus Hybrid Ownership

	City	Highway	Comb
Fuel Savings US ($/yr)	$651	$103	$404
Fuel Savings UK ($/yr)	$1,078	$170	$670
Fuel saving as % of vehicle premium US	16%	3%	10%
Fuel saving as % of vehicle premium UK	11%	2%	7%
Years to return investment US	6.2	38.9	9.9
Years to return investment UK	9.4	59.3	15.1

Source: Company data, Credit Suisse estimates.

It is noticeable that the vehicle price premium for a hybrid in the U.K. is significant, possibly due to the low level of hybrid penetration in the market (and smaller manufacturing runs). It is this high vehicle premium (just over $10,000) that makes a hybrid vehicle a noneconomical proposition for the average U.K. driver, even though the fuel savings of $670 per annum are enticing.

What is also noticeable is that even with a lower hybrid vehicle premium in the U.S., the lower fuel cost means that fuel savings are lower and ownership is a noneconomical proposition for most consumers. Of course, at much higher U.S. gasoline prices, the pay-back period would shrink.

We have not considered the impact of government tax incentives, as these are in flux in both the U.S. and the EU. In the U.S., government incentives for certain hybrids (the high-selling models) are being reduced or phased out.

For example, the Lexus 400 hybrid considered in Exhibit 238 now qualifies only for a $1,100 U.S. federal tax incentive (it used to qualify for $2,200), and by the end of 2007 it will cease to qualify for any tax incentive, presumably reducing its economic attraction.

If we added in a $1,100 tax credit to the calculation above, the U.S. payback time would fall to 7 years from 10 years—better but still not compelling. There is no corresponding hybrid tax break in the U.K., but there are some benefits to be claimed in certain aspects of vehicle taxation. The system is confusing, however.

It seems that without further government tax support or some other way of reducing the large hybrid vehicle cost premium, the future for hybrid vehicles in Europe does not look very promising, particularly as consumers already have an existing fully economic choice for greater fuel efficiency in diesel vehicles.

A more intriguing question is whether or not the U.S. consumer can be persuaded to take up the diesel vehicle in greater numbers.

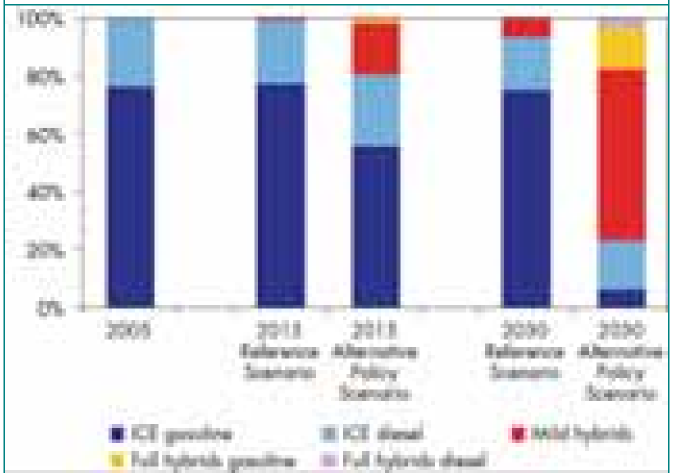
The Future Vehicle Fleet—More Diesel for the U.S.?

Some voices in the debate over the composition of the world's future vehicle fleet (the IEA or Royal Dutch Shell, for example) expect a shift toward hybrids over time. However, as we have shown, the hybrid vehicle in the U.S. and the U.K. remains a noneconomic proposition today, without greater tax or other incentives for the consumer.

Diesel vehicles have already proven their worth in Europe (with a lot of help from very high relative fuel prices) and they are already close to being an economic proposition in the U.S.

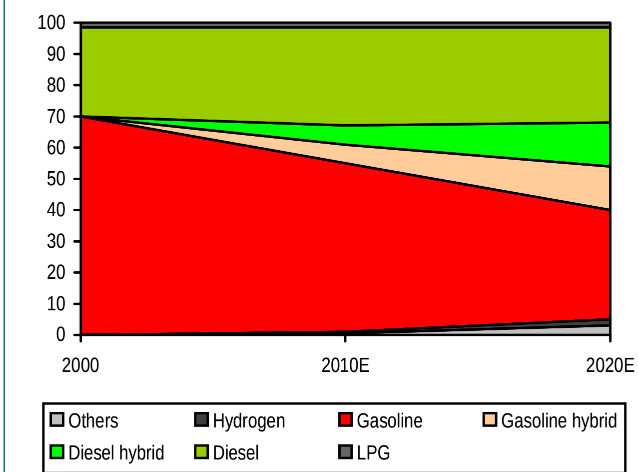
It seems possible that the U.S. could see a greater proportion of diesel vehicles in its mix in the coming 5-10 years, particularly if fuel prices remain at historically high levels and if car manufacturers respond with attractive and competitive diesel models, and if auto companies spend some marketing dollars on consumer education ("not your father's diesel engine," etc.)

Exhibit 241: Technology Shares in Transport Light Vehicle Fleet



Source: IEA.

Exhibit 242: Possible Distribution of Car Fleet by Fuel Type



Source: RDS.

The U.S. consumer will make his or her choice in the coming 5-10 years, and diesel has a chance of experiencing some fast growth in the U.S.

However, the last 10-15 years in Europe have shown that significant shifts in vehicle fuel choice by consumers can leave the oil refining industry scrambling to keep up.

European demand for gasoline has fallen significantly over the last 10 years, co-incidentally at a time when U.S. demand for gasoline was increasing rapidly, leading to a reasonable outcome for European refiners and U.S. consumers, i.e., higher gasoline exports to the U.S.

In consequence, Europe's refiners have struggled to increase diesel yields during periods of stronger demand. The same is likely to happen in the U.S. where the refining system is even more geared toward producing gasoline.

In other words, the economic impact of a shift to diesel vehicles in the U.S. does not stop with the auto companies and the consumer. The refining industry must be able to supply the right kind of fuel, and in most refineries that is not as easy as flipping a switch or turning a valve.

We believe that very significant investment would be needed to accommodate a large-scale shift to diesel in the U.S., and with on road diesel supply already tight, some of the benefits of diesel ownership could be eroded by a higher price premium for diesel fuel over gasoline.

Who Benefits from Greater Powertrain Efficiency?

In Europe, we highlight two auto suppliers that could benefit from the continuing trend toward improved powertrain efficiency or possibly from further hybrid penetration.

- *Continental AG.* In 2003, Continental Automotive Systems (CAS) began production of a mild hybrid engine package using a combination of an internal combustion engine and an electronic motor on the fly wheel. This single electronic motor replaces both starter and generator while noticeably surpassing their function. This integrated starter alternator damper (IADS) adds some economic and environmental benefit to the vehicle. With ISAD, the battery system recharges itself through regenerative braking. The system is currently available on a number of GM vehicles.

- *Valeo.* Valeo has several products that focus on powertrain efficiency, which, if all combined in one vehicle, could in theory improve efficiency by around 40%. (1) Valeo's Start-Stop system (StARS) focuses on temporary halts at traffic lights or traffic jams. Once the vehicle comes to a standstill, the engine cuts out, reducing noise pollution and vibration. This system also results in fuel savings of up to 10% and helps reduce vehicle emissions. (2) Valeo's Thermal Management Intelligent System (THEMIS) manages and optimizes engine temperature according to different driving and engine load conditions. This results in lower fuel consumption, lower emissions, and increased engine reliability.

In the U.S., we highlight two auto suppliers that would benefit from the trend to improved powertrain efficiency or from a move to hybrid vehicles.

- *BorgWarner.* Almost every product that BorgWarner makes is designed to help improve fuel economy and/or reduce vehicle emissions. As the number 2 global supplier of turbochargers, Borg is a primary beneficiary of increasing diesel penetration in various markets. (All diesels are mated to turbochargers.) BorgWarner also holds a majority stake in Beru AG, which provides diesel cold-starting technology and cabin heating systems.

  In addition to turbochargers and other diesel-related components, Borg offers a wide array of engine and driveline systems and components that help improve fuel economy, including variable cam timing (VCT) systems, dual-clutch transmission (DCT) systems, electronically controlled all-wheel-drive systems, and engine cooling and thermal management systems, among others.

- *Johnson Controls.* Johnson Controls is one of the few U.S.-based auto suppliers that offers a direct play on the growing market for hybrid vehicles. Beginning in 2008, JCI will begin supplying nickel metal hydride batteries for hybrid vehicles, and in 2009, its plans to introduce its first lithium ion battery for a European hybrid vehicle. Most of the other suppliers of hybrid batteries and powertrain components are Japanese.

Impact on the Oil and Gas Market

Alternatives Will Change the Hydrocarbon Balance

Mark Flannery
Edward Westlake

The rise of alternative energy, the increasing fear of energy insecurity, and a growing awareness of the need to confront global climate change will likely have some profound longer-term impacts on oil prices, refining margins, and traditional oil and gas stock selection.

Broadly speaking, an increase in the efficiency of energy consumption and in the amount renewable electricity production will likely lower long-term future demand growth for both oil and gas relative to current expectations.

Rising biofuels production (ethanol and biodiesel) will help alleviate tightness in the supply of transportation fuels and will have a negative impact over time on conventional refined product margins.

The current trend toward diesel and hybrid vehicles, and away from pure gasoline engines, looks set to continue with some uncertainty regarding which way the U.S. will go.

However, consumer and government choices are only one side of the equation. It is not clear at all that the global refining system could accommodate a large-scale shift toward diesel, particularly if this were to occur in the U.S.

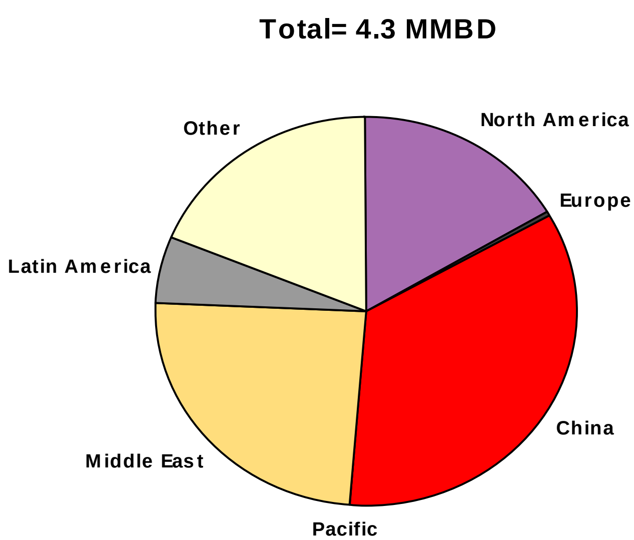
Finally, concerns over emissions and potentially higher prices for CO_2 will at some point likely lead to projects such as the Canadian oil sands or the coal-to-liquids industry.

Alternative Energy Will Lower Oil Demand Growth

Global oil demand is currently growing at around 1.5% per annum. As we outline, non-OPEC supply is struggling to keep pace, and even the strong investment levels in OPEC countries may not be enough to supply this level of demand growth, if projects suffer delays or depletion rates turn out higher than expected.

As we argued in our December 2005 report, *Energy in 2006—Resolution,* and our December 2006 report, *Energy in 2007—Plateau*, energy conservation will drive the rate of oil demand growth down over time.

Exhibit 243: Anticipated Split of Global Oil Demand Growth, 2006–10



Source: Credit Suisse research.

The question is, What is a reasonable level of long-term demand growth in a world of alternative energy?

The impact will be different in different countries. The three largest expected areas of oil demand growth for the next 10 years are China, North America, and the Middle East, with smaller contributions from India and other Asia.

China

In China, the prospects for medium term oil demand growth appear good. Oil is still mainly an industrial fuel in China, and both conservation and fuel switching (to gas) are likely to take place at today's higher oil prices. Demand should remain relatively strong in the transportation segment, though it is possible that China could introduce even tougher mileage standards for new vehicles in the next five years. Biofuels will likely have a limited impact on Chinese conventional oil demand in the near term at least.

We recently lowered our long-term growth rate for Chinese oil demand to an annual average of 5-7% from our previous 7-8%, with potential downside to 4% per annum.

North America

North American oil demand is now over 85% transportation demand (cars, trucks, and airplanes) and potential exists to improve efficiency of use in the private transportation fleet. Consumers are already choosing smaller engines and some legislative action on higher mileage standards is expected in the coming year. In addition, fast rising corn ethanol supply should alleviate the demand pull on conventional gasoline over the next three years at least.

We forecast medium-term oil demand growth in North America of around 1%, with potential downside to 0.5% per annum.

Middle East

In the Middle East, the combination of fast growing populations, rising incomes (fueled by high oil prices), and extremely low retail gasoline prices have produced annual average oil demand growth of 5-7% over the last four years. This looks set to continue as long as crude oil prices remain high and governments in the region remain wary of raising end-user fuel prices. Without higher prices there is little prospect of higher efficiency or use, although there will be some replacement of oil-fired power generation by natural gas in the coming years. Biofuels are not a meaningful factor in the Middle East.

We forecast medium-term demand growth in the Middle East of 5% per annum, with possible downside to 4% per annum.

Rest of the World

In the rest of the world, it is possible that European oil demand could fall faster than expected, although efficiency of oil use is already relatively high. Biofuels will likely provide the impetus for lower oil demand in Europe.

Natural gas substitution for oil in the rest of the world is a widespread medium-term phenomenon that should limit the growth in oil demand. This could remove 0.25% from annual oil demand growth in the rest of the world, under the right combination of investment and circumstances.

Demand Conclusion

Greater demand side investment in energy and transportation efficiency will be needed, as we have outlined elsewhere in this report. The IEA suggest that this could reduce global oil demand growth toward 0.9% by 2030, saving 750 kbd of net capacity additions *per annum* or at least $25 billion per annum in required oil investment.

Lowering our demand growth estimates to the downside cases outlined above would produce medium-term oil demand growth of 1%, down from 1.5%. This difference would reduce estimated oil demand in 2020 by 7 million barrels per day to 97 MMBD. (2006 oil demand was 84.6 MMBD.) Under this scenario, around 500 KBD per annum of net oil supply would not be needed.

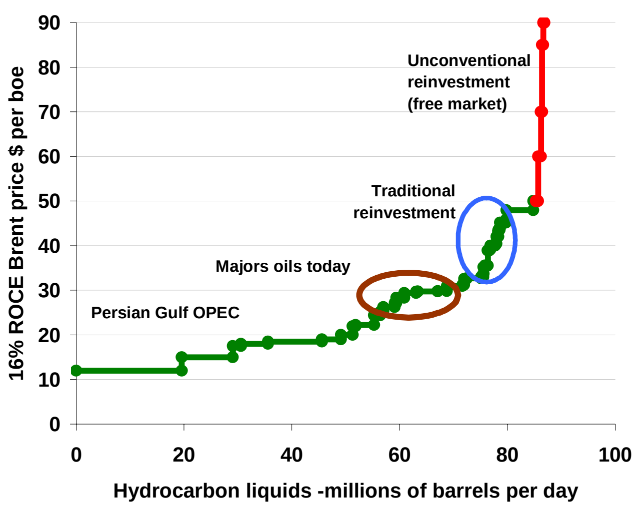
There are other effects that alternative energy and governments are having on the supply side, mainly via altering the cost curve.

Alternative Energy Will Affect the Oil Cost Curve

Before the recent oil price upcycle, it was believed that there existed a series of alternatives to conventional hydrocarbons that made economic sense only at much higher prices, and which in any case were likely unable to affect competing supply in any meaningful way.

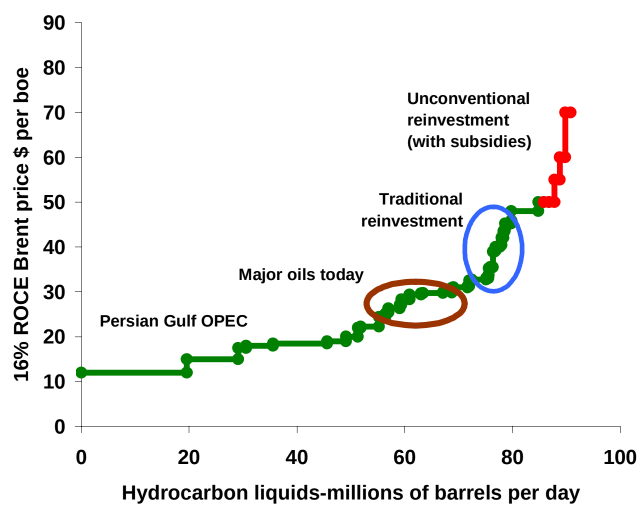
This world view is best illustrated in Exhibit 244.

Exhibit 244: Oil Cost Curve Schematic (Free Market)



Source: Company data, Credit Suisse estimates.

Exhibit 245: Oil Cost Curve Schematic (Government Affected)



Source: Company data, Credit Suisse estimates.

However, as governments have become involved in promoting alternative energy, the competitive landscape has changed. Direct competition with conventional liquid hydrocarbons is now possible in the $50-70 range, we estimate, as shown in Exhibit 245.

This is another way of showing that in the medium term there could be a cumulative 3-5 MMBD of direct competition with conventional oil from alternative energy products (biofuels, GTL, CTL, other nonconventional hydrocarbon supply).

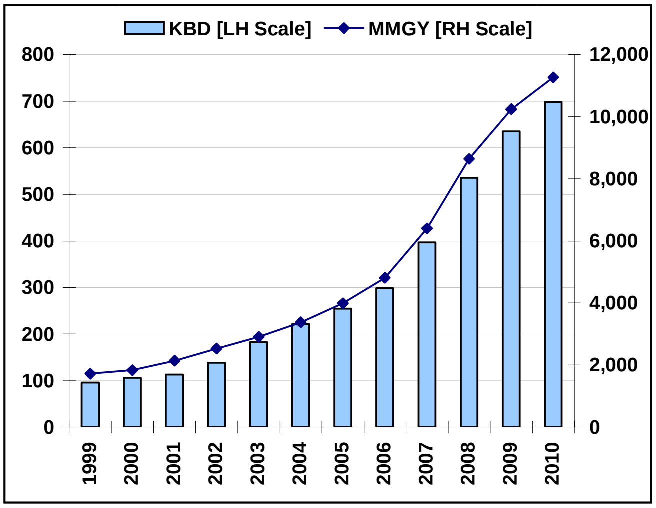
The longer that crude oil prices remain above $50, the flatter the alternative end of the cost curve could become, we think, as governments divert more resources into substitution and some alternative energy suppliers start to achieve better economies.

This analysis does *not* take into account the further impact of natural gas substituting for oil, mainly in power generation in less developed economies and the Middle East. It also does not take into account wind power substituting for oil-fired power generation in more developed economies.

U.S. Gasoline Refining Constraints Should Ease

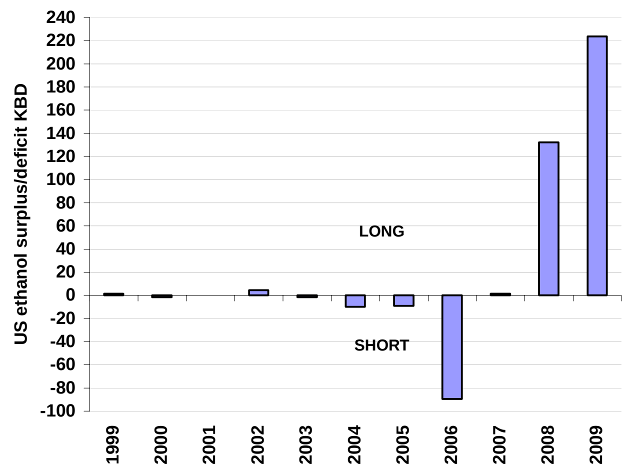
Rising corn ethanol production in the U.S. should exceed the "natural" demand for blending ethanol by 2008 and the product should start competing indirectly with conventional gasoline.

Exhibit 246: U.S. Ethanol Capacity (Annual Average)



Source: DOE, RFA, Credit Suisse estimates.

Exhibit 247: U.S. Ethanol Balance (Static Market Share)



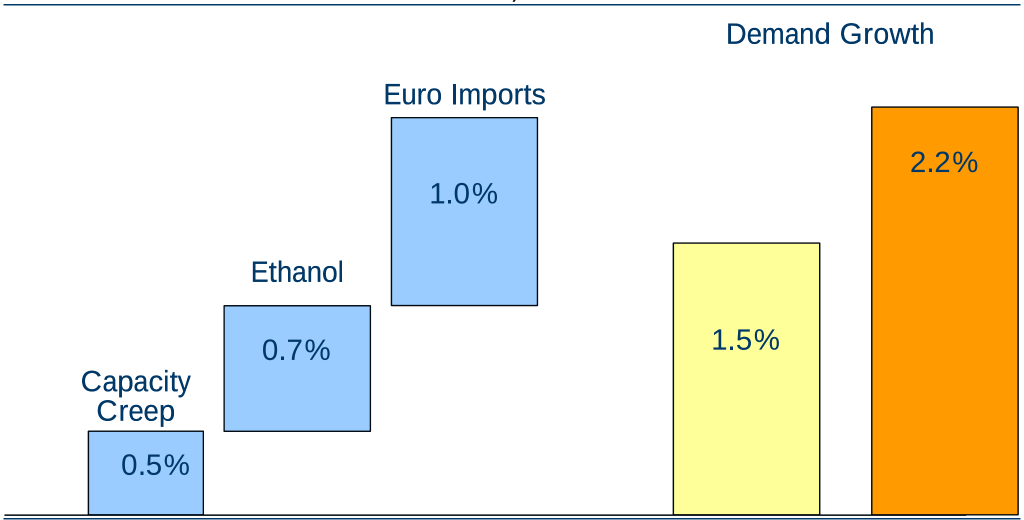
Source: Credit Suisse estimates.

Penetrating new markets in the U.S. will likely require some price discounting of ethanol against conventional gasoline, particularly against imports of gasoline from Europe. The result should be ethanol trading at a sufficient discount to gasoline to encourage further infrastructure build-out in non-RFG markets.

As many of the gasoline imports to the U.S. from Europe have a *supply push* aspect to them (they are something of a by-product of meeting European diesel demand), then overall margins on this light product are likely to fall.

Below we show the likely annual building blocks of U.S. gasoline supply for the rest of the decade. Total supply including capacity creep, biofuels, and European imports could grow at over 2% per annum above our expected rate of gasoline demand growth.

Exhibit 248: U.S. Gasoline Market Schematic, 2007–10



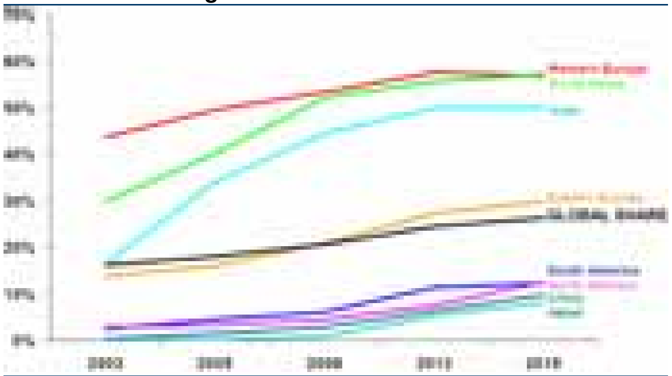
Source: Credit Suisse estimates.

While we are positive for the outlook for refining margins through the 2007 summer, this is a headwind that gasoline-oriented refiners must face in future years.

More Diesel Required, Bring on the Biodiesel

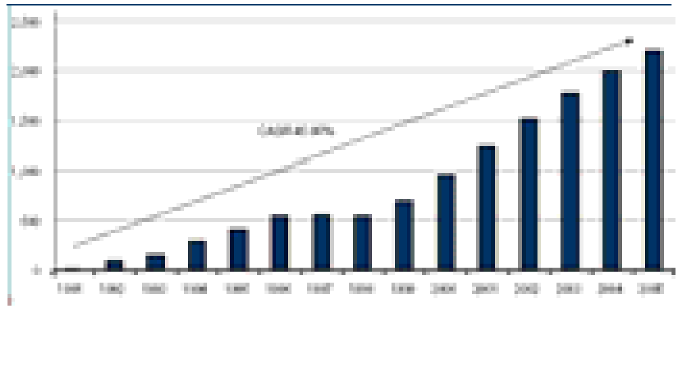
The global penetration of diesel cars is increasing and diesel refining profitability is at an all-time high as a result.

Exhibit 249: Rising Diesel Share



Source: JD Power.

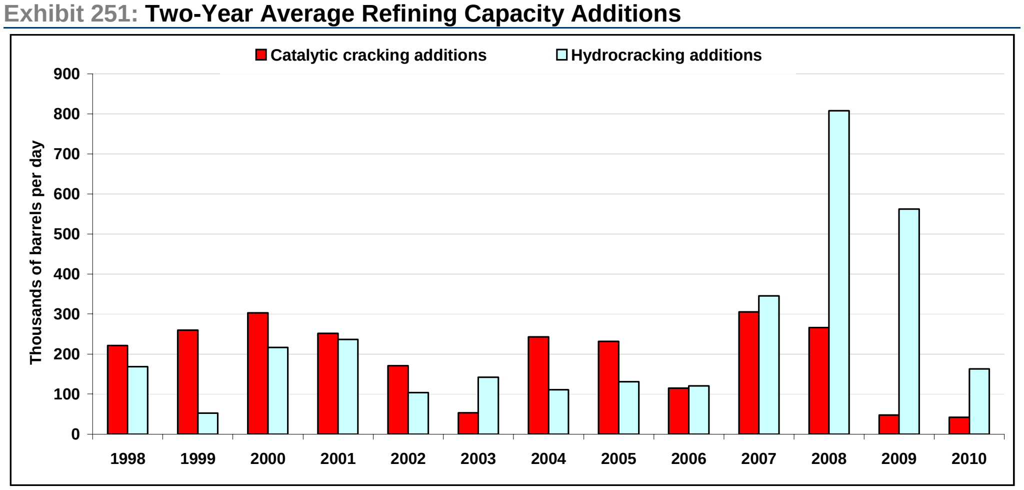
Exhibit 250: Global Biodiesel Production



Source: Worldwatch Institute, Credit Suisse research.

The conventional oil refining industry is investing in hydrocrackers to improve distillate yields (see Exhibit 251), and new refining capacity in the Middle East and Asia should help address the anticipated diesel supply shortfall.

Exhibit 251: Two-Year Average Refining Capacity Additions



Source: Credit Suisse estimates.

However, given the fact that we expect global diesel demand to grow almost twice as fast as gasoline demand for the next 10 years, it seems that the diesel market could remain tight for some time.

Can the conventional refining system cope with rising diesel demand? Persistently high diesel cracks suggest—not yet.

This suggests that in the medium term biodiesel will find an easier home in the global oil market than will ethanol.

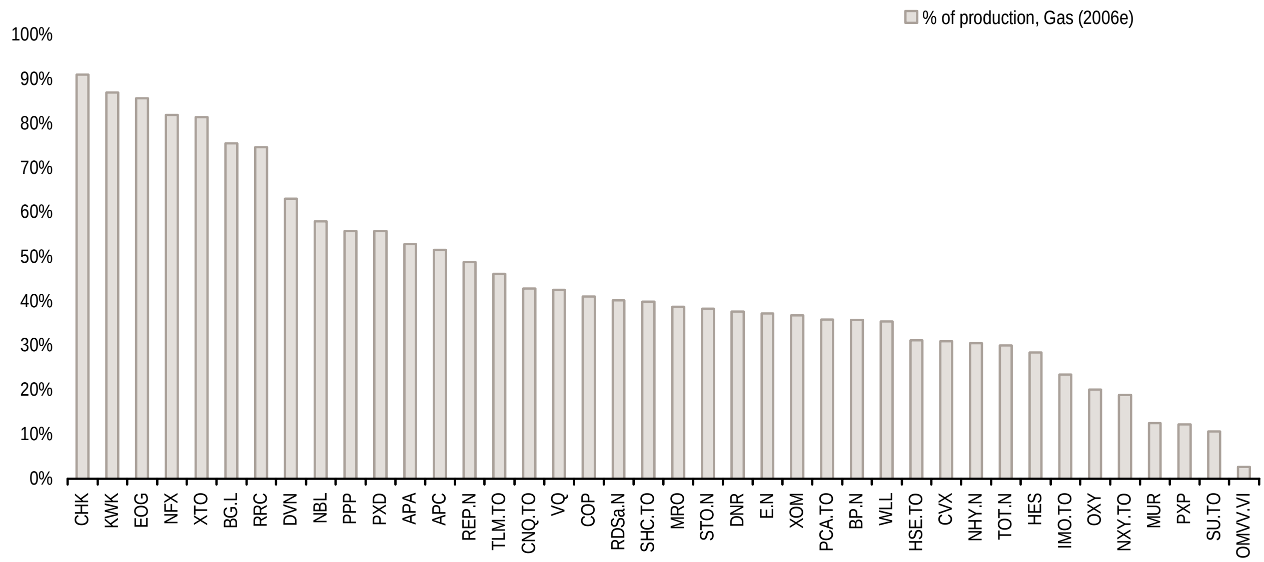
Expect Faster Growth in Natural Gas

Although the rise of renewable electrical energy will have some impact on demand growth for gas, the larger impacts are likely to be felt in oil and in coal.

Natural gas is a cleaner burning fuel, is currently cheaper on a comparative basis than oil, and should be able to compete easily for space in future energy supply.

Over time, we would generally expect those oil and gas companies more exposed to global gas production to grow more quickly than those biased toward oil. Exhibit 252 picks out the share of gas production in the larger-cap global oils. U.S. Independents such as XTO, CHK, EOG and KWK have a high focus on gas. Internationally, BG is the most exposed.

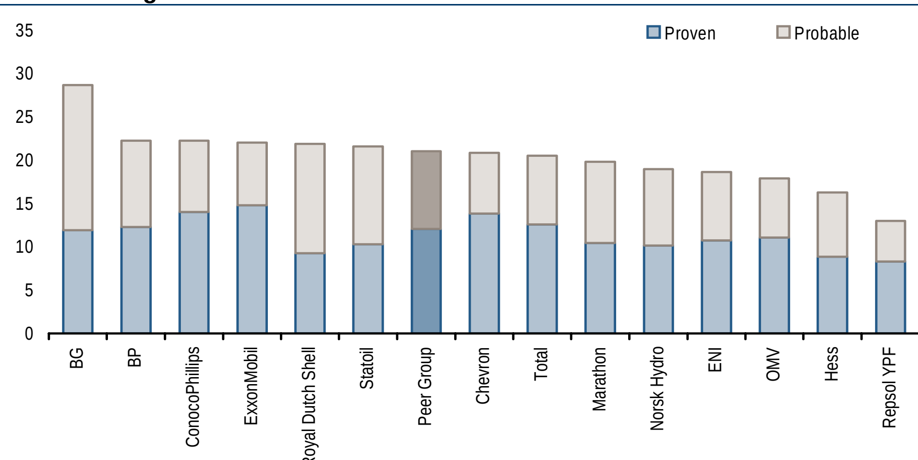
Exhibit 252: Larger-Cap Oil and Gas Companies—Percent of Natural Gas Production, 2006



Source: Company data.

However, judging future oil versus natural gas growth rates for the big oils in particular would require a look into the so-called resource bases of these companies, and that data are so far difficult to acquire. BG scores well on this metric also.

Exhibit 253: Integrated Oils Natural Gas Reserves

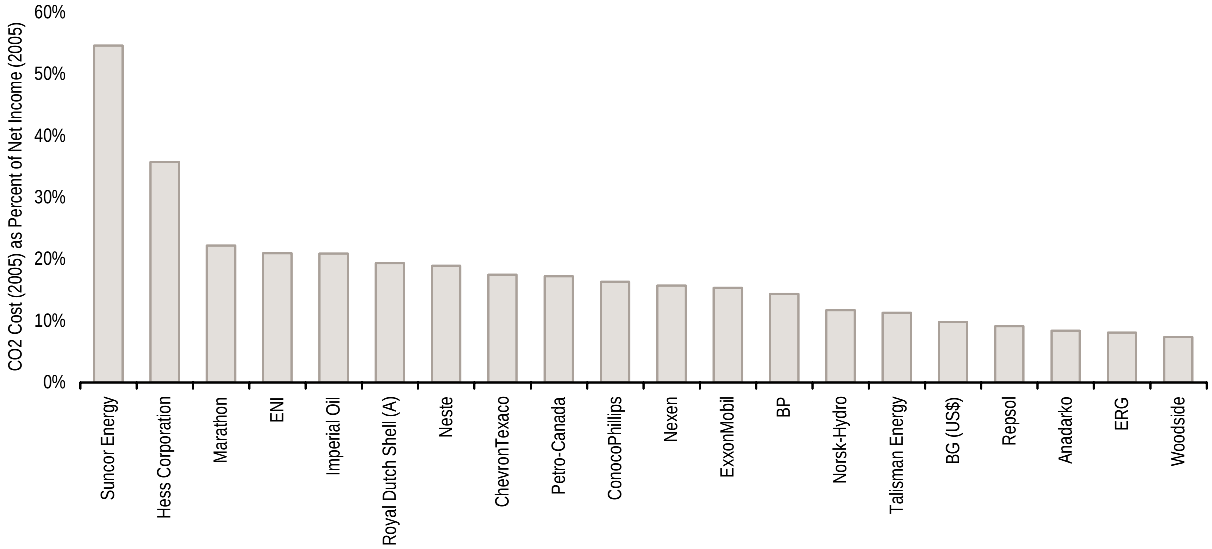


Source: Company data, Credit Suisse estimates.

Carbon Emissions Are a Risk for Oil Companies

The rising cost of carbon dioxide will become a greater stock selection factor over time, we think. Exhibit 254 shows the 2005 carbon emissions of the larger-cap oil companies per dollar of market capitalization. BG scores relatively well on this metric also.

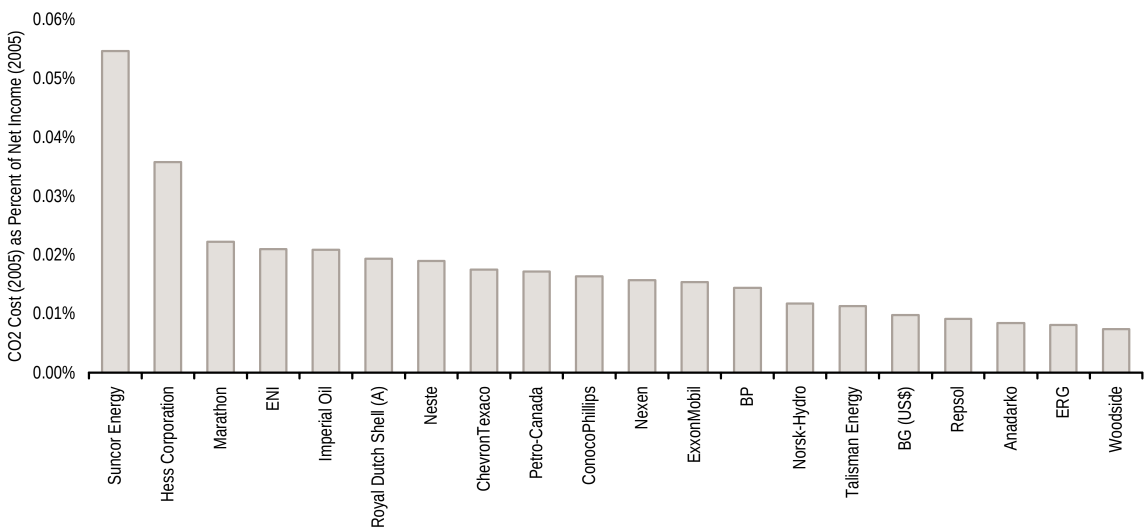
Exhibit 254: Larger-Cap Oil and Gas Companies—CO_2 Emissions MT/$Market Cap, 2005



Source: Company data, Reuters.

If we assume that the cost of carbon increases , the impact on many companies will not be significant. As an example, if the price of carbon dioxide was to increase to $40/MTe, it would account for (on average) 0.018% of net income (based on 2005 emissions) of the large-cap oil and gas companies (with companies with significant oil sand, refining or power generation being most exposed).

Exhibit 255: Carbon Dioxide Cost as a Percentage of 2005 Net Income (Assumed $40/MTe CO_2)



Source: Company data, Credit Suisse estimates, Reuters.

Global Oil Supply Outlook

Flowing OPEC's Way

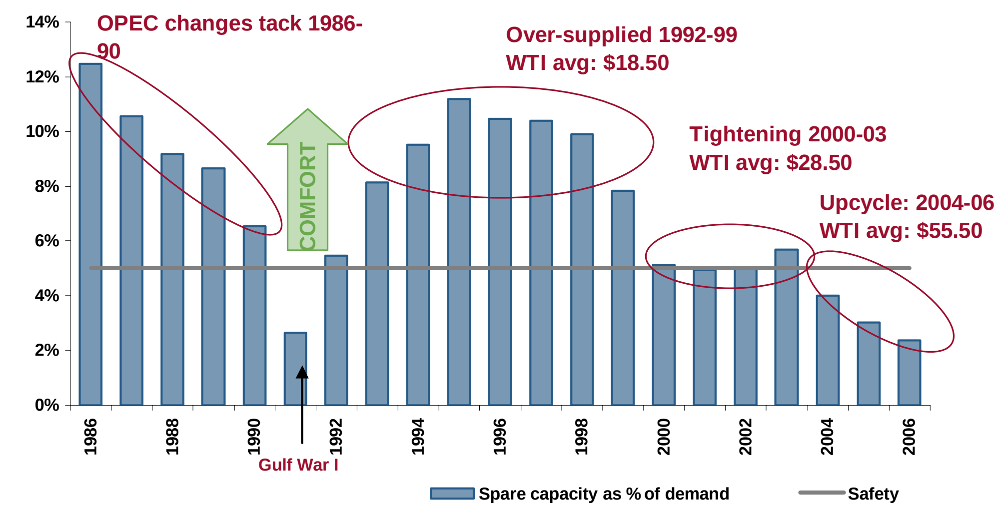
Mark Flannery

Edward Westlake

The rapid erosion of global spare crude capacity in recent years (Exhibit 256) saw oil prices triple between the late 1990s and 2006. We believe that the markets' perception of future spare deliverable oil capacity will remain a key driver of commodity pricing. In particular, a spare capacity level of 5% or more of global crude (products) demand appears to be associated with enough market confidence for marginal supply pricing to prevail. In contrast, spare capacity below this threshold level appears unable to reassure the market on future deliverability, and marginal demand pricing dynamics take over and commodity prices remain highly volatile.

In our opinion, the key question is, When will we break back into the spare capacity comfort zone and stay there?

Exhibit 256: Global Spare Crude Production Capacity versus Global Oil Demand, 1986–2006



Source: IEA, Credit Suisse estimates.

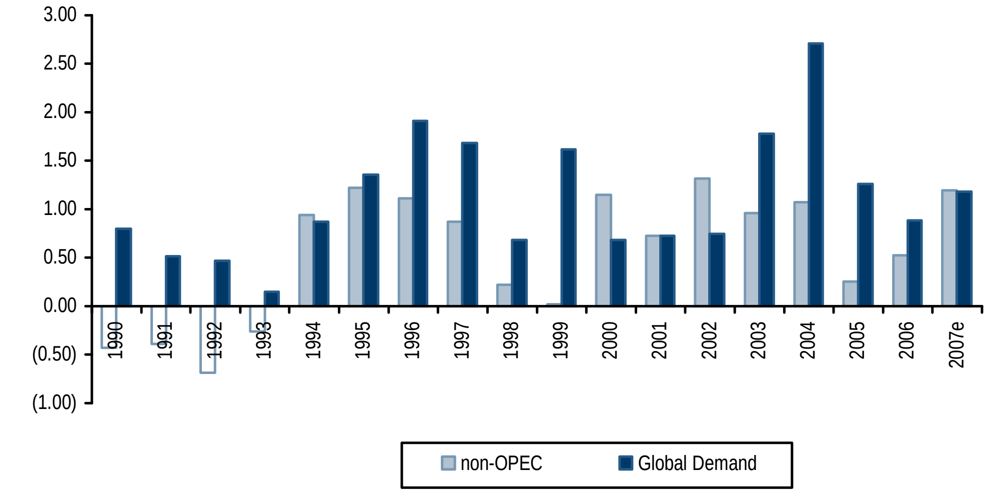
2007 Spare Capacity Is Heading Back Upward

We believe that the market came into 2007 expecting a meaningful supply build from non-OPEC (including Angola). However, since then consensus expectations have scaled back.

We estimate 2007 non-OPEC supply growth (including Angola) will be 1.18 million barrels per day (MMBD), which compares with our projection of global oil demand growth of 1.18 MMBD. Coming after two years of disappointing non-OPEC growth (Exhibit 257), 2007 will be one of the biggest builds in non-OPEC supply for some time, meaning that OPEC will need to manage the market to prevent price erosion, something that OPEC has managed so far this year.

However, the market's recent record in estimating non-OPEC supply growth has not been encouraging. In fact, consensus has overestimated non-OPEC supply growth for the last three or four years. We have already cut our initial forecast by over 100 KBD since December of last year.

Exhibit 257: Year-on-Year Growth in Non-OPEC Supply, 1990–2007E



Source: IEA for historical data, Credit Suisse estimates for forecast years. Non-OPEC forecast for 2007E includes Angola.

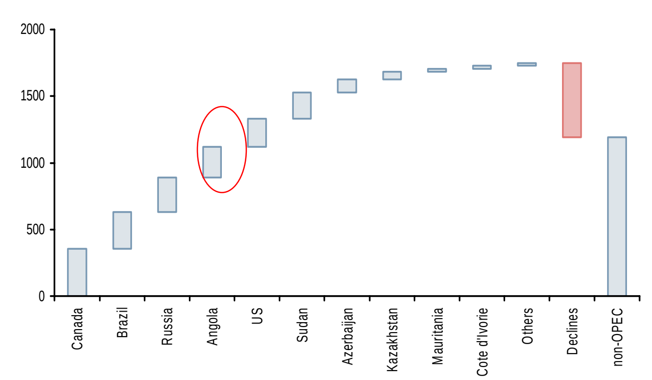
Therefore, despite the possibility of a bumper growth year for non-OPEC in 2007, we need to keep two issues in mind:

- Downside risk: non-OPEC forecasts have a recent history of being overly optimistic, and
- OPEC seems more determined than ever to defend higher oil prices.

In 2007, our base-case estimate is for a build in non-OPEC output of 1.18 MMBD, of which 0.23 MMBD is due to come from Angola, which joined OPEC on January 1, 2007, but has not been allocated a production quota and is expected to continue to behave like a non-OPEC country for several years. This compares with our expectation that global demand will grow by 1.18 MMBD. The IEA's latest forecast for non-OPEC supply growth is 1.5 MMBD.

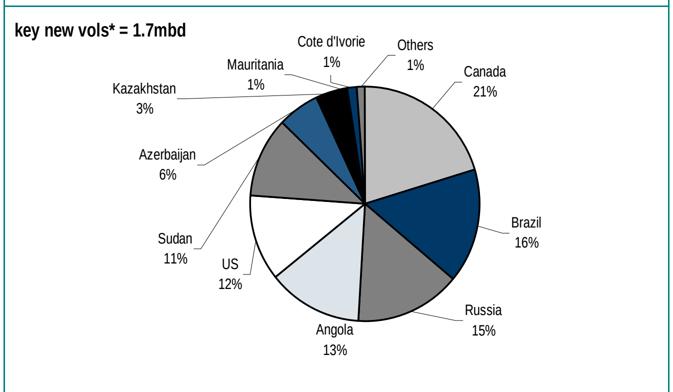
The key countries contributing to 2007's supply growth are Russia, Canada, and Brazil, which combined will add almost 900 MBD in 2007 on our numbers. There should also be smaller contributions from Sudan, Azerbaijan, the U.S., Australia, and Kazakhstan. Exhibit 272 lists the major contributing projects.

Exhibit 258: Change in Non-OPEC* Supply, 2007E



*Source: Credit Suisse estimates, NPD, Company Data, CAPP, U.K. DTI, IEA, EIA, Wood Mackenzie, Upstream Online. *Includes Angola.*

Exhibit 259: Breakdown of Key New Non-OPEC* Supply, 2007E



*Source: Credit Suisse estimates, NPD, Company Data, CAPP, U.K. DTI, IEA, EIA, Wood Mackenzie, Upstream Online. *Includes Angola.*

Non-OPEC volume growth appears sufficient to meet 2007 global demand growth, putting OPEC back into the market management business, whether it likes it or not.

However, historical forecasts for non-OPEC growth can, according to the IEA, "be reduced by 300-400 MBD in any given year due to unplanned outages, exceptional weather-related events and technical delays." Removing 450 MBD from our base-case forecast of 1.180 MMBD (includes Angola) would leave us 440 MBD below our projected global demand growth for next year. In other words, there still is not a lot of room for error in these numbers, and a range of different pricing and market balance outcomes is possible for 2007.

Long-Term Capacity: Cold Comfort Awaits

In our report, *OPEC: Too Much or Too Little?,* dated October 16, 2006, we highlighted that the markets' preoccupation with a "record" year in 2007 for non-OPEC growth is distracting attention from more pressing issues of *longer-term* global spare capacity. We argued that it is OPEC's own ability and willingness to increase production capacity that should be at the forefront of investor attention.

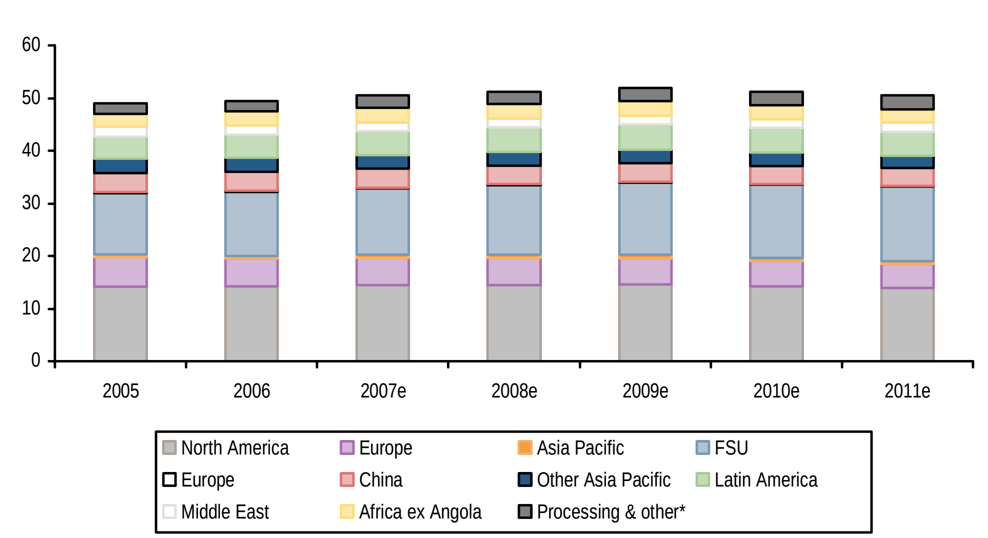
Despite a substantial increase in recent investment and activity within OPEC, there is still a lot of uncertainty regarding the cartel's ability to deliver new capacity in a timely manner. As we look beyond 2007, there is a real risk that global spare capacity never gets convincingly back into the 5%-plus comfort zone.

Below, we look at non-OPEC's medium-term growth potential, and we reiterate our view that we expect non-OPEC output to peak in 2009, placing more pressure on OPEC to deliver on its growth plans. Given the importance of OPEC's growth to future spare capacity, we undertook a scenario analysis in which it takes little deviation from central assumptions to leave the global crude market well outside its comfort zone.

Non-OPEC Production Peaks in 2009

Excluding Angola from 2007, we see non-OPEC crude oil supply topping out at around 52.0 MMBD in 2009, despite some continued growth in Russia and a number of key mega-projects coming on line in the Caspian and deepwater Brazil.

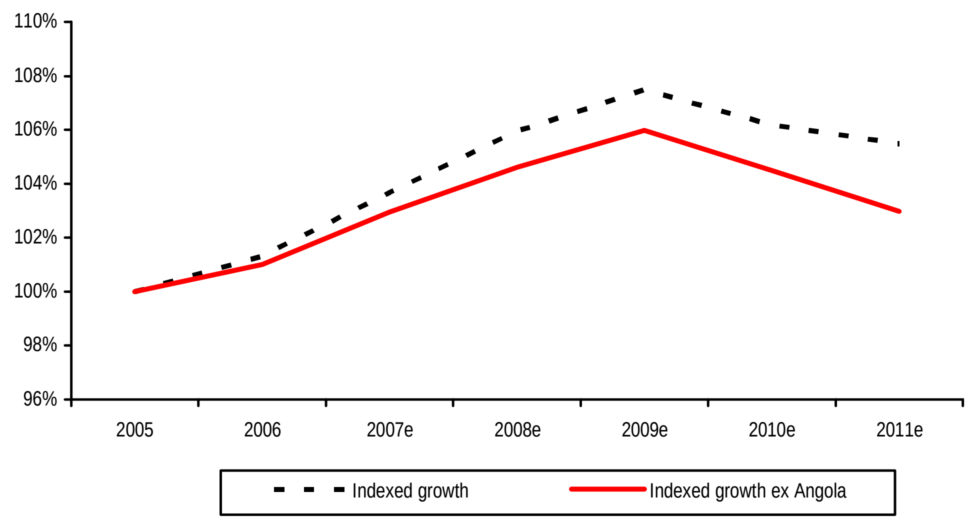
Exhibit 260: Non-OPEC Supply Forecast, 2005–2011E**
MMBD



**Includes biofuels and other. **Historical data for Africa excludes Angolan production.*
Source: Company data, Credit Suisse estimates.

Angola's transfer into OPEC changes the outlook for future growth in non-OPEC volumes. (See Exhibit 261.) Indexed (from 2005) growth from non-OPEC falls from 107% in 2009 to 105%.

Exhibit 261: Non-OPEC Indexed Growth, 2005–2011E

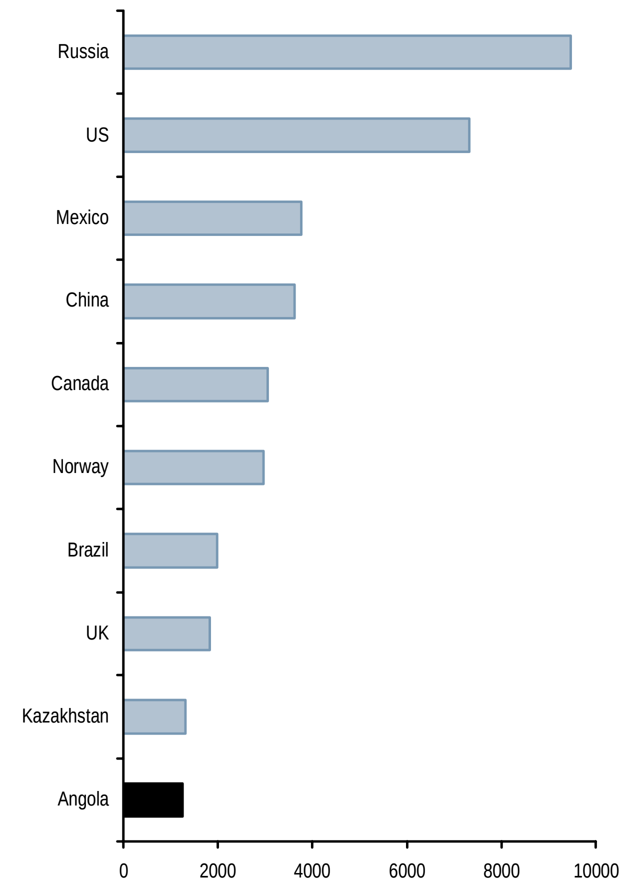


Source: Company data, Credit Suisse estimates.

Despite Angola's move and despite much emphasis on the contribution of Azerbaijan (ACG, Tengiz, and Shah Deniz) and Kazakhstan (Karachaganak and Kashagan) to non-OPEC growth, it is Russia that remains the key player in non-OPEC supply. (See Exhibit 262 and Exhibit 263.)

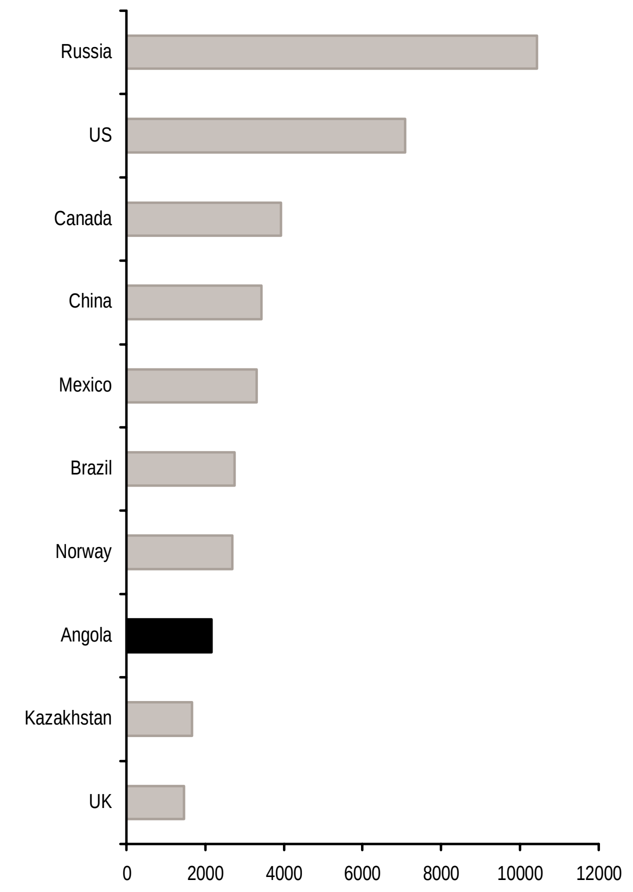
At the same time, Russia's ability to grow its output along previously assumed lines is coming under more doubt, as we set out in our scenario analysis below.

Exhibit 262: Top 10 Non-OPEC* Producers, 2000



*Source: IEA. *Includes Angola.*

Exhibit 263: Top 10 Non-OPEC* Producers, 2010E

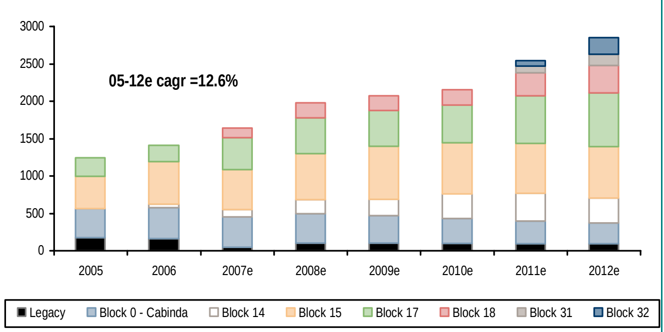


*Source: IEA, Credit Suisse estimates. *Includes Angola.*

The Pendulum Swings Back to OPEC

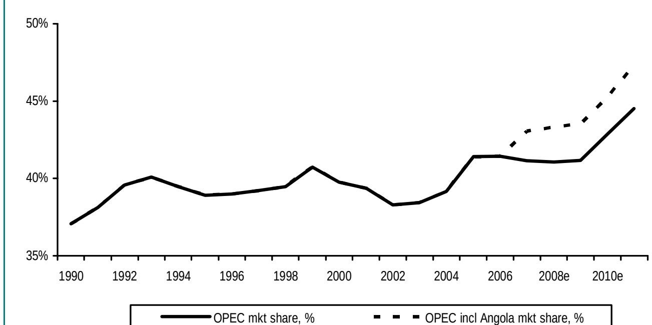
With non-OPEC output set to peak by 2009 on what we know now, the focus swings back to OPEC and its ability to deliver planned capacity expansions sufficient to meet global demand growth. Although OPEC gained a new member (Angola) with a lot of capacity growth, this transfer likely means little in practical terms: Angola in OPEC is likely to grow at roughly the same rate as Angola would have done outside the cartel.

Exhibit 264: Angola Supply Forecast, 2005–2013E
MMBD



Source: Company data, Credit Suisse estimates.

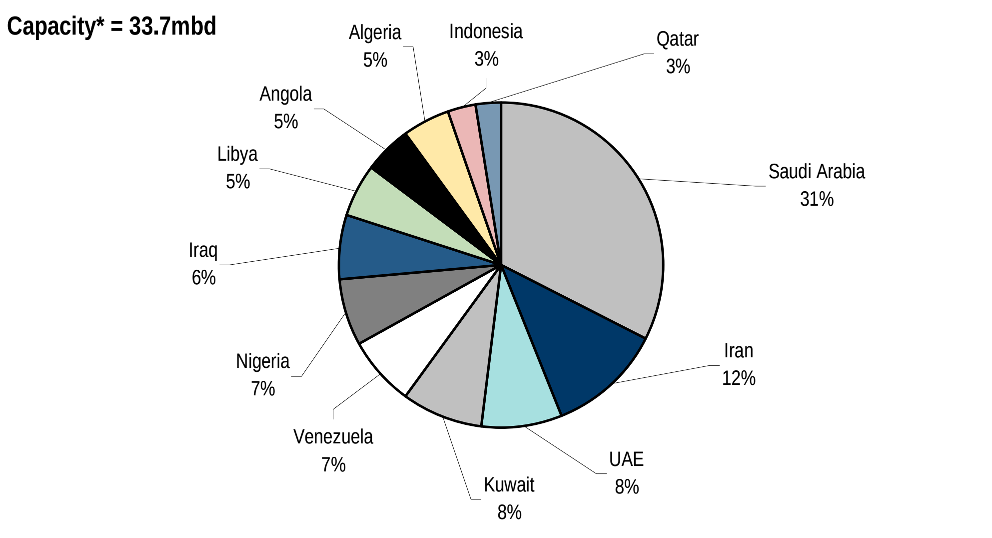
Exhibit 265: OPEC Market Share, 1990–2011E
%



Source: Company data, Credit Suisse estimates.

Angola is set to grow its output from 1.25 MMBD in 2005 to 2.15 MMBD by 2010. (See Exhibit 264.) As a result, Angola will increase OPEC's market share from 41.5% in 2006 to almost 45% by the end of the decade (Exhibit 265) and almost 50% by 2012 based on our estimates. Based on the latest figures (February 2007), Angola would have control 5% of OPEC crude capacity.

Exhibit 266: OPEC Theoretical Capacity Split* Including Angola



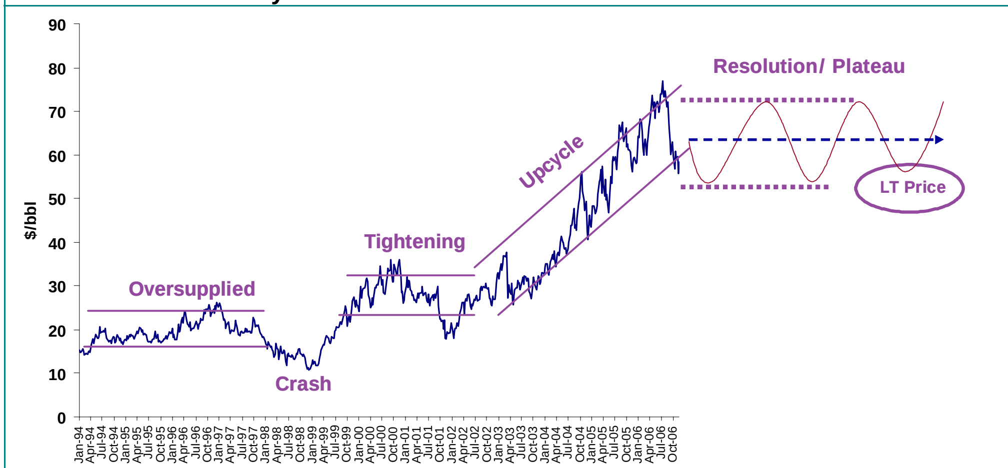
**Capacity = crude volumes although current Angolan output includes NGLs and condensates. OPEC capacity estimates as at Feb 2007.*
Source: IEA, Credit Suisse estimates.

Stress-Testing Spare Capacity: How Uncomfortable Could It Get?

Angola's shift to OPEC should increase OPEC's control over the market (depending on how Angola behaves), but this won't matter much if the global supply/demand balance remains tight into the end of the decade.

There is risk that global spare capacity does not reach the 5% comfort zone and that we remain stuck in a multiyear resolution or plateau phase. Indeed, under our worst-case scenario we could even re-ignite the commodity price upcycle seen from 2003-06. (See Exhibit 267.)

Exhibit 267: Oil Is Firmly in the Resolution Phase



Source: Bloomberg, Credit Suisse estimates.

To illustrate our concerns over future spare capacity we outline four different scenarios, which test both the demand and supply side of the equation.

Scenario 1: Demand Erosion

In our first scenario we look at our base-case supply and flex our outlook for demand to assess future spare capacity to 2010.

Our demand forecasts are noted in Exhibit 268.

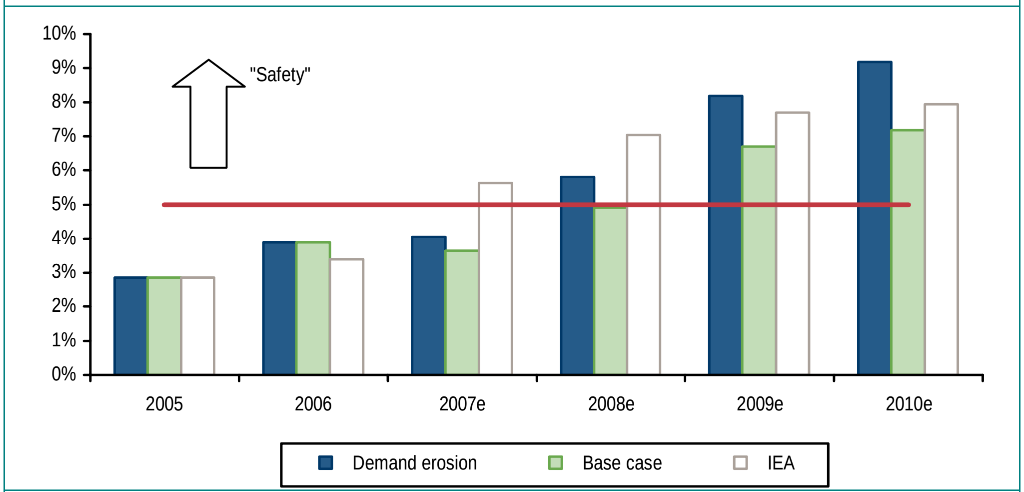
Exhibit 268: Global Crude (Product) Demand Scenarios

Demand Scenarios	2005	2006	2007e	2008e	2009e	2010e	cagr 05-10e	10-yr	20-yr
Credit Suisse base	1.5%	1.1%	1.4%	1.5%	1.5%	1.5%	1.4%	1.8%	1.6%
Credit Suisse low	1.5%	1.1%	1.0%	1.0%	1.0%	1.0%	1.0%		
IEA	1.5%	1.0%	1.8%	1.9%	2.0%	2.2%	1.8%		

Source: Company data, Credit Suisse estimates. 10-yr and 20-yr cagr based on historical IEA data to 2005.

Holding demand growth down to a little below last year's level does allow the spare capacity "cushion" to rise comfortably above 5% from 2008 (Exhibit 269), suggesting that commodity prices should begin to ease back toward marginal supply pricing, which we currently estimate at $50/bbl.

Exhibit 269: Scenario 1: Demand Erosion



Source: IEA, Credit Suisse estimates.

Demand growth erosion is not the same as demand destruction, however. A more aggressively negative view of global demand growth, probably engendered by some sort of global recession, would get us into the comfort zone much quicker.

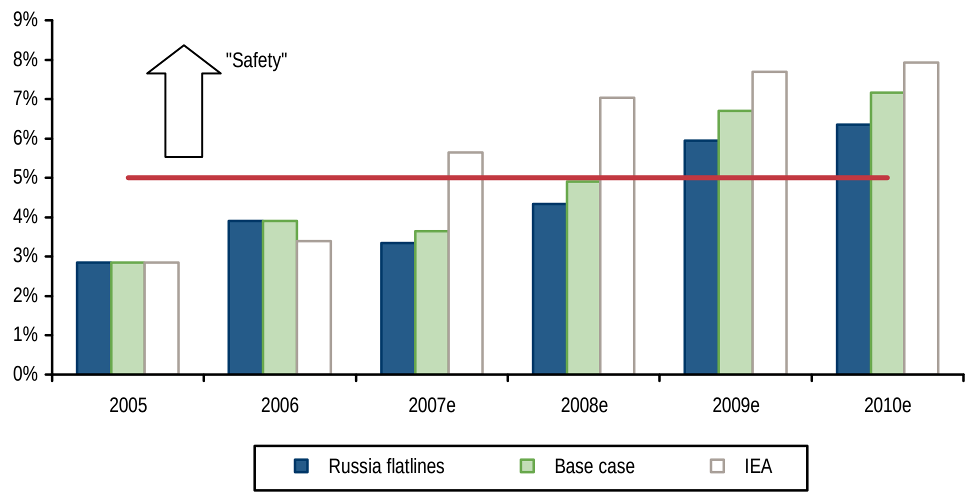
Scenario 2: Russian Oil Production Flatlines

We believe that we are at an important inflection point for Russian crude production growth as the "brownfield renaissance" in Western Siberia comes to an end. Russian oil companies will need to increase significantly their upstream spending over the next few years in order to keep output growing. We think the increasing government influence and control over the sector is likely to be negative for output growth rates for many years and in particular for exploration, which will be the driver of any meaningful future growth.

We are already seeing increased investment in Russia. For example, LUKOIL's latest 10-year plan sees upstream investment of $78-112 billion, up from the $50 billion previously assumed. However, although given the recent news flow from both Rosneft and TNK-BP of (at best) flat output over the coming years, we suspect that much of this has been driven by industry-wide inflationary pressures rather than increased activity.

In our second scenario (Exhibit 270), we forecast global spare capacity assuming that Russian volumes stay flat at 2006 levels until the end of the decade—a not unreasonable assumption given the recent production downgrades by Rosneft and TNK-BP. Our analysis shows that global spare capacity in this scenario would not meaningfully stay above the threshold 5% level.

Exhibit 270: Scenario 2: Russia Flatlines



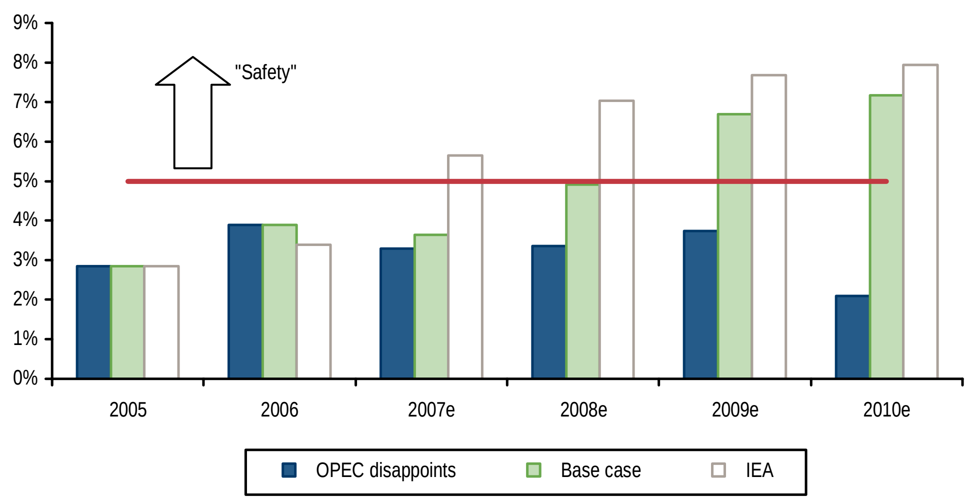
Source: IEA, Credit Suisse estimates.

The direction of Russian oil supply growth is critical to whether or not we return to marginal supply pricing around the end of the decade.

Scenario 3: OPEC Disappoints

In our next scenario (Exhibit 271), we assume that OPEC undershoots its capacity aspirations, a possibility that we first highlighted in our October report, *OPEC: Too Much or Too Little?* Here, we assume a 5% per annum decline rate for legacy OPEC fields (against a base-case assumption of 3% per annum) and we assume a new project completion rate of 90% (versus a base-case assumption of 95%).

Exhibit 271: Scenario 3: OPEC Disappoints



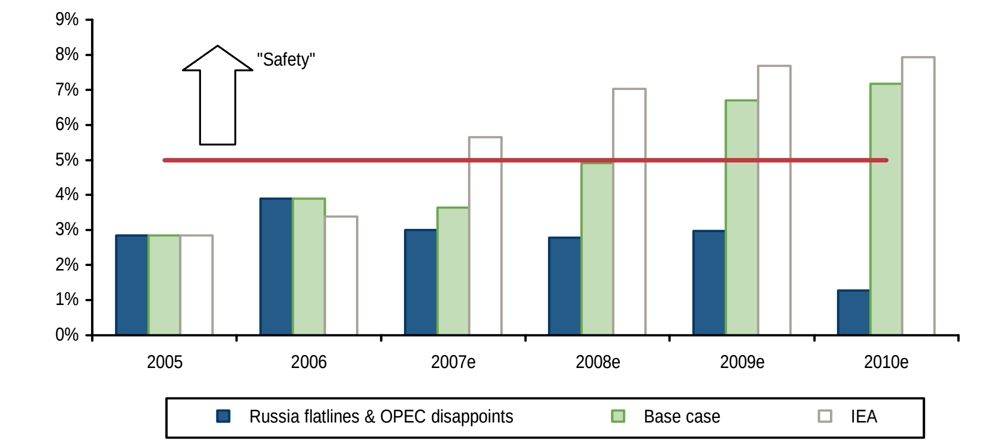
Source: IEA, Credit Suisse estimates.

A detailed discussion of OPEC's "real" decline rate is very difficult given the lack of information provided by the OPEC countries, but it is reasonable to assume decline rates in-line with geologically analogous assets elsewhere in the world. Given the continued tightness in the global rig and EPC market, we think a project completion rate of 90% is not unreasonable. Under these conditions, our spare capacity forecast falls back below levels seen in 2005.

Scenario 4: Russia Flatlines *and* OPEC Disappoints

Finally, we consider the possibility that not only does Russian crude output flatline (Exhibit 272) but that OPEC disappoints on its aggressive capacity expansion targets (as set out in the third scenario above).

Exhibit 272: Scenario 4: Russia Flatlines and OPEC Disappoints



Source: IEA, Credit Suisse estimates.

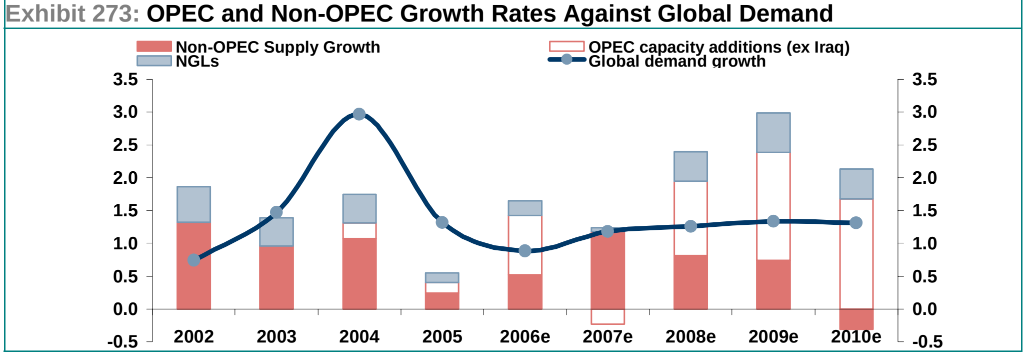
Under this "worst-case" scenario, the outlook for global spare capacity is grim, with the world falling dangerously close to becoming *undersupplied* by 2010.

We think this "worst-case" view is unlikely to happen, as before we go to the negative spare capacity implied for 2010, we would have restarted the commodity price upcycle in order to cut into demand growth much more meaningfully than we expect in our base case.

Heads Up: Looking Beyond 2007—It's Not Good

One feature of 2007, in our view, will be heightened scrutiny of the potential glut of new non-OPEC supply on world crude markets. However, we would encourage investors to lift their heads up beyond 2007 and look at the period 2008-10 where the supply outlook remains far more concerning, in our view, despite a number of well-known mega-projects coming onstream in the coming years, both in OPEC and non-OPEC.

Exhibit 273: OPEC and Non-OPEC Growth Rates Against Global Demand



Source: IEA, Credit Suisse estimates.

Key Non-OPEC Projects for 2007

Exhibit 274: **Selected Key Non-OPEC and Angolan Developments—New 2007E Volumes**

Country	Project	Operator	Start-up	2006 kbd	2007 kbd	06 vs 07
Canada	White Rose	Husky Energy	2005	70	90	20
Canada	Foster Creek Phase 1D Bitumen	EnCana	2006	3	15	12
Canada	Long Lake Phase 1	Nexen	2007	0	35	35
Canada	Primrose/Wolf Lake Bitumen Phase 2	CNR	2006	20	30	10
Canada	Suncor SAGD Phase 2&3	Suncor	2006	12	25	13
Brazil	Golfinho Module II (Cidade Vitoria)	Petrobras	2006	10	29	19
Brazil	Piranema	Petrobras	2007	0	9	9
Brazil	Roncador (P-54)	Petrobras	2007	0	6	6
Sudan	Block 5A	Petronas	2006	10	50	40
Sudan	Melut Basin Oil	Petrodar	2006	65	180	115
Angola	Benguela	Chevron	2006	9	50	41
Angola	Belize	Chevron	2006	35	49	14
Angola	Rosa	Total	2007	0	10	10
Angola	Dalia/Camelia	Total	2006	6	181	175
Angola	Greater Plutonio	BP	2007	0	125	125
Azerbaijan	Azeri East	BP	2007	0	69	69
Azerbaijan	Azeri West	BP	2006	156	188	31
Azerbaijan	Shah Deniz - Azerbaijan PSA	BP	2007	0	14	14
U.S.	Genghis Khan	BHP Billiton	2007	0	5	5
Australia	Enfield Area	Woodside	2006	20	48	28
Kazakhstan	Tengiz	Chevron	2001	270	270	0
Norway	Fram Øst	Norsk Hydro	2006	3	16	14
Norway	Skinfaks & Rimfaks	Statoil	2007	0	21	21
Norway	Statfjord Late Life	Statoil	2007	0	5	5
Norway	Volve	Statoil	2007	0	18	18
U.K.	Buzzard	Nexen	2006	1	126	125
Subtotal				**690**	**1663**	**973**

Source: Company data, Credit Suisse estimates.

While it may sound alarmist, we should not discount the possibility that the resolution phase and the plateau could be pauses for breath as we enter an even tighter period for world crude supply after 2010. This is not our base case, but neither is it impossible.

Global Gas Market Outlook

The Dash for Gas Continues

Mark Flannery

Carl Kirst

Edward Westlake

Gas markets are slowly but inevitably going global. Utility buyers in the U.S. Midwest are soon going to have to start worrying about decisions taken by Gazprom in Moscow, or about the geopolitical situation in China, or about the decline rate for gas production in the U.K., and soon they will have to compete for their gas with the fast-growing economies of Brazil, Russia, India, and China (the BRIC countries).

In our report, *LNG—To the Rescue for Gas Consumers* (September 21, 2005), we introduced a global gas supply model that, among other things, aims to identify how much LNG will target North American markets over time.

We model demand growth for each main gas-consuming country, then look at trends in that country's domestic production or piped gas imports, looking to establish how much global LNG will be absorbed by non-U.S. markets. We then assume that the remaining global LNG supply will target the North American market.

Fluctuating LNG imports into North America will shift domestic gas producers up and down the cost curve and should, eventually, help set the longer-term break-even price for U.S. natural gas.

As gas markets become more interlinked, the Henry Hub pricing point should become a more dominant price setting mechanism across the industry, and act as a de facto floor price (net of shipping costs) for the global LNG market.

Key Conclusions from Our Global Natural Gas Model

The key conclusions and risk factors from our analysis follow:

- Fast growth in LNG supply in the 2008-2012 period should allow global gas supply to match rising demand. We are more bullish than consensus on global gas demand growth for the next 10-15 years, expecting 2.7% per annum versus the IEA's 2.3%, partly due to continued substitution of cheaper gas for oil. This higher international demand for gas leaves less LNG available for North America.
- Despite this bullishness on international gas demand, we think that increasing volumes of LNG will still find their way to the North American market, particularly beyond 2010. Partially offsetting this could be a fall in Canadian exports to the U.S. due to higher domestic demand from the oil sands projects, and falling Canadian production.
- We no longer see regasification capacity as a significant market constraint. In fact, regasification is now arguably closer to being overbuilt than underbuilt. We expect total global regasification capacity over the next five years to rise by over 50% to 73 Bcfd (750 bcm), counting only those projects already under construction or close to it. This amount should outpace incremental LNG supply by 15%, or by 30% assuming a lower completion rate for liquefaction projects still in the planning phase.
- Key swing factors in the international gas supply include (1) LNG project completion, (2) FSU exports, and (3) Iran. Small adjustments to these three factors can vary our supply assumptions by +/- 5 Bcfd (50 bcm per annum).
- Our U.S. E&P Team believes that the rise in LNG imports to the U.S. will eventually dampen the impact of rising costs associated with the increased maturity of domestic gas reserves.

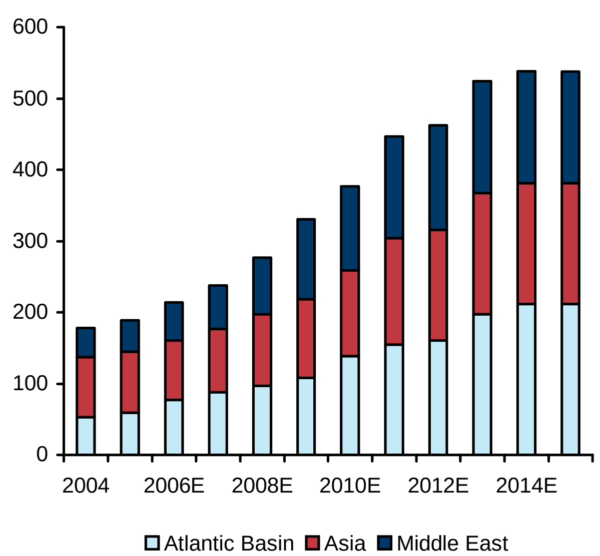
- Other key risks to our scenario for global-market-based pricing include (1) seasonality (70% of global gas demand is in the Northern Hemisphere, and many markets are storage poor, meaning demand peaks sharply in winter, generating volatility), and (2) the potential emergence of a gas supply cartel or GasPEC (65-70% of global gas reserves lie in the hands of seven countries: Russia, Iran, Qatar, Saudi, UAE, Nigeria, and Algeria).
- Even beyond the volatility of winter weather, LNG imports could magnify a seasonal impact on North American gas prices, as the U.S., with the largest and most liquid gas market supported by significant storage infrastructure, becomes the market of last resort in the nonpeak demand periods. As a result, there should be much greater use of storage in the coming years, which should drive (1) infrastructure investment (the U.S. is set to expand gas storage over the next three years by the same amount as the previous seven years), and (2) wider summer-winter NYMEX spreads, benefiting those gas marketers with storage access.

Growth in LNG Allows Global Gas Supply to Match Rising Demand

Global gas markets face several challenges. Gas demand is rising faster than oil demand, gas production in certain key producers such as the U.K. is in decline, and in other countries such as the U.S. gas production is becoming much more expensive. LNG is set to grow by up to 14% by 2015, and should provide lower-cost supply to the global market.

We are more bullish on gas demand growth than is the IEA, forecasting growth of 2.7% to 2015 compared with the IEA forecast of 2.3%. We expect North America and Europe to experience stronger demand partly due to continued oil substitution (as per our Resolution thesis) and also due to the growing needs of the oil sands in Canada. In developing economics, we see further gas substitution of oil in China, partly helped by higher LNG imports there.

Exhibit 275: **Global LNG Capacity Growth***
in bcm



** Includes projects still in planning stage.*
Source: BP Statistical Review, Credit Suisse estimates.

Exhibit 276: **IEA and Credit Suisse Demand Growth Estimates**

IEA Gas Demand Growth	2002-2020 CAGR, IEA	Credit Suisse
OECD North America	1.3	1.9
OECD Europe	1.8	2.9
OECD Pacific	2.3	2.3
OECD	1.6	
Russia	1.5	1.5
Other transition economies	1.8	
Transition economies	**1.6**	
China	5.4	8.6
Indonesia	3.5	
India	5	5.0
Other Asia	3.8	
Brazil	5.8	6.0
Other LatAm	4.1	
Africa	5.1	3.9
Middle East	2.8	3.2
Developing countries	**3.9**	
World	**2.3**	**2.7**

Source: BP Statistical Review, Credit Suisse estimates.

Increasing Volumes of LNG Will Target the North American Market

In the 1990s, the LNG market was predominantly an Asian regional market operating under long-term contracts. LNG technology has since lowered supply costs and global gas prices have risen alongside oil prices. With Europe and the U.S. looking for new supply sources, the LNG market is going global.

North America, in particular, as the largest gas market in the world, is attracting a lot of attention as an end market for global LNG. Regasification schemes have been proposed on both the east and west coasts of the U.S., Canada, and Mexico.

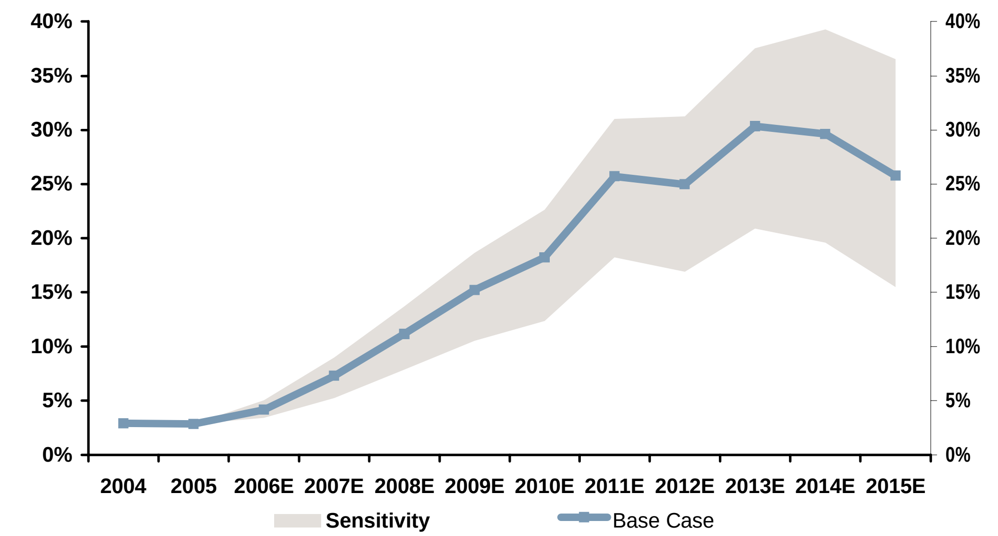
Our global gas model assumes that all incremental LNG not needed in international markets will target North America. In contrast to a “demand-pull” dynamic (which fills a gap between supply and demand), this “supply-push” should direct rising LNG volumes to North America, particularly beyond 2008-09.

We present two possible LNG import scenarios into the U.S.:

- *Low import case*. The low case assumes a faster decline of U.K. domestic production (1% per annum), lower production growth from Russia (0.5% per annum), and some LNG project delays (90% completion).
- *High import case*. The high case assumes that global gas demand growth is 0.2% lower than the base case and assumes some additional LNG (10 bcm per annum) from Iran by 2015.

At the back end of the forecasting period, either additional gas supplies would be required to sustain LNG’s penetration into the U.S., or U.S. domestic production would need to rise to meet long-term secular U.S. demand growth.

Exhibit 277: **LNG Imports as a Percentage of U.S. Demand**



Source: BP Statistical Review, Credit Suisse estimates.

Plenty of Regasification Capacity Available

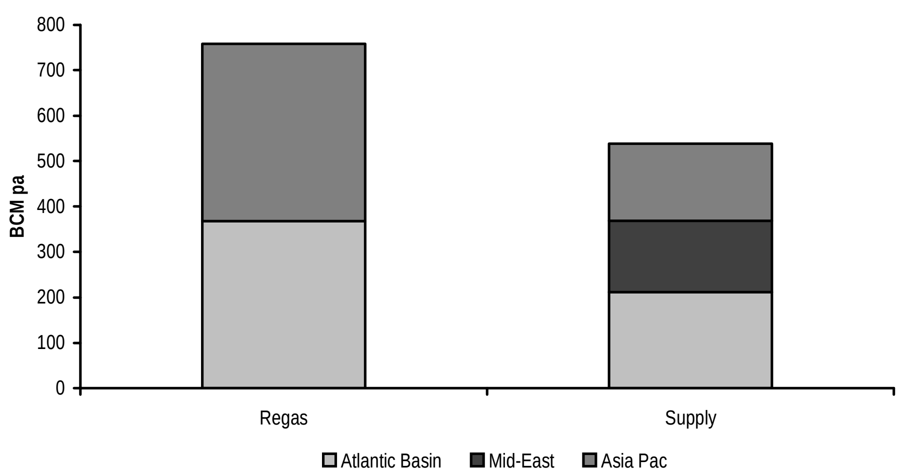
Until recently, regasification was seen as a potential barrier to the fast growth of LNG in the U.S. This constraint is not only easing but is giving way to a real risk of overbuilding. This trend is primarily being driven by very attractive terminal economics and relatively minimal long-term barriers to entry.

As a result, over the next five years, global regasification capacity should expand by over 50% to 73 Bcfd just counting what is already under (or soon to be under) construction. This 26 Bcfd of incremental regasification is likely to be 15% greater than incremental LNG supply over the same time (and potentially 30% greater if liquefaction in the planning stage does not reach fruition). There are 120 additional terminals that have been proposed in the rush to capture new LNG volumes, and existing terminals can be easily expanded at low costs and with easier approval processes.

There are three factors partially offsetting the risk of overbuilding:

- Utilization of regasification terminals has historically been low. Japan, for example, as the largest buyer of LNG, hit peak capacity utilization of only 32% in 2003. We believe average utilization in the U.S. will likely max out closer to 70%.
- As producers wish to deliver their LNG into the highest price market globally, they are contracting for more global regasification capacity in aggregate than they have supply. In this way, they hope to facilitate arbitrage.
- Capital discipline (i.e., not building terminals without dedicated supply) will remain key. Of the 154 projects still in the planning stage, only 5 are specifically focusing on a merchant model. Note that six proposed U.S. terminals were effectively cancelled in 2006, perhaps signalling the beginnings of a rationalization in regasification plans.

Exhibit 278: Global LNG Regasification Capacity* versus Supply, 2015E



** In existence and currently under construction.*
Source: Company data, Credit Suisse estimates.

Exhibit 279: U.S. FERC Regasification Existing and Proposed Terminals

CONSTRUCTED
A. Everett, MA: 1.035 Bcfd (SUEZ / Tractebel - DOMAC)
B. Cove Point, MD: 1.0 Bcfd (Dominion - Cove Point LNG)
C. Elba Island, GA: 1.2 Bcfd (El paso - Southern LNG)
D. Lake Charles, LA: 2.1 Bcfd (Southern Union - Trunkline LNG)
E. Gulf of Mexico: 0.5 Bcfd (Gulf Gateway Energy Bridge - Excelerate Energy)

APPROVED BY FERC
1. Hackberry, LA: 1.5 Bcfd (Cameron LNG - Sempra Energy)
2. Bahamas: 0.84 Bcfd (AES Ocean Express)*
3. Bahamas: 0.83 Bcfd (Calypso Tratebel)*
4. Freeport, TX: 1.5 Bcfd (Cheniere/Freeport LNG Dev.)
5. Sabine, LA: 2.6 Bcfd (Sabine Pass Cheniere LNG)
6. Corpus Christi, TX: 2.6 Bcfd (Cheniere LNG)
7. Corpus Christi, TX: 1.1 Bcfd (Vista Del Sol - ExxonMobil)
8. Fall River, MA: 0.8 Bcfd (Weaver's Cove Energy/Hess LNG)
9. Sabine, TX: 2.0 Bcfd (Golden Pass - ExxonMobil)
10. Corpus Christi, TX: 1.0 Bcfd (Ingleside Energy - Occidental Energy Ventures)
11. Logan Township, NJ: 1.2 Bcfd (Crown Landing LNG - BP)
12. Port Arthur, TX: 3.0 Bcfd (Sempra)
13. Cove Point, MD: 0.8 Bcfd (Dominion)
14. Cameron, LA: 3.3 Bcfd (Creole Trail LNG - Cheniere LNG)
15. Sabine, LA: 1.4 Bcfd (Sabine Pass Cheniere LNG - Expansion)
16. Freeport, TX: 2.5 Bcfd (Cheniere/Freeport LNG Dev. - Expantion)

APPROVED BY MARAD / COAST GUARD
17. Port Pelican: 1.6 Bcfd (Chevron Texaco)
18. Louisiana Offshore: 1.0 Bcfd (Gulf Landing - Shell)

CANADIAN APPROVED TERMINALS
19. St. John, NB: 1.0 Bcfd (Canaport - Irving Oil)
20. Port Tupper, NS: 1.0 Bcfd (Bear Head LNG - Anadarko)
21. Kitimat, BC: 0.61 Bcfd (Galveston LNG)

MEXICAN APPROVED TERMINALS
22. Altamira, Tamuipas: 0.7 Bcfd (Shell/Total/Mitsui)
23. Baja California, MX: 1.0 Bcfd (Energy Costa Azul - Sempra)
24. Baja California - Offshore: 1.4 Bcfd (Chevron Texaco)

PROPOSED TO FERDC
25. Long Beach, CA: 0.7 Bcfd (Mitsubishi/ConocoPhillips - Sound Energy Solutions)
26. LI Sound, NY: 1.0 Bcfd (Broadwater Energy - TransCanada/Shell)
27. Pascagoula, MS: 1.5 Bcfd (Gulf LNG Energy LLC)
28. Bradwood, OR: 1.0 Bcfd (Northern Star LNG - Northern Star Natural Gas LLC)
29. Pascagoula, MS: 1.3 Bcfd (Casotte Landing - Chevron Texaco)
30. Port Lavaca, TX: 1.0 Bcfd (Calhoun LNG - Gulf Coast LNG Partners)
31. Hackberry, LA: 1.15 Bcfd (Cameron LNG - Sempra Energy - Expantion)
32. Pleasant Point, ME: 2.0 Bcfd (Quoddy Bay, LLC)
33. Robbinston, ME: 0.5 Bcfd (Downeast LNG - Kestrel Energy)
34. Elba Island, GA: 0.9 Bcfd (El Paso - Southern LNG)
35. Baltimore, MD: 1.5 Bcfd (AES Sparrows Point - AES Corp.)
36. Coos Bay, OR: 1.0 Bcfd (Jordan Cove Energy Project)

PROPOSED TO MARAD / COAST GUARD
37. Offshore California: 1.5 Bcfd (Cabrillo Port - BHP Billiton)
38. Offshore Californa: 0.5 Bcfd (Clearwater Port LLC - Northern Star NG LLC)
39. Offshore Louisiana: 1.0 Bcfd (Main Pass McMoRan Exp.)
40. Gulf of Mexico: 1.5 Bcfd (Beacon Port Clean Energy Terminal - ConocoPhillips)
41. Offshore Boston: 0.4 Bcfd (Neptune LNG - SUEZ LNG)
42. Offshore Boston: 0.8 Bcfd (Northeast Gateway - Excelerate Energy)
43. Gulf of Mexico: 1.4 Bcfd (Bienville Offshore Energy Terminal - TORP)
44. Offshore Florida: ? Bcfd (SUEZ Calypso - SUEZ LNG)
45. Offshore California: 1.2 Bcfd (OceanWay - Woodside Natural Gas)

Source: FERC.

U.S. Imports Could Be the Global Price Setting Mechanism

Over time, we believe gas markets will become more global and spot pricing will govern a larger share of contracts. Liquefaction projects typically still need long-term offtake agreements to achieve project financing, but more contracts now include *redirect clauses* that allow producers to arbitrage across countries, stimulating the growing secondary market.

The physical and economic boundaries that currently exist between Atlantic Basin and Asia/Pacific Basin LNG markets should also ease in 2014 when the US$5 billion expansion of the Panama Canal is completed (allowing for the passage of all but the largest proposed LNG tankers).

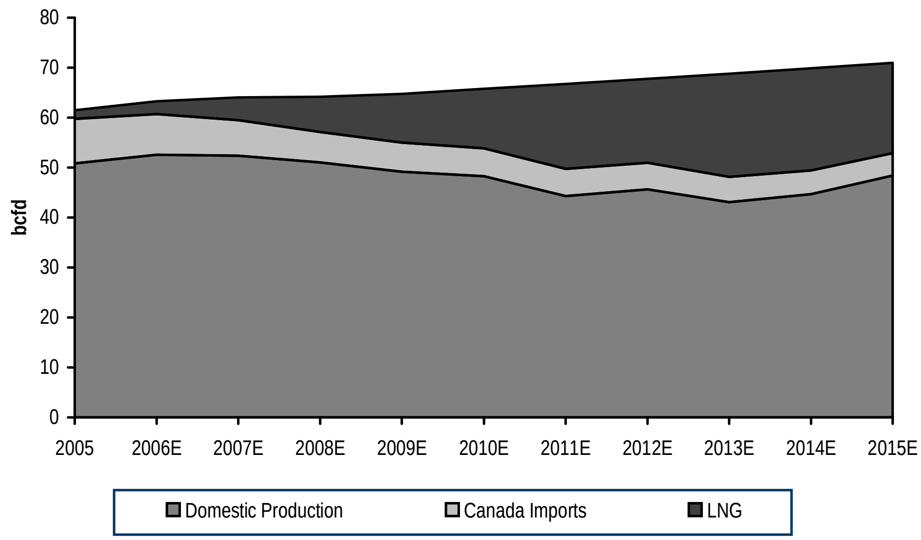
Once the U.S. market has sufficient regasification capacity on both coasts, global gas markets are likely to be more influenced by the U.S. Henry Hub gas price marker. In turn, U.S. gas prices are likely to be more influenced by LNG import volumes. This reciprocal influence is expected to be seasonal, as the U.S. is likely to become the market of last resort in the shoulder season, due to its liquidity and its advantaged gas storage position.

After the severe winter gas demand peak (in some countries winter demand can be 7-10 times that of summer demand), we believe the U.S. will act as the summer sponge for Atlantic Basin supplies.

A shift of 1 Bcfd (10 redirected cargoes per month) may only represent a 2% increase in U.S. supply, but such amounts would swamp nearly every other market that can take LNG, as most of these have very limited gas storage infrastructure. At present, only the U.K. and Italy are contemplating meaningful levels of new storage investments.

Exhibit 280 shows the potential evolution of U.S. domestic gas supply over time. Canadian imports are set to fall while LNG imports are set to accelerate. Overall, domestic producers may need to produce less in 2010-2013 than current production.

Exhibit 280: Potential Evolution of Gas Supply into U.S. Market over Time

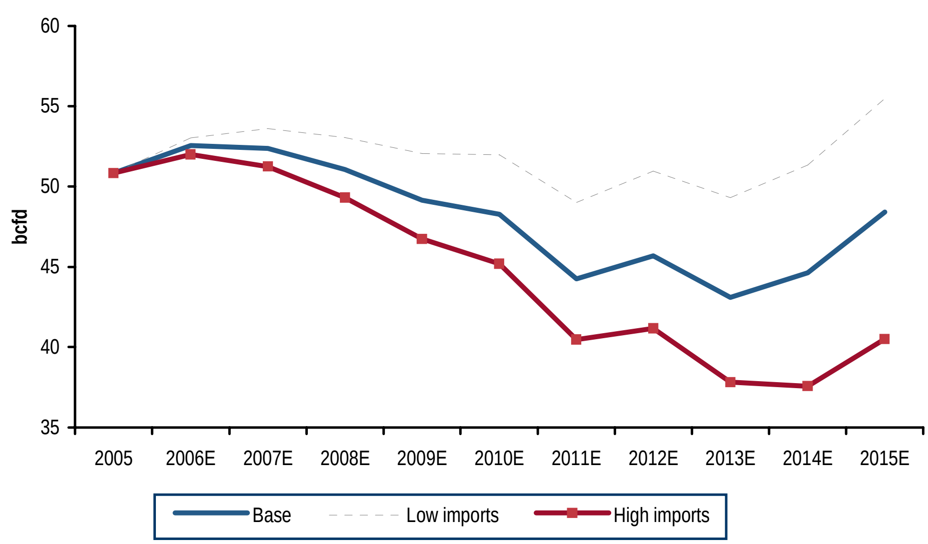


Source: BP Statistical Review, Credit Suisse estimates.

On paper, the rise in LNG imports from 2008 onwards means that, despite a decline in imports from Canada, U.S. domestic production could also decline modestly from current levels. Domestic U.S. costs per barrel of gas production are rising due partly to cyclical and partly to secular trends. We believe that the rise in LNG imports to the U.S. will dampen the impact of these rising costs and will start to set a cap on natural gas prices.

As with the import sensitivities, we can look at a high/low case for LNG availability into the U.S. market. Exhibit 281 shows the indicative outlook for domestic production under these cases. We can flex the supply model by +/- 5 Bcfd (50 bcm pa) quite plausibly.

Exhibit 281: Potential Path of U.S. Gas Production in the Face of LNG Import Competition

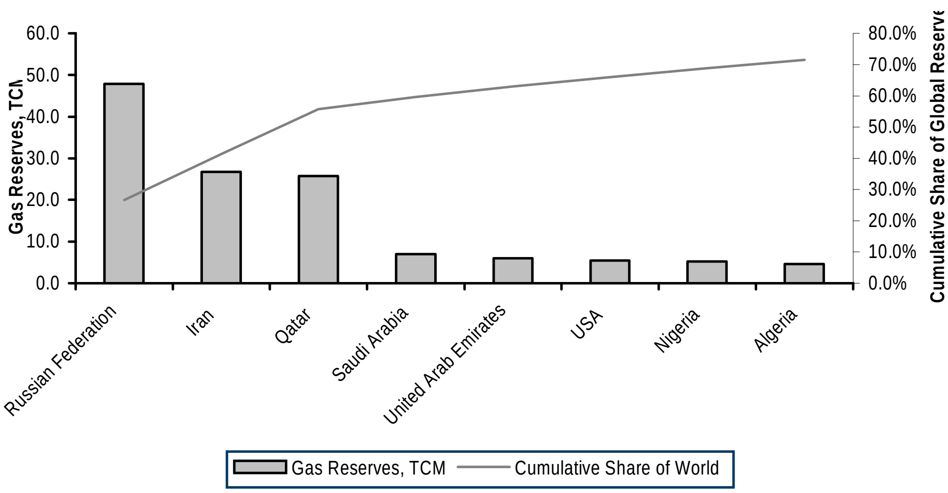


Source: BP Statistical Review, Credit Suisse estimates.

The Rise of GasPEC and Northern Hemisphere Seasonality

Although the above analysis suggests that U.S. domestic producers will face a tougher challenge from LNG in the future, note that (1) a significant portion of global reserves are contained in only a few countries that could wield the same type of influence over global gas production as OPEC does in oil markets, and (2) our global supply/demand analysis is based on annual averages, yet most demand (about 70%) lies in Northern Hemisphere countries and hence seasonal price volatility should be expected.

Exhibit 282: Gas Reserves by Country (bcm) and Cumulative Share of Global Reserves
%



Source: BP Statistical Review.

Rising Costs Are Increasing the Clearing Price, but LNG Economics Remain Very Attractive

All large-scale infrastructure projects have witnessed tremendous cost inflation over the past few years. The cost of building a liquefaction/export facility is estimated to have increased by 60-80% over the same period. One Bcfd of new terminal capacity now costs approximately US$750 million on average while liquefaction projects and shipping costs can reach US$5-10 billion. In short, the full chain LNG investment requirement has probably risen from about US$4 billion to US$7-8 billion over the past five years.

On a unit basis, break-even prices to the U.S. are partly dependent on the source of LNG (i.e., differences in regional upstream and shipping costs). This time last year we estimated a break-even unit price range for a typical 1 Bcfd project from $2.50/Mcf sourced from Trinidad and Tobago to upward of $3.50/Mcf from the Middle East. This in turn translated to a $4 netback requirement (at the high end) to provide an adequate 15% return. Today, we estimate cost inflation over the past 12 months has lifted that amount by an incremental US$0.50, yielding a netback clearing price range of US$3.25-4.50/Mcf. Consequently, while cost inflation at the EPC level is not expected to halt anytime soon, forward five-year NYMEX prices averaging $7.85 imply a still healthy 50%-plus return on investment.

The Credit Suisse Global Gas Model

In Exhibit 283 and Exhibit 284, we summarize our indicative gas supply and demand outlook on a regional basis. A more detailed, country-specific interactive version of our model is available in Excel format. Historical data are sourced from the *BP Statistical Review*. As described above, the main balancing factor assumed for supply and demand is U.S. domestic gas production. Higher ex-U.S. gas demand or lower gas supply would be likely to alter the U.S. production via the mechanism of price.

We also show our aggregate outlook for global LNG liquefaction by project status (Exhibit 285 and Exhibit 286), a current snapshot of global regasification capacity by region and status (Exhibit 287), and our view for which regasification terminals are likely to reach fruition in North America (Exhibit 288).

Exhibit 283: Global Gas Demand by Region, 2004–12E
in bcm

Global Demand	2004	2005	2006E	2007E	2008E	2009E	2010E	2011E	2012E
Total North America	**786**	**775**	**788**	**802**	**816**	**831**	**847**	**861**	**876**
% growth	0.70%	-1.50%	1.80%	1.70%	1.80%	1.80%	1.80%	1.70%	1.70%
Total S. & Cent. America	**118**	**124**	**129**	**133**	**138**	**143**	**149**	**154**	**159**
% growth Total	11.80%	5.40%	3.70%	3.70%	3.70%	3.70%	3.70%	3.40%	3.40%
Total Europe & Eurasia	**1101**	**1122**	**1173**	**1195**	**1224**	**1249**	**1272**	**1295**	**1318**
% growth, Total	2.90%	1.90%	4.60%	1.90%	2.50%	2.00%	1.80%	1.70%	1.80%
Total Middle East	**242**	**251**	**260**	**269**	**279**	**289**	**298**	**307**	**316**
% growth	7.20%	3.60%	3.60%	3.60%	3.60%	3.60%	3.00%	3.00%	3.00%
Total Africa	**69**	**71**	**74**	**77**	**80**	**83**	**86**	**89**	**93**
% growth	5.20%	3.80%	3.80%	3.80%	3.80%	3.80%	4.00%	4.00%	4.00%
Total Asia Pacific	**379**	**407**	**430**	**455**	**482**	**508**	**533**	**553**	**575**
% growth	7%	8%	6%	6%	6%	5%	5%	4%	4%
TOTAL WORLD	**2695**	**2750**	**2854**	**2931**	**3020**	**3104**	**3184**	**3259**	**3336**
% growth	3.60%	2.00%	3.80%	2.70%	3.00%	2.80%	2.60%	2.30%	2.40%

Source: BP Statistical Review, Credit Suisse estimates.

Exhibit 284: Global Pipeline Gas and LNG Production by Region, 2004–12E
in bcm

Gas Production	2004	2005	2006E	2007E	2008E	2009E	2010E	2011E	2012E
Total North America	**760**	**751**	**765**	**758**	**739**	**721**	**715**	**676**	**693**
% growth	-1.30%	-1.30%	1.90%	-0.90%	-2.60%	-2.30%	-0.90%	-5.40%	2.60%
Total S. & Cent. America	**130**	**136**	**144**	**154**	**161**	**166**	**178**	**186**	**191**
% growth	12.10%	4.50%	6.30%	7.00%	4.70%	2.90%	7.40%	4.10%	2.60%
Total Europe & Eurasia	**1056**	**1061**	**1076**	**1095**	**1121**	**1124**	**1132**	**1146**	**1155**
% growth	3.10%	0.50%	1.40%	1.80%	2.30%	0.30%	0.70%	1.30%	0.80%
Total Middle East	**280**	**293**	**310**	**327**	**355**	**396**	**411**	**447**	**460**
% growth	7.90%	4.30%	6.10%	5.30%	8.50%	11.70%	3.90%	8.60%	3.00%
Total Africa	**144**	**163**	**182**	**194**	**205**	**223**	**257**	**276**	**288**
% growth	3.30%	13.00%	12.00%	6.30%	5.60%	9.00%	15.00%	7.30%	4.30%
Total Asia Pacific	**333**	**360**	**395**	**425**	**466**	**496**	**528**	**564**	**576**
% growth	6.40%	8.10%	9.70%	7.50%	9.70%	6.60%	6.40%	6.70%	2.30%
TOTAL WORLD	**2704**	**2763**	**2874**	**2954**	**3046**	**3127**	**3221**	**3294**	**3363**
% growth	3.10%	2.20%	4.00%	2.80%	3.10%	2.70%	3.00%	2.30%	2.10%
Excess supply, % of demand	0.30%	0.50%	0.70%	0.80%	0.90%	0.80%	1.20%	1.10%	0.80%

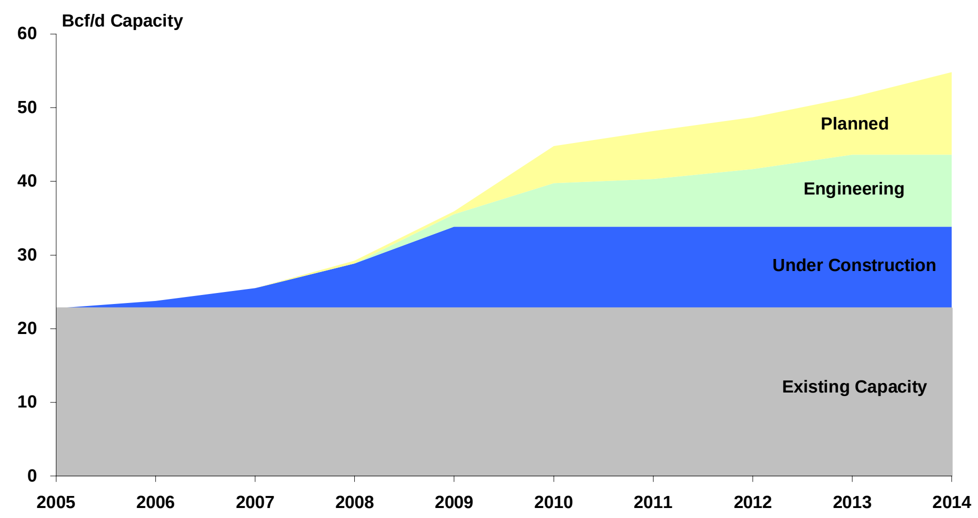
Source: Company data, Credit Suisse estimates.

Exhibit 285: Global LNG Liquefaction Timeline by Project Status

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
(BCM)										
Existing	235.4	235.4	235.4	235.4	235.4	235.4	235.4	235.4	235.4	235.4
Under Construction	0	10.5	28.1	62.6	114.2	114.2	114.2	114.2	114.2	114.2
Engineering	0	0	0	0	17.8	61.5	67	80.8	101.5	101.5
High Conviction	**235.4**	**245.8**	**263.5**	**298**	**367.4**	**411.1**	**416.6**	**430.4**	**451.1**	**451.1**
Planned	0	0	0	4.4	4.4	51.7	67.5	72.5	80.2	115.4
Total Potential	235.4	245.8	263.5	302.4	371.8	462.8	484.2	503	531.3	566.5
(Bcfd)										
Existing	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8
Under Construction	0	1	2.7	6.1	11	11	11	11	11	11
Engineering	0	0	0	0	1.7	6	6.5	7.8	9.8	9.8
High Conviction	**22.8**	**23.8**	**25.5**	**28.8**	**35.5**	**39.8**	**40.3**	**41.6**	**43.6**	**43.6**
Planned	0	0	0	0.4	0.4	5	6.5	7	7.8	11.2
Total Potential	22.8	23.8	25.5	29.2	36	44.8	46.8	48.6	51.4	54.8

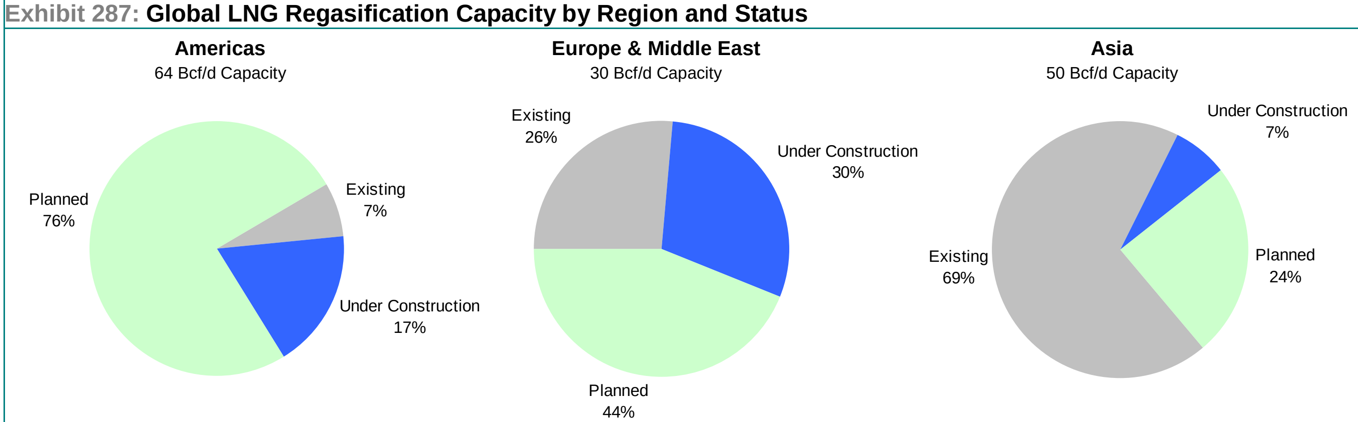
Source: Company data, Credit Suisse estimates.

Exhibit 286: Global LNG Liquefaction Timeline by Project Status



Source: IEA, Platts, EIA, Credit Suisse estimates.

Exhibit 287: Global LNG Regasification Capacity by Region and Status



Source: Company data, Platts, Credit Suisse estimates.

Exhibit 288: Existing and Approved North American LNG Terminals

	Name/Location	State	Owner	Base load Size (Bcf/d)	In-Service	CS Notes
Existing Terminals:						
1	Everett	MA	Suez/Tractebel	0.72	1971	Distrigas owns 100% capacity
2	Cove Point	MD	Dominion	0.75	1978	capacity split between BP, Shell and Statoil
3	Elba Island	GA	El Paso (Southern LNG)	0.81	1978	BG and Shell own the capacity
4	Lake Charles	LA	Southern Union (Trunkline)	1.8	1982/2006	fully committed to BG
5	Gulf Gateway	GOM	Excelerate Energy	0.4	2005	Spot/merchant model
6	Altamira (Tamulipas)	Mexico	Shell, Total, Mitsui	0.7	2006	Only 500 Mmcfd gas expected to Mexico (CFE)
	Total Existing:			**5.17**		
Under Construction:						
1	Cameron (Hackberry)	LA	Sempra	1.5	2008	73% contracted
2	Freeport	TX	(Cheniere, Dow, COP	1.5	2008	100% contracted
3	Sabine Pass	LA	Cheniere	2.6	2008	77% contracted
4	Golden Pass (Sabine)	TX	Qatar Pet., XOM, COP	2	2010	fully committed from Qatargas 3
5	Costa Azul (Baja)	Mexico	Sempra	1	2008	50% destined for U.S. markets; fully contracted
6	Canaport (Saint John, NB)	Canada	Irving Oil / Repsol	1	2008	Ultimately could be expanded to 2.5 Bcfd
	Total Under Construction:			**9.6**		
Highly Likely (but not yet under construction):						
1	Costa Azul (Baja) – expansion	Mexico	Sempra	1	2011	Strong expressions from May 2006 open season, but no supplies
2	Sabine Pass – expansion	LA	Cheniere	1.4	2009	Cheniere looking to keep 1.0 Bcfd for spot marketing and contract
3	Cove Point – expansion	MD	Dominion	0.8	2009	Second half 2009
4	Elba Island – expansion	GA	El Paso	0.9	2010	Expansion and pipeline targeted for 2010 while doubling storage by 2012; fully contracted
	Total Likely:			**4.1**		
	Total North American by 2011			**18.87**		
Other Projects Approved To Date:						
1	Corpus Christi	TX	Cheniere	2.6	2011	Cheniere won't contemplate Corpus until next contract is signed
2	Vista del Sol (Corpus Christi)	TX	ExxonMobil	--	--	Project effectively cancelled (XOM going with Golden Pass)
3	Weaver's Cove (Fall River)	MA	Amerada Hess, Poten & Ptnrs	0.4	2009	Extreme local and political opposition; uses 55,000-cu-m vessels which are all but obsolete
4	Crown Landing (Logan)	NJ	BP	1.2	2008	Faces heavy local opposition; NJ and Delaware are suing each other over water rights of way
5	Creole Trail (Cameron)	LA	Cheniere	3.3	2012	No contracts secured; wants to parlay into international upstream equity position
6	Port Arthur	TX	Sempra	3	2010/2012	1.5 bcf planned operational 2010, with expansion by 2012; no supplies dedicated
7	Ingleside (Corpus Christi)	TX	Occidental	1	2010	$665mm EPC contract signed, but notice to proceed has not been given.
8	Ocean Express LNG	Bahamas	AES	0.84	2010	Still awaiting Bahamian approvals
9	Calypso	Bahamas	Tractebel (Suez)	0.83	2009	Suez now considering separate offshore terminal given slow Bahamian approvals process
10	Cameron (Hackberry) exp.	LA	Sempra	1.15	2010	Expansion decision likely in 2007
11	Port Pelican	LA offshore	ChevronTexaco	--	--	Project effectively cancelled
12	Gulf Landing	LA offshore	Shell	1	2010	Project would use controversial open-loop vaporization
13	Bear Head (Point Tupper, NS)	Canada	Anadarko	1	Unknown	Anadarko tried selling project to private equity but it fell through
14	Freeport expansion	TX	Freeport Consortium	2.5	2009	No supplies dedicated
15	Isla Coronado (offshore Baja)	Mexico	ChevronTexaco	0.7	2010	
16	Manzanillo (Pacific)	Mexico	Comision Federal de Electricidad	0.5	2011	Most Pacific Basin projects coming online post 2012, so supplies difficult to secure
	Total Other Projects Approved:			**20.02**		

Source: Company data, EIA, Platts, Credit Suisse estimates.

The IEA Alternative Policy Scenario

Save Up to $560 Billion

Edward Westlake

In its *2006 World Energy Outlook*, the IEA sets out a broad framework for energy supply and demand and the key issues that policymakers need to address. Within this report, the IEA considers the impact of alternative energy policies on energy demand. These policies generally aim to foster improved energy efficiency, to reduce greenhouse gas emissions, but also touch on subjects such as improved energy security. Potential savings on energy imports and carbon emissions require a profound shift in investment patterns, as consumers invest to reduce their energy intensity and thereby reduce the required energy producer investments. We highlight several of the IEA's conclusions below. With headlines like this, it is understandable why politicians are paying attention to energy efficiency both on a national level but also in the pan-national institutions that are required to resolve some of the key externalities.

- Overall, the IEA estimates that the consumer investment would be US$2.4 trillion more over the 2004-2030 period but that producer investment would be US$3 trillion less, saving US$560 billion overall.
- Consumers gain an undiscounted US$8.1 trillion of benefits from their US $2.4 trillion investment, but they need to get on with it. Paybacks in developing economies and for projects undertaken before 2015 look particularly attractive. Roughly US$1.1 trillion of demand-side investment is in more efficient transport, with a further US$926 billion in the residential and services area (predominantly more efficient electrical equipment).
- Demand-side investments in electricity are particularly economical with each US$1 spent saving US$2.
- The combined oil import bills of Asia and the OECD are US$1.9 trillion lower in the IEA's Alternative Policy Scenario.
- Unfortunately, this shift from energy producer investment toward demand-side investment implies a shift in investment from a few players (oil companies, etc.) to many, to the billions of energy end-users, i.e., you—the reader. To that extent, government policies that encourage consumers to act—such as education, financing, energy labeling, aid to improve energy efficiency in developing countries, tax credits, etc.—are required.

Twelve Policies to Save the World—Power to the People

The IEA estimates that 12 policies could avoid around 2 GT of CO_2 emissions—some 37% of savings versus the Reference Scenario. These policies would also satisfy energy security policies (reducing oil imports by around 2.2 MBD). Unsurprisingly perhaps, the two policies with the greatest individual impact are improved mileage standards and energy efficiency in the industrial/commercial sectors.

Exhibit 289: Most Effective Policies for Reducing Cumulative CO_2 Emissions in the Alternative Policy Scenario

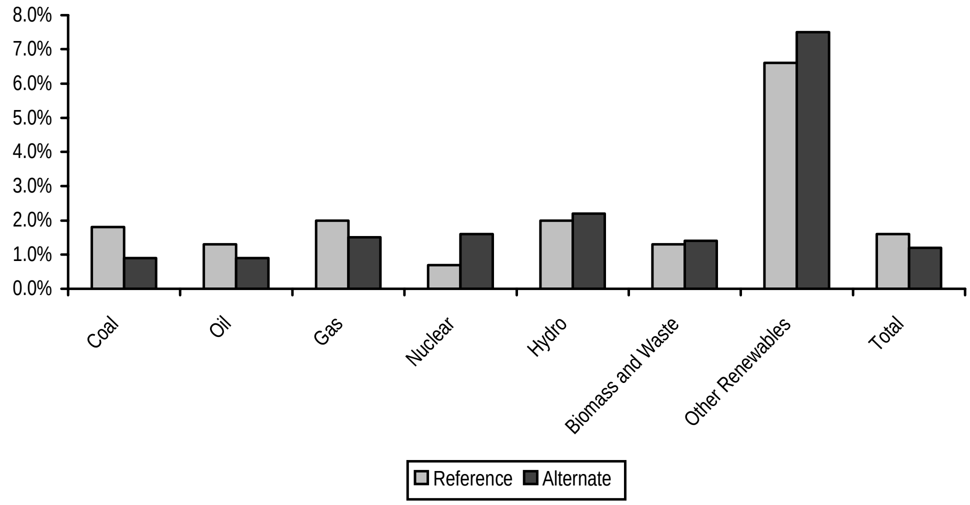
Country/ region	Policy	Avoided CO_2 emissions (Mt)	Share in global avoided CO_2 emissions (%)	Avoided oil imports (kb/d)
Demand-side energy efficiency measures				
United States	Increased CAFE standards	252	5%	1 520
China	Improved efficiency in electricity use in the industrial sector	216	4%	<50
China	Improved efficiency in electricity use in the residential sector	189	3%	<50
US	Improved efficiency in electricity use in the residential sector	161	3%	<50
China	Improved efficiency in electricity use in the commercial sector	158	3%	<50
European Union	Increased vehicle fuel economy	99	2%	590
United States	Improved efficiency in electricity use in the commercial sector	96	2%	<50
European Union	Improved efficiency in electricity use in the commercial sector	68	1%	<50
Renewables				
China	Increased renewables use in power generation	230	4%	<50
United States	Increased renewables use in power generation	150	3%	<50
European Union	Increased renewables use in power generation	141	3%	<50
Nuclear				
China	Increased nuclear use in power generation	160	3%	<50
European Union	Extension of the life of nuclear plants	148	3%	<50
Total		**2 068**	**37%**	**2 240**

Source: IEA.

Reducing Global Energy Intensity

In its Alternative Policy Scenario, the IEA estimates that 10% could be shaved off world energy demand by 2030. Even by 2015, it is possible under this scenario to shave 4% from global energy demand, though the pace of energy reduction is always limited by capital stock turnover. In aggregate, global energy intensity would decline at an average of 2.1% per annum over 2004-2030 relative to 1.7% per annum in the Reference Scenario. This would reduce growth in Middle East and North Africa (MENA) oil and gas revenues from 5% per annum to 4% per annum over 2005-2030. Global energy demand would be lower and, within the mix, fossil-based primary energy production would fall, while nuclear and renewables would rise.

Exhibit 290: IEA—Energy Demand Growth Under Reference and Alternate Scenarios

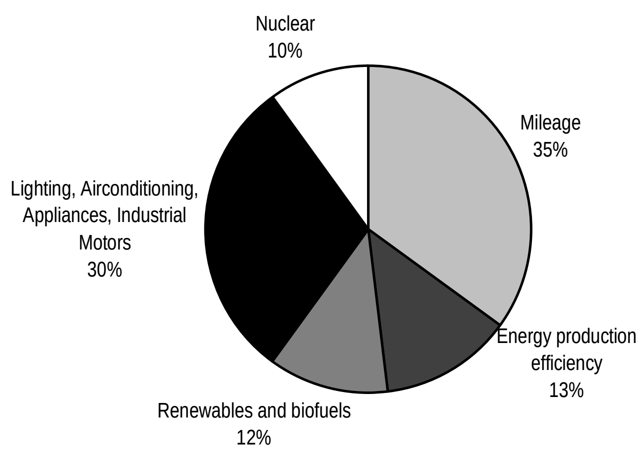


Source: IEA.

Reducing CO_2

CO_2 emissions would be 16% lower in this scenario, with energy efficiency driving 80% of the reduction. Improved mileage accounts for 36%, improved electricity efficiency in lighting/air conditioning/appliances and industrial motors for 30%, energy production 13%, renewables and biofuels 12%, and nuclear the remaining 10%.

Exhibit 291: CO_2 Savings by Type, 2030

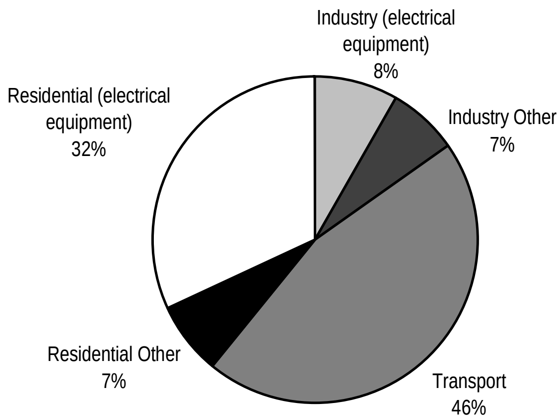


Source: IEA.

$2.4 Trillion Additional Demand-Side Investment by 2030

Around half of the additional demand-side investment to reduce CO_2 emissions is in the transport sector, while 40% is in improving electrical appliance efficiency. Countries such as China could lead the way given their strong manufacturing base and access to capital. Within transport investment, light-duty vehicles (hybrids/alternate fuels/use of lightweight materials) account for about 50% of demand-side investment, buses and high-speed trains (some modal switching) account for 30%, and aviation accounts for the remaining 20%. Noting that although 20% of the transport investment is likely to target aviation efficiency improvement, this spend only delivers 11% of the expected benefits due to the high cost of improving aviation efficiency.

Exhibit 292: Demand Side Investment by Type

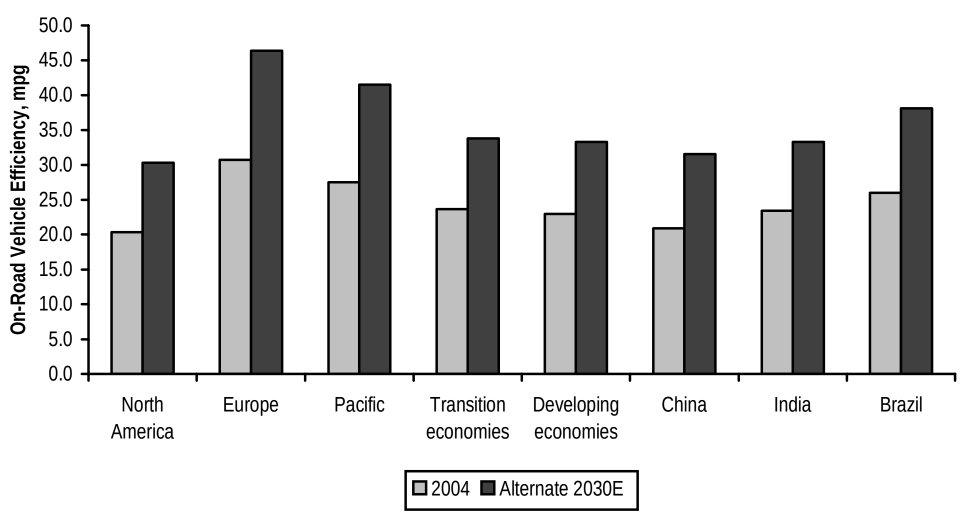


Source: IEA.

Improved Mileage per Gallon

Our Global Autos Team outlines a smaller-engined vision of the future, a trend that is gaining pace in the U.S. Since 1987-88, the average mileage per gallon (MPG) of the U.S. light-duty vehicle fleet has fallen from 22.1 to 21 (primarily due to the rise of SUVs). In its Alternative Scenario, the IEA assumes that new CAFE standards as outlined by National Highway Traffic Safety Administration (NHTSA) and introduction of California Air Resources Board (CARB) emissions for light-duty vehicles, would, if operational, increase efficiency by 14% as early as 2010 and by 31% by 2030. Biofuels are also expected to increase to 7% by 2030 from 1% today. Overall, the IEA expects vehicle efficiency to improve by around 47% by 2030, with Europe and Japan maintaining their leading positions. The number of conventional internal combustion-engine-powered gasoline and diesel cars is expected to fall to 80% of the global fleet by 2015 and to 20% of the fleet by 2030 in the Alternative Policy Scenario, with mild hybrids accounting for around 60% of the fleet and full hybrids around 20%.

Exhibit 293: Average On-Road Vehicle Efficiency, 2004 and 2030 in the Alternative Policy Scenario

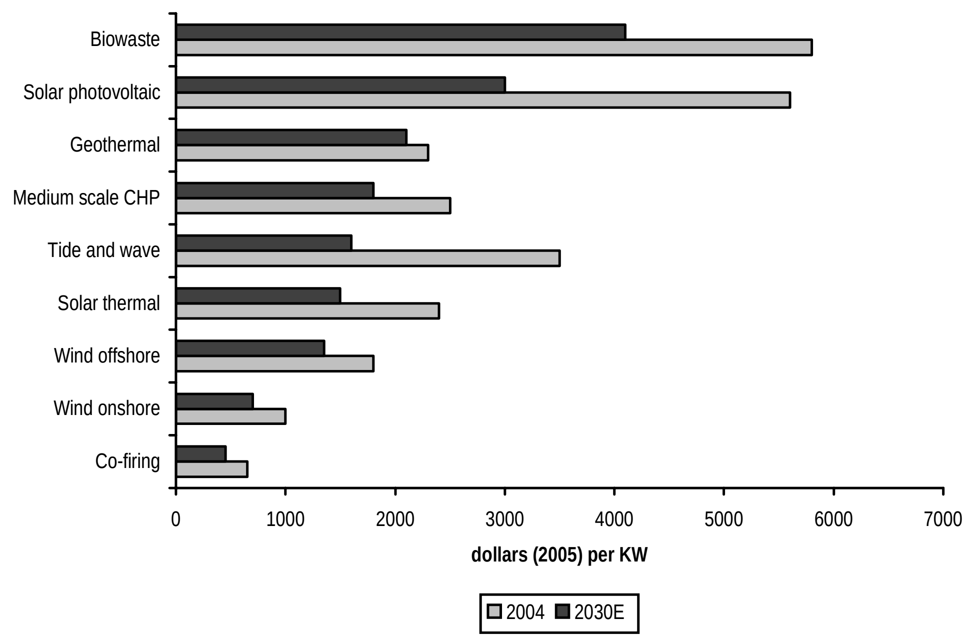


Source: IEA.

Nuclear and Renewables

Energy supply from nuclear and renewables is higher in the Alternative Scenario, with nuclear expected to provide the largest increase relative to the Reference Scenario. The IEA expects slightly more hydro to be built (up 3% versus the Reference Scenario), a 26% increase in other renewables (driven mainly by renewable power generation), and a greater amount of biomass (as less traditional biomass heating/cooking is replaced by CHP schemes and biofuels). Within the renewables sector, government incentives should support growth in all subsegments, although CHP schemes and wind should enjoy the best underlying economics.

Exhibit 294: Investment Costs of Renewables-Based Power Generation

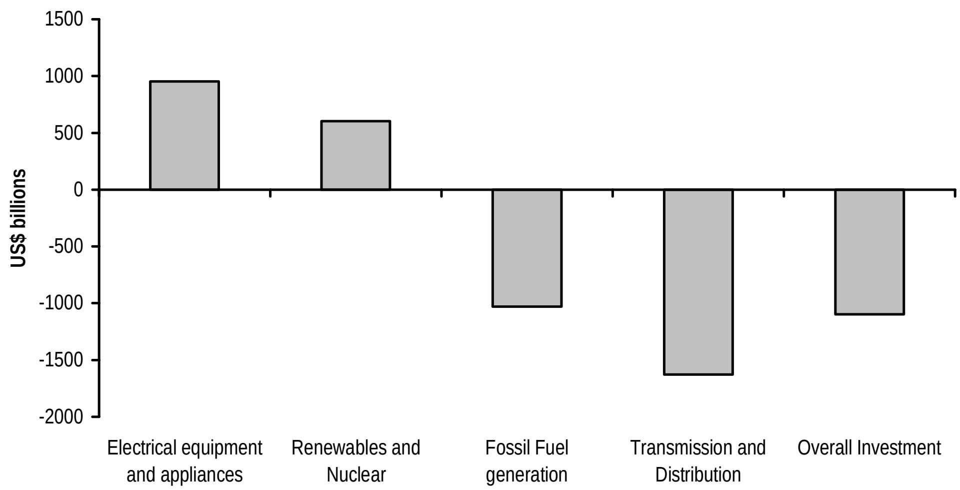


Source: IEA.

Less End-User Electricity Demand, Less Transmission and Distribution

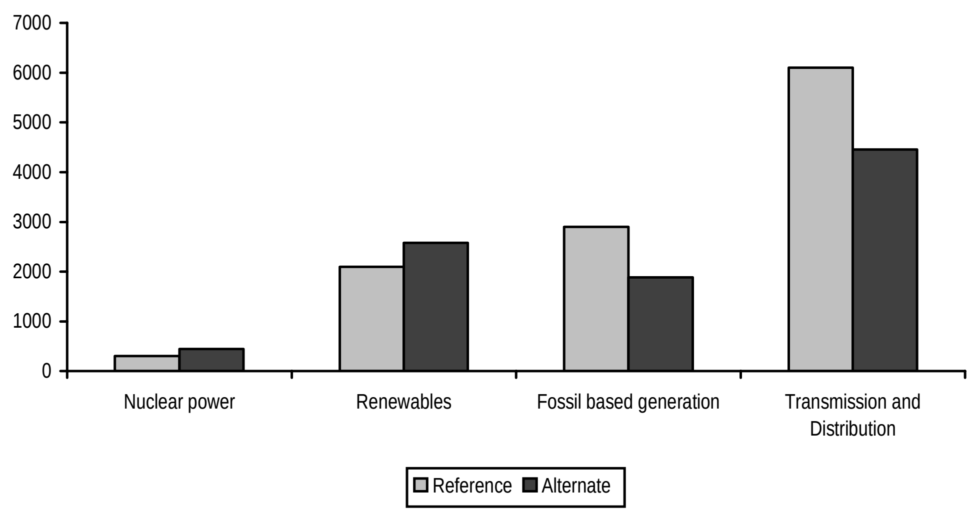
In the Alternative Scenario, electricity demand is 12% less compared with the Reference Scenario due to energy efficiency, particularly around appliances, air conditioning, and lighting. We estimate that the required additional investment in energy efficiency and renewables is around US$1 trillion less than the investment in generation/transmission/distribution that would otherwise be necessary. Paybacks of around two years can be achieved in commercial lighting retrofits or generally buying compact fluorescent lamps as opposed to incandescent bulbs. High-efficiency industrial motors and irrigation pumps in most developing countries can save electricity at a cost in the range of US$5-30 per MWh. Investment in non-OECD residential and services sectors can save 1 kWh at a cost of around US$0.015 compared with US$0.03 in the OECD and up to US$0.045 in the United States. In the three-year period from 2002 to 2005, U.K. consumers saved 38 TWh of electricity and 53 TWh of gas at a saving of US$0.022/kWh and US$0.09/kWh, respectively.

Exhibit 295: Changes to the Pattern of Electricity Investment in the Alternative Policy



Source: IEA.

Exhibit 296: Electricity Supply Investment



Source: IEA.

Industrial Savings—More Potential to Save in Non-OECD

Energy savings in non-OECD are over twice the potential savings within the OECD, with China alone saving as much as the whole OECD. Over half of the energy savings in the industrial sector are derived from the iron and steel, chemicals, and nonmetallic industries. For example, the energy intensity in the steel and cement industries in Japan is 50% lower than in China. The most efficient motors available today are some 20-25% more efficient than the existing capital stock; motors account for around 60% of the electricity demand in the industrial sector. Market penetration of efficient motors is 70% in Canada and the U.S. (driven by regulation). However, in selected European countries that have not adopted such standards, market share of efficient motors can be as low as 15%.

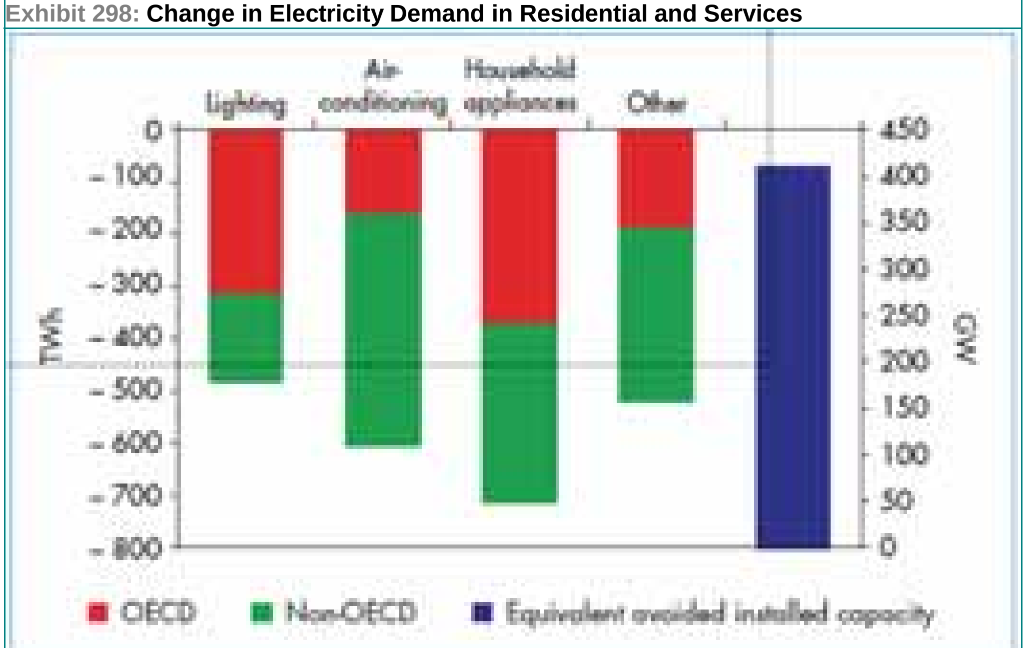
Exhibit 297: **Change in Industrial Energy Demand by Region and Sector**

Source: IEA.

Residential and Services

Improved energy efficiency in lighting (19% of global electricity demand), air conditioning, and household appliances drives most of the savings overall. The savings in electricity overall would avoid the installation of around 400 GW of new generation capacity.

Exhibit 298: **Change in Electricity Demand in Residential and Services**

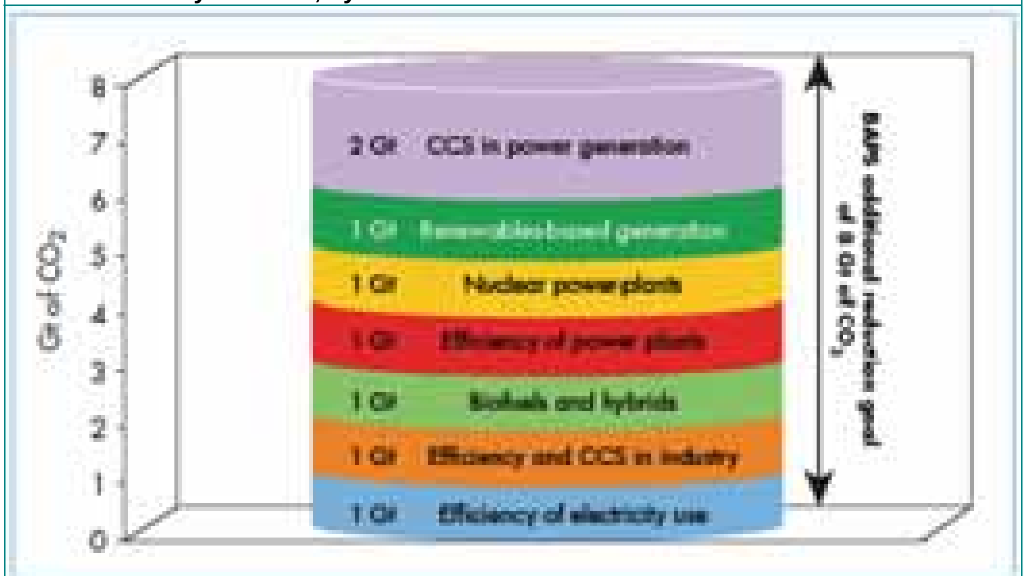


Source: IEA.

Going Beyond the Alternative Policy Scenario

In the IEA's Alternative Policy Scenario, CO_2 emissions would still be 8 GT higher than they are today. The IEA also discusses a Beyond the Alternative Policy Scenario (BAPS), which aims to maintain CO_2 emissions at their 2004 level of 26.1 GT. More effective demand-side policies, greater switching to nuclear and renewables, CO_2 capture and sequestration (CCS), and second-generation biofuels are the key policies for avoiding even more CO_2 emissions. Meeting the BAPS case would also lower oil demand from 103 mbd (Alternative Policy) to 95 mbd (BAPS). This level of oil demand looks a more producible goal relative to comments made by Total's CEO, for example, that global oil supply may peak around 100 mbd (15% higher than current capacity levels).

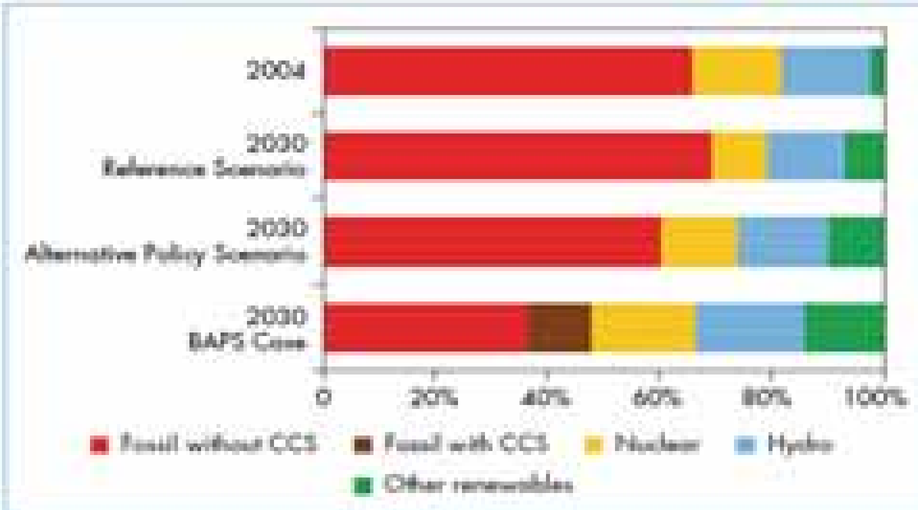
Exhibit 299: **Reduction in Energy-Related CO_2 Emissions in the BAPS Case versus the Alternative Policy Scenario, by Source**



Source: IEA.

- *Industry*. Subsidies or tax credits for the most efficient equipment and smaller-scale carbon capture and sequestration.
- *Hybrids and second-generation biofuels*. Hybrids would need to account for 60% of sales as opposed to 18% in the Alternative Policy Scenario. Technology would need to provide the breakthrough in biofuels (e.g., cellulosic feedstock) to avoid competition with the food sector.
- *Improved efficiency in power generation*. Inefficient coal-fired power stations would need to be retired early. Technological breakthroughs in hydrogen fuel cells could also save 0.5 GT.
- *Increased nuclear power*. Retired coal power would be predominantly replaced with new nuclear, with installed capacity rising to 660 GW (as opposed to 416 GW in the Reference Scenario).
- *Increased renewables*. An additional 550 TWH of hydropower and 550 TWH of renewables could save 0.5 GT emissions.
- *CO_2 capture in power generation*. Seventy percent of new coal and 35% of new CCGT would need to be equipped with CCS technology. This change would require technological improvements, regulation, or market-driven mechanisms on carbon prices to be achieved.

Exhibit 300: Fuel Mix in Power Generation in Different Scenarios



Source: IEA.

Beyond 2030—More Technology Required

The IEA lists a number of technologies that could make a significant contribution to emission reduction beyond 2030. (See Exhibit 301.) Some of these technologies are complementary (e.g., renewables investment could accelerate but would be likely to require improvements/investments in long-range transmission lines). Some are limited by technology and also political acceptance (e.g., fourth-generation nuclear plants). Some require improved costs to operate on a small enough scale to justify widespread adoption (e.g., small-scale combined heat and power schemes and small-scale carbon capture and sequestration). The IEA notes building policy in developing countries as an area of potential; new buildings can be made 70% more efficient than existing buildings. (There are over 6,000 passive solar buildings in Europe, mainly in Germany.) Hydrogen fuel cells could play a meaningful role by 2030 and beyond if the required breakthroughs in low carbon hydrogen production, hydrogen storage, and infrastructure develop. In the very long term (beyond 2050), nuclear fusion could have a more material role.

Exhibit 301: Options for Emissions Reductions Beyond 2030

Power generation	Solar PV and concentrating solar power in combination with long-distance electricity transportation Ocean energy Deep-water wind turbines Hot dry rock geothermal Generation IV nuclear reactors Large-scale storage systems for intermittent power sources Advanced network design Low-cost CCS for gas-fired power plants Distributed generation Low-cost unconventional gas
Transport	Hydrogen fuel-cell vehicles Plug-in hybrids Transmodal transportation systems Intermodal shift
Industry	CCS Biomass feedstocks/biorefineries
Buildings	Advanced urban planning Zero-energy buildings

Source: IEA.

The European Emissions Trading Scheme

Richard Gray

The European Emissions Trading Scheme (EETS) was established by two E.U. directives: (1) the first in October 2003, which established the EETS itself, and (2) the second in October 2004, which extended EETS to include the Kyoto mechanisms of Joint Implementation (JIs) and Clean Development Mechanism (CDMs). The European Parliament approved the first directive in July 2004 and the scheme came into effect (having been adopted by national parliaments) on January 1, 2005.

The EETS is a cap and trade scheme (with allowances tradable across both industries and E.U. borders) designed to limit, via allowances, the CO_2 emissions from installations covered by the scheme (essentially power generation, refineries, cement, bricks, ceramics, glass, pulp and paper—although there is talk of extending the scheme to airlines and other industry groups).

The principle is that it does not matter how emissions are cut, or indeed from where, geographically, they are reduced, because they all end up in the same place (i.e., the earth's atmosphere). Instead, the scheme is designed to reduce emissions at a point where it is financially or politically cheapest and/or easiest—hence, the market mechanism. Remember that Kyoto covers all greenhouse gas (GHG) emissions whereas the EETS covers CO_2 only.

Methane is the other major GHG, but that is mainly the by-product of agriculture and thus more difficult to control. The six greenhouse gases are carbon dioxide (CO_2, about 84% of total), methane (CH_4, about 9%), nitrous oxide (NO_X, about 5%), perfluorocarbons (PFCs), sulphur hexafluoride (SFs), hydrofluorocarbons (HFCs). Methane traps about 21 times more heat per molecule than CO_2 but is broken down after about 10 years whereas CO_2 takes 50-200 years to break down.

The total number of allowances will be set by each E.U. member state under a National Allocation Plan (NAP). Those NAPs must be consistent with the individual member state's Kyoto obligations, although they can take into account the ability of a particular sector to reduce emissions and the potential impact of competition from outside the EU. However, the allocations must comply with E.U. rules on state aid (i.e., installations cannot be given more allocations than they need) and competition. The NAPs will also outline allowances for new entrants—the NER (New Entrant Reserve). A maximum of 5% of the allowances could be auctioned during Phase I, increasing to 10% in Phase II.

The primary objective of the EETS is to meet the EU's commitments under the Kyoto Protocol. At Kyoto, the E.U. negotiated en bloc for the member states and agreed to reduce total 1990 level GHG emissions by 8% by 2008-12. This commitment was then subdivided into individual targets for member states under the "burden sharing" agreement. This burden sharing took into account levels of emissions, expected economic growth, and the ability of each state to reduce emissions. The targets were wide ranging, from cuts of approximately 21% for Germany to increases of 27% for Portugal. Much of the overall reduction thus far, however, has been due to the U.K.'s "dash for gas" and the collapse of the industry in eastern German following reunification.

The expansion of the E.U. to include some former Eastern European states—e.g., Poland, Czech Republic, and Hungary—has brought with it so-called "hot air" (i.e., 200 million tonnes of surplus permits generated by the significant contraction in Eastern European heavy industry since the Soviet era), which has led to some uncertainty over the future price of allowances.

The pilot phase of the scheme, Phase I, started on January 1, 2005, and runs to December 31, 2007 (inclusive). Any subsequent phases will each last for five years each, with their National Allocation Plans submitted to the European Commission 18 months before the beginning of the relevant period. Phase II of the scheme covers the Kyoto commitment period to 2012. The Phase II (January 1, 2008–December 31, 2012) NAP are currently being finalized. The EETS directives detail a number of changes that can occur from 2008, the most pertinent being: (1) member states may provide for the use of credits from JIs and CDMs in the scheme up to a limit per installation, and (2) the penalty for emissions in excess of allowances surrendered increases from €40 to €100 per tonne.

The "cost" (market price) of the carbon permits that the generators must surrender to be able to emit CO_2, is another cost, rather like the cost of fuel. This additional cost is reflected in power prices and passed on to customers (if the regulatory environment allows this). As a result, power prices rise. However, given that many of the permits are given to the power generators for free (depending on the NAP—see above), the generators are not in all cases reflecting an increase in cash costs but an increase in opportunity costs (i.e., that the generator could sell the permit in the market rather than use it by generating).

This in effect gives an increase in margin and this is even more pertinent for those noncarbon-producing generators (nuclear, hydro, wind) where there is an increase in the power price (where fossil fuels set the power price in a marginal cost market) but no increase in cost.

Most countries have elected to place the burden for the necessary Phase I (2005-07) emissions reductions on thermal electricity generators and, to a lesser extent, the steel, materials, and paper industries.

Under the scheme, each plant must return the number of certificates each April equal to its emissions measured in tonnes. Within the thermal generation sector and subject to the overall cap, each plant is given a "free" allowance, which, in Phase I, was based on historical output.

If a plant exceeds its allowance, it must purchase the shortfall of certificates in the market from other producers that have elected to produce less than their allowance. Alternatively:

- Companies can "borrow" allowances from future years (up to the end of the current phase), but this increases the effective burden of the cap in subsequent years.
- Certificates can be purchased from overseas projects under the CDM or JI initiatives, which achieve carbon abatement outside the EETS mechanism to monetize the value of that abatement by selling their certificates within the EETS scheme. To date, a limited number of CDM projects have delivered certificates into the scheme, but strong growth is expected in this sector.

The scheme envisages that the cap will be reduced for each country in each progressive phase of the EETS. (Phase II runs from 2008-2012.) As the national caps are tightened, companies that can abate most easily will do so, as they will be able to benefit from selling their surplus certificates, or at least avoid having to purchase extra allowances. Those producers that cannot meet their cap must either purchase extra allowances from the market or curb their output.

Consumer Carbon Mitigation

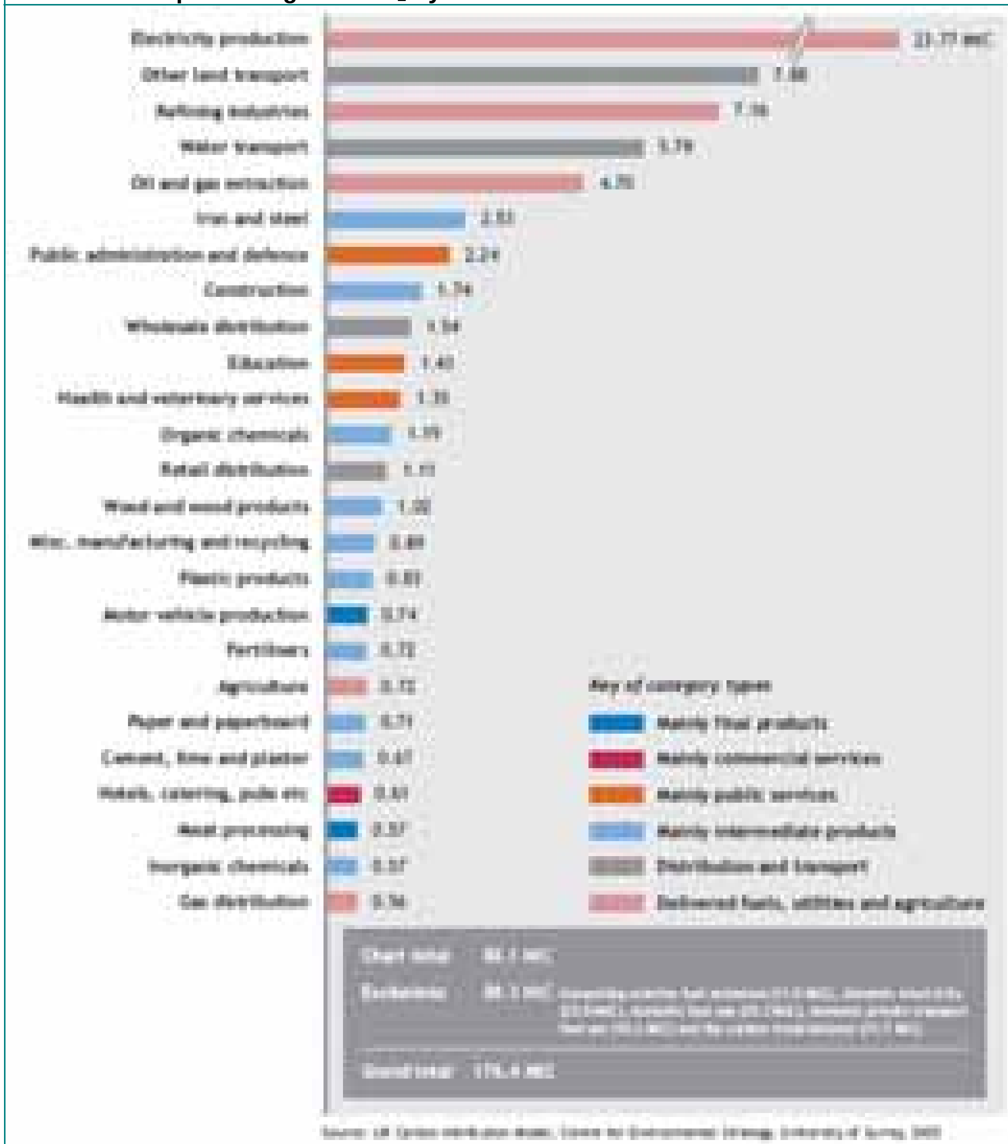
What You Can Do to Help

Richard Gray

Carbon Trust, a U.K. organization, has studied the key CO_2 production and consumption data for the U.K. This provides a useful starting point for where CO_2 emissions can be mitigated. Although reducing CO_2 emissions may help mitigate global warming, there are other direct economic benefits—e.g., in the three-year period from 2002-05, U.K. consumers saved 38 TWh of electricity and 53 TWh of gas at a saving of US$0.022 /kWh and US$0.09/kWh, respectively, and tax benefits are available under the Enhanced Capital Allowance for various energy technology investments.

On the production side, electricity generation, transport, oil and gas extraction, refining, iron and steel accounted for the largest share of U.K. CO_2 emissions.

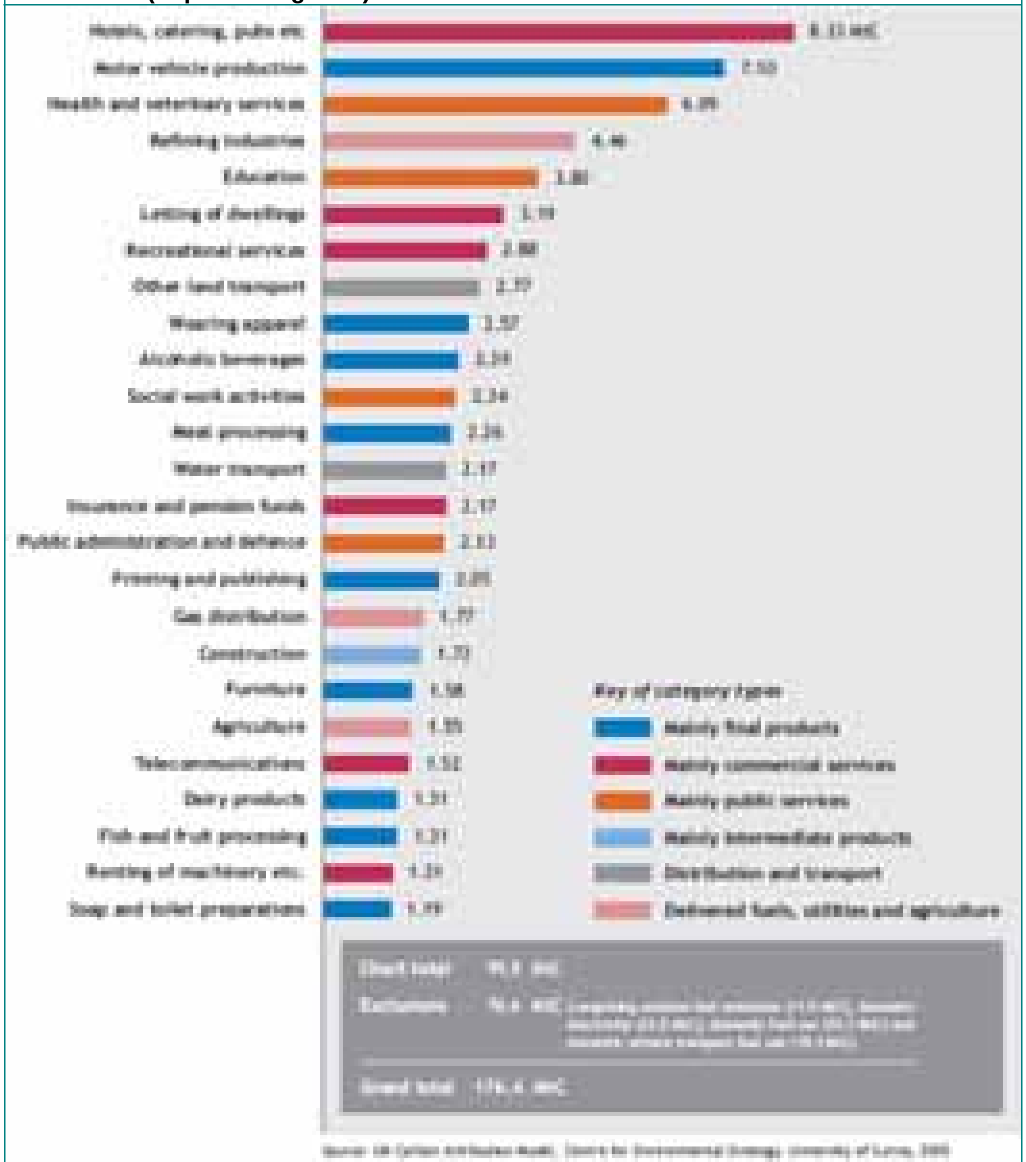
Exhibit 302: Top 25 Categories CO_2 by Production



Source: Carbon Trust.

On the consumption side, hotels, motor vehicles, health services and refining accounted for the greatest CO_2 emissions.

Exhibit 303: Consumption-Based Account with Fixed Capital and Distribution Reallocated (Top 25 Categories)



Source: CarbonTrust.

Within the domestic environment, space/water heating, transport and food accounted for the largest category of CO_2 emissions by source.

Exhibit 304: Domestic Functional Use Account

Source: CarbonTrust.

Carbon Capture and Sequestration

Edward Westlake

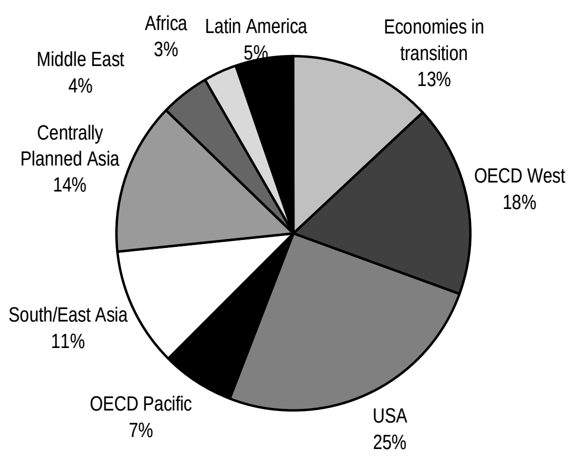
While reducing emissions created through industrial activities is an essential first step in stabilizing CO_2 concentrations in the atmosphere (the U.S. for example avoided around 5% of its total GHG emissions of 7,147.2 million MTCO2e in 2005 according to EIA reporting), major changes in global energy infrastructure will also be required if the risks posed by climate change are to be managed.

Improve Vehicle and Power Generation Efficiency

Atmospheric CO_2 concentrations are already rising, and the slow rate of natural CO_2 absorption will likely mean higher temperatures for several hundred years already.

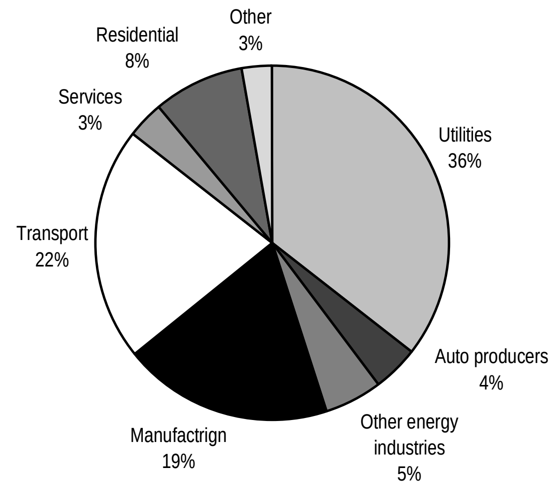
However, future CO_2 emissions can be reduced, particularly in the transport and utility sectors, that contribute 60% of current energy-based GHG emissions.

Exhibit 305: 2000 GHG Emissions by Region



Source: IPCC.

Exhibit 306: 2000 GHG Emissions by Type



Source: IPCC.

Likely changes in future energy utilization and power generation in order to reduce GHG emissions follow:

- *A further shift to natural gas.* A combined cycle gas turbine produces less than half the CO_2 of a typical coal-fired facility.
- *Nuclear energy.* A zero emissions alternative for power generation, but public acceptance remains an issue.
- *Renewables.* Wind turbines and solar cells, built in place of the equivalent energy generation from coal.
- *Bioproducts.* Advanced biofuels offer the prospect of a liquid transport fuel with low or zero carbon emissions.
- *Advanced vehicle technologies.* High efficiency drive trains would make a significant contribution while new vehicle fuels such as hydrogen may offer a sustainable solution.

However, while demand-side and generation efficiency is probably the key step toward reducing prospective CO_2 emissions, some form of carbon capture and sequestration (CCS) technology will likely also be required.

Exhibit 307: CO_2 Emission Fundamentals

Process	CO_2 concentration in gas stream % by vol.	Number of sources	Emissions ($MtCO_2$)	% of total CO_2 emissions	Cumulative total CO_2 emissions (%)	Average emissions/source ($MtCO_2$ per source)
CO_2 from fossil fuels or minerals						
Power						
Coal	12 to 15	2,025	7,984	59.69	59.69	3.94
Natural gas	3	985	759	5.68	65.37	0.77
Natural gas	7 to 10	743	752	5.62	70.99	1.01
Fuel oil	8	515	654	4.89	75.88	1.27
Fuel oil	3	593	326	2.43	78.31	0.55
Other fuels[a]	NA	79	61	0.45	78.77	0.77
Hydrogen	NA	2	3	0.02	78.79	1.27
Natural gas sweetening						
	NA[b]	NA	50[c]	0.37	79.16	
Cement production						
Combined	20	1175	932	6.97	86.13	0.79
Refineries						
	3 to 13	638	798	5.97	92.09	1.25
Iron and steel industry						
Integrated steel mills	15	180	630[d]	4.71	96.81	3.50
Other processes[d]	NA	89	16	0.12	96.92	0.17
Petrochemical industry						
Ethylene	12	240	258	1.93	98.85	1.08
Ammonia: process	100	194	113	0.84	99.70	0.58
Ammonia: fuel combustion	8	19	5	0.04	99.73	0.26
Ethylene oxide	100	17	3	0.02	99.75	0.15
Other sources						
Non-specified	NA	90	33	0.25	100.00	0.37
		7,884	**13,375**	**100**		**1.76**
CO_2 from biomass[e]						
Bioenergy	3 to 8	213	73			0.34
Fermentation	100	90	17.6			0.2

[a] Other gas, other oil, digester gas, landfill gas.
[b] A relatively small fraction of these sources has a high concentration of CO_2. In Canada, only two plants out of a total of 24 have high CO_2 concentrations.
[c] Based on an estimate that about half of the annual worldwide natural gas production contains CO_2 at concentrations of about 4% mol and that this CO_2 content is normally reduced from 4% to 2% mol (see Section 3.2.2).
[d] This amount corresponds to the emissions of those sources that have been individually identified in the reference database. The worldwide CO_2 emissions, estimated by a top-down approach, are larger than this amount and exceed 1 Gt (Gielen and Moriguchi, 2003).
[e] For North America and Brazil only. All numbers are for 2003, except for power generation from biomass and waste in North America, which is for 2000.

Source: IPCC.

Carbon Capture and Sequestration

Carbon dioxide capture and sequestration (CCS) is the storage of CO_2 within some medium for the long term as an alternative to emitting that CO_2 to the atmosphere today. It is an important option within a portfolio of technologies the world has available to address climate change. Indeed, if policymakers become serious about stabilizing CO_2 emissions around current levels, 25 GTOE, then CCS technology will have to be deployed. The key issue is the high cost.

According to the U.S. Energy Information Administration (EIA), carbon emissions avoided using present technology would cost in the range of US$100-300/ton of carbon, significantly above the expected global average value of carbon emissions in trading systems.

Governments around the world have responded to the challenge with additional R&D spend. For example, the goal of the EIA's research program is to reduce the cost of carbon sequestration to US$10 or less per net ton of carbon emissions avoided by 2015. Achieving this goal would save the U.S. trillions of dollars in CCS costs. Further, were successful CCS to allow the achievement of a midpoint stabilization scenario (e.g., 550 parts per million CO_2 in the atmosphere), then wholesale introduction of zero-emission systems in the near term would not be required. This would allow time to develop cost-effective zero emission technology over the next 10-15 years that could be deployed for new capacity and capital stock replacement capacity.

Exhibit 308: Range of Total Costs for CO_2 Capture, Transport, and Geological Sequestration

	NGCC Reference Plant		PC Reference Plant	
	US$/t$CO_2$ avoided	US$/tC avoided	US$/t$CO_2$ avoided	US$/tC avoided
Power plant with capture and geological storage[a]				
NGCC	40-90	140-330	20-60	80-220
PC	70-270	260-980	30-70	110-260
IGCC	40-220	150-790	20-70	80-260
Power plant with capture and EOR[b]				
NGCC	20-70	70-250	0-30	0-110
PC	50-240	180-890	10-40	40-160
IGCC	20 – 190	80 – 710	0 – 40	0 – 160

[a] Capture costs represent range from Table 3.11. Transport costs range from 0–5 US$/t$CO_2$. Geological storage costs (including monitoring) range from 0.6–8.3 US$/t$CO_2$.

[b] Capture costs represent range from Table 3.11. Transport costs range from 0–5 US$/t$CO_2$. EOR credits range from 10–16 US$/t$CO_2$.

Source: IGCC. Note NGCC refers to Natural Gas Combined Cycle, PC refers to Pulverized Coal.

- *CO_2 capture.* CO_2 is routinely separated today and captured as a by-product from industrial processes such as synthetic ammonia production, H_2 production, and limestone calcination.

- *Geological sequestration* involves the injection of CO_2 into subsurface geological formations. If the CO_2 source is not of sufficient purity, separation must take place first. The technology required for geological sequestration is already proven for enhanced oil recovery. Widespread, large storage capacity has been identified that is sufficient to store significant amounts of global CO_2 emissions over the next century. Research has shown that CO_2 can be securely stored for thousands of years or longer, with ongoing work and field trials to further clarify the risks involved. Companies such as RDS/Statoil are already studying the capture of CO_2 from a Norwegian power plant and providing long-term storage in oil fields offshore Norway by 2012. It is estimated the project could have the potential to store up to 2.5 million tonnes of CO_2 every year, equivalent to taking half a million cars off the road. This provides near-zero emission electrical power and the benefit of extra oil production at the Draugen field. At the Gorgon field, partners are looking at sequestering the CO_2 contained within the natural gas at the point of production. BP and GE have launched a collaboration on power, carbon capture, and sequestration technologies. The U.S. government has sponsored the FutureGen clean coal project. The United States is the world leader in enhanced oil recovery technology, using about 32 million tonnes of CO_2 per year for this purpose. From the perspective of the sequestration program, enhanced oil recovery represents an opportunity to sequester carbon at low net cost, due to the revenues from recovered oil/gas.

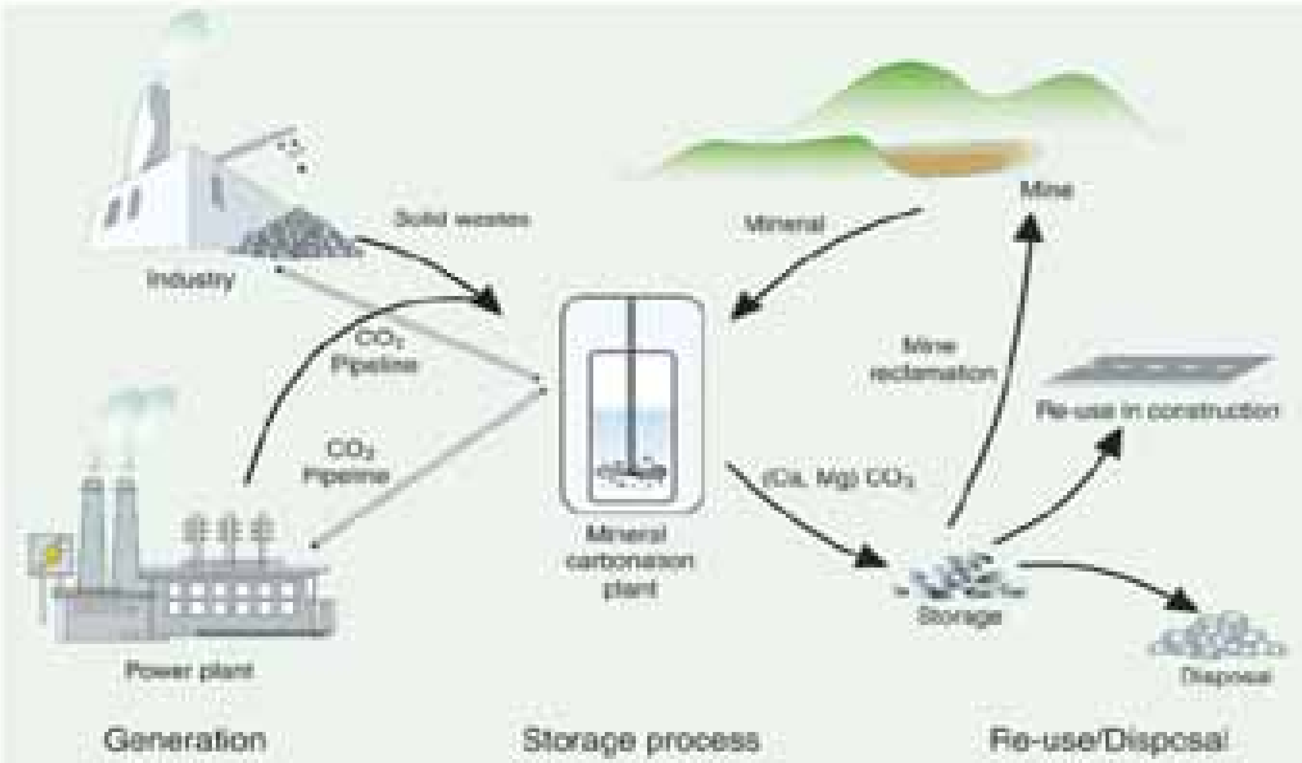
- *Coal bed methane storage.* Coal beds typically contain large amounts of methane-rich gas that is adsorbed onto the surface of the coal. The current practice for recovering coal bed methane is to depressurize the bed, usually by pumping water out of the reservoir. An alternative approach is to inject carbon dioxide gas into the bed. Tests have shown that the adsorption rate for CO_2 to be approximately twice that of methane, giving it the potential to efficiently displace methane and remain sequestered in the bed. CO_2 recovery of coal bed methane has been demonstrated in limited field tests, but much more work is necessary to understand and optimize the process. Similar to the by-product value gained from enhanced oil recovery, the recovered methane provides a value-added revenue stream to the carbon sequestration process, creating a low net cost option. The U.S. coal resources are estimated at 6 trillion tons, and 90% of it is unmineable due to seam thickness, depth, and structural integrity. Another promising aspect of CO_2 sequestration in coal beds is that many of the large unmineable coal seams are near electricity generating facilities that are large point sources of CO_2 gas. Thus, limited pipeline transport of CO_2 gas would be required. Integration of coal bed methane with a coal-fired electricity generating system can provide an option for additional power generation with low emissions.

- *Saline formations.* Sequestration of CO_2 in deep saline formations does not produce value-added by-products, but it has other advantages. First, the estimated carbon storage capacity of saline formations in the United States is large, making them a viable long-term solution. It has been estimated that deep saline formations in the United States could potentially store up to 500 billion tonnes of CO_2.

- *Biological sequestration*. Utilizes the natural uptake of CO_2 by plant material to remove CO_2 from the atmosphere and store it in biological "carbon sinks." Activities in this area include land-use management change (including afforestation and reforestation), or conversion of CO_2 to algal biomass that can be used as a renewable fossil fuel. Vegetation and soils are widely recognized as carbon storage sinks. The global biosphere absorbs roughly 2 billion tons of carbon annually, an amount equal to roughly one-third of all global carbon emissions from human activity. Significant amounts of this carbon remains stored in the roots of certain plants and in the soil. In fact, the inventory of carbon stored in the global ecosystem equals roughly 1,000 years worth of annual absorption, or 2 trillion tons of carbon.

- *Surface mineralization* involves the chemical fixation of CO_2 via a high-pressure synthesis into inorganic carbonates (such as olivine, of which there are known large reserves) that can be used for building materials and other long-life goods, e.g., paper fillers and in paving stones. Two promising chemical pathways are magnesium carbonate and CO_2 clathrate, an ice-like material. Both provide quantum increases in volume density compared to gaseous CO_2. As an example of the potential of chemical pathways, the entire global emissions of carbon in 1990 could be contained as magnesium carbonate in a space 10 kilometers by 10 kilometers by 150 meters.

Exhibit 309: **Mineral Carbonization**



Source: Energy Research Centre of the Netherlands.

- *Ocean sequestration* involves the deposition of high purity CO_2 into the deep part of the oceans where it can remain in liquid state at low temperature and under high pressure. This is a technology that is still in its infancy, requiring considerable development and resolution of issues, including ecosystem impact and the longevity of the storage. It is widely believed that the oceans will eventually absorb 80-90% of the CO_2 in the atmosphere and transfer it to the deep ocean. However, the kinetics of ocean uptake are unacceptably slow, causing a peak atmospheric CO_2 concentration of several hundred years. The program will explore options for speeding up the natural processes by which the oceans transport CO_2 and for injecting CO_2 directly into the deep ocean. One approach to enhancing export production of carbon to the deep ocean is via the addition of iron chelates (a micronutrient) to high-nutrient, low-chlorophyll regions, in order to increase the drawdown of CO_2 as a result of stimulated phytoplankton blooms.

Carbon Capture

- Existing capture technologies, however, are not cost-effective when considered in the context of sequestering CO_2 from power plants. Most power plants and other large point sources use air-fired combustors, a process that exhausts CO_2 diluted with nitrogen. Flue gas from coal-fired power plants contains 10-12% CO_2 by volume, while flue gas from natural gas combined cycle plants contains only 3-6% CO_2. For effective carbon sequestration, the CO_2 in these exhaust gases must be separated and concentrated.

- CO_2 is currently recovered from combustion exhaust by using amine absorbers and cryogenic coolers. The cost of CO_2 capture using current technology, however, is on the order of $150 per ton of carbon—much too high for carbon emissions reduction applications. *Analysis performed by SFA Pacific, Inc. indicates that adding existing technologies for CO_2 capture to an electricity generation process could increase the cost of electricity by US$0.025 to US$0.04/kWh depending on the type of process.*

Exhibit 310: Carbon Dioxide Capture Costs Based on Current Technology

Performance and Cost Measures	New NGCC Plant			New PC Plant			New IGCC Plant			New Hydrogen Plant			Units for H_2 Plant
	Range		Rep. Value	Range		Rep. Value	Range		Rep. Value	Range		Rep. Value	
	low	high		low	high		low	high		low	high		
Emission rate without capture (kg CO_2 MWh^{-1})	344	379	367	736	811	762	682	846	773	78	174	137	kg CO_2 GJ^{-1} (without capture)
Emission rate with capture (kg CO_2 MWh^{-1})	40	66	52	92	145	112	65	152	108	7	28	17	kg CO_2 GJ^{-1} (with capture)
Percent CO_2 reduction per kWh (%)	83	88	86	81	88	85	81	91	86	72	96	86	% reduction/unit of product
Plant efficiency with capture, LHV basis (%)	47	50	48	30	35	33	31	40	35	52	68	60	Capture plant efficiency (% LHV)
Capture energy requirement (% more input MWh^{-1})	11	22	16	24	40	31	14	25	19	4	22	8	% more energy input per GJ product
Total capital requirement without capture (US$ kW^{-1})	515	724	568	1161	1486	1286	1169	1565	1326	[No unique normalization for multi-product plants]			Capital requirement without capture
Total capital requirement with capture (US$ kW^{-1})	909	1261	998	1894	2578	2096	1414	2270	1825				Capital requirement with capture
Percent increase in capital cost with capture (%)	64	100	76	44	74	63	19	66	37	-2	54	18	% increase in capital cost
COE without capture (US$ MWh^{-1})	31	50	37	43	52	46	41	61	47	6.5	10.0	7.8	H_2 cost without capture (US$ GJ^{-1})
COE with capture only (US$ MWh^{-1})	43	72	54	62	86	73	54	79	62	7.5	13.3	9.1	H_2 cost with capture (US$ GJ^{-1})
Increase in COE with capture (US$ MWh^{-1})	12	24	17	18	34	27	9	22	16	0.3	3.3	1.3	Increase in H_2 cost (US$ GJ^{-1})
Percent increase in COE with capture (%)	37	69	46	42	66	57	20	55	33	5	33	15	% increase in H_2 cost
Cost of CO_2 captured (US$/$tCO_2$)	33	57	44	23	35	29	11	32	20	2	39	12	US$/$tCO_2$ captured
Cost of CO_2 avoided (US$/$tCO_2$)	37	74	53	29	51	41	13	37	23	2	56	15	US$/$tCO_2$ avoided
Capture cost confidence Level (see Table 3.7)	moderate			moderate			moderate			moderate to high			Confidence Level (see Table 3.7)

COE = Cost of electricity

Notes: [a] Ranges and representative values are based on data from Tables 3.7, 3.9, 3.10 and 3.11. All costs in this table are for capture only and do not include the costs of CO_2 transport and storage; see Chapter 8 for total CCS costs. [b] All PC and IGCC data are for bituminous coals only at costs of 1.0-1.5 US$ GJ^{-1} (LHV); all PC plants are supercritical units. [c] NGCC data based on natural gas prices of 2.8-4.4 US$ GJ^{-1} (LHV basis). [d] Costs are in constant US$ (approx. year 2002 basis). [e] Power plant sizes range from approximately 400-800 MW without capture and 300-700 MW with capture. [f] Capacity factors vary from 65-85% for coal plants and 50-95% for gas plants (average for each=80%). [g] Hydrogen plant feedstocks are natural gas (4.7-5.3 US$ GJ^{-1}) or coal (0.9-1.3 US$ GJ^{-1}); some plants in dataset produce electricity in addition to hydrogen. [h] Fixed charge factors vary from 11-16% for power plants and 11-20% for hydrogen plants. [i] All costs include CO_2 compression but not additional CO_2 transport and storage costs.

Source: IPCC.

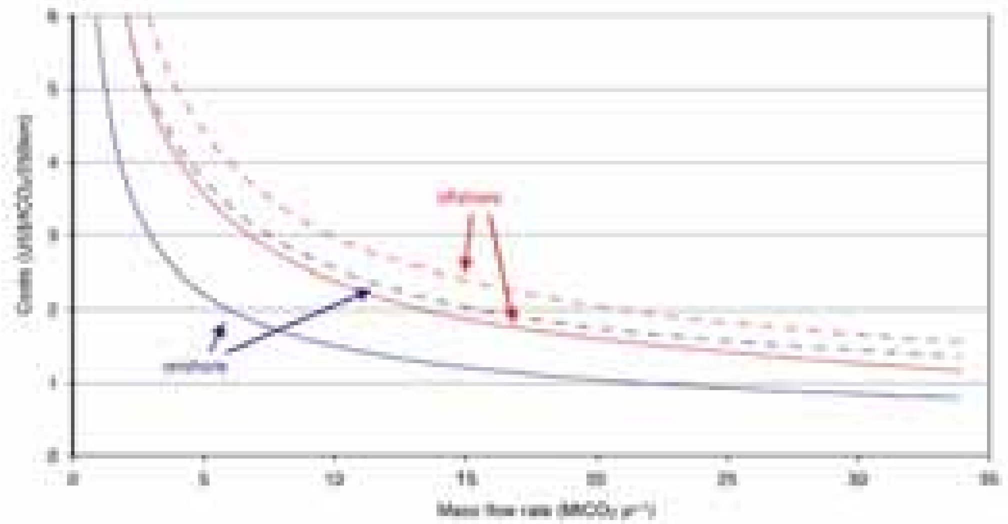
Furthermore, carbon dioxide capture is generally estimated to represent three-fourths of the total cost of a carbon capture, storage, transport, and sequestration system. The U.S. Department of Energy has launched a research program to pursue evolutionary improvements in existing CO_2 capture systems and is exploring revolutionary new capture and sequestration concepts. The most likely options currently identifiable for CO_2 separation and capture include the following:

- Opportunities for significant cost reductions exist since very little R&D has been devoted to CO_2 capture and separation technologies. Several innovative schemes have been proposed that could significantly reduce CO_2 capture costs, compared with conventional processes. "One box" concepts that combine CO_2 capture with reduction of criteria pollutant emissions are being explored as well.
- Development of retrofittable CO_2 reduction and capture options for existing large-point sources of CO_2 emissions such as electricity generation units, petroleum refineries, and cement and lime production facilities.
- Companies such as BASF are taking part in a European Union-sponsored research project with the objective of investigating ways to remove the major greenhouse gas carbon dioxide from combustion gases. BASF's project involves high-throughput screening for new amine-based scrubbing agents.

Carbon Transport

Having captured the CO_2 from a large point source emitter (e.g., power station), it would need to be transported to a place of sequestration. The IPCC estimates that the typical cost of this would range from $1-5/t CO_2.

Exhibit 311: Cost of Carbon Transport



Source: IPCC.

Carbon Sequestration

The IPCC estimates the cost of geological storage of CO_2 in the range $0.5-8.0/MT.

Exhibit 312: Cost of C0$_2$ Sequestration

Option	Representative Cost Range (US$/tonne CO_2 stored)	Representative Cost Range (US$/tonne C stored)
Geological - Storage	0.5-8.0	2-29
Geological - Monitoring	0.1-0.3	0.4-1.1
Ocean		
Pipeline	6-31	22-114
Ship (Platform or Moving Ship Injection)	12-16	44-59
Mineral Carbonation	50-100	180-370

Source: Company data, Credit Suisse estimates.

Alternative Energy through the HOLT® Lens

Edward Westlake

Will Forbes

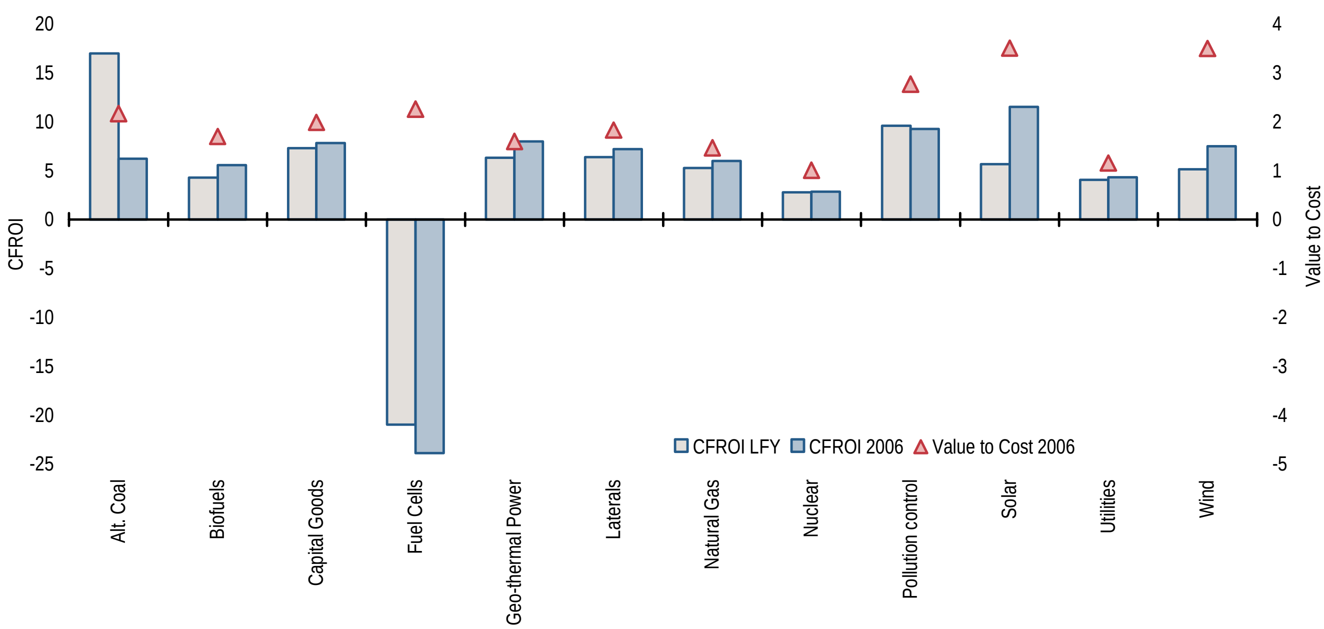
As this report suggests, we should experience strong growth and, depending on government policies, good returns across the energy efficiency and alternative energy production space. Investor focus on these areas has led to strong relative performance versus global markets. In this section, we use the HOLT tool to evaluate the level of overall valuation by subsector and on a stock-by-stock basis. We group the global universe into nine subsectors that we believe will benefit from the faster growth of the alternative energy space: solar, wind, bioenergy, nuclear, natural gas, fuel cells, capital goods, utilities, and a catch-all group, laterals, that includes stocks exposed to areas such as geothermal or energy efficiency.

Subsector: Value to Cost Ratios versus Returns

- The HOLT system offers many excellent methods of screening for performance and for valuation. We focus on value to cost ratios (the ratio of enterprise value to gross inflation-adjusted capital) versus profitability (CFROI®) on a subsector and a company basis. We also compare growth rates and profitability.

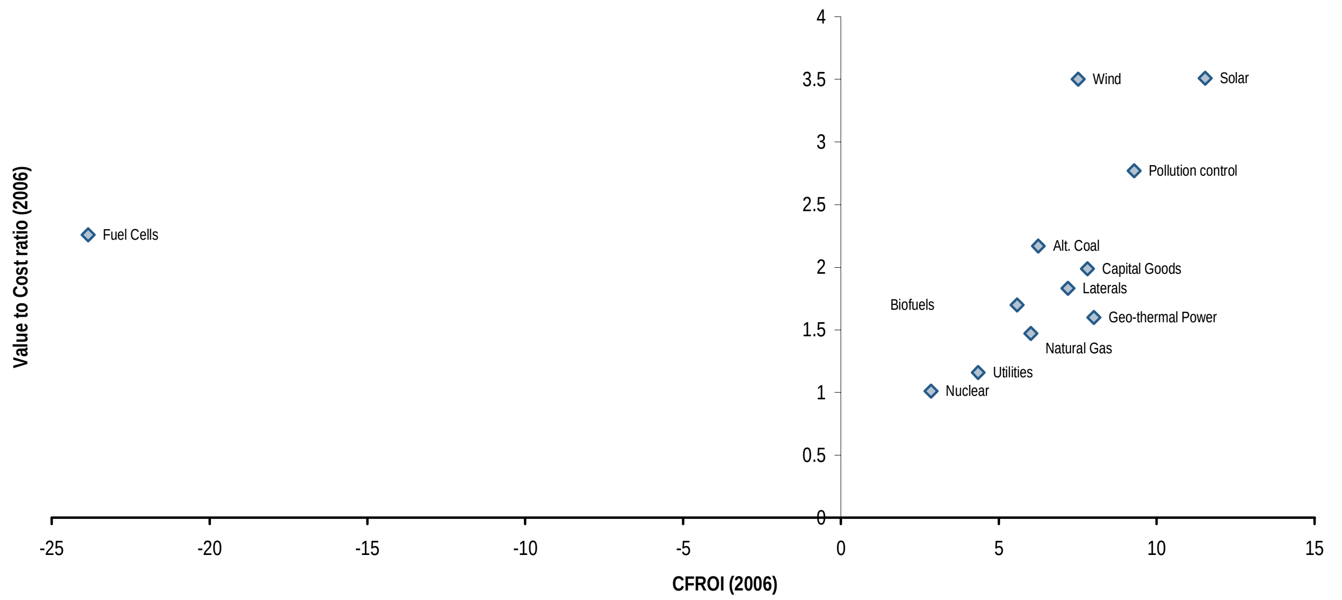
Note that the constituents of each subsector can be found in subsequent charts in this section. We include more conventional valuation multiples such as P/E multiples and PEG ratios at the end of this report. We also include a brief company description of each of the companies mentioned.

Exhibit 313: **Alternative Energy Subsectors—Value to Cost Ratio versus CFROI® (Global)**



Source: Credit Suisse HOLT®.

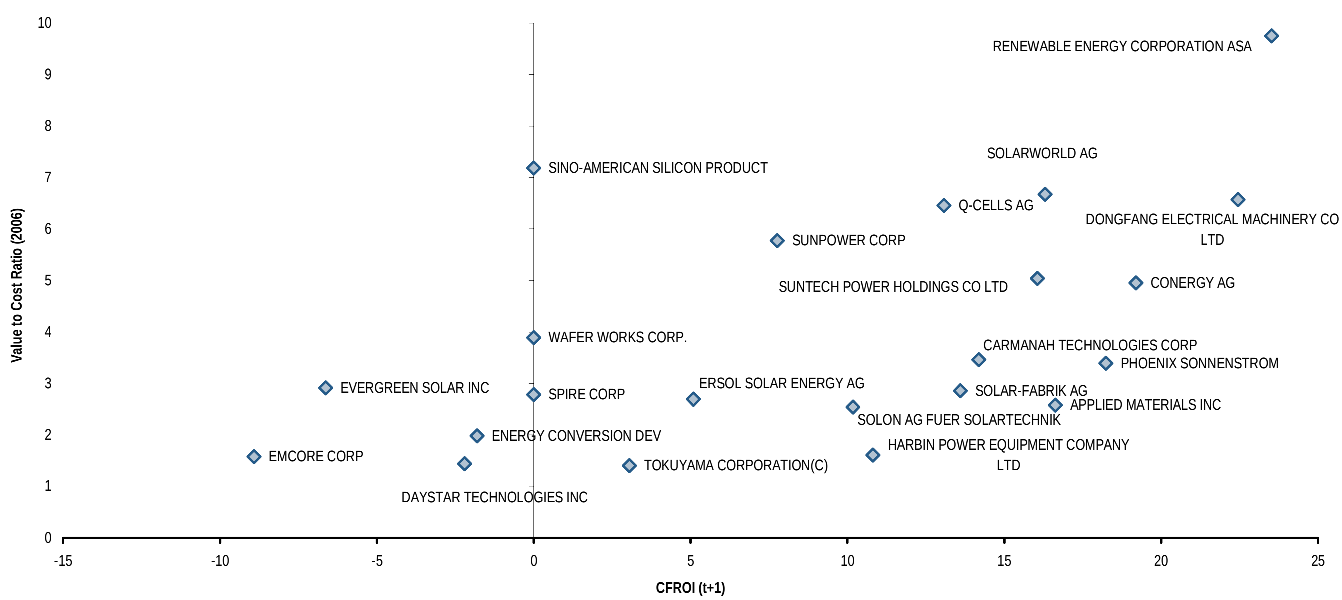
Exhibit 314: CFROI (t+1) versus Value to Cost Ratio (2006) for Alternative Universe, Not Market Weighted



Source: Credit Suisse HOLT®.

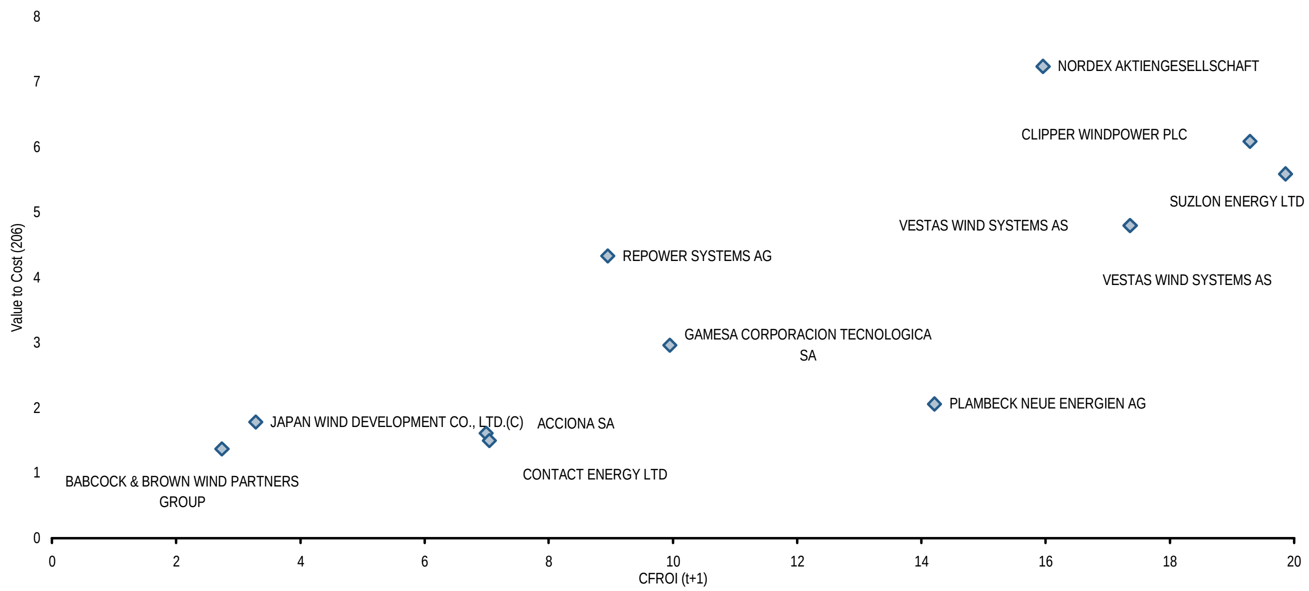
Solar—Value to Cost Ratios

Exhibit 315: Solar—Value to Cost Ratio versus CFROI® (t+1) (Global)



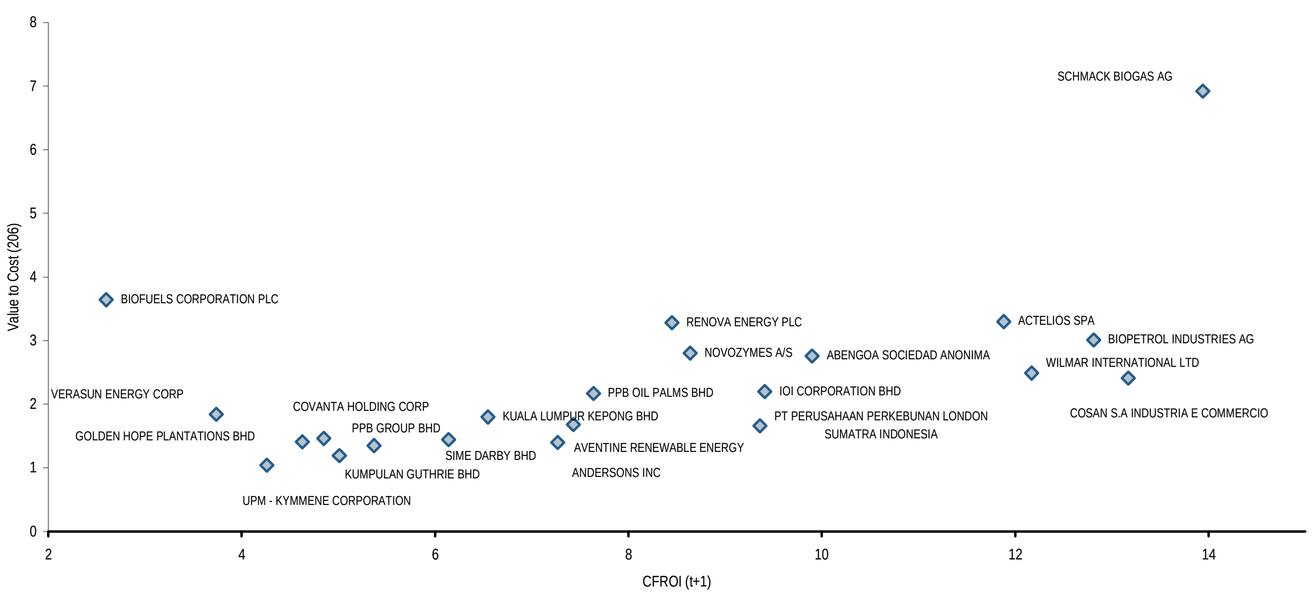
Note: Outliers omitted.
Source: Credit Suisse HOLT®.

Exhibit 316: Wind—Value to Cost Ratio versus CFROI® (t+1) (Global)



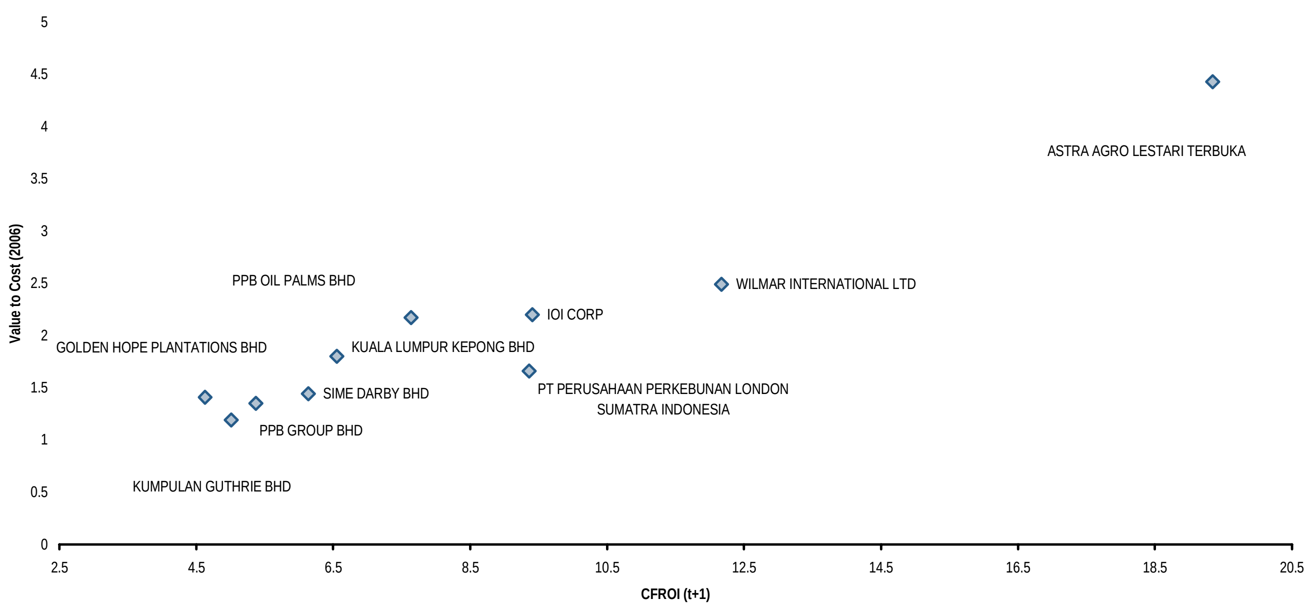
Note: Outliers omitted.
Source: Credit Suisse HOLT®.

Exhibit 317: Biofuels—Value to Cost Ratio versus CFROI® (t+1) (Global)



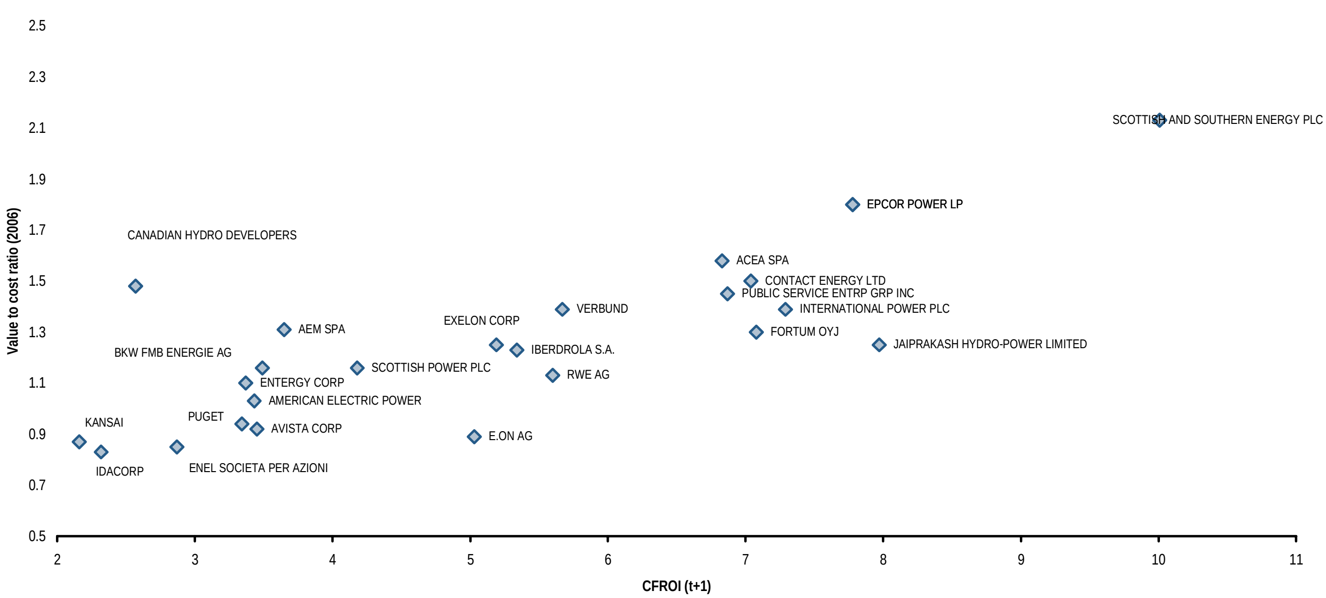
Note: Outliers omitted.
Source: Credit Suisse HOLT®.

Exhibit 318: Asia Plantation Stocks—Value to Cost Ratio versus CFROI® (t+1)



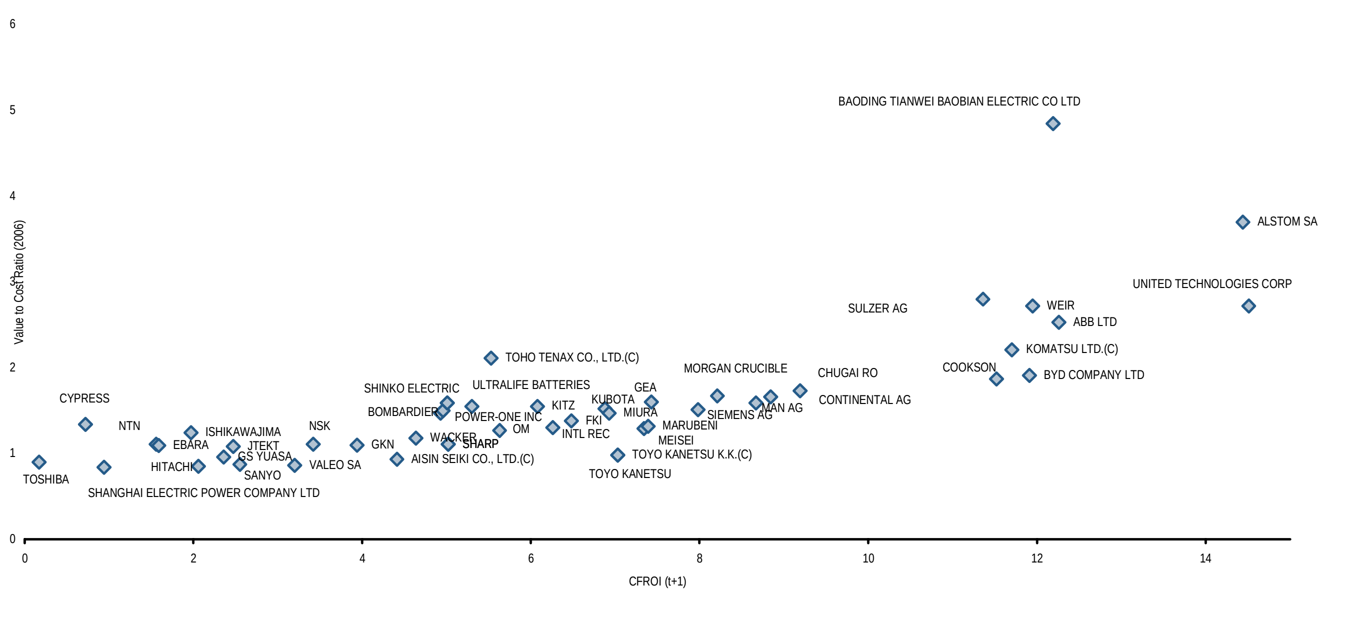
Note: Outliers omitted.
Source: Credit Suisse HOLT®.

Exhibit 319: Utilities—Value to Cost Ratio versus CFROI® (t+1)



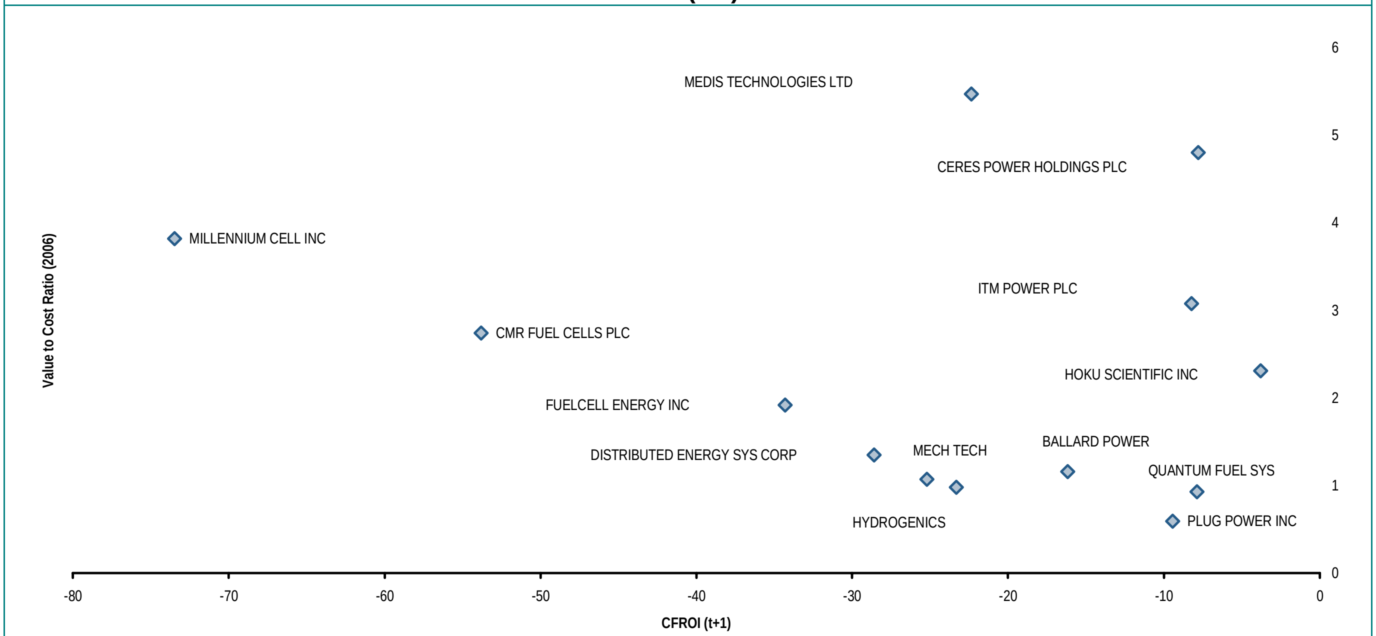
Note: Outliers omitted.
Source: Credit Suisse HOLT®.

Exhibit 320: Capital Goods—Value to Cost Ratio versus CFROI® (t+1)



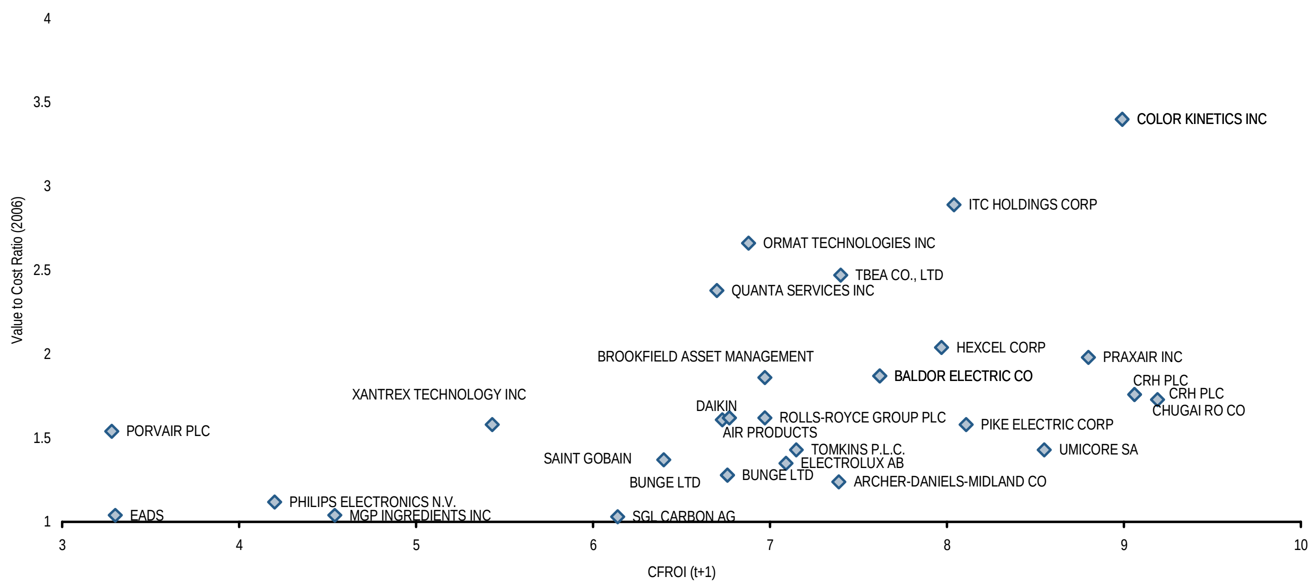
Note: Outliers omitted.
Source: Credit Suisse HOLT®.

Exhibit 321: Fuel Cells—Value to Cost Ratio versus CFROI® (t+1)



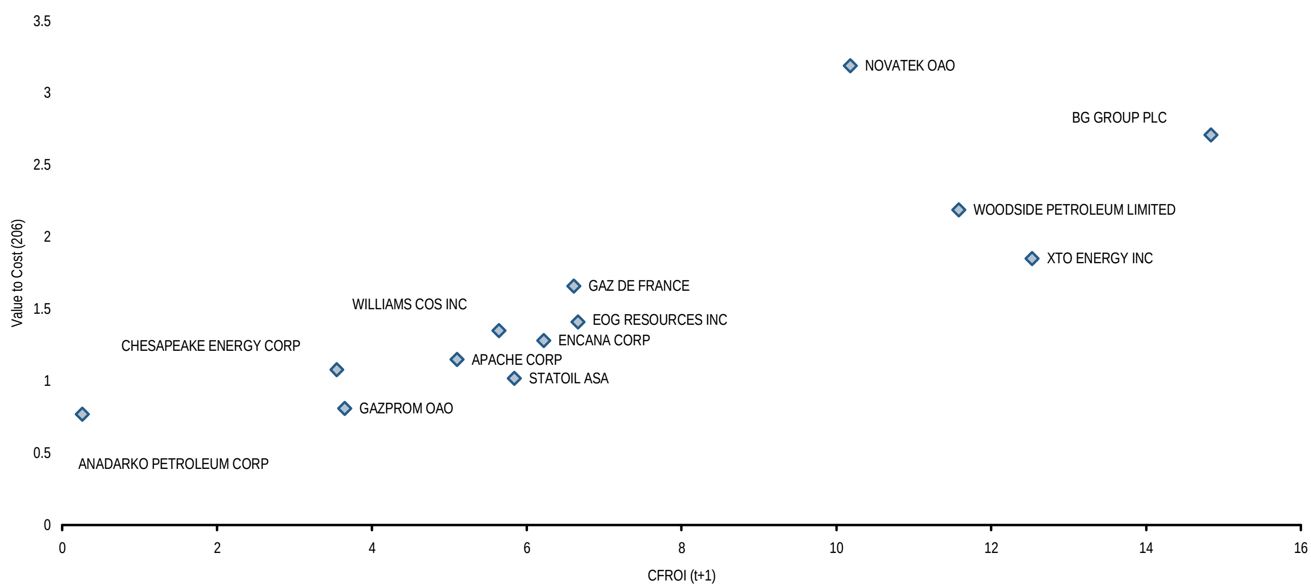
Note: Outliers omitted.
Source: Credit Suisse HOLT®.

Exhibit 322: Lateral Ideas—Value to Cost Ratio versus CFROI® (t+1)



Note: Outliers omitted.
Source: Credit Suisse HOLT®.

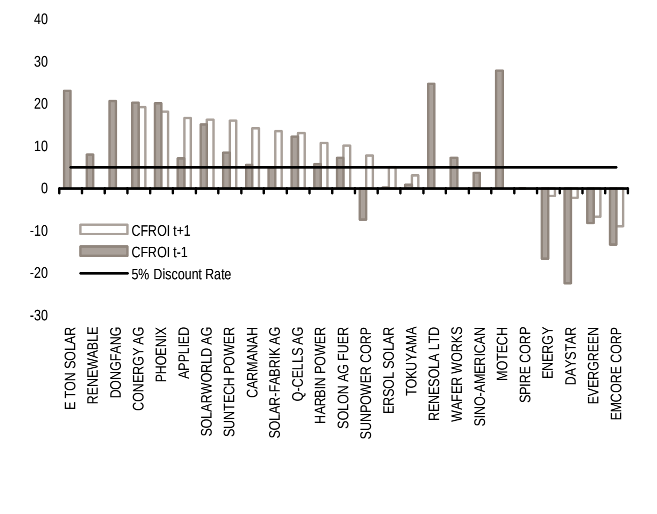
Exhibit 323: Natural Gas—Value to Cost Ratio versus CFROI® (t+1)



Note: Outliers omitted.
Source: Credit Suisse HOLT®.

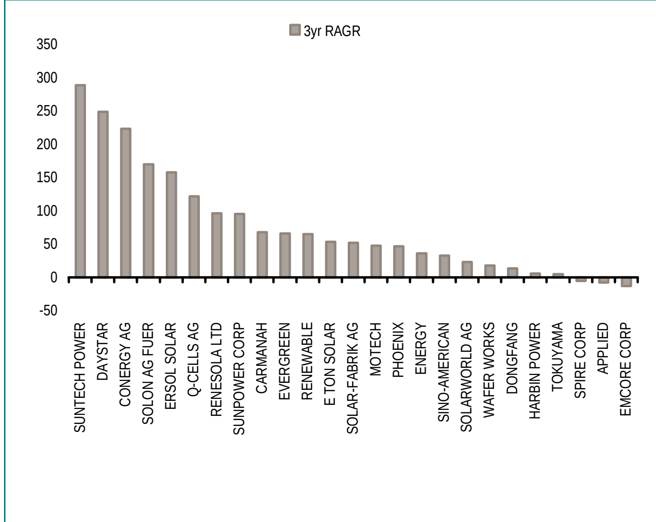
Focus on Solar: Asset Growth and Profitability

Exhibit 324: CFROI®, t-1, t+1



Source: Credit Suisse HOLT®.

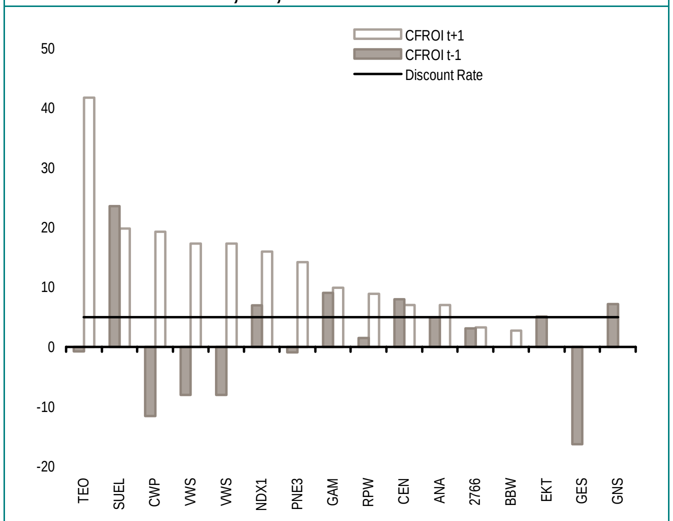
Exhibit 325: RAGR, Three Year



Source: Credit Suisse HOLT®.

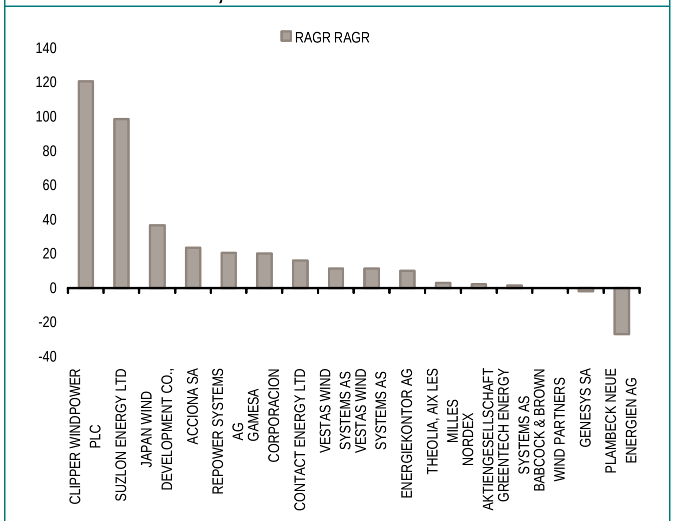
Focus on Wind: Asset Growth and Profitability

Exhibit 326: CFROI®, t-1, t+1



Source: Credit Suisse HOLT®.

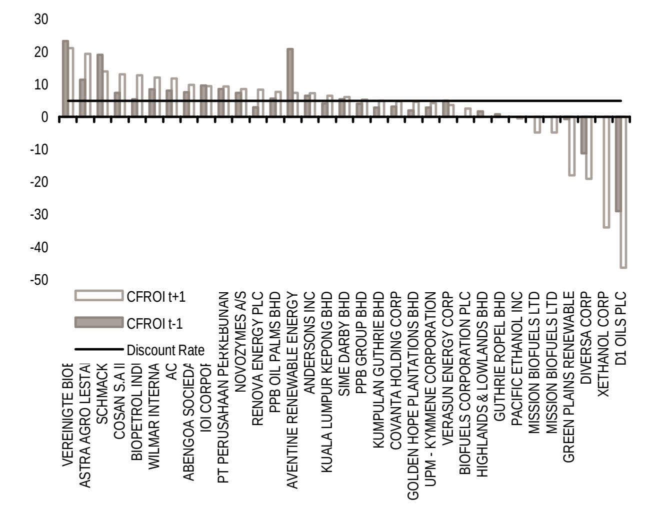
Exhibit 327: RAGR, Three Year



Source: Credit Suisse HOLT®.

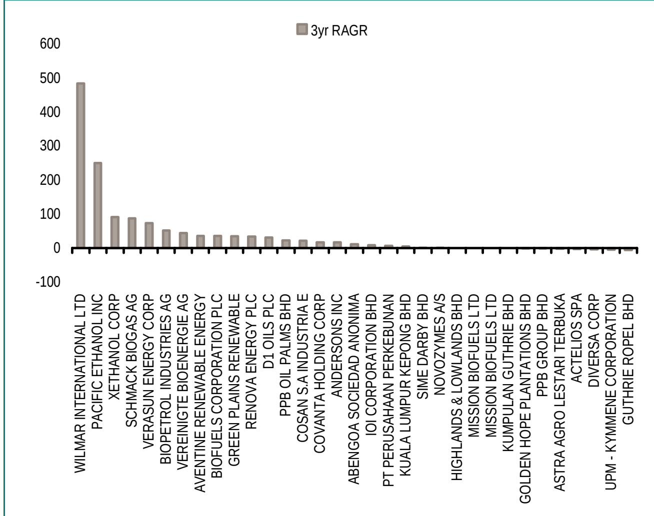
Focus on Biofuels: Asset Growth and Profitability

Exhibit 328: CFROI, t-1, t+1



Source: Credit Suisse HOLT®.

Exhibit 329: RAGR, Three Year

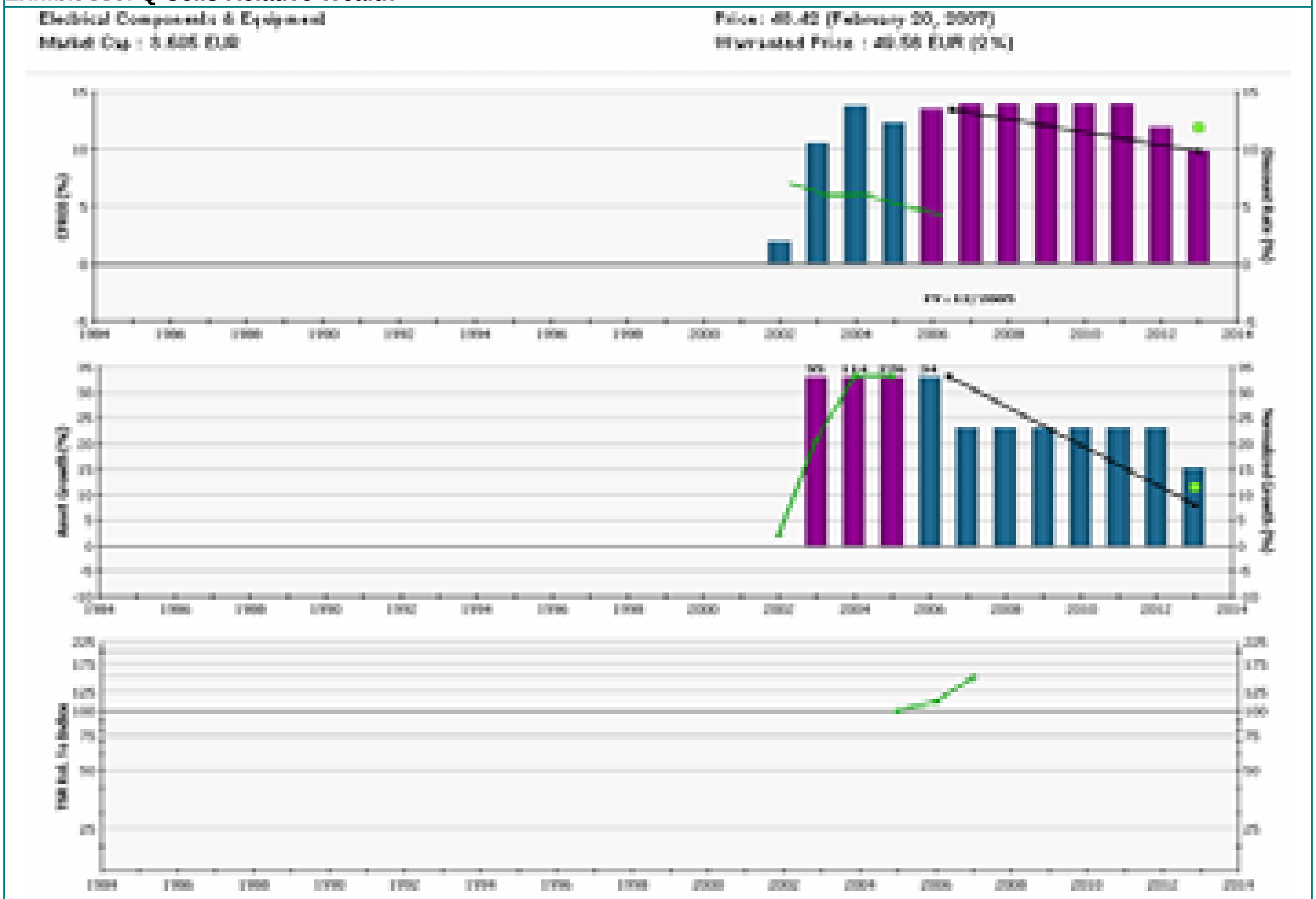


Source: Credit Suisse HOLT®.

Case Study—Q Cells

- Q Cells (Germany) is currently discounting strong returns in the 13% CFROI® range and strong asset growth (23%), albeit this is broadly representative of market growth rates through to 2015.
- We believe that within the next three to four years, Q-Cells will be able to maintain these high levels of CFROI® as operating margins stay at a relatively high level. The company is doing a good job, in our view, of offsetting the rise in input costs (higher silicon/wafer costs) through economies of scale. We also believe the company has managed to raise the efficiency of its solar cells through efficient R&D.

Exhibit 330: **Q Cells Relative Wealth**

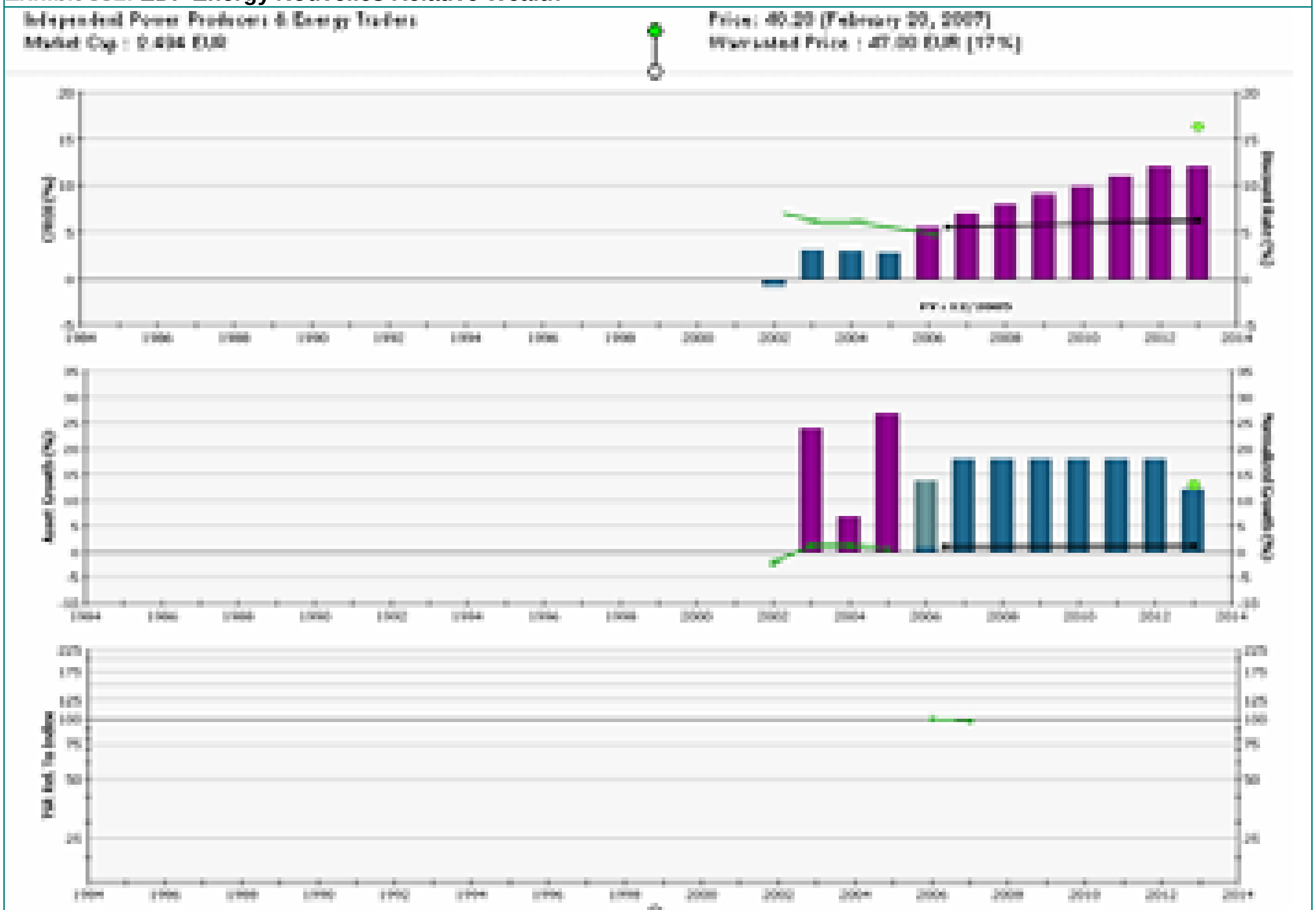


Source: Credit Suisse HOLT®, Credit Suisse research.

Case Study—EDF Energy Nouvelles (EEN)

- EDF Energy Nouvelles is a power producer focused on the fast-growing wind generation sector. Our utility analyst, Marie Fedotov, expects strong asset growth and IRRs on investments in the 10-14% range.
- We can use the HOLT® sensitivity to model this fast initial growth and improving profitability. In the longer term, HOLT assumes that returns fade to cost of capital at 10% per annum. In practice, the wind contracts that EEN sign are typically 10-15 years in duration, which could provide some overall valuation upside relative to this default fade.

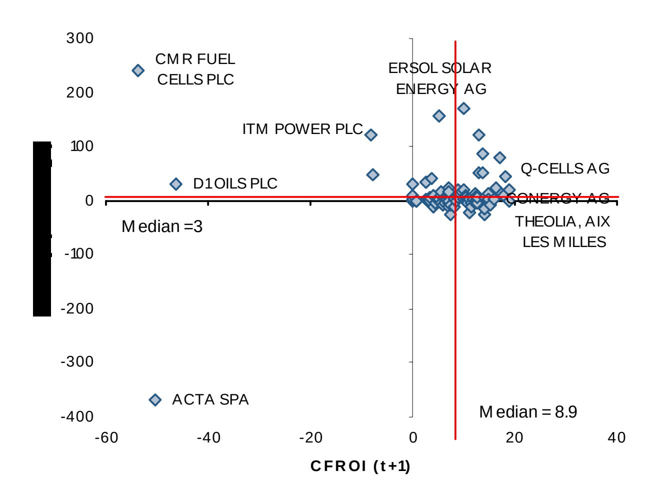
Exhibit 331: **EDF Energy Nouvelles Relative Wealth**



Source: Credit Suisse HOLT®, Credit Suisse Research.

Alternative Energy—Growth versus Returns

Exhibit 332: Alternative Energy—Asset Growth versus CFROI® (t+1) (Europe)

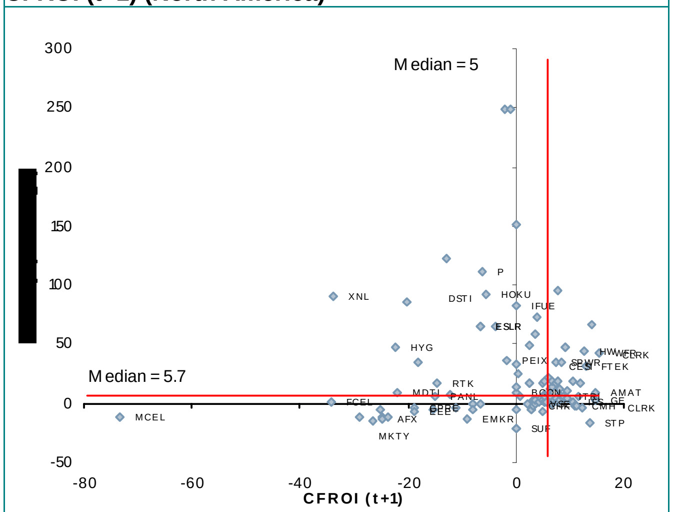


Source: Credit Suisse HOLT®.

Exhibit 333: Alternative Energy—Asset Growth versus CFROI® (t+1) (Europe)—Exploded View

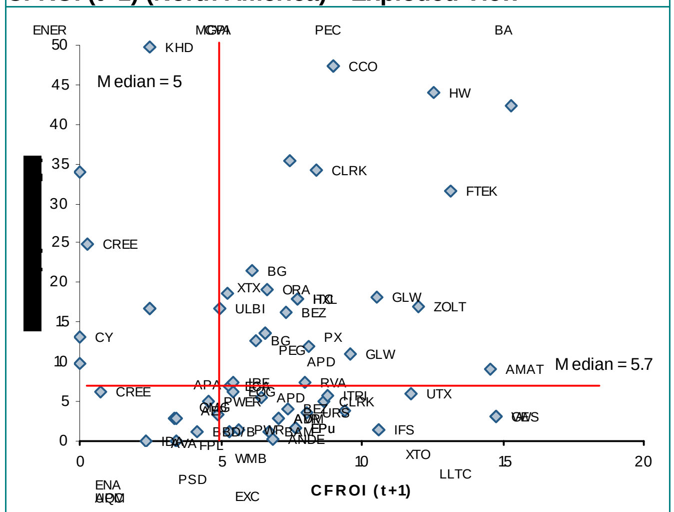
Source: Credit Suisse HOLT®.

Exhibit 334: Alternative Energy—Asset Growth versus CFROI (t+1) (North America)



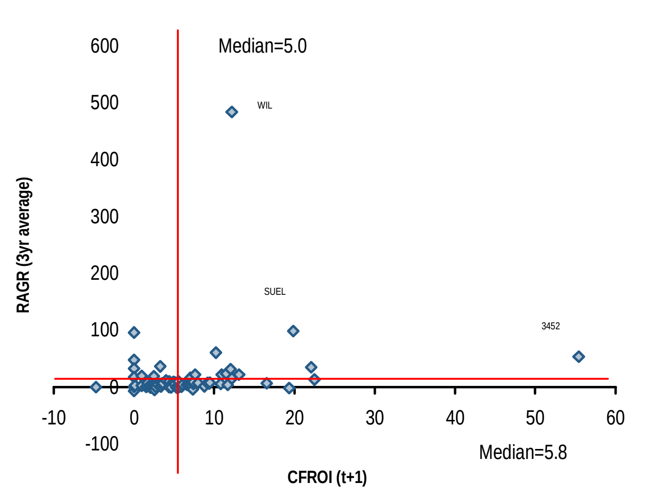
Source: Credit Suisse HOLT®.

Exhibit 335: Alternative Energy—Asset Growth versus CFROI (t+1) (North America)—Exploded View



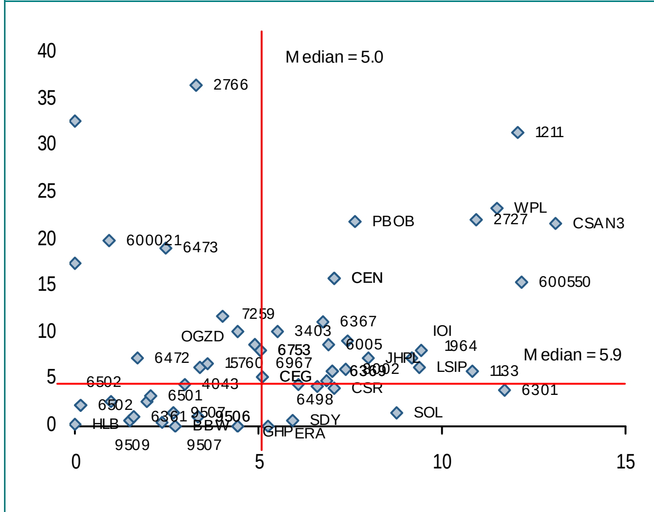
Source: Credit Suisse HOLT®.

Exhibit 336: Alternative Energy—Asset Growth versus CFROI (t+1) (Emerging)



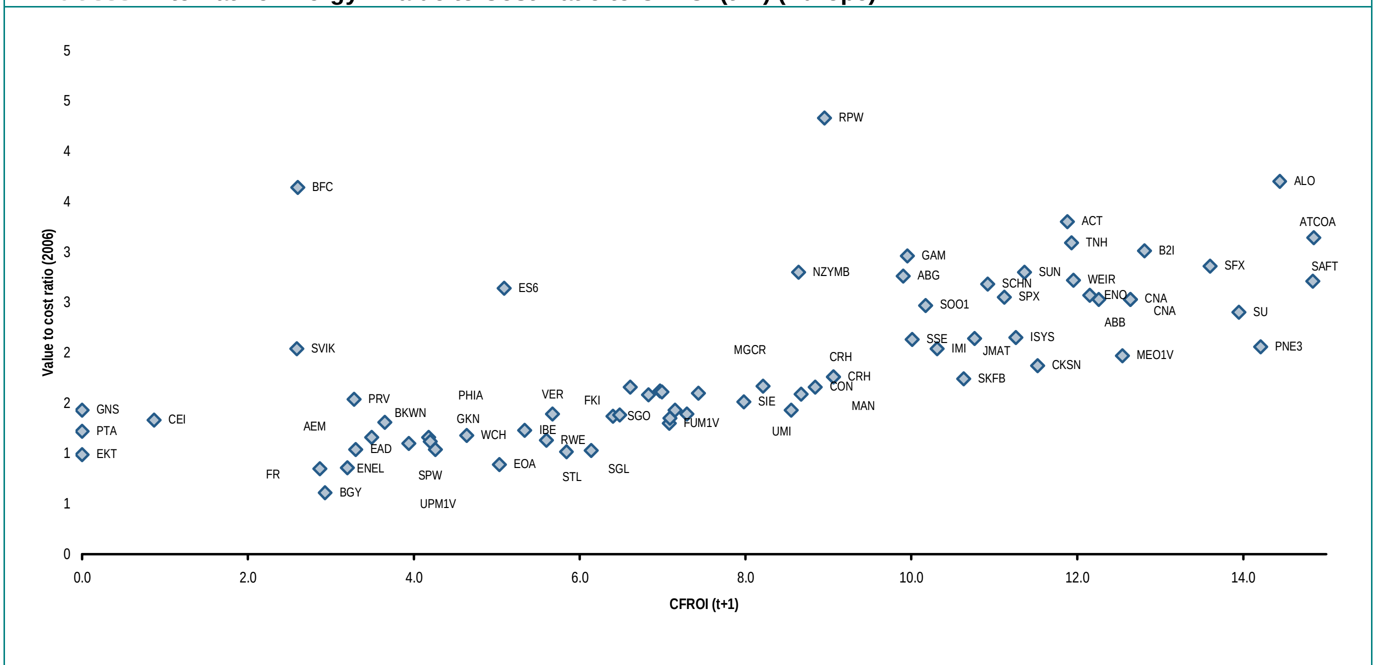
Source: Credit Suisse HOLT®.

Exhibit 337: Alternative Energy—Asset Growth versus CFROI (t+1) (Emerging)—Exploded View



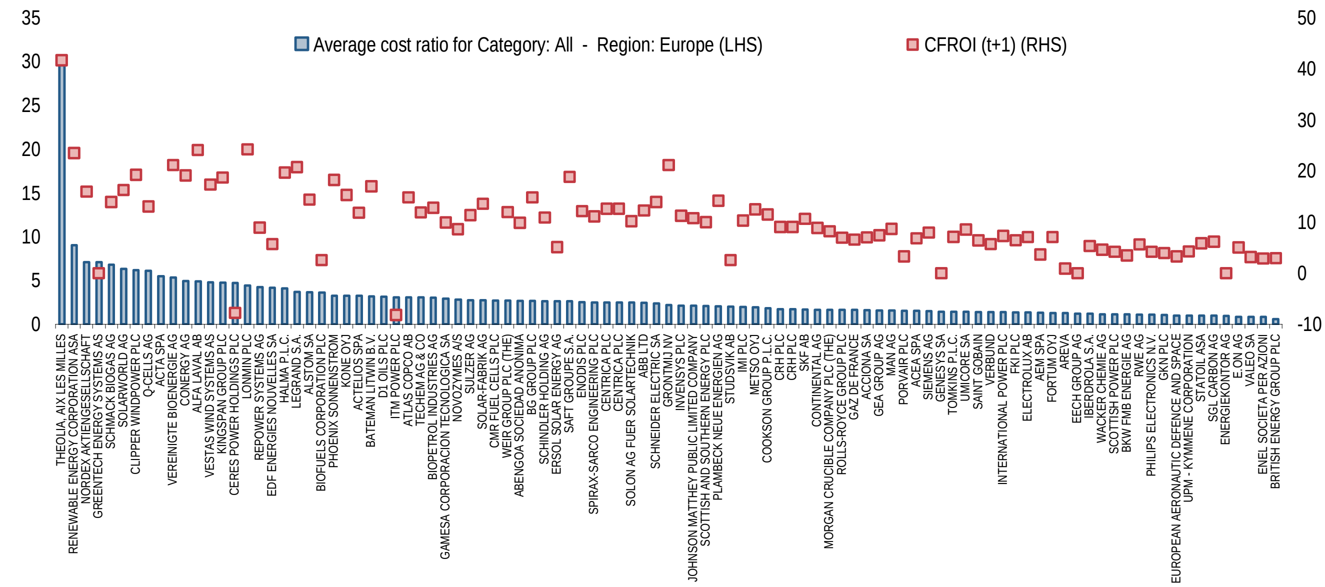
Source: Credit Suisse HOLT®.

Exhibit 338: Alternative Energy—Value to Cost Ratio to CFROI (t+1) (Europe)



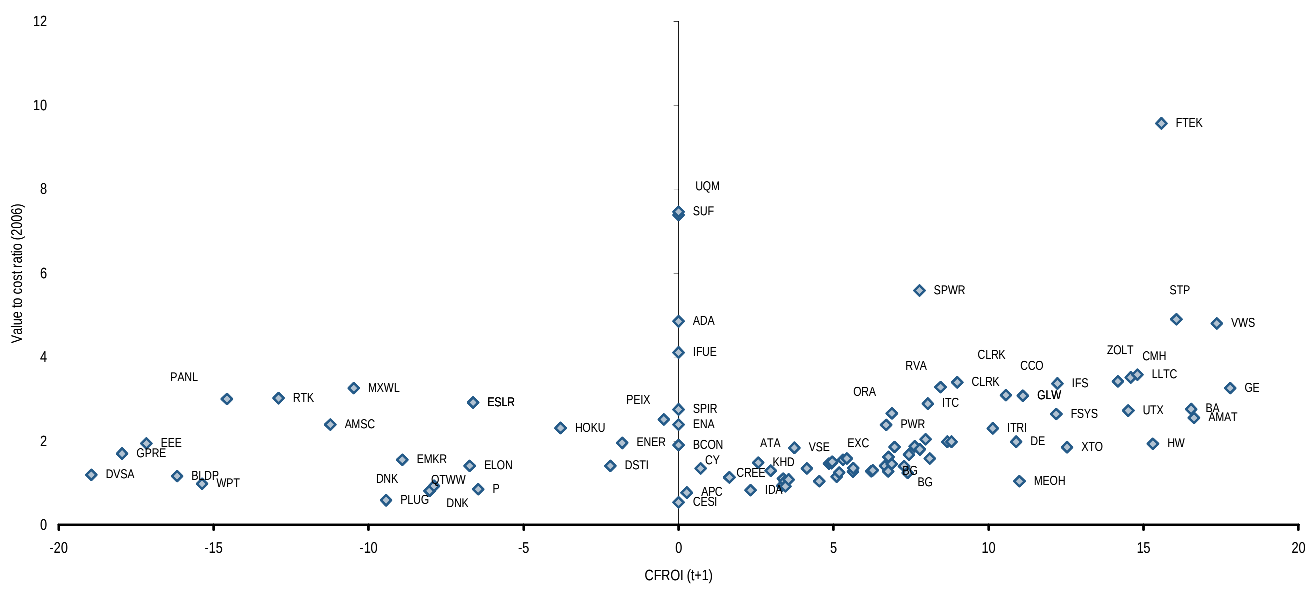
Source: Credit Suisse HOLT®.

Exhibit 339: Alternative Energy—Value to Cost Ratio (Europe)



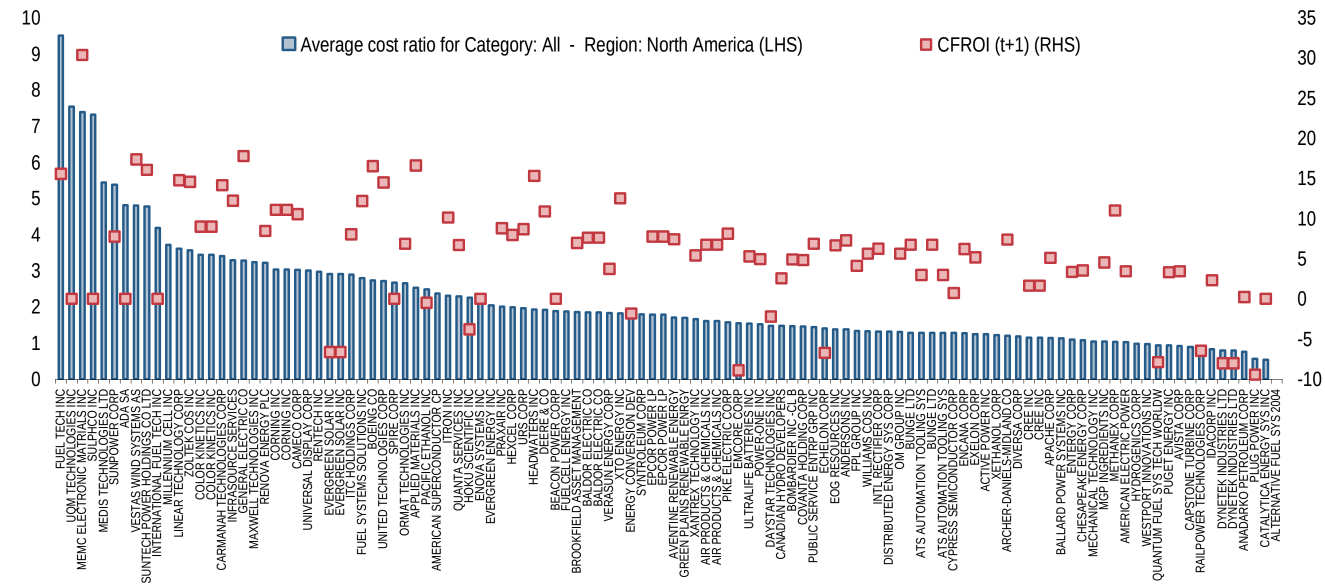
Source: Credit Suisse HOLT®.

Exhibit 340: Alternative Energy—Value to Cost Ratio versus CFROI (t+1) (North America)



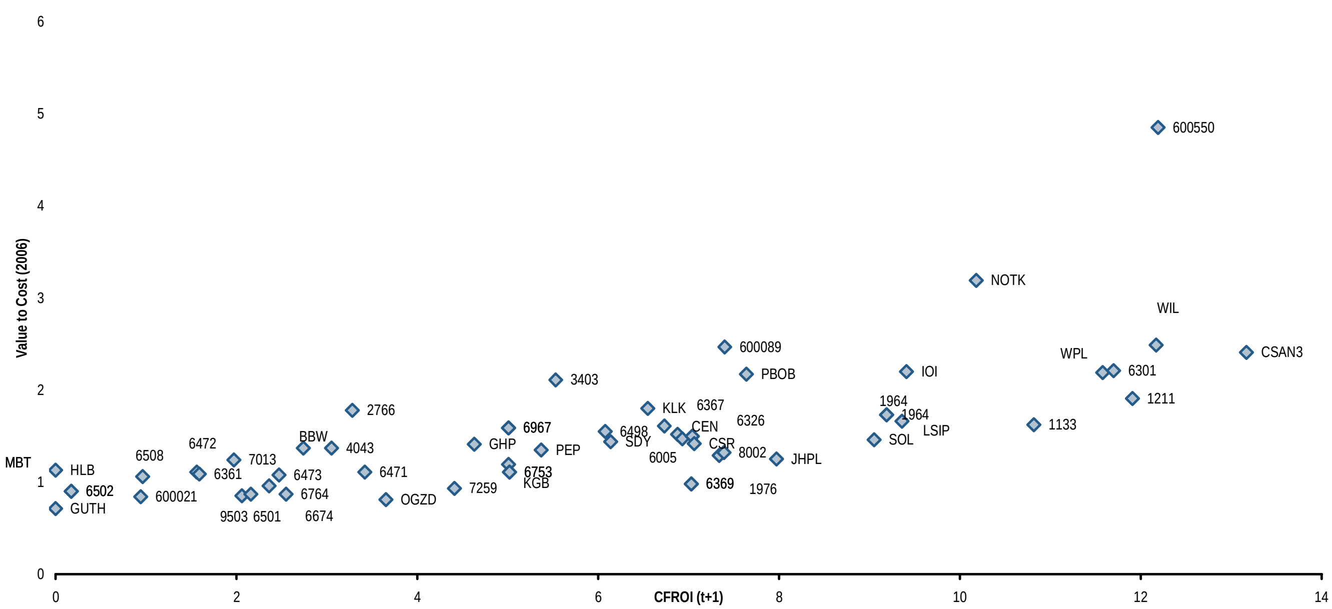
Note: Company Tickers omitted where grouping too tight , outliers omitted.
Source: Credit Suisse HOLT®.

Exhibit 341: Alternative Energy—Value to Cost Ratio (North America)



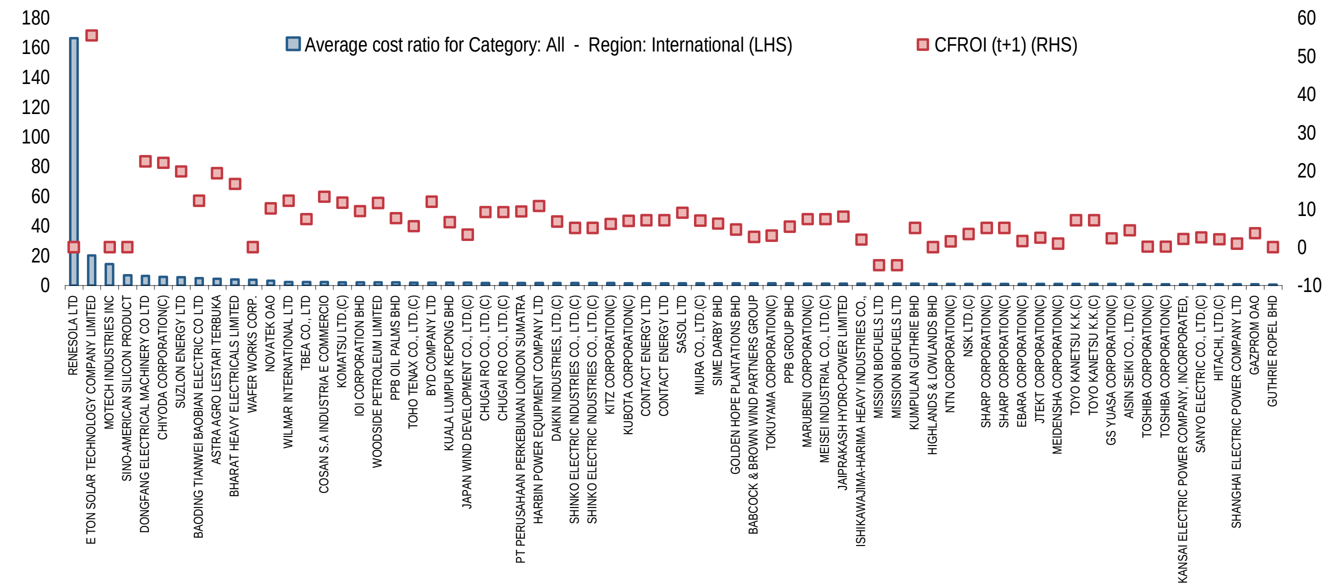
Source: Credit Suisse HOLT®.

Exhibit 342: Alternative Energy—Value to Cost Ratio versus CFROI (t+1) (Emerging)



Note: Company Tickers omitted where grouping too tight , outliers omitted.
Source: Credit Suisse HOLT®.

Exhibit 343: Alternative Energy—Value to Cost Ratio (Emerging Markets)



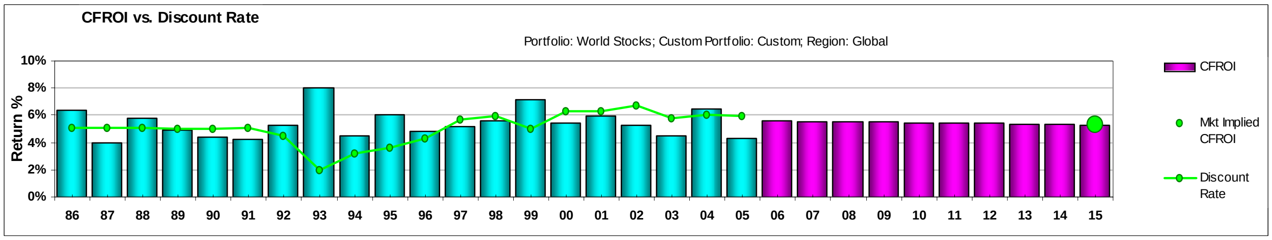
Source: Credit Suisse HOLT®.

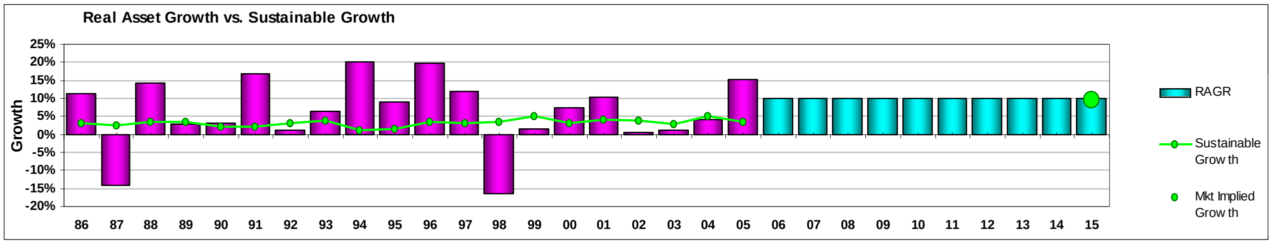
HOLT® Aggregator Tool

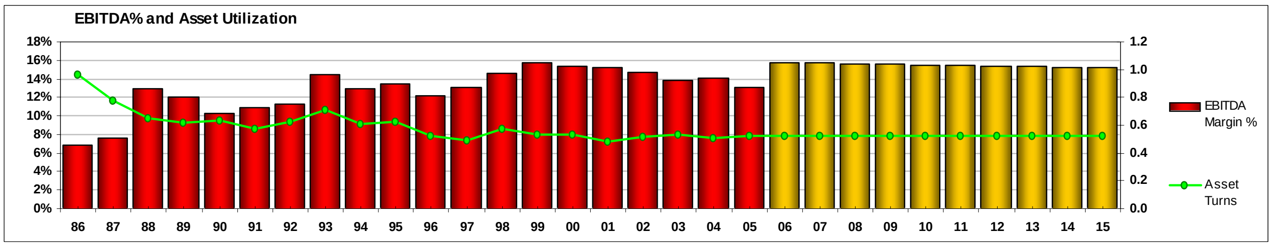
Exhibit 344: HOLT® Aggregator Tool for Biofuels Companies

RELATIVE WEALTH CHARTS

Data Date: 07-Mar-2007







HOLT MARKET IMPLIEDS

VALUATION DRIVERS	2006	2015
CFROI	5.6%	5.3%
Real Asset Growth	10.0%	10.0%
Discount Rate	5.0%	
Forecast Horizon (Yrs)	10	
Final Fade Rate	10%	

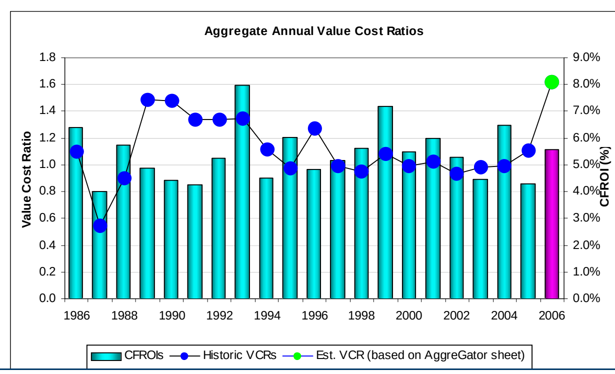
HOLT MARKET IMPLIEDS	2006 Mkt Imp	
CFROI	5.6%	5.3%
Real Asset Growth	10.0%	9.7%

BENCHMARKS	Peak	5 Yr Avg	10 Yr Avg	5 Yr Med	10 Yr Med
CFROI	8.0%	5.3%	5.5%	5.3%	5.4%
Real Asset Growth	25.4%	6.3%	5.6%	4.2%	5.8%

SENSITIVITY	----------CFROI 2015----------					
		3.3%	4.3%	5.3%	6.3%	7.3%
---- 2015 ---- Growth	8.0%	-47%	-27%	-7%	13%	33%
	9.0%	-46%	-25%	-4%	18%	40%
	10.0%	-46%	-23%	0%	23%	47%
	11.0%	-45%	-20%	4%	29%	55%
	12.0%	-44%	-17%	9%	36%	63%

DR Sensitivity	4.0%	4.5%	5.0%	5.5%	6.0%
	42.0%	19.8%	0.0%	-17.5%	-33.1%

CAP Sensitivity	0 Yrs	2 Yrs	5 Yrs	7 Yrs	10 Yrs
	0.0%	2.3%	5.7%	8.0%	11.5%

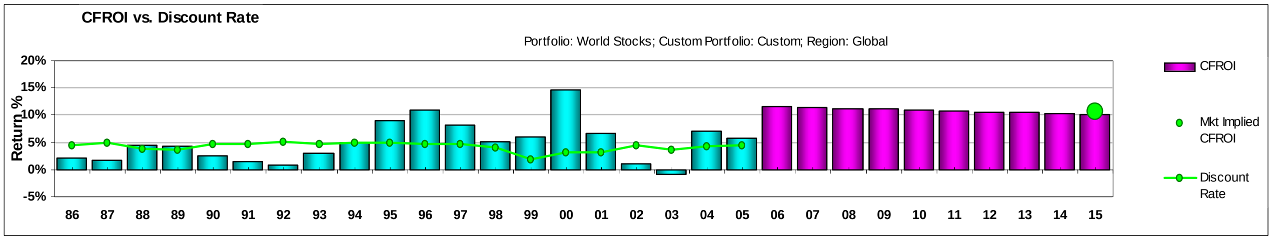


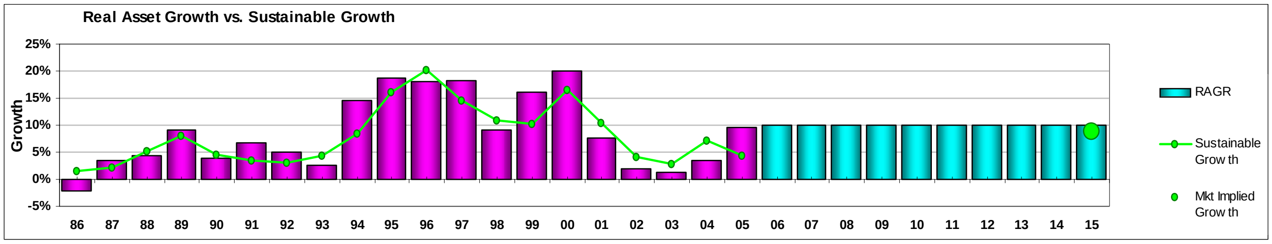
**No of firms in aggregate: 27, Total Market Cap $58 billion.*
Source: Credit Suisse HOLT®.

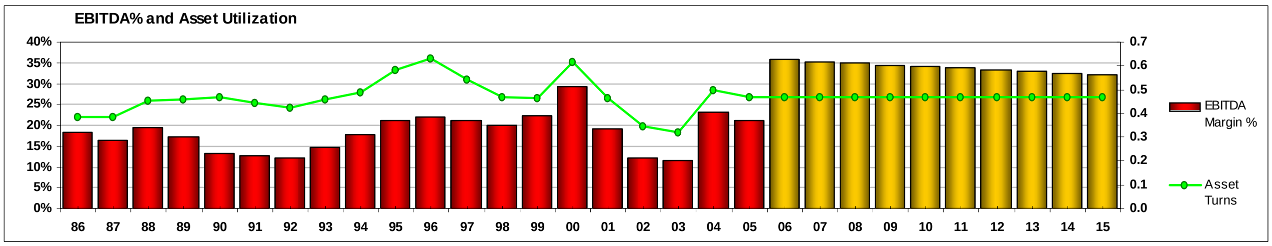
Exhibit 345: HOLT® Aggregator Tool for Solar Companies

RELATIVE WEALTH CHARTS

Data Date: 07-Mar-2007







HOLT MARKET IMPLIEDS

VALUATION DRIVERS	2006	2015
CFROI	11.5%	10.1%
Real Asset Growth	10.0%	10.0%
Discount Rate	5.0%	
Forecast Horizon (Yrs)	10	
Final Fade Rate	10%	

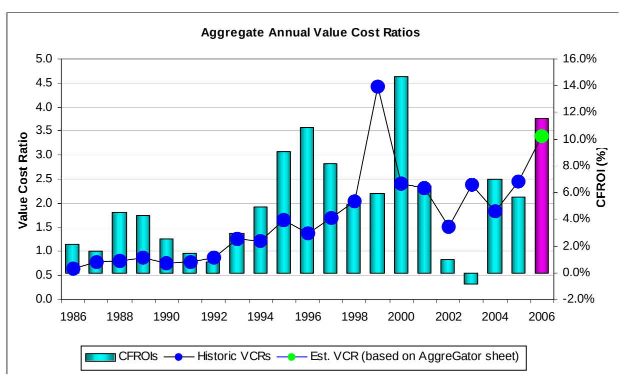
HOLT MARKET IMPLIEDS	2006	Mkt Imp
CFROI	11.5%	10.7%
Real Asset Growth	10.0%	9.0%

DR Sensitivity	4.0%	4.5%	5.0%	5.5%	6.0%
	22.7%	10.7%	0.0%	-9.6%	-18.3%

BENCHMARKS	Peak	5 Yr Avg	10 Yr Avg	5 Yr Med	10 Yr Med
CFROI	14.6%	3.9%	6.4%	5.7%	6.2%
Real Asset Growth	28.9%	4.8%	11.4%	3.5%	9.4%

SENSITIVITY	--------------------CFROI 2015--------------------				
---- 2015 ---- Growth	8.1%	9.1%	10.1%	11.1%	12.1%
8.0%	-23%	-16%	-9%	-2%	5%
9.0%	-20%	-12%	-5%	3%	11%
10.0%	-16%	-8%	0%	8%	17%
11.0%	-13%	-4%	5%	14%	23%
12.0%	-8%	1%	11%	20%	30%

CAP Sensitivity	0 Yrs	2 Yrs	5 Yrs	7 Yrs	10 Yrs
	0.0%	9.8%	25.9%	37.7%	57.1%

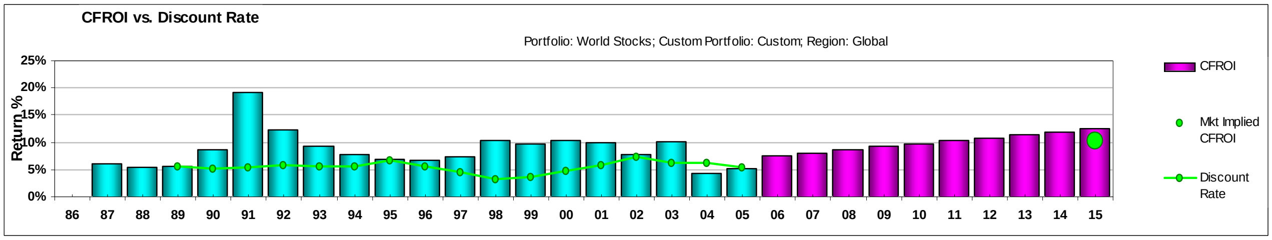


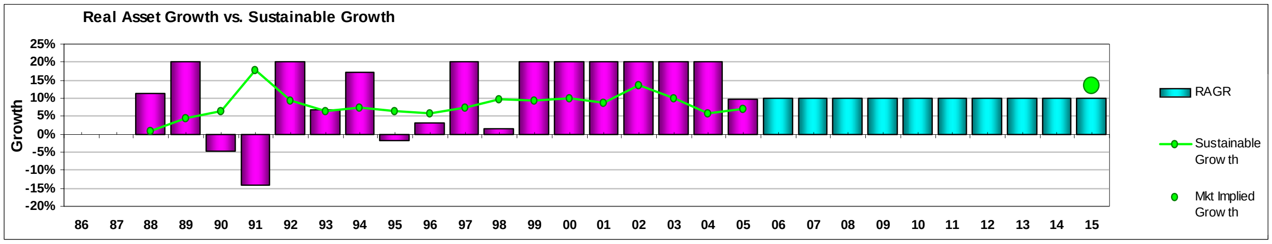
**No of firms in aggregate: 21, Total Market Cap $67 billion.*
Source: Credit Suisse HOLT®.

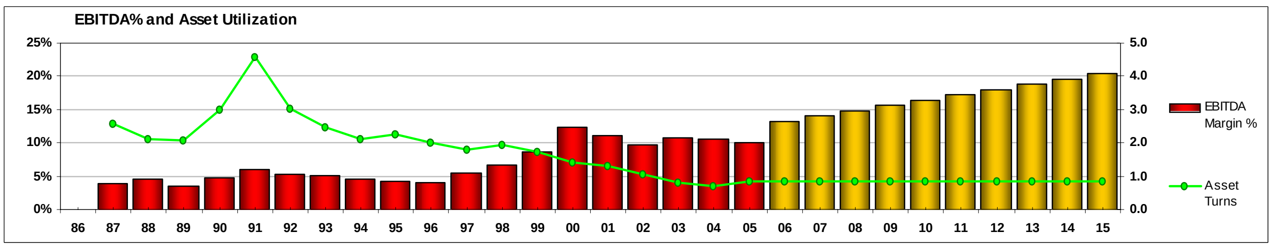
Exhibit 346: HOLT® Aggregator Tool for Wind Companies

RELATIVE WEALTH CHARTS

Data Date: 07-Mar-2007







HOLT MARKET IMPLIEDS

VALUATION DRIVERS	2006	2015
CFROI	7.5%	12.5%
Real Asset Growth	10.0%	10.0%
Discount Rate	5.0%	
Forecast Horizon (Yrs)	10	
Final Fade Rate	10%	

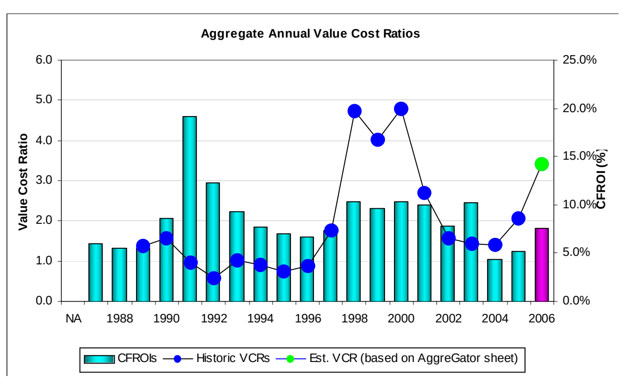
HOLT MARKET IMPLIEDS	2006	Mkt Imp
CFROI	7.5%	10.3%
Real Asset Growth	10.0%	13.5%

BENCHMARKS	Peak	5 Yr Avg	10 Yr Avg	5 Yr Med	10 Yr Med
CFROI	19.1%	7.5%	8.2%	7.9%	8.7%
Real Asset Growth	95.2%	29.1%	29.4%	25.1%	24.5%

SENSITIVITY	---------------------CFROI 2015---------------------				
---- Growth 2015 ----	10.5%	11.5%	12.5%	13.5%	14.5%
8.0%	-27%	-19%	-11%	-3%	5%
9.0%	-23%	-14%	-6%	3%	11%
10.0%	-18%	-9%	0%	9%	18%
11.0%	-13%	-3%	6%	16%	26%
12.0%	-8%	3%	13%	24%	34%

DR Sensitivity	4.0%	4.5%	5.0%	5.5%	6.0%
	26.7%	12.6%	0.0%	-11.4%	-21.6%

CAP Sensitivity	0 Yrs	2 Yrs	5 Yrs	7 Yrs	10 Yrs
	0.0%	14.2%	37.5%	54.7%	82.9%

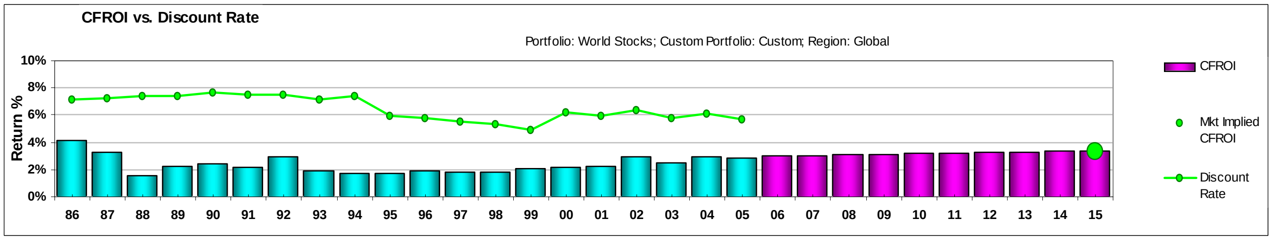


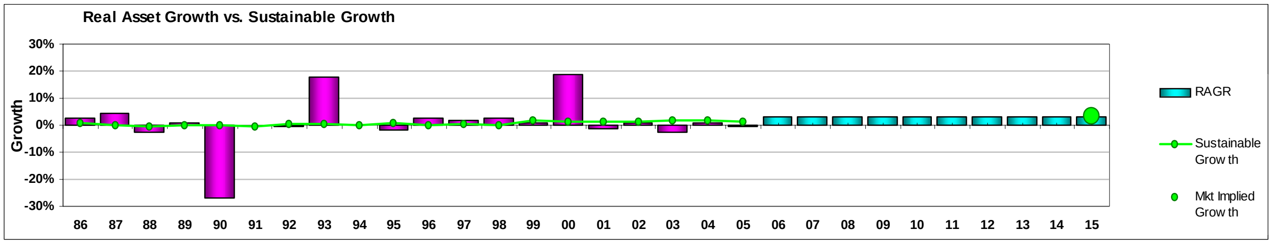
**No of firms in aggregate: 11, Total Market Cap $40 billion.*
Source: Credit Suisse HOLT®.

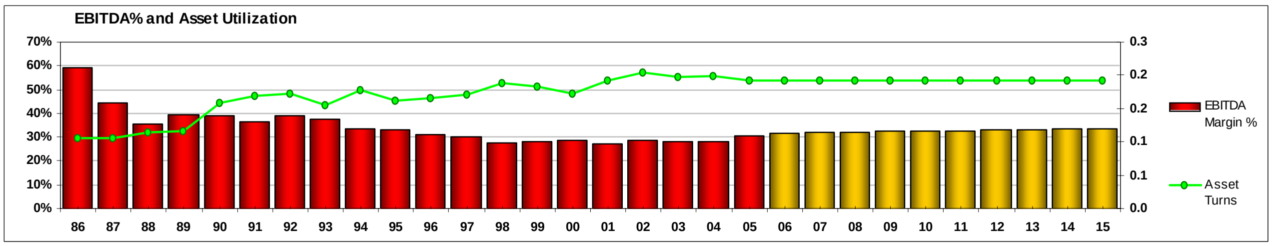
Exhibit 347: HOLT® Aggregator Tool for Nuclear Companies

RELATIVE WEALTH CHARTS

Data Date: 07-Mar-2007







HOLT MARKET IMPLIEDS

VALUATION DRIVERS	2006	2015
CFROI	3.0%	3.4%
Real Asset Growth	3.0%	3.0%
Discount Rate	5.0%	
Forecast Horizon (Yrs)	10	
Final Fade Rate	10%	

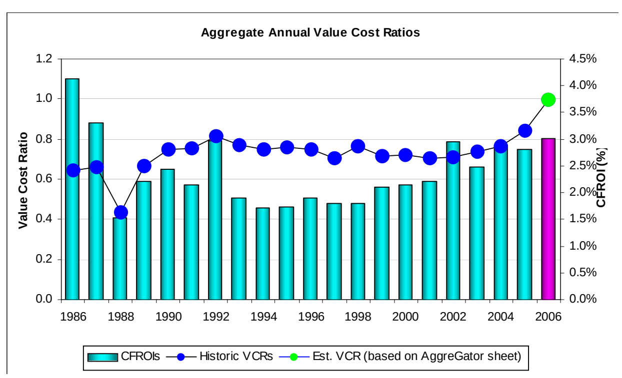
HOLT MARKET IMPLIEDS	2006 Mkt Imp	
CFROI	3.0%	3.4%
Real Asset Growth	3.0%	3.4%

BENCHMARKS	Peak	5 Yr Avg	10 Yr Avg	5 Yr Med	10 Yr Med
CFROI	4.1%	2.7%	2.3%	2.8%	2.2%
Real Asset Growth	18.5%	-0.5%	2.4%	-0.3%	1.0%

SENSITIVITY		--------------------CFROI 2015--------------------				
		1.4%	2.4%	3.4%	4.4%	5.4%
---- 2015 ---- Growth	1.0%	-36%	-19%	0%	19%	38%
	2.0%	-39%	-20%	0%	20%	41%
	3.0%	-41%	-21%	0%	21%	44%
	4.0%	-44%	-22%	0%	23%	47%
	5.0%	-46%	-23%	1%	25%	50%

DR Sensitivity	4.0%	4.5%	5.0%	5.5%	6.0%
	37.1%	17.6%	0.0%	-15.7%	-29.9%

CAP Sensitivity	0 Yrs	2 Yrs	5 Yrs	7 Yrs	10 Yrs
	0.0%	-6.5%	-15.6%	-21.4%	-29.4%

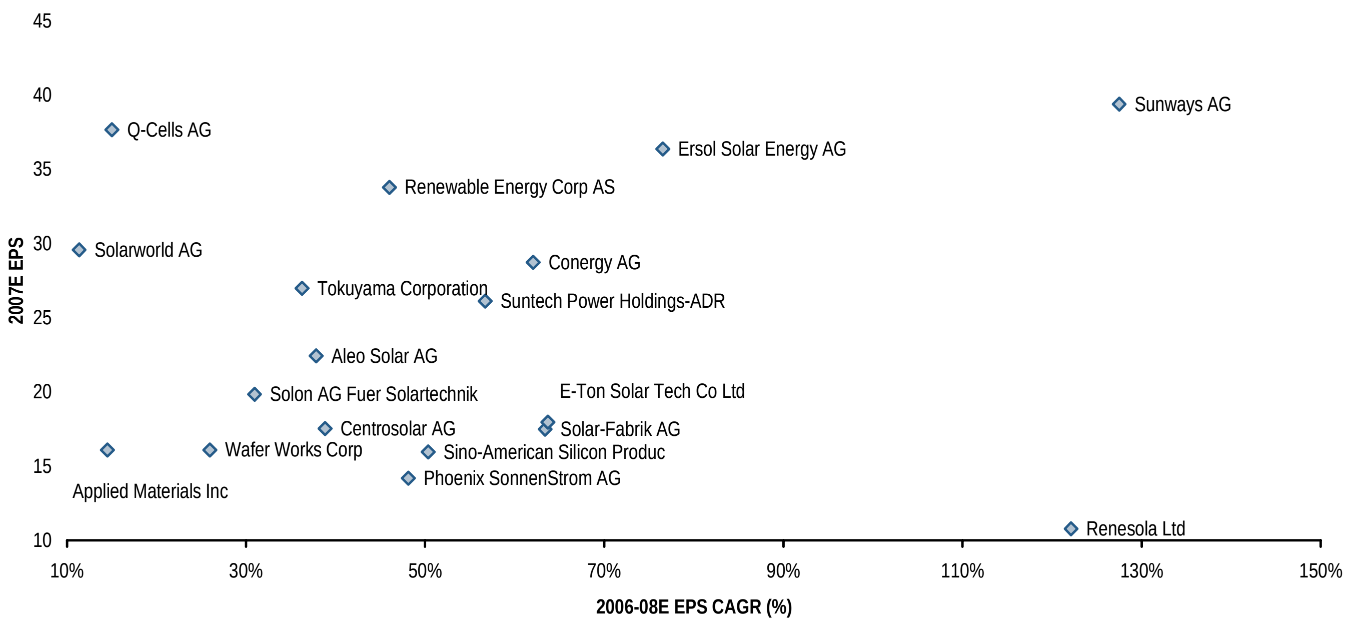


**No of firms in aggregate: 8, Total Market Cap $190 billion.*
Source: Credit Suisse HOLT®.

Alternative Energy Stock Watch List

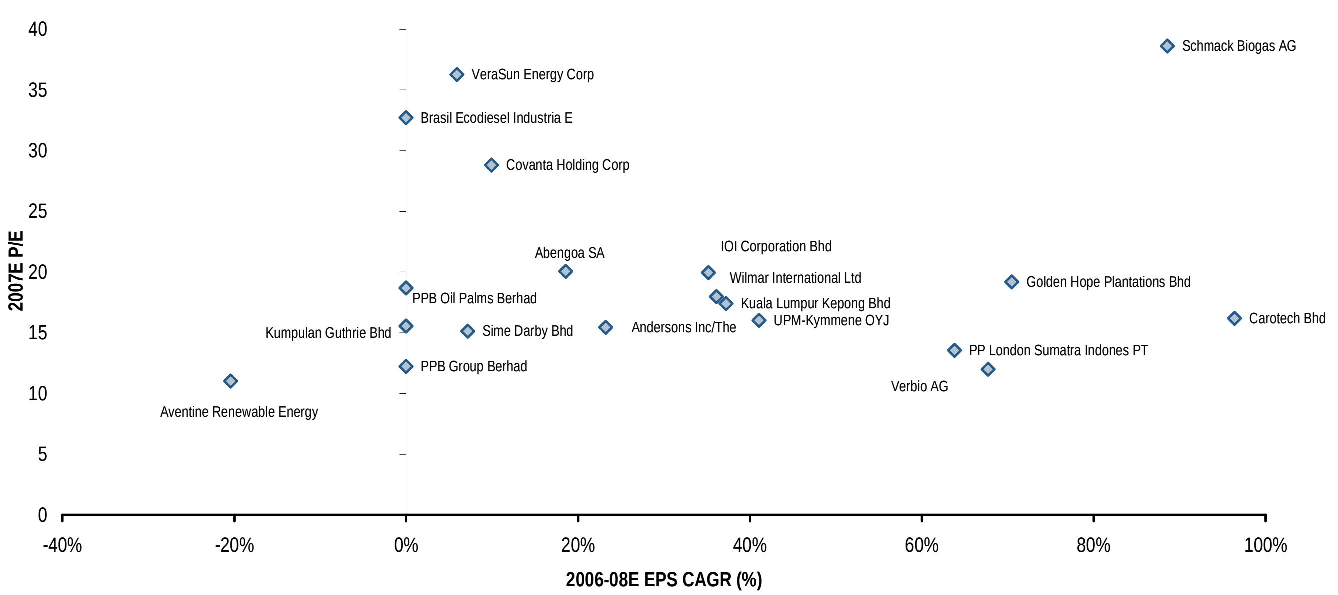
Subsector PEG Ratio Charts

Exhibit 348: Global Solar—PEG Ratios



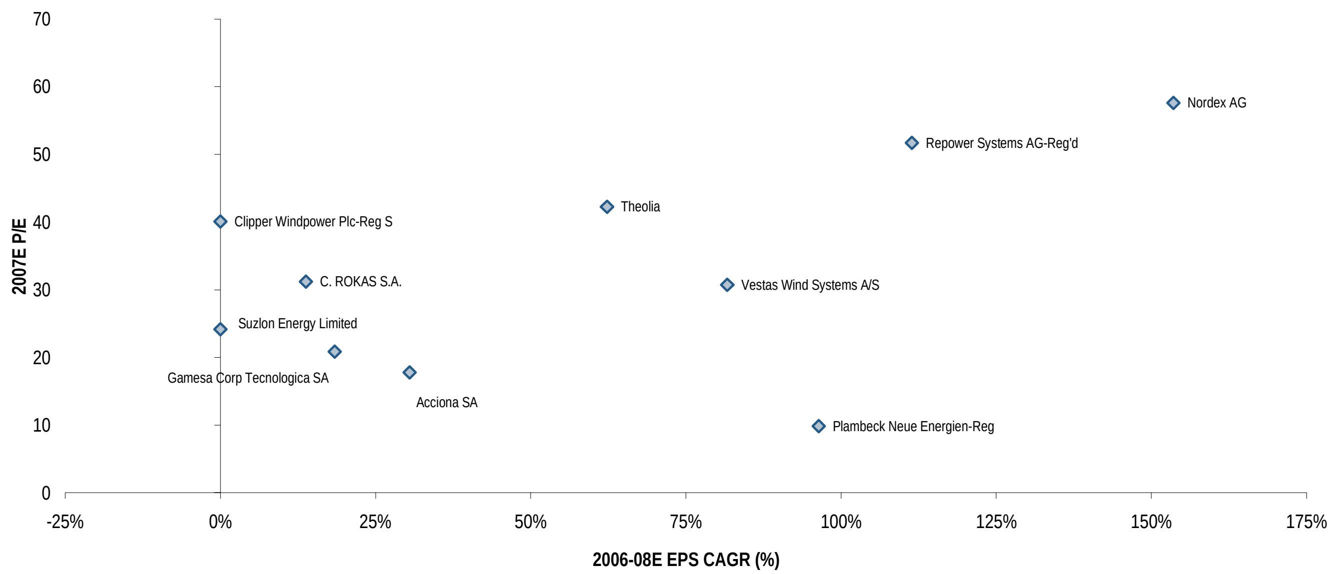
Source: Bloomberg, Reuters, Credit Suisse estimates.

Exhibit 349: Global Biofuels—PEG Ratios



Source: Company data, Credit Suisse estimates.

Exhibit 350: Global Wind—PEG Ratios



Source: Company data, Credit Suisse estimates.

Valuation Comparables

Exhibit 351: Europe—Stock Watch List and Valuation Comps

Company	Bloomberg code	Recommendation	Target Price local	Market Cap mns	EPS 2006E	EPS 2007E	EPS 2008E	P/E 2006E	P/E 2007E	P/E 2008E
Solar										
Aleo Solar AG	AS1 GR Equity			139	0.37	0.49	0.74	28.73	21.69	14.40
Centrosolar AG	C3O GR Equity			138	0.45	0.62	0.87	22.96	16.80	11.91
Conergy AG	CGY GR Equity			1,616	1.25	1.86	3.06	43.22	28.93	17.62
Ersol Solar Energy AG	ES6 GR Equity			517	1.32	1.49	4.10	40.01	35.43	12.84
Phoenix SonnenStrom AG	PS4 GR Equity			88	0.68	1.17	1.54	23.53	13.71	10.42
Q-Cells AG	QCE GR Equity	OUTPERFORM	58.5	3,407	1.18	1.18	1.57	38.69	38.85	29.24
Renewable Energy Corp AS	REC NO Equity	OUTPERFORM	168.0	64,737	2.36	3.78	5.03	55.51	34.69	26.04
Solar-Fabrik AG	SFX GR Equity			125	0.42	0.80	1.12	33.68	17.51	12.62
Solarworld AG	SWV GR Equity			3,135	1.98	1.95	2.46	28.38	28.83	22.89
Solon AG Fuer Solartechnik	SOO1 GR Equity			373	1.41	1.95	2.49	28.20	20.45	16.03
Sunways AG	SWW GR Equity			102	0.13	0.24	0.65	72.46	37.57	14.00
Biofuels										
Abengoa SA	ABG SM Equity			2,578	1.06	1.33	1.49	26.81	21.38	19.08
Actelios SPA	ACT IM Equity			563	-	-	-	-	-	-
Biopetrol Industries AG	B2I GR Equity			274	0.11	0.39	0.86	66.07	18.83	8.62
Biofuels Corp Plc	BFC LN Equity			6	-	-0.14	0.03	-	-	4.82
CropEnergies AG	CE2 GR Equity			655	0.22	0.17	0.36	35.00	71.96	28.41
D1 Oils Plc	DOO LN Equity			80	-0.30	-0.13	0.10	-	-	13.71
EOP Biodiesel	E2B GR Equity			57	0.19	0.77	0.96	52.85	13.33	10.68
Neste Oil Oyj	NES1V FH Equity	NEUTRAL	26.5	6,541	1.68	2.14	2.43	15.16	11.94	10.50
Schmack Biogas AG	SB1 GR Equity			315	0.73	1.45	2.61	79.13	39.92	22.25
UPM-Kymmene OYJ	UPM1V FH Equity			10,115	0.79	1.22	1.57	24.47	15.83	12.30
Verbio AG	VBK GR Equity	OUTPERFORM	17.0	747	0.76	1.10	2.14	15.57	10.77	5.53
Wind										
Acciona SA	ANA SM Equity			9,301	5.63	9.03	9.59	26.00	16.21	15.26
Aerowatt	MLWAT FP Equity			61	-	-	-	-	-	-
Clipper Windpower Plc-Reg S	CWP LN Equity			615	-0.08	0.29	0.49	-	37.74	22.39
C. ROKAS S.A.	ROKKA GA Equity			522	0.54	0.62	0.70	40.52	35.71	31.29
EnergieKontor AG	EKT GR Equity			46	-	-	-	-	-	-
Fersa Energias Renovables SA	FRSA SM Equity			272	-	-	-	-	-	-
Gamesa Corp Tecnologica SA	GAM SM Equity			5,370	0.90	1.06	1.26	24.50	20.92	17.47
Genesys Wind AG	GJ1 GR Equity			-	-	-	-	-	-	-
Greentech Energy Systems	GES DC Equity			2,184	-	-	-	-	-	-
Nordex AG	NDX1 GR Equity			1,480	0.13	0.39	0.86	172.56	58.25	26.84
Novera Energy Ltd	NVE LN Equity			3,891	-0.03	-0.02	-0.03	-	-	-
Nevag-Neue Energie Verbund	NNE NM Equity			-	-	-	-	-	-	-
Plambeck Neue Energien-Reg	PNE3 GR Equity			92	0.07	0.25	0.27	35.14	9.84	9.11
Repower Systems AG-Reg'd	RPW GR Equity			1,065	0.90	2.53	3.96	145.63	51.89	33.25
Solarparc AG	SLX GR Equity			69	-	-	-	-	-	-
Theolia	TEO FP Equity			738	0.31	0.59	0.84	80.81	42.82	29.72
Unit Energy Europe AG	UEE1 GR Equity			1	-	-	-	-	-	-
Vestas Wind Systems A/S	VWS DC Equity			50,098	0.54	1.16	1.80	67.23	31.30	20.19
Utilities										
ACEA Spa	ACE IM Equity	NEUTRAL	14.2	2,743	0.67	0.79	0.88	19.18	16.32	14.56
AEM Spa	AEM IM Equity	RESTRICTED	R	4,579	R	R	R	nm	nm	nm
BKW FMB Energie AG	BKWN SW Equity			6,864	6.33	6.36	6.77	20.53	20.43	19.19
Centrica Plc	CNA LN Equity	OUTPERFORM	390.0	13,261	18.30	23.18	25.69	19.78	15.62	14.09
EDF Energies Nouvelles SA	EEN FP Equity	OUTPERFORM	50.5	26	23.83	42.62	95.29	1.79	1.00	0.45
Energias De Portugal SA	EDP PL Equity	UNDERPERFORM	3.2	14,882	0.25	0.29	0.34	16.17	14.07	12.02
E.ON AG	EOA GR Equity	OUTPERFORM	120.0	67,678	6.67	8.69	10.36	14.67	11.25	9.44
ENEL Spa	ENEL IM Equity	NEUTRAL	7.8	49,673	0.54	0.54	0.00	14.97	14.76	nm
Fortum Oyj	FUM1V FH Equity	NEUTRAL	22.0	18,742	1.22	1.62	1.66	17.26	13.02	12.73
Iberdrola SA	IBE SM Equity	NEUTRAL	32.0	29,418	1.77	1.94	2.27	18.39	16.85	14.35
International Power Plc	IPR LN Equity	NEUTRAL	290.0	5,602	20.40	28.70	30.68	18.63	13.24	12.39
RWE AG	RWE GR Equity	OUTPERFORM	92.0	42,290	4.70	6.49	8.08	16.00	11.59	9.31
Scottish & Southern Energy	SSE LN Equity	NEUTRAL	1440.0	12,566	69.90	90.82	104.99	20.86	16.05	13.89
Scottish Power Plc	SPW LN Equity	NEUTRAL	575.0	11,354	28.83	48.18	51.78	26.45	15.83	14.73
OEST ELEKTRIZITATSWIRTS-A	VER AV Equity			9,739	1.76	2.05	2.16	17.94	15.45	14.66
Fuel Cells										
Ceres Power Holdings Plc	CWR LN Equity			137	-0.04	-0.06	-0.05	-	-	-
CMR fuel cells plc	CMF LN Equity			30	-0.20	-0.29	-0.17	-	-	-
ITM Power Plc	ITM LN Equity			116	-0.02	-0.05	-0.05	-	-	-
Proton Power Systems Plc	PPS LN Equity			-	-	-	-	-	-	-
SFC Smart Fuel Cell AG	F3C GR Equity			137	-	-	-	-	-	-
Voller Energy Group	VLR LN Equity			6	-	-	-	-	-	-

Source: Reuters, Credit Suisse estimates.

Exhibit 351: Europe—Stock Watch List and Valuation Comps continued

		Recommendation	Target Price	Market Cap	EPS			P/E		
Company	**Bloomberg code**		**local**	**mns**	**2006E**	**2007E**	**2008E**	**2006E**	**2007E**	**2008E**
Cap Goods										
ABB Ltd-Reg	ABBN VX Equity	OUTPERFORM	22.0	44,958	0.64	0.94	1.12	32.15	21.86	18.35
ACTA SPA	ACTA LN Equity			40	-	-	-	-	-	-
Alfa Laval AB	ALFA SS Equity	NEUTRAL	365.0	40,984	18.14	23.54	26.85	20.24	15.59	13.67
Alstom	ALO FP Equity	OUTPERFORM	108.0	12,193	1.72	3.96	5.38	51.30	22.28	16.39
Bateman Litwin *	BNLN LN Equity	OUTPERFORM	190.0	362	19.86	20.96	26.64	9.82	9.30	7.32
Continental AG	CON GR Equity	OUTPERFORM	120.0	10,268	708.66	799.56	899.84	13.05	11.57	10.28
Cookson Group Plc	CKSN LN Equity	UNDERPERFORM	600.0	1,161	0.38	0.41	0.49	15.76	14.58	12.19
FKI Plc	FKI LN Equity	UNDERPERFORM	90.0	639	0.16	0.09	0.09	6.73	11.83	12.49
GEA AG -ORD	GEA GR Equity			-	-	-	-	-	-	-
GKN Plc	GKN LN Equity	OUTPERFORM	330.0	2,577	0.23	0.26	0.29	15.61	14.26	12.66
Halma Plc	HLMA LN Equity	NEUTRAL	230.0	823	0.11	0.12	0.14	19.25	17.81	15.52
Hexagon Composites ASA	HEX NO Equity			1,228	0.11	0.36	0.58	88.57	26.20	16.17
MAN AG	MAN GR Equity	NEUTRAL	90.0	12,344	5.05	5.85	6.50	16.64	14.35	12.91
Morgan Crucible Company Plc	MGCR LN Equity	OUTPERFORM	315.0	798	0.15	0.17	0.19	17.98	15.82	14.61
Rolls Royce	RR/ LN Equity	OUTPERFORM	570.0	8,739	0.29	0.33	0.36	16.93	14.73	13.38
Siemens AG-Reg	SIE GR Equity	OUTPERFORM	95.0	74,123	3.06	5.32	6.18	25.90	14.89	12.83
Sulzer AG-Reg	SUN SW Equity	RESTRICTED	R	5,207	61.61	R	R	23.94	nm	nm
Valeo SA	FR FP Equity	UNDERPERFORM	26.0	3,102	1.50	2.09	2.38	24.86	17.92	15.70
Wacker Chemie AG	WCH GR Equity			5,961	5.77	6.50	6.77	19.81	17.59	16.88
Weir Group Plc (The)	WEIR LN Equity	OUTPERFORM	565.0	1,182	0.32	0.37	0.00	17.71	15.24	nm
Lateral Ideas										
Alpha Leasing S.A.	ALLH GA Equity			257	-	-	-	-	-	-
Atlas Copco AB-A Shs	ATCOA SS Equity	NEUTRAL	240.0	135,204	25.67	13.17	16.02	8.63	16.82	13.83
BASF AG	BAS GR Equity			38,243	6.58	6.92	6.95	11.59	11.03	10.98
Borevind AB	BORE SS Equity			93	-	-	-	-	-	-
CRH Plc	CRH ID Equity	OUTPERFORM	34.0	16,888	2.22	2.38	2.55	13.98	13.05	12.19
EECH Group AG	PTA GR Equity			11	-	-	-	-	-	-
Electrolux AB-Ser B	ELUXB SS Equity	UNDERPERFORM	150.0	48,356	10.15	10.22	11.16	15.92	15.80	14.47
Enodis Plc	ENO LN Equity	NEUTRAL	220.0	823	0.09	0.12	0.14	21.84	16.84	15.28
Grontmij-CVA	GRONC NA Equity			429	4.98	6.61	7.31	19.41	14.63	13.21
Heliocentris Fuel Cells AG	H2F GR Equity			6	-	-	-	-	-	-
IMI Plc	IMI LN Equity	NEUTRAL	540.0	2,001	0.36	0.37	0.40	15.59	15.04	13.96
Invensys Plc	ISYS LN Equity	NEUTRAL	315.0	2,257	0.02	0.20	0.20	135.00	14.48	13.97
Johnson Matthey Plc	JMAT LN Equity	NEUTRAL	1375.0	3,247	72.71	81.06	93.57	21.17	18.99	16.45
Kingspan Group Plc	KSP ID Equity	UNDERPERFORM	16.0	3,316	0.90	1.02	1.09	21.66	19.13	17.85
Kone Oyj-B	KNEBV FH Equity			5,345	1.84	2.37	2.74	22.51	17.49	15.15
Metso Oyj	MEO1V FH Equity	NEUTRAL	40.0	5,386	2.89	2.64	3.39	13.18	14.45	11.24
Legrand SA	LR FP Equity	NEUTRAL	26.0	6,465	1.46	1.64	1.68	16.47	14.64	14.25
Lonmin Plc	LMI LN Equity	OUTPERFORM	3200.0	4,643	2.34	2.01	0.00	12.86	14.98	nm
Philips Electronics NV	PHIA NA Equity	NEUTRAL	27.0	35,309	0.80	1.46	0.00	35.07	19.10	nm
Porvair Plc	PRV LN Equity			55	0.05	0.06	0.08	28.13	24.55	18.00
Saft Groupe SA	SAFT FP Equity			481	1.88	1.99	2.33	13.86	13.06	11.17
Compagnie de Saint-Gobain	SGO FP Equity	OUTPERFORM	80.0	25,611	4.44	5.17	5.74	15.63	13.44	12.11
Scania	SCVB SS Equity	NEUTRAL	500.0	53,100	29.70	27.00	29.50	17.88	19.67	18.00
Schindler Holding-Part Cert	SCHP SW Equity			9,019	3.89	3.82	4.89	18.75	19.08	14.90
Schneider Electric SA	SU FP Equity	NEUTRAL	93.0	19,547	6.03	6.40	7.10	14.99	14.12	12.73
SGL Carbon AG	SGL GR Equity			1,253	0.72	1.35	1.53	27.71	14.83	13.03
SIG Plc	SHI LN Equity			1,403	0.62	0.67	0.74	18.45	16.99	15.45
SKF AB-B Shares	SKFB SS Equity	UNDERPERFORM	135.0	63,066	9.48	9.53	10.02	14.61	14.53	13.82
Spirax-Sarco Engineering Plc	SPX LN Equity	NEUTRAL	970.0	754	0.56	0.59	0.62	17.70	16.99	16.04
Syngenta AG-Reg	SYNN VX Equity			22,754	8.89	10.48	11.83	20.20	17.14	15.18
Techem AG	TNH GR Equity			1,352	2.22	2.54	2.91	24.63	21.54	18.83
Tomkins Plc	TOMK LN Equity	UNDERPERFORM	240.0	2,243	0.22	0.16	0.18	12.08	16.62	14.79
Umicore	UMI BB Equity			3,276	8.44	9.58	10.22	14.93	13.14	12.33
Novozymes A/S-B Shares	NZYMB DC Equity			31,395	14.25	16.00	17.92	33.91	30.19	26.95
Voltalia	MLVLT FP Equity			-	-	-	-	-	-	-
Volkswagen	VOW GR Equity	NEUTRAL	110.0	38,990	4.45	7.10	8.60	22.72	14.25	11.76
Natural Gas										
BG Group Plc	BG/ LN Equity	NEUTRAL	775.0	23,519	47.72	53.69	55.88	14.45	12.84	12.34
Gaz de France	GAZ FP Equity	NEUTRAL	32.0	32,822	2.38	2.48	2.51	14.00	13.47	13.31
Statoil ASA	STL NO Equity	OUTPERFORM	205.0	335,199	16.74	16.94	18.98	9.26	9.15	8.17
Nuclear										
Areva - CI	CEI FP Equity			23,392	12.56	18.83	20.45	52.57	35.04	32.28
British Energy Group Plc	BGY LN Equity	NEUTRAL	378.0	2,482	0.76	0.29	0.23	5.71	14.97	18.52
International Nuclear soluti	INS LN Equity			39	-	-	-	-	-	-
Rio Tinto Plc	RIO LN Equity	OUTPERFORM	4000.0	36,059	5.58	5.50	5.51	4.81	4.87	4.87
Studsvik AB	SVIK SS Equity			1,981	4.30	8.25	13.97	56.05	29.21	17.25

Source: Company data, Credit Suisse estimates.

Exhibit 352: North America—Stock Watch List and Valuation Comps

Company	Bloomberg code	Recommendation	Price	Target Price local	Market Cap mns	EPS 2006E	EPS 2007E	EPS 2008E	P/E 2006E	P/E 2007E	P/E 2008E
Solar											
Akeena Solar Inc	AKNS US Equity		-		-	-	-	-	-	-	-
Applied Materials Inc	AMAT US Equity	OUTPERFORM	18.3	21.0	25,619	1.04	1.13	1.37	17.55	16.23	13.39
Ascent Solar Technologies	ASTI US Equity		-		-	-	-	-	-	-	-
DayStar Technologies Inc	DSTI US Equity		4.3		61	-3.24	-2.12	-	-	-	-
Emcore Corp	EMKR US Equity		4.8		247	-0.36	-0.38	-0.09	-	-	-
Energy Conversion Devices	ENER US Equity		31.3		1,236	-0.64	-0.20	0.50	-	-	62.52
Evergreen Solar Inc	ESLR US Equity		9.8		680	-0.39	-0.29	0.01	-	-	892.73
First Solar Inc	FSLR US Equity	OUTPERFORM	53.7	40.0	3,886	0.07	0.19	0.63	770.6	282.7	85.9
Photowatt Technologies Inc	PHWT US Equity		-		-	-	-	-	-	-	-
RESO International Inc	RSOI US Equity		-		-	-	-	-	-	-	-
Solar Integrated Technologie	SIT LN Equity		1.9		68	0.07	-	-	26.18	-	-
Spire Corp	SPIR US Equity		9.9		82	-	-	-	-	-	-
Sunpower Corp-Class A	SPWR US Equity	OUTPERFORM	43.9	47.0	1,063	0.36	0.02	1.67	121.9	2194	26.27
Biofuels											
Alternative Energy Sources	AENS US Equity		-		-	-	-	-	-	-	-
Andersons Inc/The	ANDE US Equity		40.6		723	2.06	2.68	3.13	19.67	15.14	12.96
Aventine Renewable Energy	AVR US Equity	NEUTRAL	14.8	20.0	631	1.64	1.40	1.04	9.03	10.57	14.26
Covanta Holding Corp	CVA US Equity		22.0		3,386	0.72	0.76	0.86	30.83	28.89	25.51
Diversa Corp	DVSA US Equity		6.7		321	-0.68	-0.83	-1.15	-	-	-
Green Plains Renewable Energ	GPRE US Equity		21.0		126	-	-	-	-	-	-
Pacific Ethanol Inc	PEIX US Equity		15.3		616	0.06	0.30	0.85	250.82	50.83	17.92
Renova Energy Plc	RVA LN Equity		2.2		37	-	-	-	-	-	-
US Bioenergy Corp	USBE US Equity		11.6		768	0.17	0.77	1.90	70.30	15.07	6.12
VeraSun Energy Corp	VSE US Equity	NEUTRAL	16.9	16.0	1,348	1.25	0.47	1.40	13.49	35.68	12.03
Xethanol Corp	XNL US Equity		2.4		65	-0.65	-0.78	-	-	-	-
Wind											
AAER Inc	AAE CN Equity		-		-	-	-	-	-	-	-
Americas Wind Energy Corp	AWNE US Equity		-		-	-	-	-	-	-	-
Cleanfield Alternative Energ	AIR CN Equity		-		-	-	-	-	-	-	-
First National Power Corp	FNPR US Equity		0.1		4	-	-	-	-	-	-
Jetstream Power Intl Inc	JSPI US Equity		-		-	-	-	-	-	-	-
Sea Breeze Power Corp	SBX CN Equity		-		31	-	-	-	-	-	-
Keewatin Windpower Corp	KWPW US Equity		-		-	-	-	-	-	-	-
Mass Megawatts Wind Power In	MMGW US Equity		-		3	-	-	-	-	-	-
McKenzie Bay International	MKBY US Equity		0.1		4	-	-	-	-	-	-
Shear Wind Inc	SWX CN Equity		-		-	-	-	-	-	-	-
Tower tech Holdings Inc	TWRT US Equity		3.4		120	-	-	-	-	-	-
Western Wind Energy Corp	WND CN Equity		-		28	-	-	-	-	-	-
Utilities											
American Electric Power	AEP US Equity	OUTPERFORM	45.3	47.0	17,957	2.77	2.92	3.14	16.34	15.49	14.41
Avista Corp	AVA US Equity		23.7		1,249	1.47	1.44	1.65	16.16	16.50	14.42
Can Hydro Developers Inc	KHD CN Equity		6.2		736	0.07	0.11	0.12	84.25	55.91	50.00
Constellation Energy Group	CEG US Equity	RESTRICTED	80.3	59.0	14,510	3.56	4.63	5.34	22.55	17.34	15.03
Entergy Corp	ETR US Equity	OUTPERFORM	98.6	101.0	19,543	4.71	5.63	6.84	20.91	17.51	14.42
Exelon Corp	EXC US Equity		65.0		43,527	3.20	4.32	4.50	20.27	15.04	14.45
Emera Inc	EMA CN Equity	OUTPERFORM	20.4	23.0	2,255	1.08	1.19	-	18.83	17.15	nm
Epcor Power LP	EP-U CN Equity		26.8		1,334	1.84	0.83	0.85	14.54	32.35	31.58
FPL Group Inc	FPL US Equity	NEUTRAL	58.3	52.0	23,650	3.03	3.35	3.73	19.23	17.38	15.62
Idacorp Inc	IDA US Equity		32.2		1,354	2.22	2.07	2.24	14.52	15.59	14.40
Great Lakes Hydro Income Fnd	GLH-U CN Equity		19.5		941	1.10	1.06	1.00	17.74	18.48	19.56
Public Service Enterprise Gp	PEG US Equity		76.0		19,221	3.65	4.86	5.77	20.82	15.64	13.18
Puget Energy Inc	PSD US Equity		24.3		2,839	1.56	1.60	1.70	15.62	15.17	14.31

Source: Reuters, Credit Suisse estimates, Bloomberg Consensus, Bloomberg Consensus.

Exhibit 352: North America—Stock Watch List and Valuation Comps continued

Company	Bloomberg code	Recommendation	Price	Target Price local	Market Cap mns	EPS 2006E	EPS 2007E	EPS 2008E	P/E 2006E	P/E 2007E	P/E 2008E
Fuel Cells											
Astris Energi Inc	ASRNF US Equity		-		1	-	-	-	-	-	-
Ballard Power Systems Inc	BLD CN Equity		5.7		763	-0.78	-0.52	-0.41	-	-	-
Distributed Energy Systems	DESC US Equity		1.5		58	-0.63	-0.61	-0.42	-	-	-
Electro-Chemical Technologie	ELCH US Equity		-		-	-	-	-	-	-	-
ENOVA systems Inc	ENA US Equity		4.3		63	-0.30	-0.05	0.12	-	-	36.96
FuelCell Energy Inc	FCEL US Equity		6.5		371	-1.52	-1.52	-1.10	-	-	-
Global Thermoelectric Inc	GLE CN Equity		-		-	-	-	-	-	-	-
Hydrogen Corp	HYDG US Equity		4.6		59	-	-	-	-	-	-
Hydrogen Engine Center Inc	HYEG US Equity		3.2		82	-	-	-	-	-	-
Hydrogenics Corporation	HYG CN Equity		1.0		110	-0.83	-0.34	-0.32	-	-	-
Hoku Scientific Inc	HOKU US Equity		4.6		75	0.05	-0.02	-0.33	97.02	-	-
Mechanical Technology Inc	MKTY US Equity		1.5		48	-0.42	-0.41	-0.09	-	-	-
Medis Technologies Ltd	MDTL US Equity		16.6		535	-0.83	-0.06	1.60	-	-	10.39
Millennium Cell Inc	MCEL US Equity		1.0		48	-0.24	-0.14	-	-	-	-
Nuvera Fuel Cells Inc	NVRA US Equity		-		-	-	-	-	-	-	-
Pacific Fuel Cell Corp	PFCE US Equity		-		23	-	-	-	-	-	-
Plug Power Inc	PLUG US Equity		2.9		253	-0.57	-0.53	-0.48	-	-	-
Polyfuel Inc	PYF LN Equity		0.9		27	-	-	-	-	-	-
Protonex Technology Co-Reg S	PTX LN Equity		1.8		40	-0.35	0.00	-0.18	-	-	-
Quantum Fuel Systems Technol	QTWW US Equity		1.4		91	-0.58	-1.75	-0.55	-	-	-
Trimol Group Inc	TMOL US Equity		0.0		3	-	-	-	-	-	-
GTL											
Rentech Inc	RTK US Equity	NEUTRAL	2.0	5.8	285	-0.02	0.03	0.01	-103.93	67.90	183.95
Syntroleum Corp	SYNM US Equity		3.0		166	-	-	-	-	-	-
Cap Goods											
Active Power Inc	ACPW US Equity		1.9		93	-0.42	-0.33	-0.27	-	-	-
American Superconductor Corp	AMSC US Equity		13.8		480	-	-0.93	-0.60	-	-	-
Bombardier Inc 'B'	BBD/B CN Equity	UNDERPERFORM	4.5	2.7	7,790	0.08	0.10	0.13	53.81	46.16	33.99
Borgwarner Inc	BWA US Equity	OUTPERFORM	73.0	80.0	4,233	4.03	4.80	5.75	18.12	15.22	12.71
Capstone Turbine Corp	CPST US Equity		0.9		124	-0.45	-0.36	-0.21	-	-	-
Catalytica Energy Systems	CESI US Equity		1.5		27	-	-	-	-	-	-
Cooper Industries Ltd-CL A	CBE US Equity	OUTPERFORM	90.5	105.0	8,258	4.95	5.95	6.65	18.30	15.21	13.61
Cypress Semiconductor Corp	CY US Equity		19.3		2,940	0.42	0.64	0.84	45.61	30.22	22.92
Emerson Electric Co	EMR US Equity	OUTPERFORM	42.2	50.0	33,679	2.24	2.60	3.00	18.86	16.24	14.08
General Electric Co	GE US Equity	OUTPERFORM	34.1	41.0	350,552	1.96	2.21	2.48	17.36	15.43	13.72
Intl Rectifier Corp	IRF US Equity		41.6		3,019	1.61	2.27	2.53	25.94	18.35	16.45
Johnson Controls Inc	JCI US Equity	NEUTRAL	94.6	90.0	18,592	5.23	6.02	7.23	18.11	15.72	13.09
OM Group Inc	OMG US Equity		40.0		1,190	5.78	3.06	3.35	6.92	13.08	11.96
Power-One Inc	PWER US Equity		5.3		459	0.03	0.20	0.47	176.67	26.77	11.21
Rockwell Automation Inc	ROK US Equity	UNDERPERFORM	59.9	55.0	9,922	3.35	3.50	4.00	17.90	17.09	14.97
SPX Corp	SPW US Equity	UNDERPERFORM	69.2	65.0	4,129	3.05	3.92	4.50	22.64	17.66	15.38
Ultralife batteries Inc	ULBI US Equity		8.4		126	-0.10	0.34	0.77	-	24.62	10.87
UQM technologies Inc	UQM US Equity		4.1		102	-	-	-	-	-	-
United Technologies Corp	UTX US Equity	NEUTRAL	64.3	73.0	64,039	3.71	4.14	4.80	17.33	15.55	13.40
Natural Gas											
Anadarko Petroleum Corp	APC US Equity	RESTRICTED	40.1	R	18,597	5.73	R	R	6.99	nm	nm
Apache Corp	APA US Equity	NEUTRAL	67.2	69.0	22,354	7.33	6.30	7.43	9.16	10.67	9.04
Chesapeake Energy Corp	CHK US Equity	NEUTRAL	29.4	33.0	14,435	3.43	2.47	2.23	8.56	11.92	13.20
EOG Resources Inc	EOG US Equity	NEUTRAL	65.9	67.0	16,236	4.83	4.00	4.20	13.63	16.47	15.70
Williams Cos Inc	WMB US Equity		26.6		15,909	1.12	1.43	1.79	23.67	18.60	14.87
XTO Energy Inc	XTO US Equity	OUTPERFORM	50.2	57.0	18,631	4.16	4.66	3.58	12.06	10.77	14.03
Nuclear											
Cameco Corp	CCO CN Equity	OUTPERFORM	43.4	50.0	15,294	0.78	1.60	0.00	55.95	27.13	nm
Denison Mines Corp	DMLCF US Equity		11.1		2,073	0.03	0.01	0.22	368.96	1229.86	50.54
Starmet Corporation	STMT US Equity		0.0		0	-	-	-	-	-	-
SXR Uranium One Inc	SXRFF US Equity		12.8		1,733	-0.19	0.09	1.07	-	146.00	12.03
GeoThermal											
ORMAT technologies Inc	ORA US Equity		38.3		1,459	1.06	1.16	1.56	36.04	33.05	24.61
Alternative Coal											
Evergreen Energy Inc	EEE US Equity		7.1		585	-0.55	-0.51	-0.40	-	-	-
Headwaters Inc	HW US Equity		22.0		929	2.15	1.81	1.66	10.23	12.13	13.22

Source: Company data, Credit Suisse estimates, Bloomberg Consensus.

Exhibit 352: North America—Stock Watch List and Valuation Comps continued

Company	Bloomberg code	Recommendation	Price	Target Price local	Market Cap mns	EPS			P/E		
						2006E	2007E	2008E	2006E	2007E	2008E
Laterals Ideas (read across)											
Advanced Micro Devices	AMD US Equity	UNDERPERFORM	13.9	13.0	7,736	0.59	-0.34	0.77	23.51	nm	18.11
Agco	AG US Equity	UNDERPERFORM	36.1	17.0	3,297	1.11	1.30	2.15	32.38	27.70	16.76
Alternative Fuel Systems Inc	AFX CN Equity		-		-	-	-	-	-	-	-
Archer-Daniels-Midland Co	ADM US Equity	UNDERPERFORM	33.5	25.0	22,001	2.04	2.27	1.69	16.45	14.74	19.83
Air Products & Chemicals Inc	APD US Equity	OUTPERFORM	73.1	86.0	15,814	3.51	4.09	4.70	20.81	17.86	15.54
ATS Automation Tooling Sys	ATA CN Equity		9.4		559	0.10	0.23	0.43	97.32	40.52	21.80
Baldor Electric	BEZ US Equity		36.0		1,648	1.50	1.78	2.28	23.97	20.21	15.81
Beacon Power Corporation	BCON US Equity		0.8		45	-0.20	-0.19	-0.15	-	-	-
Boeing	BA US Equity	OUTPERFORM	89.5	104.0	70,129	2.85	4.73	6.12	31.41	18.92	14.61
Brookfield Asset Manage-CL A	BAM US Equity	RESTRICTED	51.4	50.0	20,469	1.62	1.79	0.00	31.70	28.73	nm
Bunge Limited	BG US Equity		75.7		9,099	3.63	4.37	5.04	20.84	17.32	15.03
Carmanah Technologies Corp	CMH CN Equity		3.1		133	0.05	0.10	0.14	67.83	30.29	21.67
Clean Air Power Ltd	CAP LN Equity		1.2		17	-	-	-	-	-	-
Color Kinetics Inc	CLRK US Equity		17.7		374	0.26	0.47	0.57	68.70	37.64	30.87
Corning Inc	GLW US Equity		21.3		33,466	1.08	1.25	1.45	19.72	17.08	14.73
Cree Inc	CREE US Equity		16.7		1,282	0.95	0.37	0.40	17.66	45.49	42.17
DAIS Analytic Corp	DLYT US Equity		-		-	-	-	-	-	-	-
Deere & Co	DE US Equity	OUTPERFORM	109.3	130.0	24,804	6.37	6.60	8.65	17.16	16.58	12.64
Dynetek Industries Ltd	DNK CN Equity		1.8		37	0.13	0.01	-	13.77	179.00	-
Fairchild Semiconductor International	FCS US Equity	UNDERPERFORM	18.4	14.0	2,276	0.88	0.94	1.34	20.93	19.60	13.72
Fluor Corp	FLR US Equity	OUTPERFORM	88.5	112.0	7,778	2.95	4.15	5.15	29.96	21.34	17.18
Foster Wheeler Ltd	FWLT US Equity		54.7		3,820	2.68	3.10	3.58	20.37	17.66	15.29
Ford	F US Equity	NEUTRAL	7.6	8.0	13,918	-1.44	-1.47	-0.45	-5.29	-5.19	-17.16
Fuel Systems Solutions Inc	FSYS US Equity		19.1		289	0.70	0.99	-	27.31	19.31	-
Hexcel Corp	HXL US Equity	OUTPERFORM	18.8	23.0	1,792	0.63	0.79	0.99	29.87	23.82	19.01
Intel Inc	INTC US Equity	UNDERPERFORM	19.1	18.5	112,177	0.82	1.08	1.26	23.22	17.66	15.14
Intermagnetics General Corp	IMGC US Equity		-		-	0.65	0.77	1.00	-	-	-
Infrasource Services Inc	IFS US Equity	OUTPERFORM	24.2	30.0	970	0.72	0.95	1.25	33.62	25.42	19.32
ITC Holdings Corp	ITC US Equity		41.4		1,753	0.99	1.62	1.93	41.98	25.53	21.43
Itron Inc	ITRI US Equity		61.3		1,579	2.31	2.81	3.41	26.59	21.84	17.96
Kinder Morgan	KMP US Equity	OUTPERFORM	51.6	58.0	11,670	1.97	1.69	2.38	26.15	30.58	21.67
Linear Technology Corp	LLTC US Equity	OUTPERFORM	33.5	34.0	10,012	1.37	1.37	1.47	24.48	24.41	22.79
Manhattan Scientifics Inc	MHTX US Equity		0.0		3	-	-	-	-	-	-
Maxwell Technologies Inc	MXWL US Equity		12.5		216	-1.25	-0.59	-0.06	-	-	-
McDermott Intl Inc	MDR US Equity		46.9		5,196	2.74	3.23	3.86	17.13	14.51	12.13
MEMC Electronic Materials	WFR US Equity	OUTPERFORM	55.2	64.0	12,678	1.98	3.03	0.00	27.87	18.21	nm
Methanex Corp	MX CN Equity		25.4		3,133	4.03	3.09	1.19	6.30	8.21	21.27
MGP Ingredients Inc	MGPI US Equity		18.7		307	0.81	1.43	1.46	23.06	13.04	12.82
Minterra Resource Corp	MTR CN Equity		-		7	-	-	-	-	-	-
Monsanto Co	MON US Equity		52.5		28,523	1.31	1.65	1.97	40.15	31.90	26.68
O2Micro International-ADR	OIIM US Equity		7.4		281	0.24	0.35	0.66	30.50	20.85	11.18
ON Semiconductor Corporation	ONNN US Equity		10.0		2,868	0.68	0.80	1.05	14.61	12.43	9.54
Pike Electric Corp	PEC US Equity		16.2		532	1.09	0.73	0.82	14.88	22.13	19.85
Power Integrations Inc	POWI US Equity		23.5		673	0.68	1.05	1.27	34.41	22.36	18.48
Praxair Inc	PX US Equity		60.1		19,241	2.93	3.40	3.86	20.51	17.65	15.54
Quanta Services Inc	PWR US Equity	OUTPERFORM	24.0	30.0	2,834	0.57	0.80	1.00	41.89	30.12	23.92
Railpower Technologies Corp	P CN Equity		0.9		72	-0.52	-0.22	0.04	-	-	21.25
Universal Display Corp	PANL US Equity		12.1		379	-0.48	-0.38	-	-	-	-
Viaspace Inc	VSPC US Equity		0.5		135	-	-	-	-	-	-
Whirlpool Corp	WHR US Equity		84.8		6,673	6.06	7.96	9.62	13.99	10.66	8.82
Washington Group Intl Inc	WGII US Equity		56.7		1,637	2.52	2.95	3.16	22.51	19.25	17.98
Westport Innovations Inc	WPT CN Equity		1.5		113	-	-0.25	-0.18	-	-	-
Wild brush Energy Inc	WBRS US Equity		-		-	-	-	-	-	-	-
York Research Corp	YORK US Equity		0.0		0	-	-	-	-	-	-
Zoltek Companies Inc	ZOLT US Equity		27.5		742	0.34	0.58	1.43	80.79	47.36	19.21
Pollution Control											
ADA-ES Inc	ADES US Equity		14.4		81	0.02	0.14	-	719.00	106.52	-
Intl Fuel Technology Inc	IFUE US Equity		-		48	-	-	-	-	-	-
Fuel Tech Inc	FTEK US Equity		25.7		568	0.27	0.43	0.63	94.56	60.23	40.96
Sulphco Inc	SUF US Equity		3.1		222	-	-	-	-	-	-
URS Corp	URS US Equity		40.9		2,145	2.18	2.48	2.74	18.76	16.48	14.91

Source: Company data, Credit Suisse estimates, Bloomberg Consensus.

Exhibit 353: International—Stock Watch List and Valuation Comps

Company	Bloomberg code	Recommendation	Price	Target Price local	Market Cap mns	EPS 2006E	EPS 2007E	EPS 2008E	P/E 2006E	P/E 2007E	P/E 2008E
Solar											
Canadian Solar Inc	CSIQ US Equity		10.8		295	-	-	-	-	-	-
E-Ton Solar Tech Co Ltd	3452 TT Equity	OUTPERFORM	619	718	24,849	20.28	33.40	54.35	30.53	18.53	11.39
JA Solar Holdings Co Ltd-ADR	JASO US Equity		146.2		871	-	-	-	-	-	-
Solarfun power Hold-Spon ADR	SOLF US Equity		12.5		600	-	-	-	-	-	-
Motech Industries Inc	6244 TT Equity	RESTRICTED	464	R	66,829	R	R	R	nm	nm	nm
Renesola Ltd	SOLA LN Equity		9.6		497	0.26	0.89	1.29	36.62	10.79	7.42
Sino-American Silicon Produc	5483 TT Equity	OUTPERFORM	141.0	145.0	25,521	4.75	8.50	10.74	29.66	16.59	13.12
Suntech Power Holdings-ADR	STP US Equity	OUTPERFORM	38.8	38.0	5,789	0.65	1.37	1.59	59.90	28.34	24.40
Tokuyama Corporation	4043 JP Equity	OUTPERFORM	2,015	2,200	553,376	51.03	72.84	94.70	39.49	27.66	21.28
Trina Solar Ltd-SPON ADR	TSL US Equity		45.0		956	-	-	-	-	-	-
Wafer Works Corp	6182 TT Equity	NEUTRAL	92.5	64.0	19,368	4.03	5.37	6.40	22.94	17.23	14.46
Biofuels											
Brasil Ecodiesel Industria E	ECOD3 BZ Equity		10.0		1,267	-	0.29	1.09	-	34.59	9.20
Carotech Bhd	CARO MK Equity		0.8		347	0.03	0.05	-	27.14	15.51	-
Cosan SA Industria Comercio	CSAN3 BZ Equity	OUTPERFORM	17.5	25.0	3,311	0.07	0.46	0.79	239.79	38.47	22.21
Golden Hope Plantations Bhd	GHP MK Equity	OUTPERFORM	6.6	8.3	9,701	0.18	0.37	0.53	36.17	18.01	12.45
Guthrie Ropel Berhad	GUTH MK Equity		4.9		628	-	-	-	-	-	-
Highlands & Lowlands Berhad	HLB MK Equity		5.9		3,566	-	-	-	-	-	-
IOI Corporation Bhd	IOI MK Equity	OUTPERFORM	19.3	23.5	24,177	0.72	1.06	1.31	26.92	18.18	14.73
Kuala Lumpur Kepong Bhd	KLK MK Equity	OUTPERFORM	10.9	12.0	11,650	0.41	0.61	0.77	26.61	17.98	14.13
Kumpulan Guthrie Bhd	KGB MK Equity		5.1		5,227	0.23	0.32	0.48	21.89	16.19	10.54
Mentakab Rubber Co (M) Bhd	MTK MK Equity		2.1		131	-	-	-	-	-	-
Mission Biofuels Ltd	MBT AU Equity		1.3		115	-	-	0.16	-	-	8.13
Novera Energy Ltd	NVE LN Equity		0.7		3,891	-0.03	-0.02	-0.03	-	-	-
PPB Group Berhad	PEP MK Equity		5.7		6,698	0.34	0.45	0.69	16.57	12.47	8.25
PPB Oil Palms Berhad	PBOB MK Equity		11.4		5,078	0.40	0.59	0.70	28.72	19.45	16.40
Astra Agro Lestari Tbk PT	AALI IJ Equity	UNDERPERFORM	12500	12500	########	532.30	892.70	######	23.48	14.00	11.93
PP London Sumatra Indones PT	LSIP IJ Equity	UNDERPERFORM	5800	5500	6,352,328	224.06	457.19	601.21	25.89	12.69	9.65
Sime Darby Bhd	SDY MK Equity	OUTPERFORM	7.9	9.8	19,807	0.45	0.59	0.52	17.38	13.29	15.13
Wilmar International Ltd	WIL SP Equity	OUTPERFORM	2.4	2.7	6,053	0.04	0.06	0.08	57.87	39.79	31.24
Wind											
Babcock & Brown Wind Partner	BBW AU Equity		1.6		937	-0.02	0.02	0.02	-	66.67	66.67
IndoWind Energy Ltd	IEL IN Equity		-		-	-	-	-	-	-	-
Japan Wind Development Co	2766 JP Equity		257,000		25,235	-	-	-	-	-	-
NEPC India Limited	NEPM IN Equity		16.7		1,105	-	-	-	-	-	-
New Zealand WindFarms Ltd	NWF NZ Equity		2.0		21	-	-	-	-	-	-
Suzlon Energy Limited	SUEL IN Equity		1058.0		304,455	-	43.04	59.52	-	24.57	17.77
Viridis Clean Energy Group	VIR AU Equity		1.0		188	0.01	-0.07	-0.02	86.25	-	-
Windflow Technology Ltd	WTL NZ Equity		3.1		21	-	-	-	-	-	-
Utilities											
Chubu Electric Power Co Inc	9502 JP Equity	NEUTRAL	4160.0	4200.0	3,253,756	152.72	121.43	188.08	27.24	34.26	22.12
Chugoku Electric Power Co	9504 JP Equity	NEUTRAL	2810.0	3000.0	1,042,665	123.44	136.77	158.75	22.76	20.55	17.70
Contact Energy Ltd	CEN NZ Equity	RESTRICTED	9.1	4.6	5,230	R	R	R	nm	nm	nm
Hokkaido Electric Power Co	9509 JP Equity	NEUTRAL	3270.0	3500.0	704,005	152.20	184.04	203.02	21.48	17.77	16.11
Hokuriku Electric Power Co	9505 JP Equity	NEUTRAL	3070.0	3000.0	676,425	91.00	106.56	131.31	33.74	28.81	23.38
Jaiprakash Hydro Power Ltd	JHPL IN Equity		27.3		13,404	-	1.53	1.55	-	17.83	17.63
Kansai Electric Power Co Inc	9503 JP Equity	NEUTRAL	3670.0	3700.0	3,533,105	172.84	178.28	197.20	21.23	20.59	18.61
Kyushu Electric Power Co Inc	9508 JP Equity	NEUTRAL	3500.0	3500.0	1,659,644	161.67	168.39	193.74	21.65	20.78	18.07
Shikoku Electric Power Co	9507 JP Equity	NEUTRAL	3010.0	3000.0	761,789	110.17	116.82	121.29	27.32	25.77	24.82
Tohoku Electric Power Co Inc	9506 JP Equity	NEUTRAL	3220.0	3500.0	1,619,283	107.90	119.78	171.88	29.84	26.88	18.73
Fuel Cells											
Ceramic fuel cells ltd	CFU AU Equity		1.1		353	-	-0.05	-0.06	-	-	-
Intervia Inc	ITVA US Equity		-		-	-	-	-	-	-	-
GTL											
Sasol Ltd	SOL SJ Equity	NEUTRAL	222.7	265.0	140,969	21.74	24.58	27.29	10.24	9.06	8.16

Source: Company data, Credit Suisse estimates, Bloomberg Consensus.

Exhibit 353: International—Stock Watch List and Valuation Comps continued

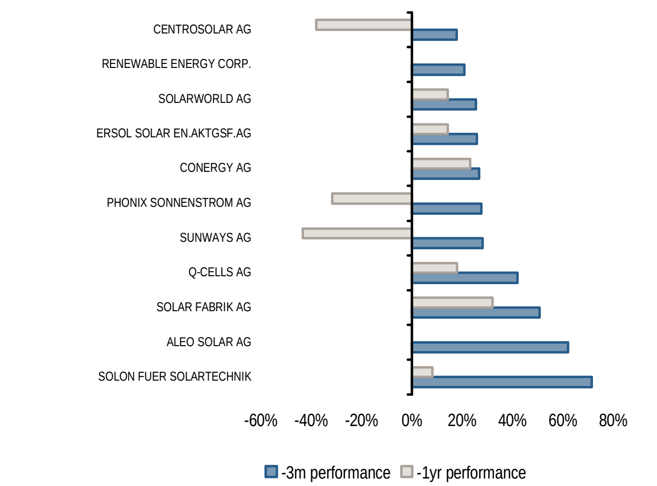
Company	Bloomberg code	Recommendation	Price	Target Price local	Market Cap mns	EPS 2006E	EPS 2007E	EPS 2008E	P/E 2006E	P/E 2007E	P/E 2008E
Cap Goods											
Aisin Seiki Co Ltd	7259 JP Equity	OUTPERFORM	4,050	4,800	1,193,434	213	234	257	19.02	17.29	15.75
Baoding Tianwei Baobian-A	600550 CH Equity		30.3		11,060	-	-	-	-	-	-
Bharat Heavy Electricals	BHEL IN Equity	UNDERPERFORM	303.7	260.0	109,778	56.39	45.70	-	5.38	6.64	nm
Chiyoda Corp	6366 JP Equity	NEUTRAL	2,515	2,700	485,621	101.27	113.92	120.37	24.83	22.08	20.89
Dongfang Electrical Machin-A	600875 CH Equity		46.0		18,542	-	-	-	-	-	-
Harbin Power Equipment Co-H	1133 HK Equity		8.9		12,391	-	-	-	-	-	-
Hitachi Ltd	6501 JP Equity	NEUTRAL	833	900	2,805,649	11.20	-9.54	19.25	74.38	-87.29	43.27
Ishikawajima-Harima Hvy Ind	7013 JP Equity	OUTPERFORM	475	430	696,853	3.93	12.56	15.12	120.87	37.82	31.42
JTEKT Corp	6473 JP Equity	OUTPERFORM	2,145	2,300	686,537	110	115	136	19.56	18.61	15.75
Kitz Corp	6498 JP Equity		1,036		124,731	-	-	-	-	-	-
Komatsu Ltd	6301 JP Equity	OUTPERFORM	2,540	2,900	2,536,810	114.93	122.02	145.81	22.10	20.82	17.42
Kubota Corp	6326 JP Equity	NEUTRAL	1,152	1,100	1,497,449	62.14	64.54	69.78	18.54	17.85	16.51
Meisei Industrial Co Ltd	1976 JP Equity		573		38,040	-	-	-	-	-	-
Mitsubishi Corp	8058 JP Equity		2,640		4,459,628	229	241	253	11.53	10.96	10.44
Miura Co Ltd	6005 JP Equity		3,100		129,468	-	-	-	-	-	-
NSK Ltd	6471 JP Equity	NEUTRAL	1,053	1,100	580,485	47.28	62.34	69.06	22.27	16.89	15.25
NTN Corp	6472 JP Equity	NEUTRAL	997	950	463,291	41.94	55.09	59.24	23.77	18.10	16.83
Pyeong San Co Ltd	089480 KS Equity		25,500		372,300	1847	1732	2476	13.81	14.73	10.30
Shanghai Electric Grp Co L-H	2727 HK Equity	OUTPERFORM	3.6	5.0	43,048	0.18	0.21	0.24	19.58	16.96	14.80
Sharp Corp	6753 JP Equity	OUTPERFORM	2,240	2,300	2,487,968	81	96	108	27.56	23.33	20.75
Shinko Electric Industries	6967 JP Equity	UNDERPERFORM	2,695	2,400	364,289	361	167	152	7.46	16.18	17.76
Toshiba Corp	6502 JP Equity	NEUTRAL	762	700	2,452,899	24.32	32.28	31.51	31.33	23.61	24.18
Toyo Kanetsu K K	6369 JP Equity		307		42,590	-	-	-	-	-	-
Lateral Ideas (read across)											
Anhui BBCA Biochemical-A	000930 CH Equity		7.9		7,628	-	-	-	-	-	-
Byd Co Ltd-H	1211 HK Equity		30.5		16,617	-	-	-	-	-	-
Chugai Ro Co Ltd	1964 JP Equity		477		45,234	-	-	-	-	-	-
Daikin Industries Ltd	6367 JP Equity		3,840		1,013,046	-	-	-	-	-	-
Dalmia Cement (bharat) Ltd	DCB IN Equity		355		15,169	-	-	-	-	-	-
Ebara Corp	6361 JP Equity		539		227,849	-	-	-	-	-	-
GS Yuasa Corp	6674 JP Equity		250		91,894	-	-	-	-	-	-
Impala Platinum Holdings Ltd	IMP SJ Equity	OUTPERFORM	205	188	129,334	7.53	13.50	14.00	27.24	15.19	14.64
Iseki & Co Ltd	6310 JP Equity		294		66,602	-	-	-	-	-	-
Marubeni Corp	8002 JP Equity		713		1,195,195	-	-	-	-	-	-
Meidensha Corp	6508 JP Equity		381		86,730	-	-	-	-	-	-
Sanyo Electric Co Ltd	6764 JP Equity		183		342,638	-	-	-	-	-	-
Xinjiang Tebian Electric-A	600089 CH Equity		-		-	-	-	-	-	-	-
Toho Tenax Co Ltd	3403 JP Equity		661		103,093	-	-	-	-	-	-
Toyota Motor Corp	7203 JP Equity	OUTPERFORM	7790	10000	########	423.28	506.84	546.88	18.40	15.37	14.24
Natural Gas											
OAO Gazprom-Spon ADR	OGZD LI Equity	UNDERPERFORM	9.9	10.0	235,315	0.91	1.05	1.15	10.87	9.51	8.61
Novatek OAO-CLS	NVTK RU Equity	NEUTRAL	5.3	7.0	15,941	0.20	0.25	0.38	26.48	20.75	13.89
Woodside Petroleum Ltd	WPL AU Equity	OUTPERFORM	36.0	45.0	24,020	2.09	2.40	4.21	17.21	14.99	8.56
Nuclear											
Energy Resources of Aust	ERA AU Equity		23		4,387	0.27	0.54	1.23	85.19	42.51	18.64

Source: Company data, Credit Suisse estimates, Bloomberg Consensus.

Share Performance, One-Year, Three-Year

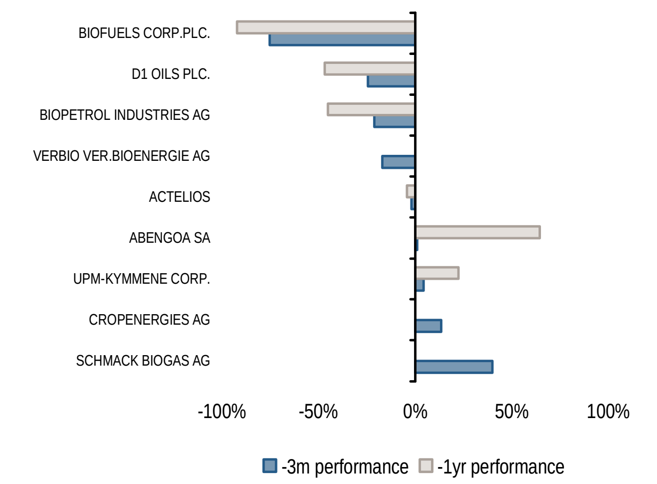
European Companies

Exhibit 354: European Solar Stocks



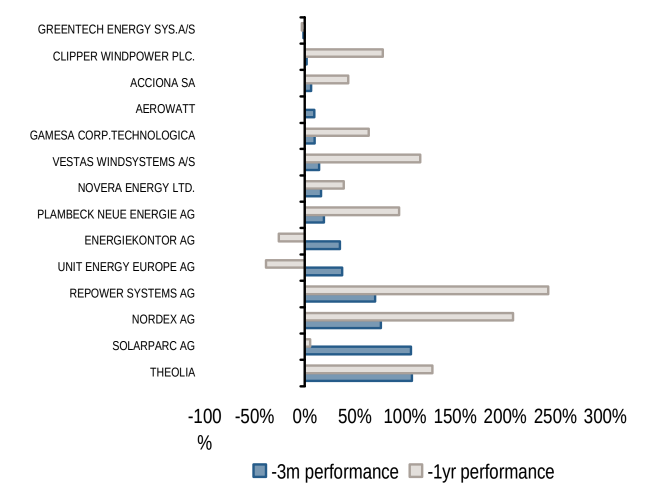
Source: Datastream.

Exhibit 355: European Biofuels Stocks



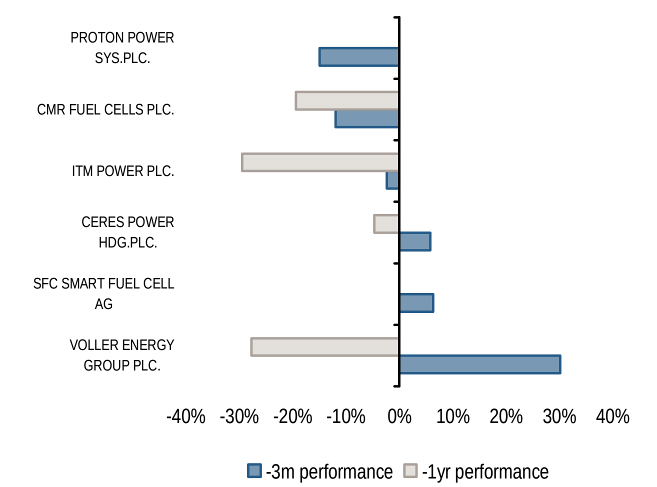
Source: Datastream.

Exhibit 356: European Wind Stocks



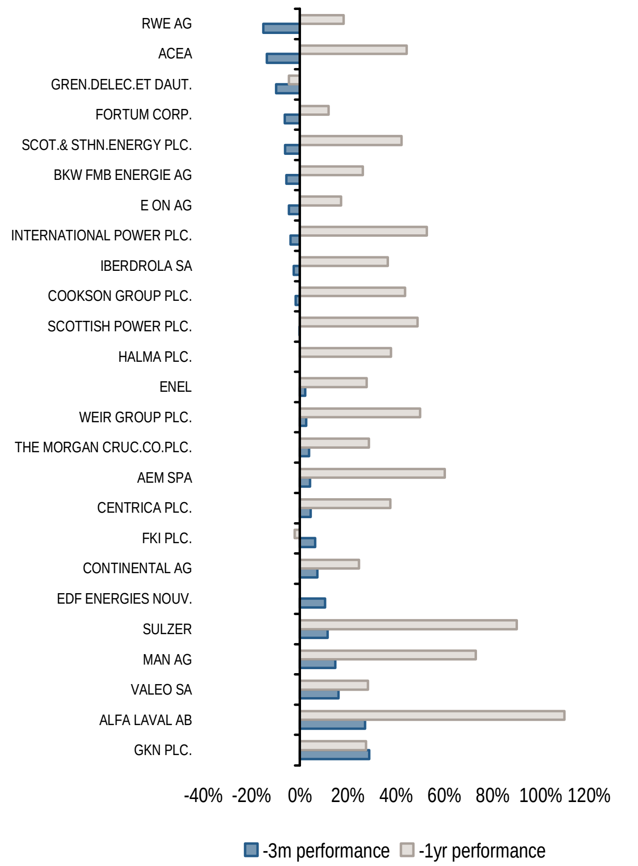
Source: Datastream.

Exhibit 357: European Fuel Cell Stocks



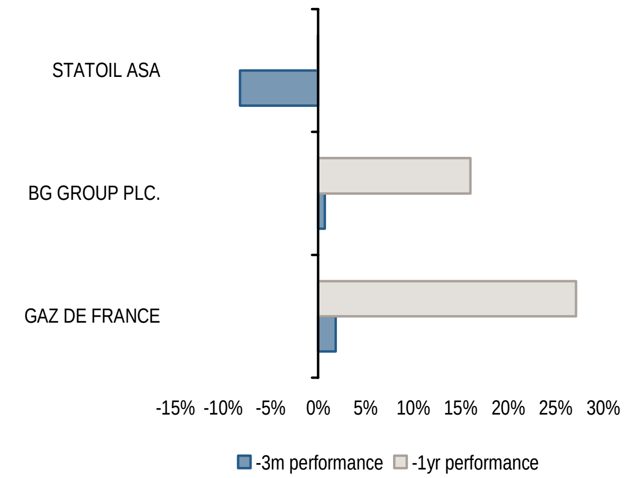
Source: Datastream.

Exhibit 358: European Utilities Stocks



Source: Datastream.

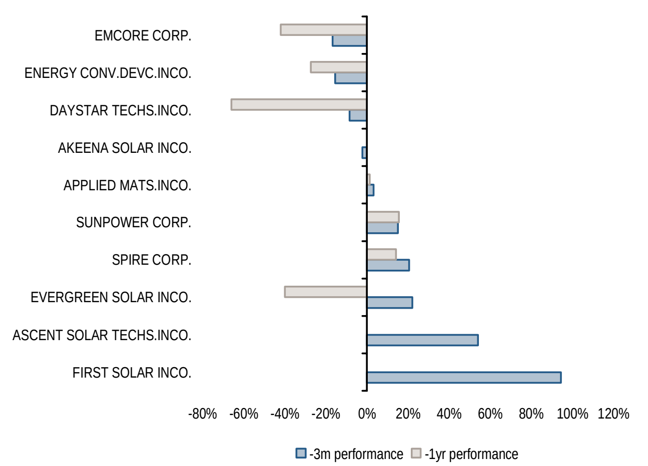
Exhibit 359: European Natural Gas Stocks



Source: Datastream.

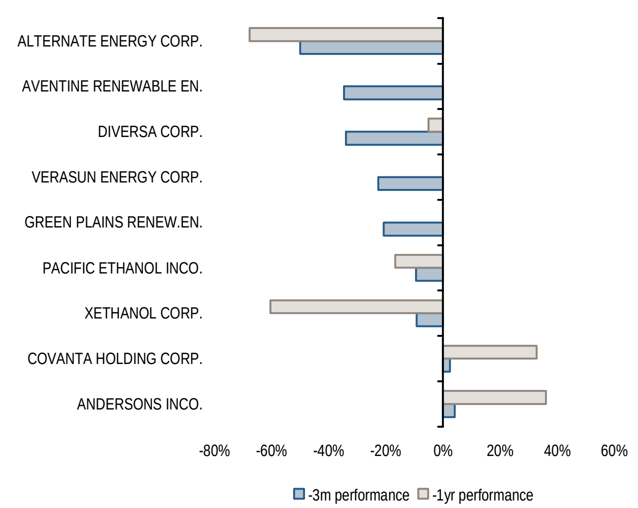
North American Companies

Exhibit 360: North American Solar Stocks



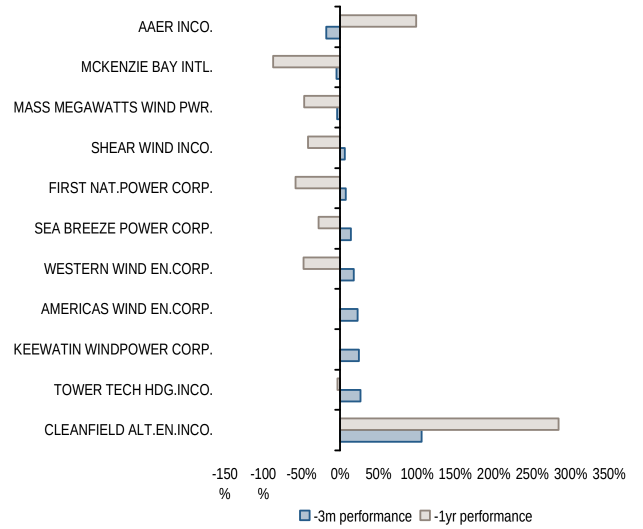
Source: Datastream.

Exhibit 361: North American Biofuels Stocks



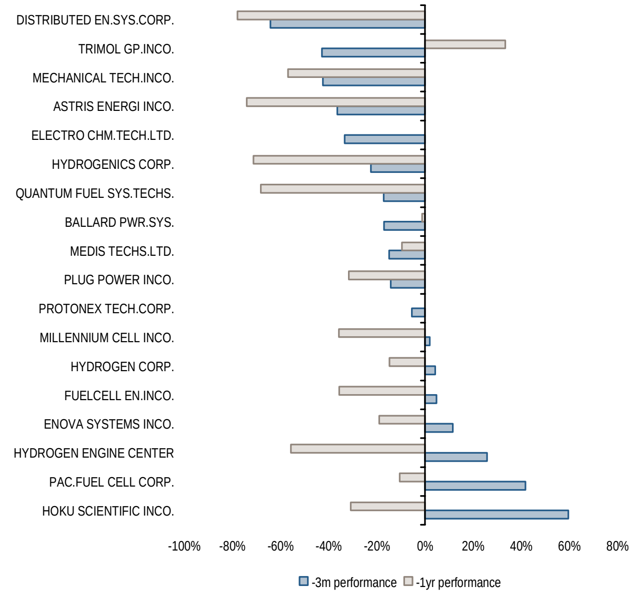
Source: Datastream.

Exhibit 362: North American Wind Stocks



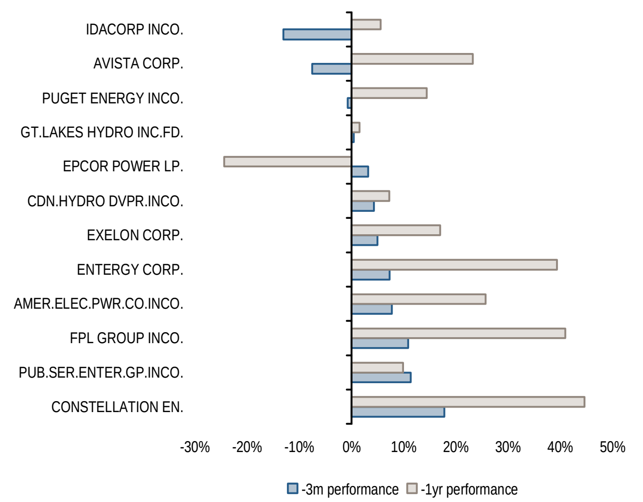
Source: Datastream.

Exhibit 363: North American Fuel Cell Stocks



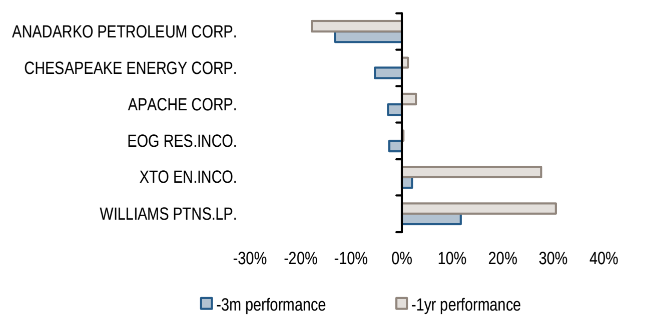
Source: Datastream.

Exhibit 364: North American Utilities Stocks



Source: Datastream.

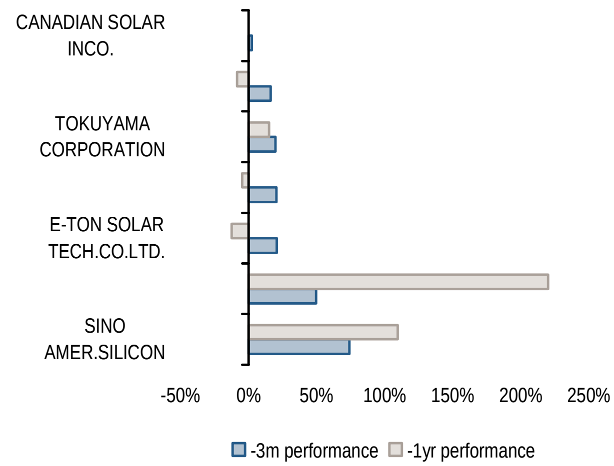
Exhibit 365: North American Natural Gas Stocks



Source: Datastream.

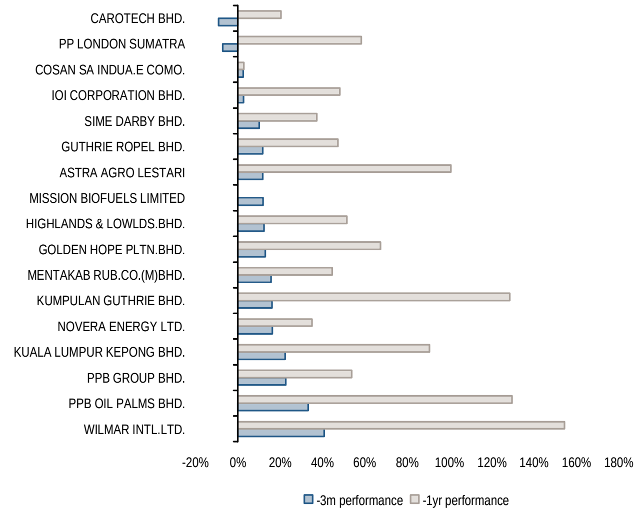
International Companies

Exhibit 366: Non U.S./Europe Solar Stocks



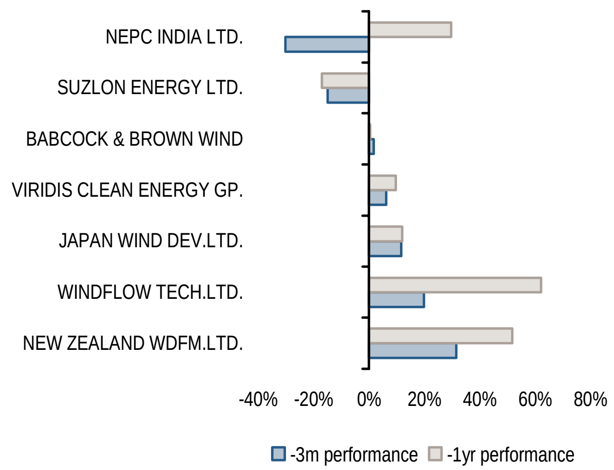
Source: Datastream.

Exhibit 367: Non U.S./Europe Biofuels Stocks



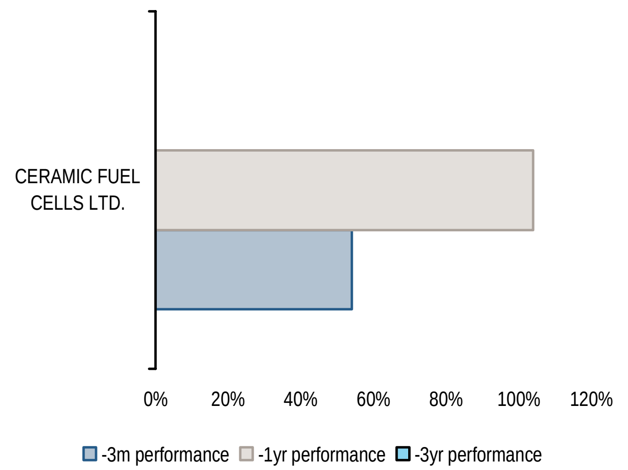
Source: Datastream.

Exhibit 368: Non U.S./Europe Wind Stocks



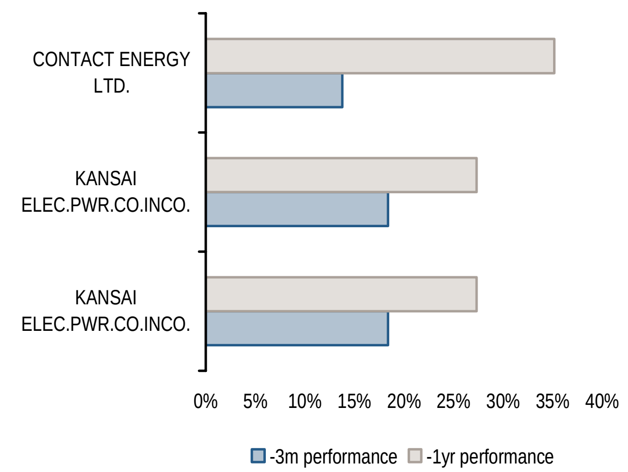
Source: Datastream.

Exhibit 369: Non U.S./Europe Fuel Cell Stocks



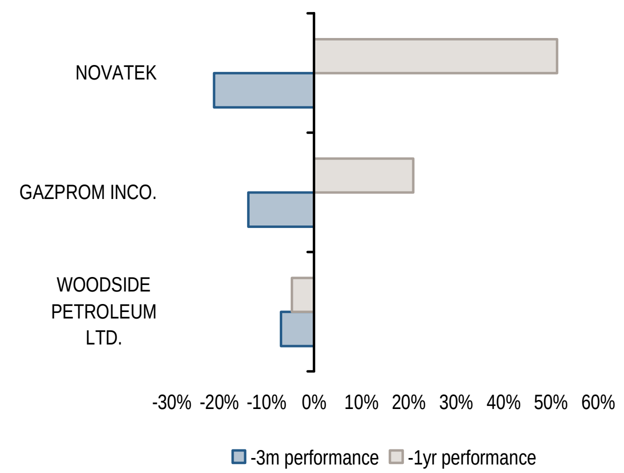
Source: Datastream.

Exhibit 370: Non U.S./Europe Utilities Stocks



Source: Datastream.

Exhibit 371: Non U.S./Europe Natural Gas Stocks

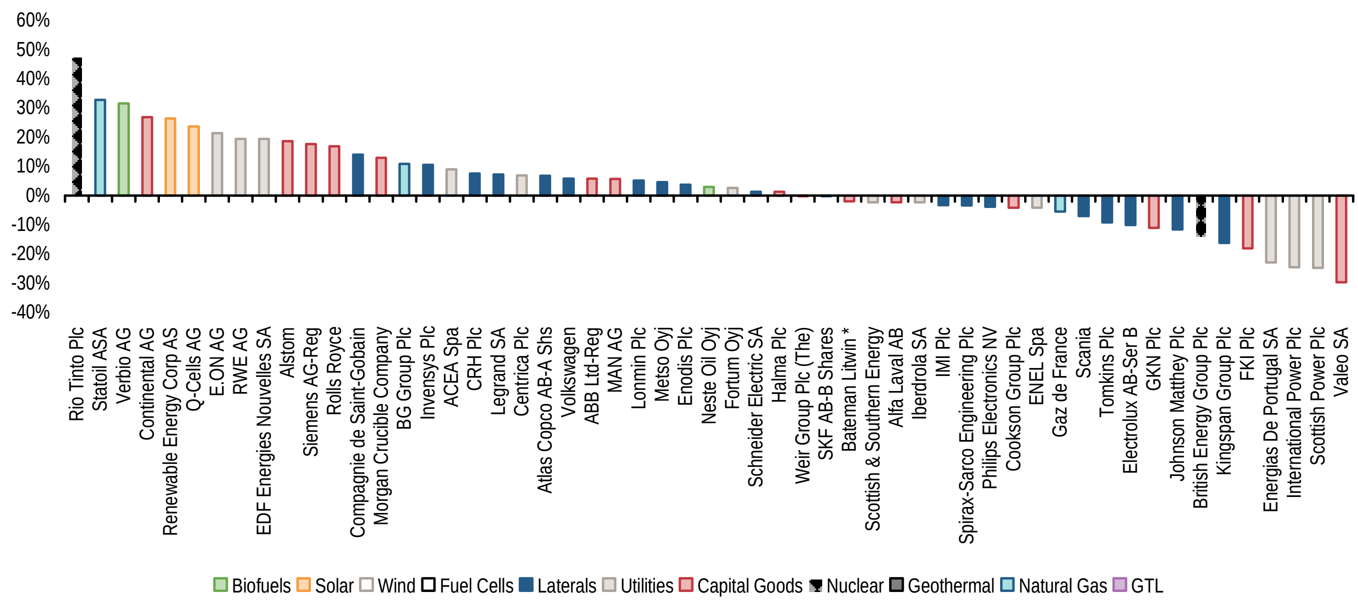


Source: Datastream.

Upside/Downside to Target Price

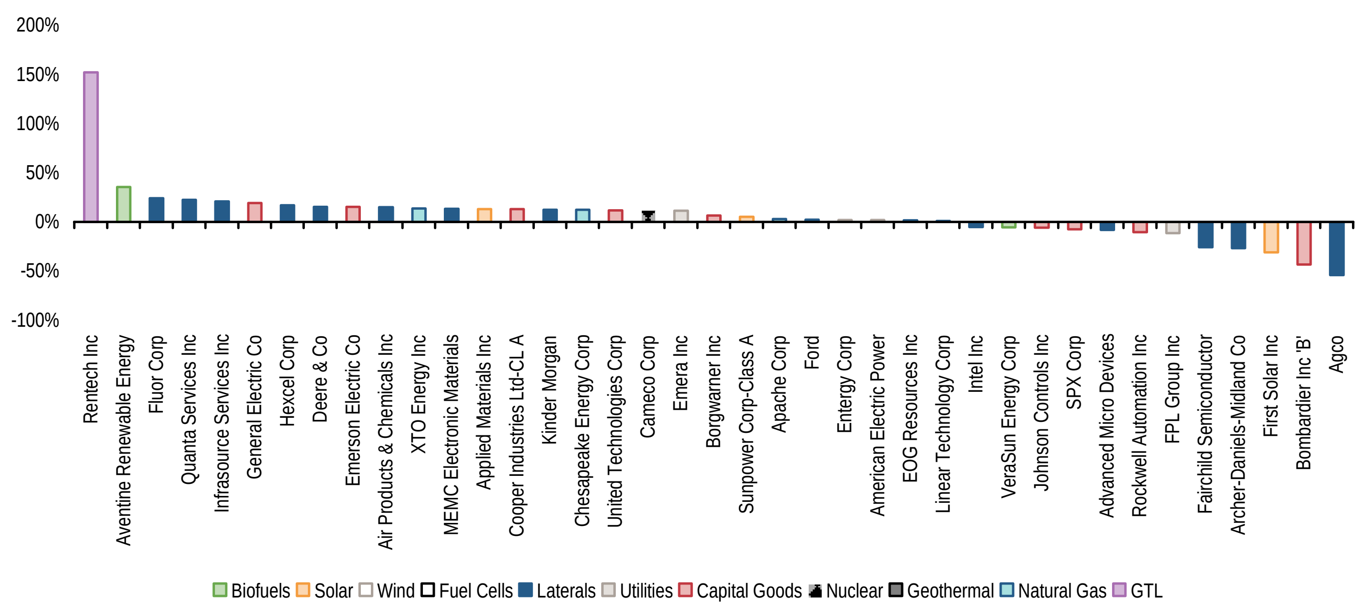
By Region

Exhibit 377: European Stocks—Upside/Downside to Target Price



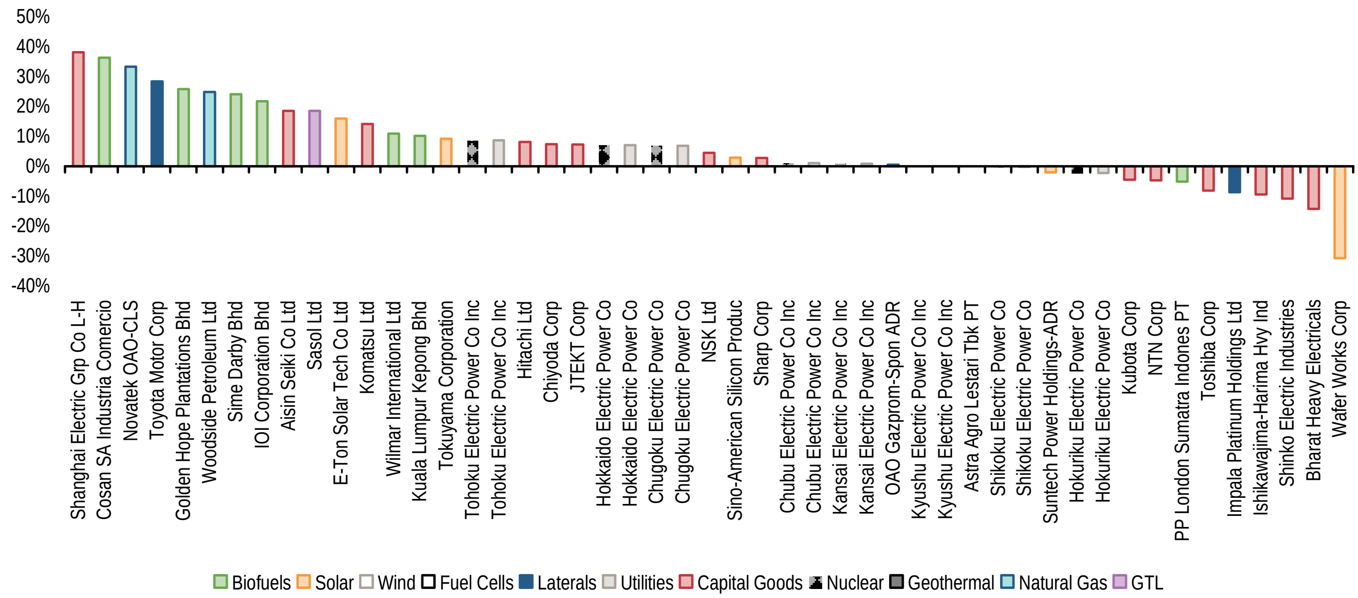
Source: Credit Suisse estimates, Bloomberg.

Exhibit 378: North American Stocks—Upside/Downside to Target Price



Source: Credit Suisse estimates, Bloomberg.

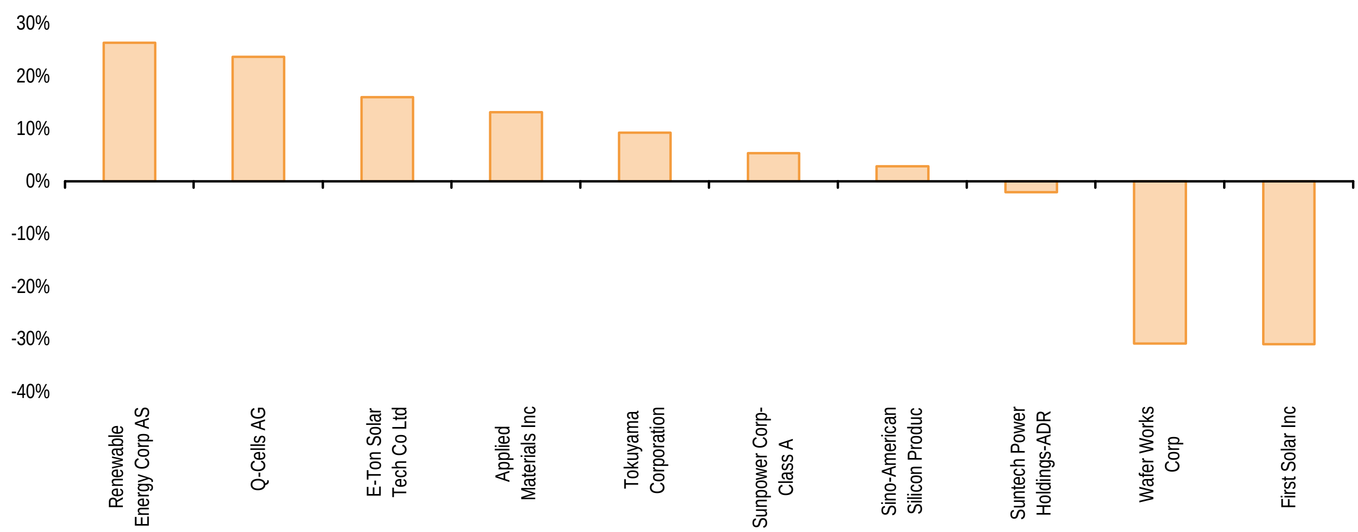
Exhibit 379: **Emerging Stocks—Upside/Downside to Target Price**



Source: Credit Suisse estimates, Bloomberg.

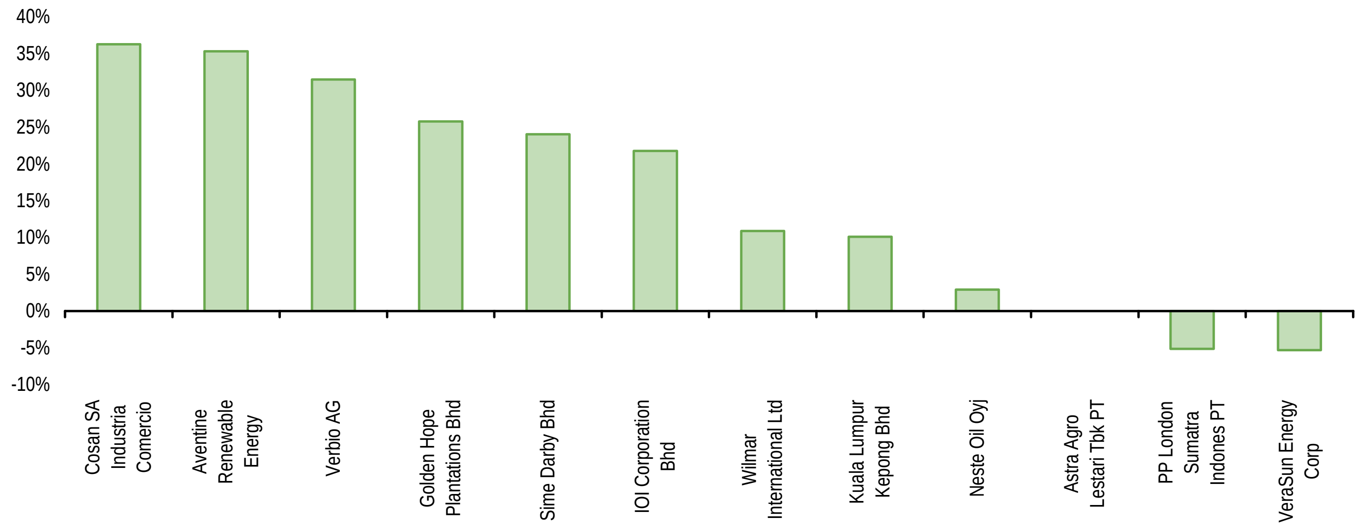
By Category

Exhibit 380: **Solar Upside/Downside to Target Price**



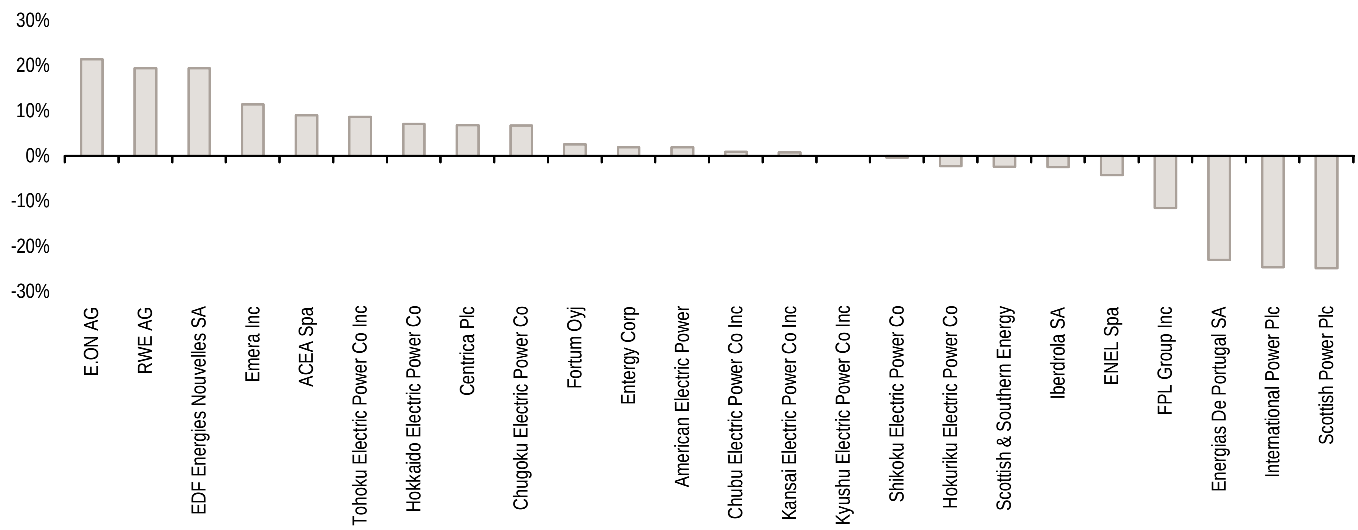
Source: Credit Suisse estimates, Bloomberg.

Exhibit 381: Biofuels—Upside/Downside to Target Price



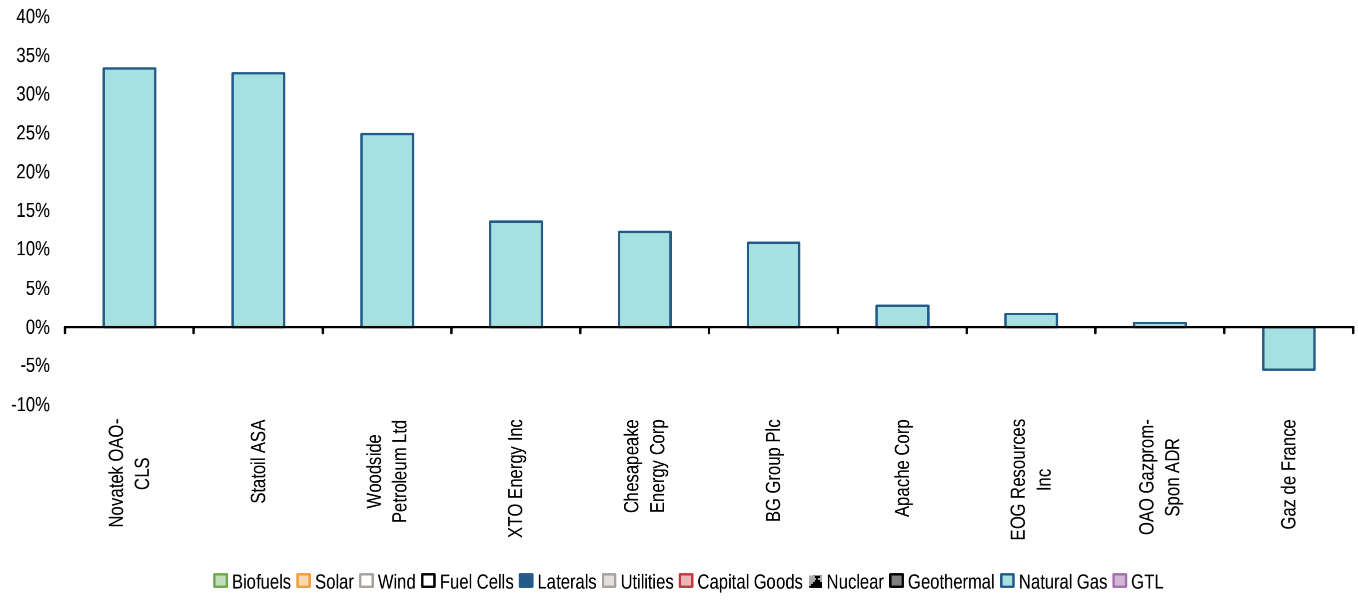
Source: Credit Suisse estimates, Bloomberg.

Exhibit 382: Utilities—Upside/Downside to Target Price



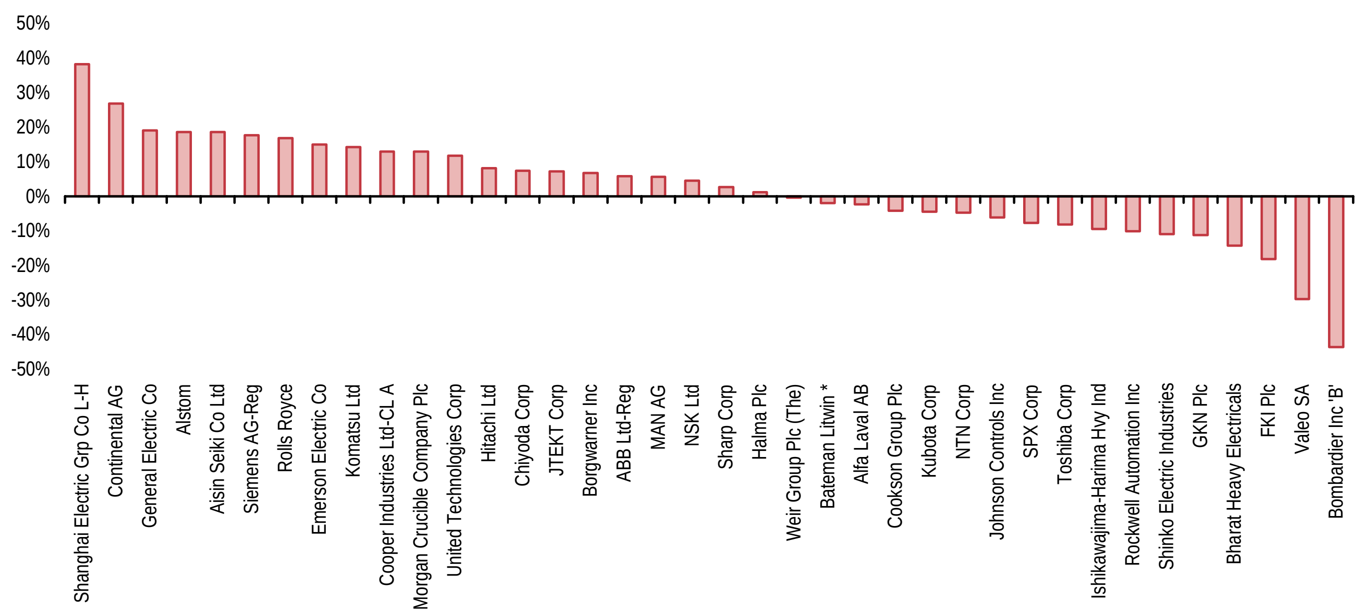
Source: Credit Suisse estimates, Bloomberg.

Exhibit 383: Natural Gas—Upside/Downside to Target Price



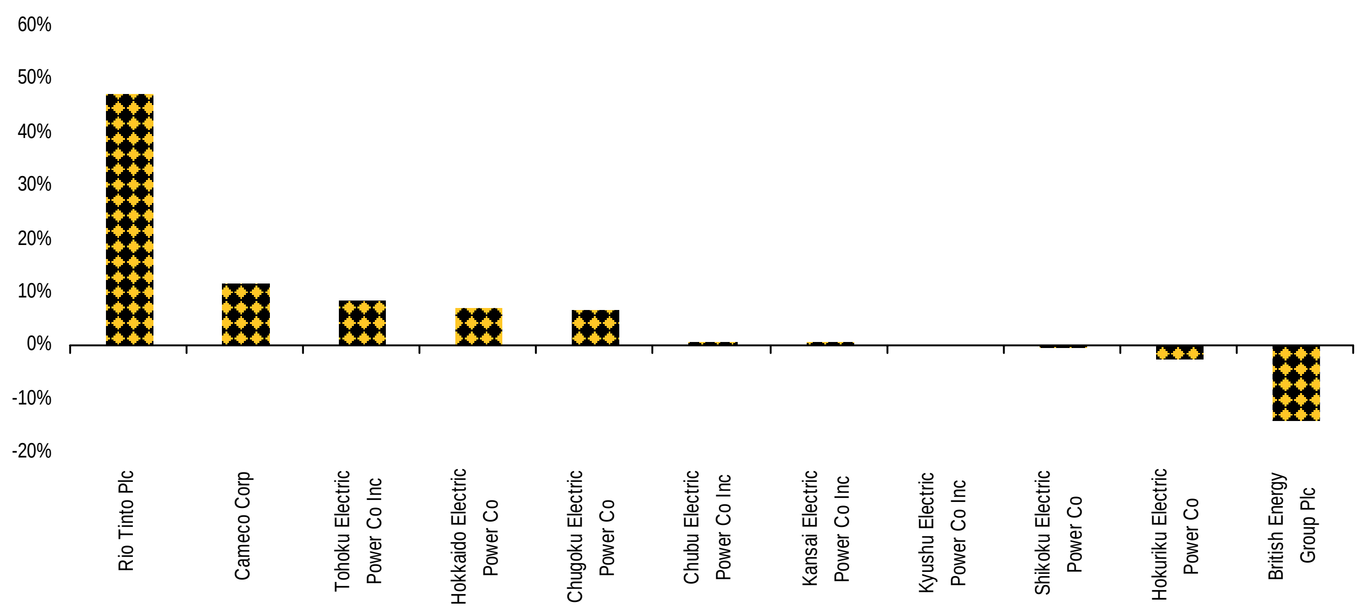
Source: Credit Suisse estimates, Bloomberg.

Exhibit 384: Capital Goods—Upside/Downside to Target Price



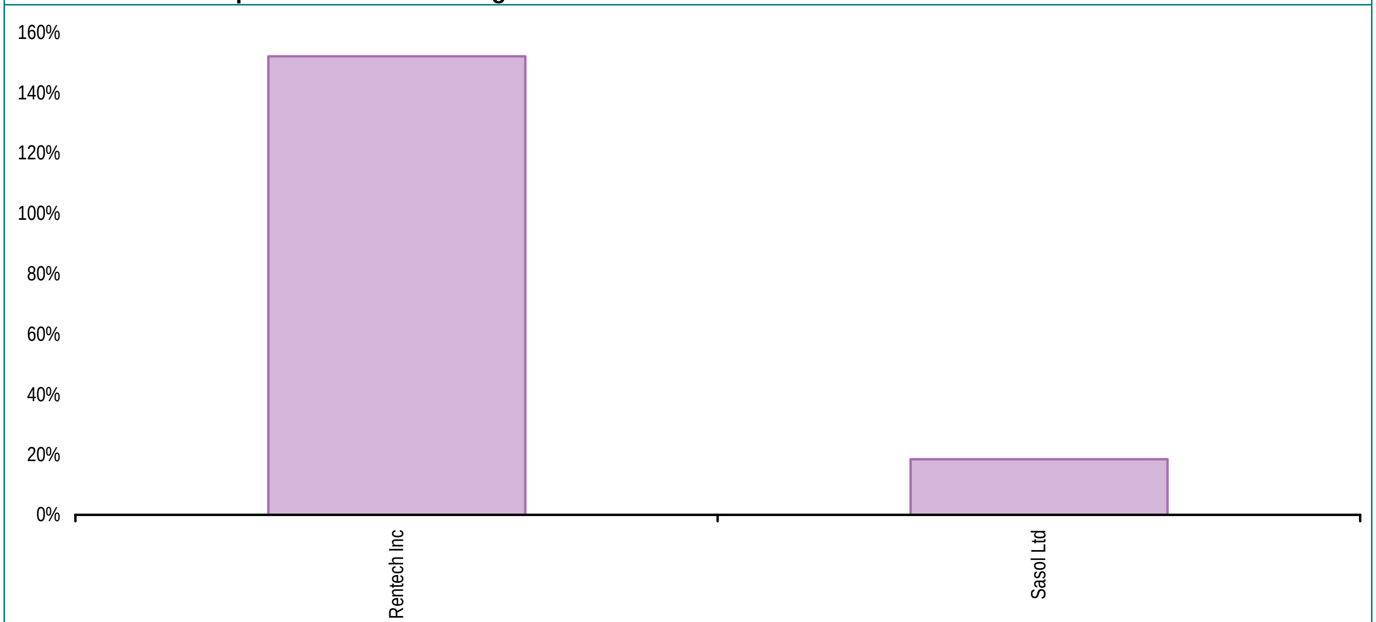
Source: Credit Suisse estimates, Bloomberg.

Exhibit 385: Nuclear—Upside/Downside to Target Price



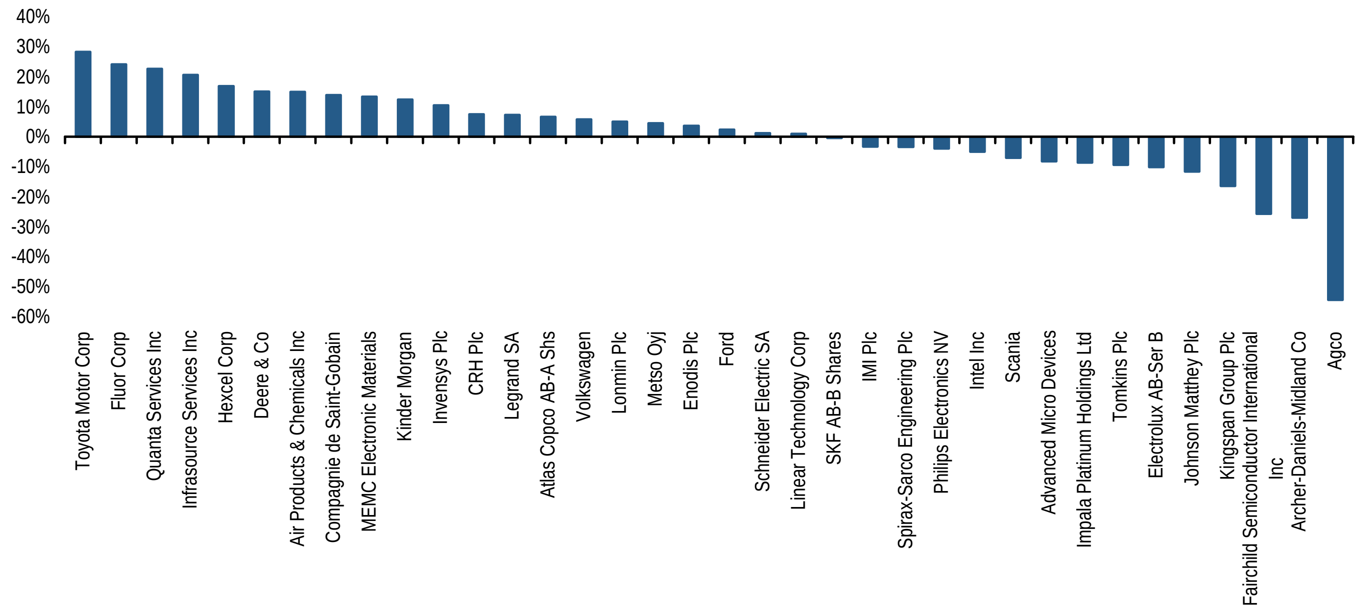
Source: Credit Suisse estimates, Bloomberg.

Exhibit 386: GTL—Upside/Downside to Target Price



Source: Credit Suisse estimates, Bloomberg.

Exhibit 387: Laterals—Upside/Downside to Target Price



Source: Credit Suisse estimates, Bloomberg.

Companies Mentioned *(Price as of 13 Mar 07)*
ABB, Ltd. (ABB.ST)
Abengoa (ABG.MC, Eu28.90)
Acciona SA (ANA.MC, Eu149.20)
ACEA (ACE.MI, Eu12.88, NEUTRAL, TP Eu14.20, UNDERWEIGHT)
Acta SpA (ACTAq.L)
Actelios SpA (ACT.MI)
AEM Milano (AEMI.MI, Eu2.54, RESTRICTED)
Alfa Corporation (ALFA, $17.46)
Alstom (ALSO.PA, Eu88.19, OUTPERFORM, TP Eu108.00, UNDERWEIGHT)
AREVA (CEPFi.PA)
Atlas Copco (ATCOa.ST, SKr221.50, NEUTRAL, TP SKr240.00, UNDERWEIGHT)
Bateman Litwin (BNLN.L, 195.00 p, OUTPERFORM [V], TP 190.00 p, OVERWEIGHT)
BG Group plc (BG.L, 689.50 p, NEUTRAL, TP 775.00 p, OVERWEIGHT)
Biofuels Corporation PLC (BFC.L)
Biopetrol Industries AG (B2I.DE)
BKW FMB Energie AG (BKWN.S)
British Energy (BGY.L, 433.50 p, NEUTRAL, TP 378.00 p, UNDERWEIGHT)
Canadian Solar, Inc. (CSIQ)
Centrica (CNA.L, 362.00 p, OUTPERFORM, TP 390.00 p, UNDERWEIGHT)
Ceres Power Holdings PLC (CWR.L)
Clipper Windpower PLC (CWP.L)
CMR Fuel Cells PLC (CMF.L)
Conergy (CGYG.DE, Eu55.27)
Continental (CONG.DE, Eu92.50, OUTPERFORM, TP Eu120.00, MARKET WEIGHT)
Cookson Group (CKSN.L, 600.00 p, UNDERPERFORM, TP 600.00 p, UNDERWEIGHT)
CRH (CRH.I, Eu31.11, OUTPERFORM, TP Eu34.00, UNDERWEIGHT)
D1 Oils PLC (DOO.L)
E.ON (EONG.DE, Eu97.80, OUTPERFORM, TP Eu120.00, UNDERWEIGHT)
EADS (EAD.PA, Eu22.44, UNDERPERFORM, TP Eu16.50, MARKET WEIGHT)
EDF Energies Nouvelles (EEN.PA, Eu42.64, OUTPERFORM [V], TP Eu50.50, UNDERWEIGHT)
EECH Group AG (PTAG.DE)
Electrolux (ELUXb.ST, SKr161.50, UNDERPERFORM, TP SKr150.00, UNDERWEIGHT)
Enel (ENEI.MI, Eu8.04, NEUTRAL, TP Eu7.80, UNDERWEIGHT)
Energiekontor AG (EKTG.DE)
Enodis (ENO.L, 207.25 p, NEUTRAL, TP 220.00 p, UNDERWEIGHT)
EOP Biodiesel (E2BG.DE)
Ersol Solar Energy AG (ES6G.DE)
FKI plc (FKI.L, 108.75 p, UNDERPERFORM, TP 90.00 p, UNDERWEIGHT)
Fortum (FUM1V.HE, Eu21.12, NEUTRAL, TP Eu22.00, UNDERWEIGHT)
Gamesa (GAM.MC, Eu22.54)
Gaz de France (GAZ.PA, Eu33.36, NEUTRAL, TP Eu32.00, UNDERWEIGHT)
GEA Group AG (G1AG.DE)
Genesys SA (GNSY.PA)
GKN (GKN.L, 366.00 p, OUTPERFORM, TP 330.00 p, MARKET WEIGHT)
Greentech Energy Systems SA (GES.CO)
GRONTMIJ NV (GRONc.AS)
Halma (HLMA.L, 221.00 p, NEUTRAL, TP 230.00 p, UNDERWEIGHT)
Iberdrola (IBE.MC, Eu32.63, NEUTRAL, TP Eu32.00, UNDERWEIGHT)
IMI (IMI.L, 554.50 p, NEUTRAL, TP 540.00 p, UNDERWEIGHT)
International Power (IPR.L, 380.00 p, NEUTRAL, TP 290.00 p, UNDERWEIGHT)
Invensys (ISYS.L, 283.50 p, NEUTRAL [V], TP 315.00 p, UNDERWEIGHT)
ITM Power PLC (ITM.L)
Johnson Matthey (JMAT.L, 1539.00 p, NEUTRAL, TP 1375.00 p, MARKET WEIGHT)
Kingspan (KSP.I, Eu19.45, UNDERPERFORM, TP Eu16.00, UNDERWEIGHT)
Kone Corporation (KNEBV.HE, Eu42.80)
Legrand SA (LEGD.PA)
Lonmin Plc (LMI.L, 3005.00 p, OUTPERFORM, TP 3200.00 p, OVERWEIGHT)
MAN AG (MANG.DE)
Metso (MEO1V.HE, Eu38.10, NEUTRAL, TP Eu40.00, UNDERWEIGHT)
Morgan Crucible (MGCR.L, 276.00 p, OUTPERFORM, TP 315.00 p, UNDERWEIGHT)
Neste (NES1V.HE, Eu25.51, NEUTRAL, TP Eu26.50, OVERWEIGHT)

Nordex Aktiengesellschaft (NDXGk.DE)
Novozymes (NZYMb.CO, DKr495.00)
Philips (PHG.AS, Eu27.94, NEUTRAL, TP Eu27.00, OVERWEIGHT)
Phoenix Sonnestrom (PS4G.DE)
Plambeck Neue Energien AG (PNEGnk.DE)
Porvair PLC (PRV.L)
Q-Cells (QCEG.DE, Eu45.77, OUTPERFORM [V], TP Eu58.50, MARKET WEIGHT)
Renewable Energy (REC.OL, NKr131.00, OUTPERFORM [V], TP NKr168.00, MARKET WEIGHT)
Rolls-Royce (RR.L, 484.00 p, OUTPERFORM, TP 570.00 p, MARKET WEIGHT)
RWE AG (RWEG.DE)
SAFT Groupe SA (SAFT.PA)
Saint-Gobain (SGOB.PA, Eu69.46, OUTPERFORM, TP Eu80.00, UNDERWEIGHT)
Schmack Biogas AG (SB1Gn.DE)
Schneider (SCHN.PA, Eu90.40, NEUTRAL, TP Eu93.00, UNDERWEIGHT)
Schneider Electric SA (SCHN.S)
Scottish & Southern Energy (SSE.L, 1458.00 p, NEUTRAL, TP 1440.00 p, UNDERWEIGHT)
ScottishPower (SPW.L, 762.50 p, NEUTRAL, TP 575.00 p, UNDERWEIGHT)
SGL Carbon (SGCG.DE, Eu21.00)
Siemens (SIEGn.DE, Eu79.23, OUTPERFORM, TP Eu95.00, UNDERWEIGHT)
Solar-Fabrik AG (SFXG.DE)
Solarworld (SWVG.DE, Eu58.30)
Solon AG Fuer Solartechnik (SOOG.DE)
Spirax Sarco (SPX.L, 997.00 p, NEUTRAL, TP 970.00 p, UNDERWEIGHT)
Statoil ASA (STL.OL, NKr155.00, OUTPERFORM, TP NKr205.00, OVERWEIGHT)
Studsvik AB (SVIK.ST)
Sunoco, Inc. (SUN, $66.22, NEUTRAL, TP $80.00, MARKET WEIGHT)
Techem AG (TNHG.DE, Eu55.40, RESTRICTED)
Theolia, Aix Les Milles (TEO.PA)
Tomkins (TOMK.L, 262.00 p, UNDERPERFORM, TP 240.00 p, UNDERWEIGHT)
Umicore (ACUMt.BR, Eu130.36)
UPM-Kymmene (UPM1V.HE, Eu19.74, OUTPERFORM, TP Eu24.30, MARKET WEIGHT)
Valeo (VLOF.PA, Eu37.37, UNDERPERFORM, TP Eu26.00, MARKET WEIGHT)
Verbio (VBKG.DE, Eu11.85, OUTPERFORM [V], TP Eu17.00, OVERWEIGHT)
Verbund (VERB.VI, Eu32.03)
Vestas (VWS.CO, DKr279.00)
Wacker Chemie AG (WCHG.DE)
Weir Group (WEIR.L, 560.00 p, OUTPERFORM, TP 565.00 p, UNDERWEIGHT)
Active Power, Inc. (ACPW)
ADA-ES, Inc. (ADES)
Advanced Micro Devices, Inc. (AMD, $13.94, UNDERPERFORM [V], TP $13.00, OVERWEIGHT)
AGCO Corp (AG, $36.10, UNDERPERFORM, TP $17.00, MARKET WEIGHT)
Air Products and Chemicals, Inc. (APD, $73.06, OUTPERFORM, TP $86.00, MARKET WEIGHT)
Alternative Fuel Systems, Inc. (AFX)
American Superconductor Corp. (AMSC, $13.80)
Anadarko Petroleum Corp. (APC, $40.08, RESTRICTED, MARKET WEIGHT)
Apache Corp. (APA, $67.16, NEUTRAL, TP $69.00, MARKET WEIGHT)
Archer Daniels Midland Inc. (ADM, $33.48, UNDERPERFORM, TP $25.00, MARKET WEIGHT)
Aventine Renewable Energy (AVR, $14.78, NEUTRAL [V], TP $20.00, MARKET WEIGHT)
Baldor Electric Co. (BEZ, $36.02)
Beacon Power Corporation (BCON)
BorgWarner, Inc. (BWA, $73.01, OUTPERFORM, TP $80.00, UNDERWEIGHT)
Brookfield Asset Management (BAM, $51.43, RESTRICTED, MARKET WEIGHT)
Bunge Limited (BG, $75.69, OUTPERFORM, TP $85.00, MARKET WEIGHT)
Capstone Turbine Corp. (CPST, $.86)
Carmanah Technologies Corp. (CMH)
Catalytica Energy Systems (CESI)
Chesapeake Energy Corp. (CHK, $29.40, NEUTRAL, TP $33.00, MARKET WEIGHT)
Clean Air Power, Ltd. (CAP)
Color Kinetics, Inc. (CLRK)
Cooper Industries (CBE, $90.50, OUTPERFORM, TP $105.00, MARKET WEIGHT)
Corning Incorporated (GLW, $21.32)
Cree Inc. (CREE, $16.74)

Cypress Semiconductor Corporation (CY, $19.34, NEUTRAL, TP $19.00, OVERWEIGHT)
DAIS Analytic Corp. (DLYT)
Deere & Co. (DE, $109.34, OUTPERFORM, TP $130.00, MARKET WEIGHT)
Emerson (EMR, $42.21, OUTPERFORM, TP $50.00, MARKET WEIGHT)
EOG Resources (EOG, $65.87, NEUTRAL, TP $67.00, MARKET WEIGHT)
Evergreen Energy, Inc. (EEE)
Fairchild Semiconductor (FCS, $18.42, UNDERPERFORM, TP $14.00, OVERWEIGHT)
Fluor (FLR, $88.45, OUTPERFORM, TP $112.00, MARKET WEIGHT)
Ford Motor Co. (F, $7.64, NEUTRAL [V], TP $8.00, UNDERWEIGHT)
FosterWheeler (FWLT, $54.65)
Fuel Systems Solutions, Inc. (FSYS)
Fuel Tech, Inc. (FTEK)
General Electric (GE, $34.09, OUTPERFORM, TP $41.00, MARKET WEIGHT)
Headwaters, Inc. (HW, $21.95)
Hexcel Corporation (HXL, $18.82, OUTPERFORM, TP $23.00, MARKET WEIGHT)
Infrasource Services, Inc. (IFS, $24.21, OUTPERFORM, TP $30.00, MARKET WEIGHT)
Intel Corporation (INTC, $19.12, UNDERPERFORM [V], TP $18.50, OVERWEIGHT)
Intermagnetics General Corp. (IMGC)
International Fuel Technology (IFUE)
International Rectifier Corp (IRF, $41.63)
ITC Holdings Corp (ITC, $41.35, OUTPERFORM, TP $46.00, UNDERWEIGHT)
Itron, Inc. (ITRI, $61.31)
Johnson Controls, Inc. (JCI, $94.62, NEUTRAL, TP $90.00, UNDERWEIGHT)
Linear Technology Corp. (LLCT)
Manhattan Scientifics, Inc. (MHTX)
Maxwell Technologies, Inc. (MXWL)
McDermott Int (MDR, $46.88)
MEMC Electronics Materials (WFR, $55.19, OUTPERFORM [V], TP $64.00, MARKET WEIGHT)
MGP Ingredients, Inc. (MGPI)
Monsanto Company (MON, $52.48, UNDERPERFORM, TP $43.00, OVERWEIGHT)
O2Micro International-ADR (OIIM)
OM Group (OMG, $40.01)
ON Semiconductor Corp (ONNN, $9.98, NEUTRAL [V], TP $11.00, OVERWEIGHT)
ORMAT Technologies, Inc. (ORA)
Pacific Ethanol, Inc. (PEIX, $15.30, NEUTRAL [V], TP $17.00, MARKET WEIGHT)
Pike Electric Corp. (PEC)
Power Integrations, Inc (POWI, $22.60)
Power-One, Inc. (PWER, $5.30)
Praxair Inc. (PX, $60.06, NEUTRAL, TP $70.00, MARKET WEIGHT)
Quanta Services (PWR, $23.95, OUTPERFORM, TP $30.00, MARKET WEIGHT)
Rockwell Automation (ROK, $59.89, UNDERPERFORM, TP $55.00, MARKET WEIGHT)
SPX Corporation (SPW, $69.16, UNDERPERFORM, TP $65.00, MARKET WEIGHT)
Starmet Corporation (STMT)
SulphCo Inc. (SUF, $3.06)
Ultralife Batteries Inc. (ULBI, $8.37)
United Technologies (UTX, $64.31, NEUTRAL, TP $73.00, MARKET WEIGHT)
Universal Display Corp (PANL, $12.12)
UQM Technologies (UQM)
URS Corporation (URS, $40.85, OUTPERFORM, TP $47.50, MARKET WEIGHT)
VeraSun Energy Corporation (VSE, $16.89, NEUTRAL [V], TP $16.00, MARKET WEIGHT)
Viaspace, Inc. (VSPC)
Washington Group Intl, Inc. (WGII, $56.72)
Whirlpool Corporation (WHR, $84.79)
Wild brush Energy, Inc. (WBRS)
Williams Companies (WMB, $26.61, OUTPERFORM, TP $34.00, MARKET WEIGHT)
XTO Energy Inc. (XTO, $50.19, OUTPERFORM, TP $57.00, MARKET WEIGHT)
York Research Corp. (YORK)
Zoltek Companies, Inc. (ZOLT)
Aisin Seiki Co. Ltd. (7259.T)
Babcock & Brown Wind Partners Group (BBW.AX)
Baoding Tianwei Boabian Electric Co. Ltd. (600550.SS)
Bharat Heavy Electricals (BHEL.BO, Rs2117.00)
BYD Co Ltd - H (1211.HK, HK$31.55)
Chiyoda Corporation (6366.T)

Chugai Ro Co. Ltd. (1964.T)
Contact Energy (CEN.NZ, NZ$9.07)
Cosan SA Industria E Commericio (CSAN3.SA)
CSR Limited (CSR.AX, A$3.64, UNDERPERFORM, TP A$3.50, OVERWEIGHT)
Daikin Industries, Ltd. (6367.T)
Ebara Corporation (6361.T)
E-Ton Solar Tech Co Ltd (3452.TWO, NT$619.00, OUTPERFORM, TP NT$718.00)
Golden Hope Plantation (GHOP.KL, RM6.60, OUTPERFORM, TP RM8.30)
GS Yuasa Corporation (6674.T)
Guthrie Ropel Bhd (GTRS.KL, RM5.00)
Harbin Power Equipment Company Ltd. (1133.HK)
Highlands & Lowlands Bhd (HILO.KL, RM6.00)
Hitachi, Ltd. (6501.T)
IOI Corporation (IOIB.KL, RM19.30, OUTPERFORM, TP RM23.50)
Ishikawajima-Harima Heavy Industries Co. Ltd. (7013.T)
Jaiprakash Hydro-Power Ltd. (JAPR.BO)
Japan Wind Development Co. Ltd. (2766.T)
JTEKT Corporation (6473.T)
Kansai Electric Power Company, Inc. (9503.T)
Kitz Corporation (6498.T)
Komatsu, Ltd (6301.T)
Kuala Lumpur Kepong (KLKK.KL, RM10.90, OUTPERFORM, TP RM12.00)
Kubota Corporation (6326.T)
Marubeni Corporation (8002.T)
Meidensha Corporation (6508.T)
Meisei Industrial Co. Ltd. (1976.OX)
Mission Biofuels Ltd. (MBT.AX)
Miura Co. Ltd. (6005.T)
Motech Industries (6244.TWO, NT$464.00, RESTRICTED [V])
NSK Ltd. (6471.T)
NTN Corporation (6472.T)
PPB Group Bhd (PEPT.KL, RM5.95)
PT Astra Agro Lestari Tbk (AALI.JK, Rp12500.00, UNDERPERFORM, TP Rp12500.00)
PT London Sumatra Indonesia (LSIP.JK, Rp5800.00, UNDERPERFORM [V], TP Rp5500.00)
Sanyo Electric Co. Ltd. (6764.T)
Sasol Limited (SOLJ.J, R222.70, NEUTRAL, TP R265.00, OVERWEIGHT)
Shanghai Electric Power Co Ltd (600021.SS, RMB6.74)
Sharp Corporation (6753.T)
Shinko Electric Industries Co. Ltd. (6967.T)
Sime Darby (SIME.KL, RM7.90, OUTPERFORM, TP RM9.80)
Sino-American Silicon Products (5483.TWO, NT$141.00, OUTPERFORM [V], TP NT$145.00)
Suzlon Energy Ltd. (SUZL.BO)
TBEA Co. Ltd. (600089.SS)
Toho Tenax Co. Ltd. (3403.T)
Tokuyama Coporation (4043.T)
Toshiba Corporation (6502.T)
Toyo Kanetsu K.K. (6369.T)
Wafer Works Corp (6182.TWO, NT$92.50, NEUTRAL [V], TP NT$64.00)
Wilmar International Ltd (WLIL.SI, S$2.39, OUTPERFORM [V], TP S$2.65)

Disclosure Appendix

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