STRATEGIC OVERVIEW

1.1 The Need for Distributed Generation (DG)

There are major drivers underlying the need and the opportunity for reestablishing energy generation and delivery on a global scale. Some of these drivers are:

- Global economic and population growth
- Power quality and reliability problems
- Advanced technologies
- Restructuring in the energy sector
- Environmental quality considerations

As economies expand in the industrialized and developing worlds, so too does the demand for energy. Sales of electricity generation equipment are showing steady growth, and the value of reliable electricity has become more crucial for the businesses across the world in recent years.

The maturation of cogeneration and other electricity production technologies is encouraging businesses, manufacturers and institutions to generate their own power.

The new international emphasis on cogeneration and combined cycle power generation has a simple underpinning — efficiency. Current fuel-burning power generation technologies, i.e., boilers and reciprocating engines, offer efficiencies of around 30%. Cogeneration and combined cycle power generation using gas turbines yield energy conversion efficiencies of between 60 and 70%. Diesel engines can do even better.

But why burn anything at all? Several electricity generation technologies regarded as fringe or futuristic for decades are now stepping onto the world stage as practical solutions.

Fuel cells, photovoltaics and wind turbines have long been considered “science fiction alternatives,” yet the surging activity in recent years has brought them into reality. The question has become “How many units more?” instead of “Are they really available?” of only a decade ago.

standards. The object is to ensure that power stations are not shut down with the aim of stifling supply and driving up prices as occurred in 2001.

Although EU countries accepted energy deregulation and privatization, some of the members led by France do not want to risk their state-owned gas and electric companies. Deregulation will still be one of the drivers of DG. However; deregulation will come slower than earlier expectations.

1.5 Technological Outlook

Common DG technologies are summarized according to their typical market sizes in Table 1-3. First of the DG technologies is reciprocating engines. Reciprocating engines dominate DG systems currently. Approximately 80% of sales are accounted for by gensets. Caterpillar is the market leader in gensets.

Small gas turbines are used because of their low cost and efficiency. Hybrid models coupled with microturbines and fuel cells will be drawing attention in coming two to three years.

Microturbines started fast in 1999 and 2000; however, 2001 was challenging for microturbine manufacturers. The 2002 to 2003 time span will certainly be an indication for the industry in terms of technological advancements and sales.

Fuel cells have already started to see installations in areas such as wastewater treatment plants and mail distribution services. Although technological and capital cost challenges will affect early rollout ability, ABI analysis indicates strong shipments after 2006 to 2007 when the manufacturers shift to mass-market production plants.

Photovoltaics are still unattractive from a capital cost perspective, yet technological advancements and strong government subsidies make this technology attractive especially in off-grid markets.

Wind turbines have seen enormous installations — 25,000 MW worldwide — in last few years across the world. It has become the fastest growing power technology by getting substantial amount of incentives from the governments. Wind turbines have increased power output from several KWs to over 2 MW.

1.6 New Century, New Rules in Power Generation Business

Small power generation will undergo a tremendous transformation if the drivers of DG technology maintain their relevance to bring highly reliable, low emissions-based electricity generation into twenty-first century.

Smaller facilities will soon start to see the advantages of supplying their own power given the conditions. In contrast, cost containment is still a mainstay of business and government. Buildings, equipment and lighting consume large amounts of power. It is a major expense that is always there, hitting the bottom line.

If electricity can be produced significantly cheaper in house and with a level of reliability that is demonstrably equivalent to the local utility, then an organization must consider this alternative. And if a facility can produce its own power at a lower cost than a utility, it is also possible to produce power for others.

Many utilities are saddled with old generators, a large distribution network that must be maintained and nuclear power plants. This is having a significant impact on the economics on what consumers pay. By and large, regulatory bodies are permitting utilities to recover the cost of constructing and decommissioning older facilities.

Twenty-first century governing dynamics of energy markets will be different than the twentieth century's inclination toward centralized power generation, transmission and distribution (T&D). End users will select alternatives from a diverse array of high-efficiency, no emissions, fuel-flexible and cost-competitive DG systems.

These systems will be easily interconnected into the nation's infrastructure for electricity, natural gas and renewable energy resources and operated in an optimized manner to maximize value to users and energy suppliers while protecting the environment.

Microturbines started to gain interest from 1950 to 1970 when automotive companies were looking at gas turbines. Although the technology started to be pursued for stationary markets since the 1980s, interest rose significantly in the second half of 1990s.

Most microturbines are single-stage, radial flow devices with high rotating speeds of 90,000 to 120,000 rpm. However, a few manufacturers have developed alternative systems with multiple stages and/or lower rotation speeds. Chart 2-4 illustrates typical microturbine features.

Chart 2-4
Operating Characteristics of Microturbines

Typical Unit Size	[redacted] kW to [redacted] kW
Temperature (°C)	[redacted] to [redacted]
Electric Efficiency (%)	[redacted] to [redacted]
Installed Capital Cost ($/kW in 2002 $)	[redacted] to [redacted]
NOx emission levels (ppm)	[redacted]
O & M cost (cents/kWh)	[redacted] to [redacted]

Source: Allied Business Intelligence Inc

Microturbines have three major markets:

- Distributed generation
- Combined heat and power
- Niche markets

2.5.1 Microturbine Technology Overview

The technology for microturbines has evolved from automotive turbochargers, auxiliary power units in airplanes and small jet engines. Development of microturbine systems specifically for the stationary power market began in the 1980s after the deregulation of power generation. The high-speed generator inside a microturbine is driven by a shaft rotating at 50,000 to 120,000 rpm.

Modest efficiency of about 25% can be boosted to 30 to 35% with a recuperator that transfers heat from the exhaust back into the incoming air stream. Microturbines can use a variety of fuels, including natural gas,

3.8 DG Technologies Business Overview

For power delivery at the highest possible efficiency and availability, there is still no strong competition with cogeneration and its sister technology, combined cycle power generation. For power production alone, gas turbines are the universal choice in sizes above 3 MW. There are some environmental decrements, but their magnitude is a matter of some controversy.

With the rapid expansion of natural gas delivery pipelines on several continents, a pipeline grid that nearly mimics national electricity delivery grids is being established in North and Latin America and in Western Europe.

Gas turbines are preferred because of the short time to installation, as well as the modularity of the technology. A turbine with outputs ranging from 50 to 300 MW can be up and running in six months. Only wind-powered generators now compete with gas-fired turbines for lowest-cost electricity (discounting coal with its heavy carbon emissions control requirements).

Wind power is more advanced and cheaper than both fuel cell and solar cell technologies. However, large tracts of land are required to produce utility-scale amounts of power. The areas with the highest average wind velocities are normally areas with low population. Also, the land can continue to be used for other purposes such as farming and ranching. The decision on whether to purchase or lease the land can have a significant impact on the economics of individual wind power projects.

Solar cell technologies have progressed to the multimegawatt stage. Commercial packages are now available in the hundreds of kilowatts range. It is expected that the price of power from photovoltaics will drop below 5 cents per kilowatt hour in a few short years. This will open large grid-connected application markets to photovoltaics, particularly in areas at lower latitudes with a large number of clear days.

Fuel cell installations, depending on the type of fuel cell, have reached either the commercialization stage or are soon to become commercial products. Units providing anywhere from a few kilowatts to 2 MW are up and running. The most common size range emerging is for 200 to 500 kW. This size is intended as either a final product or a module that can be scaled to any size desired.

Table 4-6
Global Gas Turbine Production Capacity
2001 to 2011

Year	Size 200 kW to 3 MW Total Capacity in MW	Size 3 MW to 10 MW Total Capacity in MW	Size 10 MW to 20 MW Total Capacity in MW
2001	[redacted]		
2002			
2003			
2004			
2005			
2006			
2007			
2008			
2009			
2010			
2011			
Total	[redacted]		

Source: Allied Business Intelligence Inc

Table 5-8
US Fuel Cell Landfill Gas-Fueled Generation Capacity Growth
2001 to 2011

Year	Capacity (Megawatts) Moderate	Capacity (Megawatts) Aggressive
2001	[redacted]	
2002		
2003		
2004		
2005		
2006		
2007		
2008		
2009		
2010		
2011		
CAAG	[redacted]	

Source: Allied Business Intelligence Inc