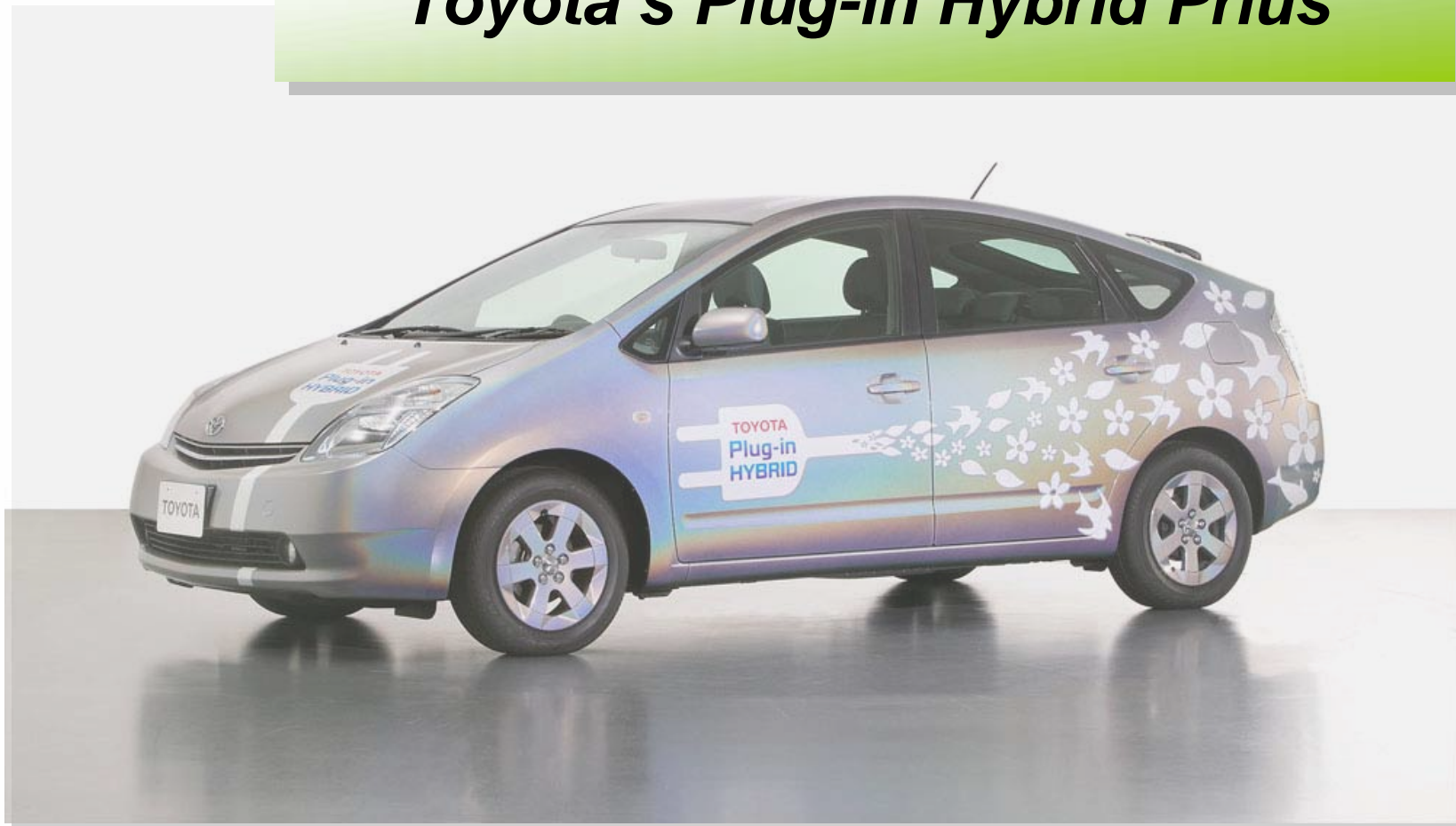


Toyota's Plug-in Hybrid Prius

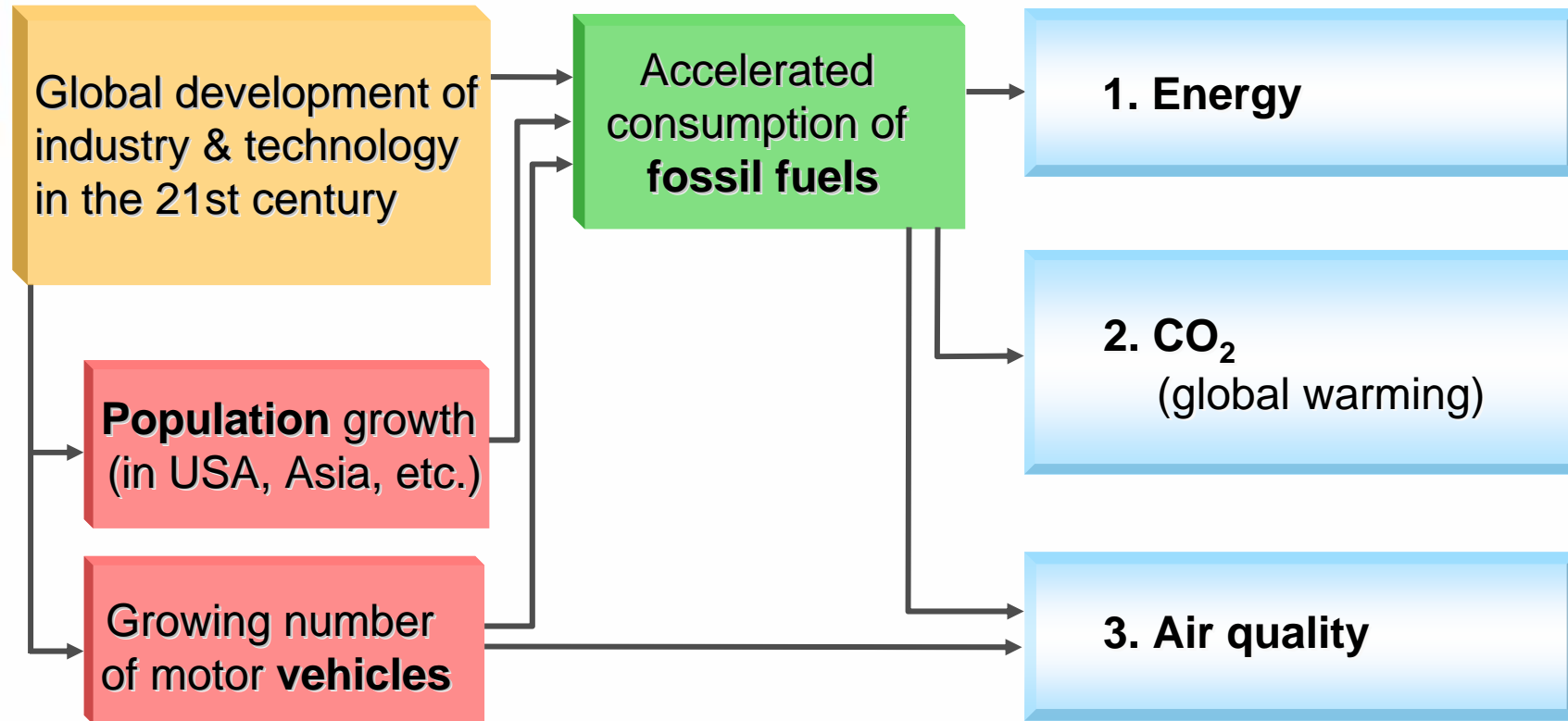


Shizuo Abe

Toyota Motor Corporation

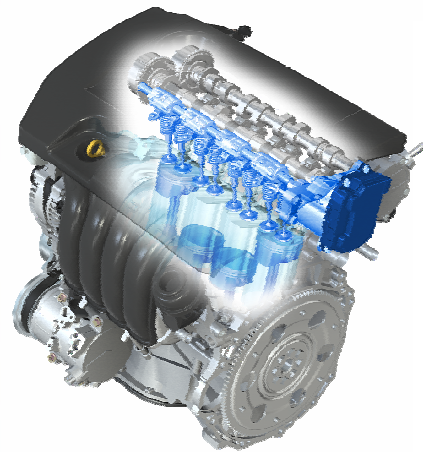
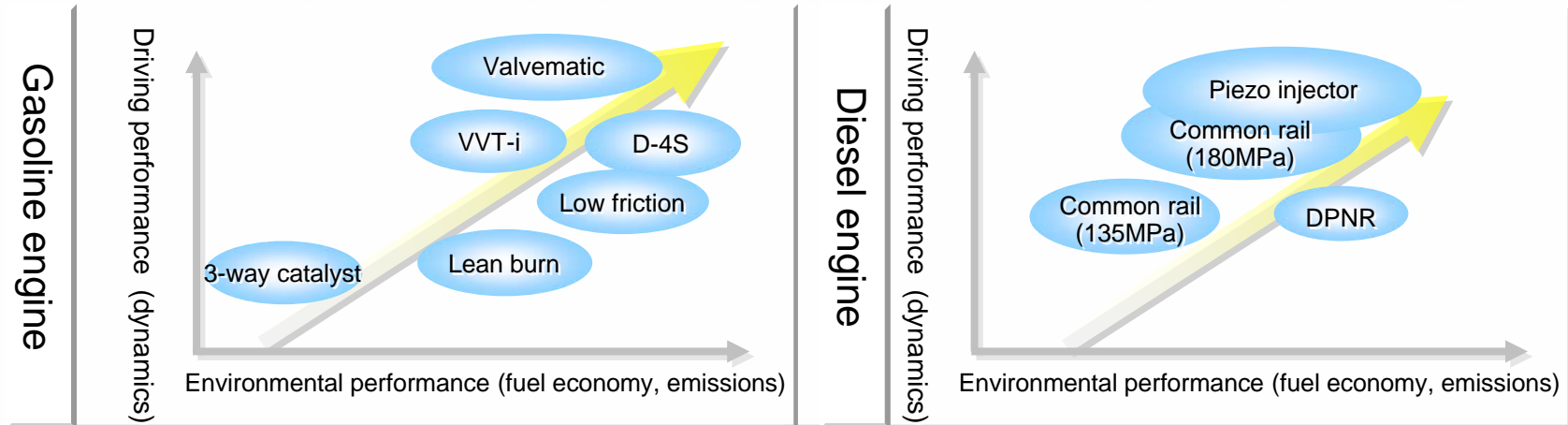
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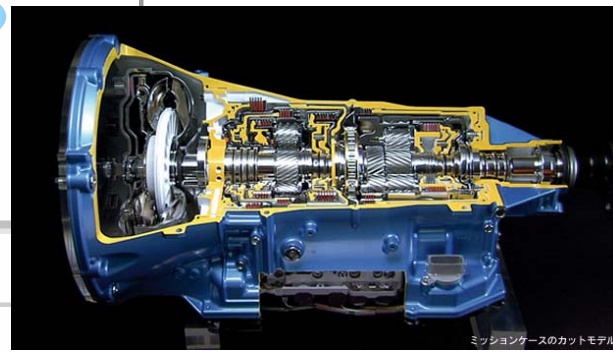
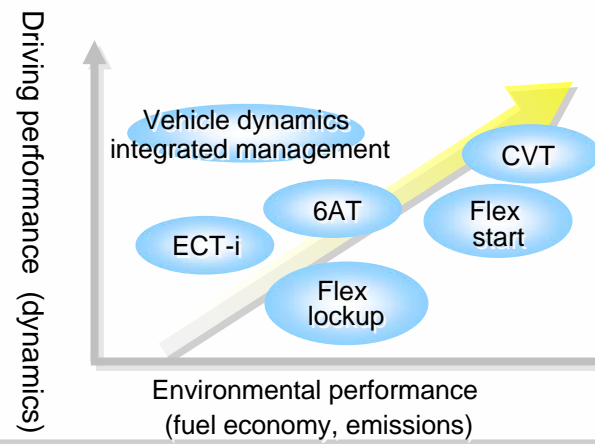


Three issues: Energy, CO₂, air quality

SUSTAINABILITY: THE FUTURE OF TRANSPORTATION



Transmission



ミッションケースのカットモデル

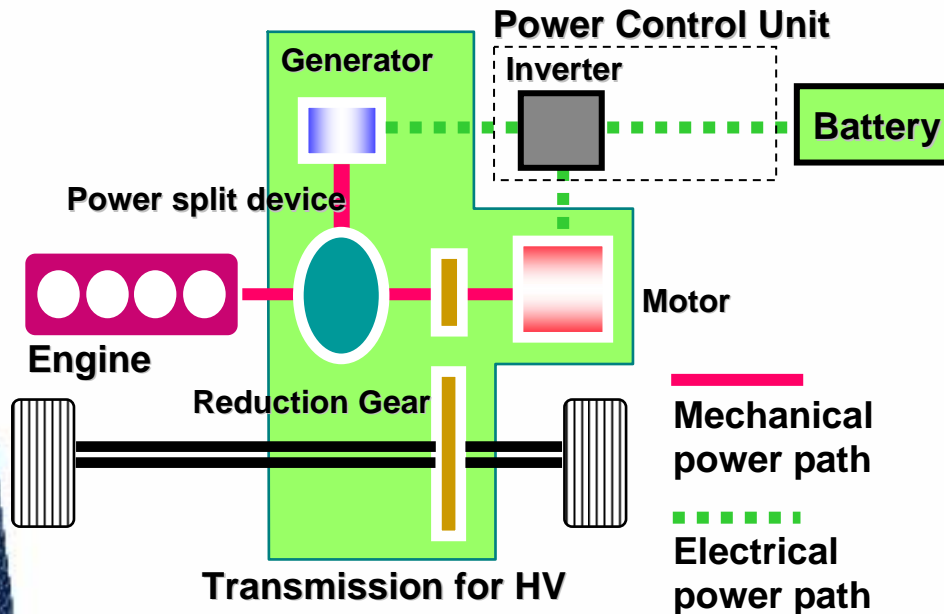
Improving engine & transmission performance with new technologies

Prius (THS) 1997~2003



Features of System

- 1 . Two electric motors
- 2 . Ni-MH battery
- 3 . Power split device



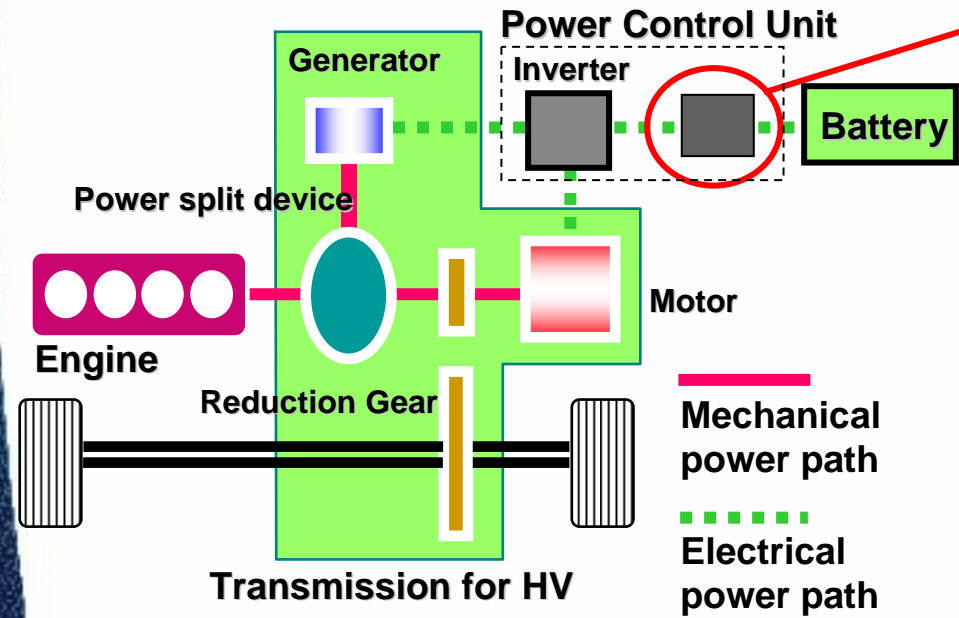
Prius (THSII) 2003~



Features of System

- 1 . Two electric motors
- 2 . Ni-MH battery
- 3 . Power split device

4. High-voltage boost circuit

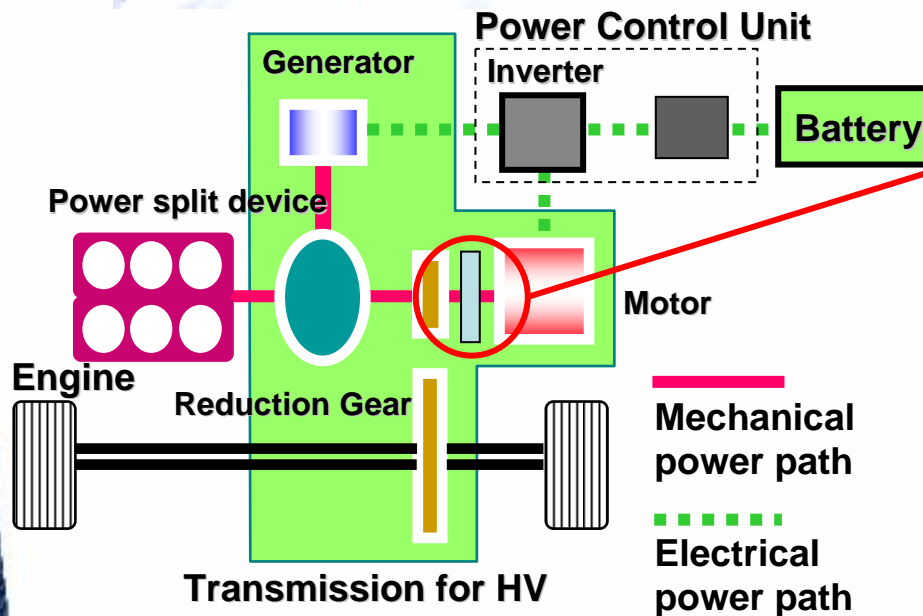


RX400h (THSII) 2005~



Features of System

- 1 . Two electric motors
- 2 . Ni-MH battery
- 3 . Power split device
- 4 . High-voltage boost circuit



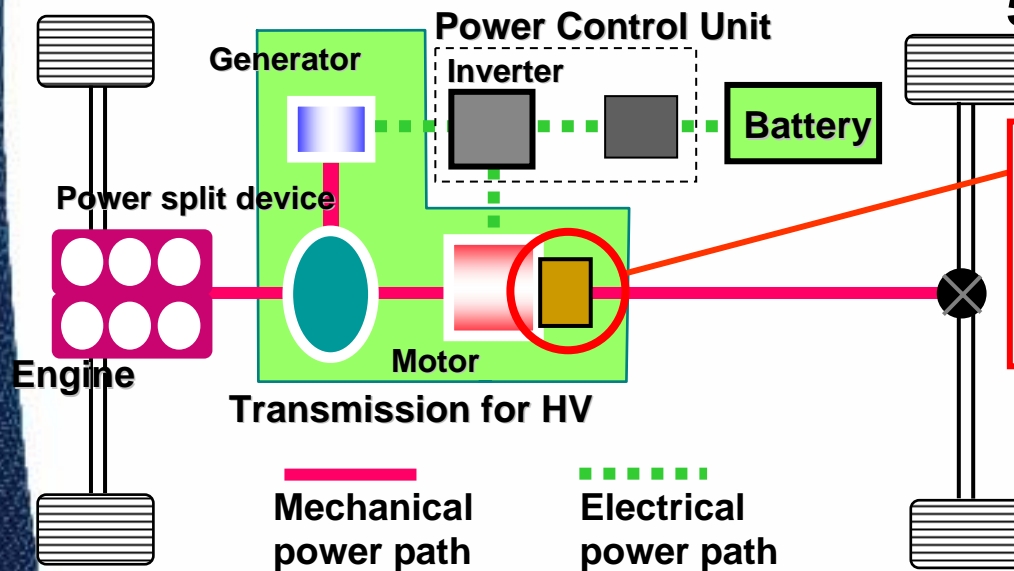
5. Motor speed reduction device

GS450h (THSII) 2006 ~



Features of System

1. Two electric motors
2. Ni-MH battery
3. Power split device
4. High-voltage boost circuit
5. Motor speed reduction device



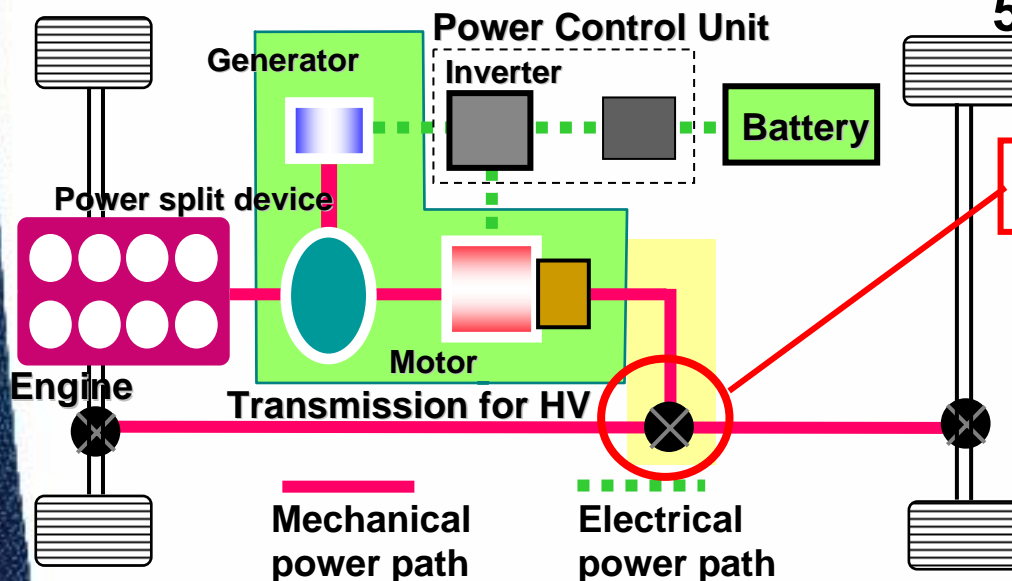
5+. 2-stage motor speed reduction device

LS600h (THSII) 2007~



Features of System

- 1 . Two electric motors
- 2 . Ni-MH battery
- 3 . Power split device
- 4 . High-voltage boost circuit
- 5 . 2-stage motor speed reduction device



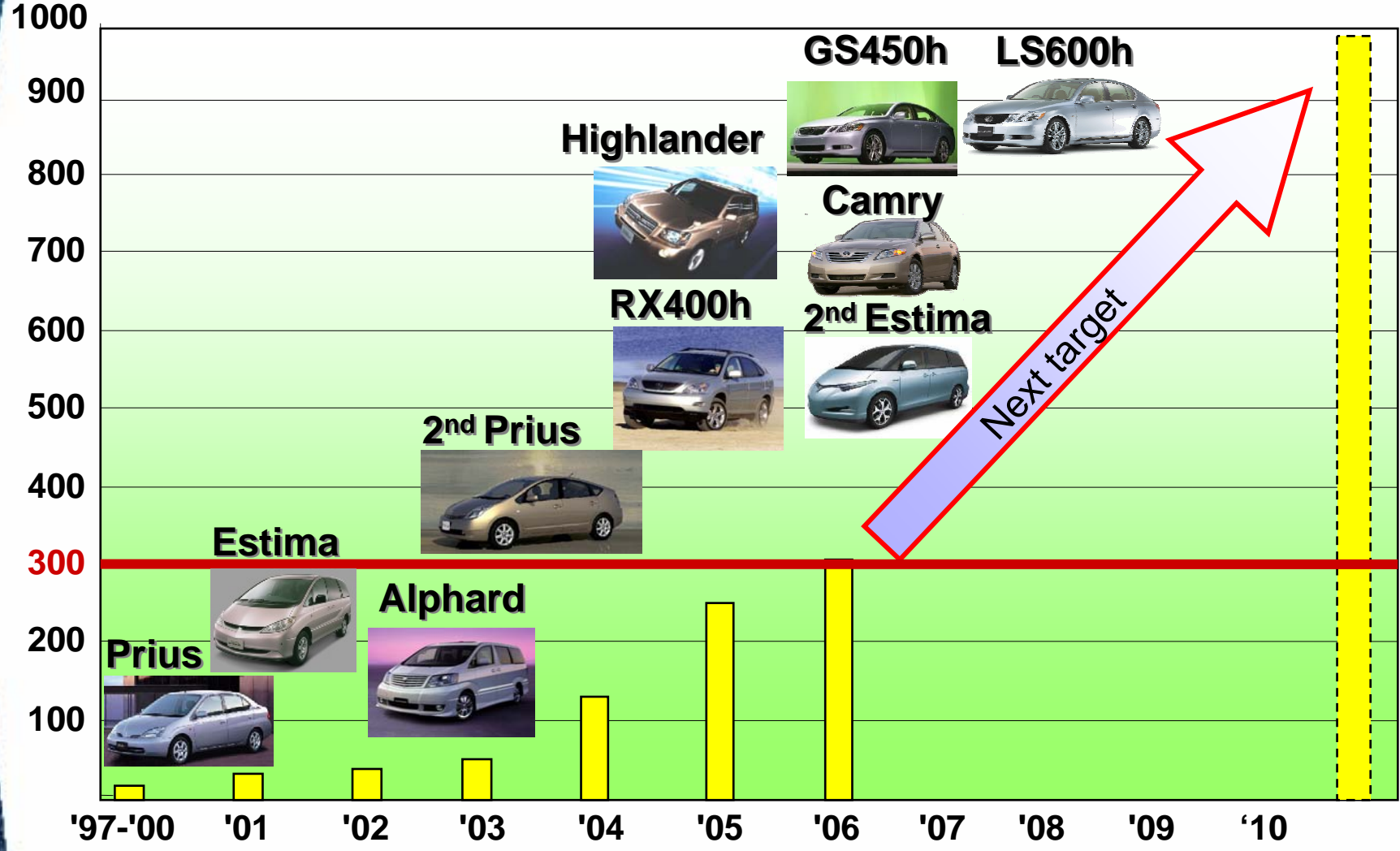
6. Mechanical 4WD

I. History of Toyota's HV Development

SUSTAINABILITY: THE FUTURE OF TRANSPORTATION

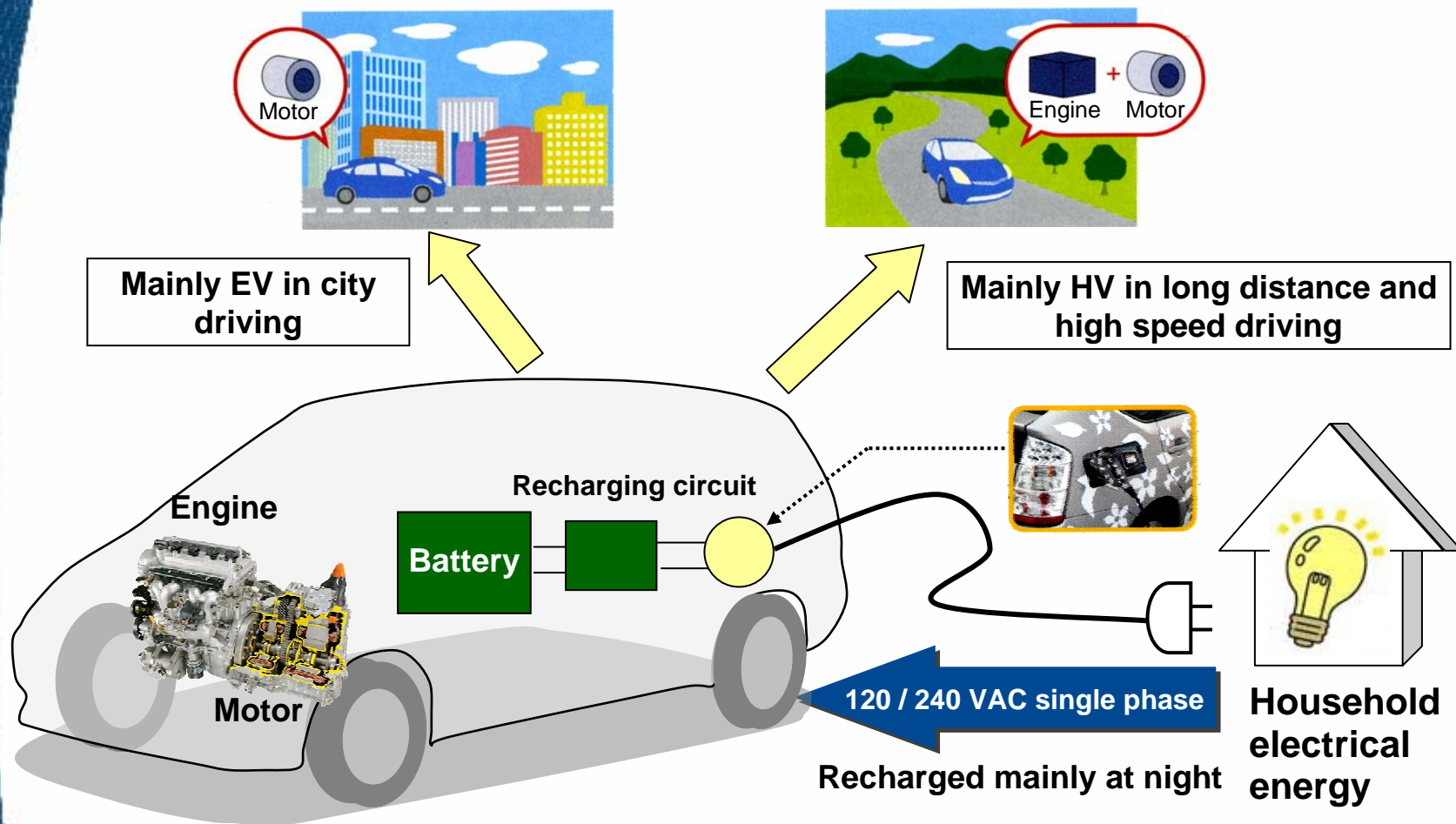
Model and market strategy

Annual sales volume of Toyota HV (x1000/year)



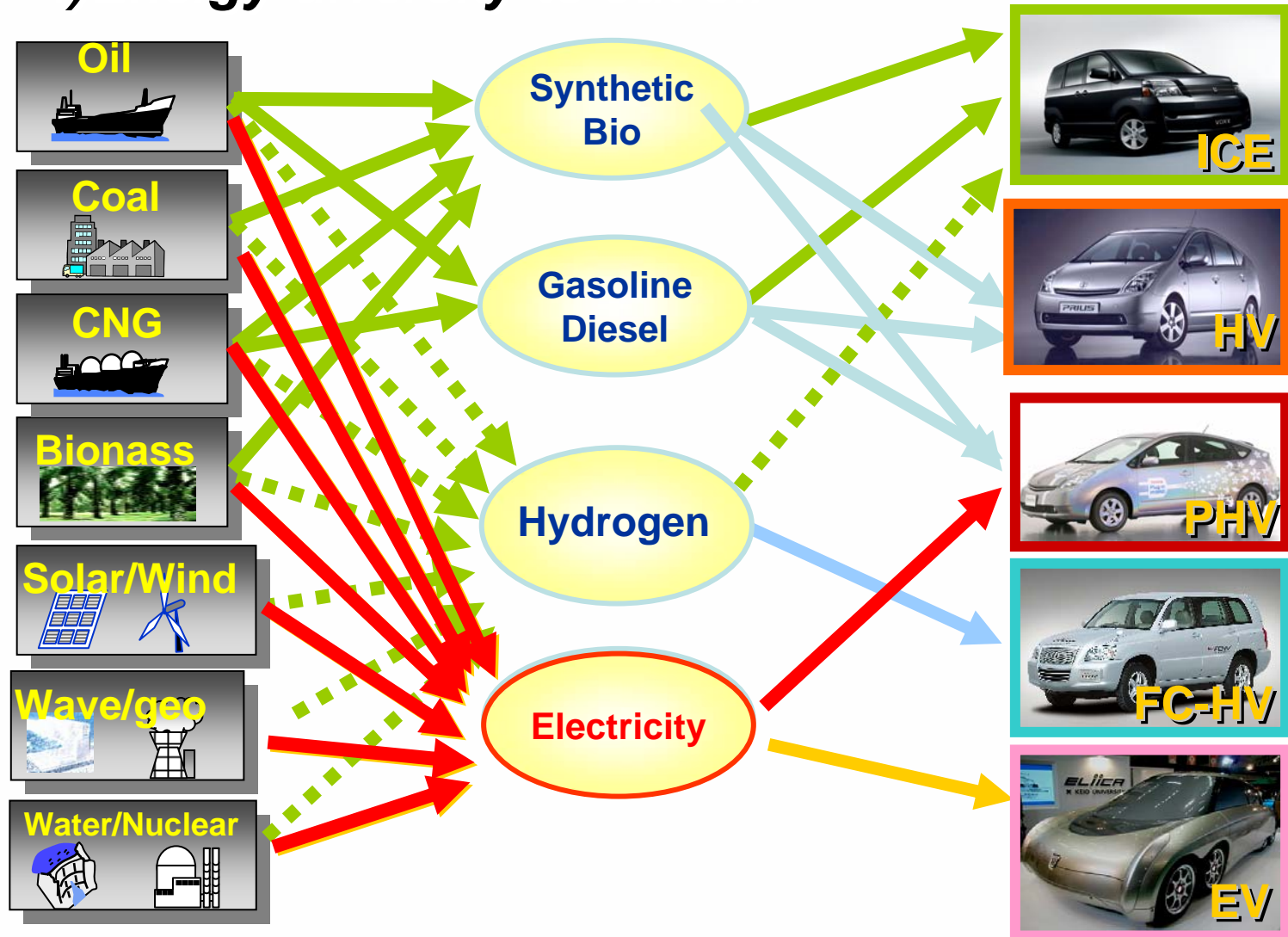
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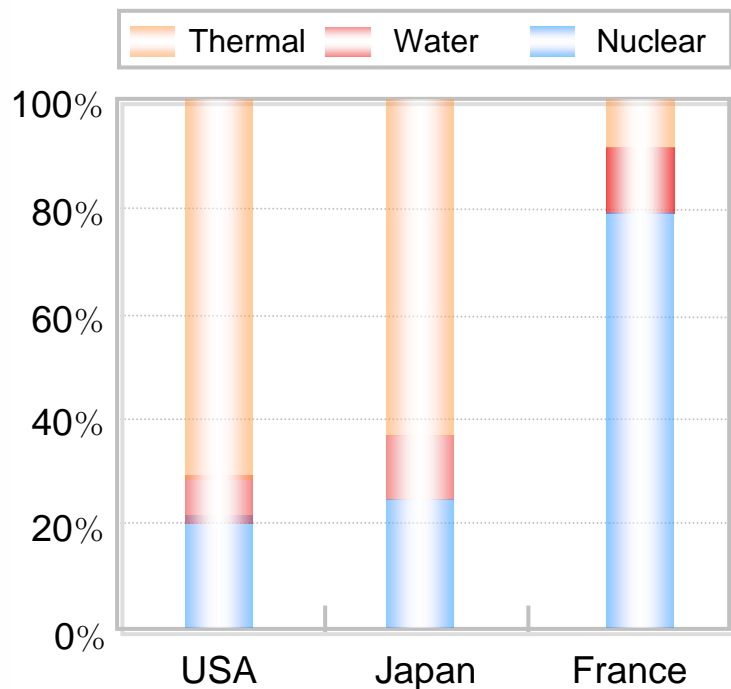


Plug-in hybrids : A new style of electricity utilization

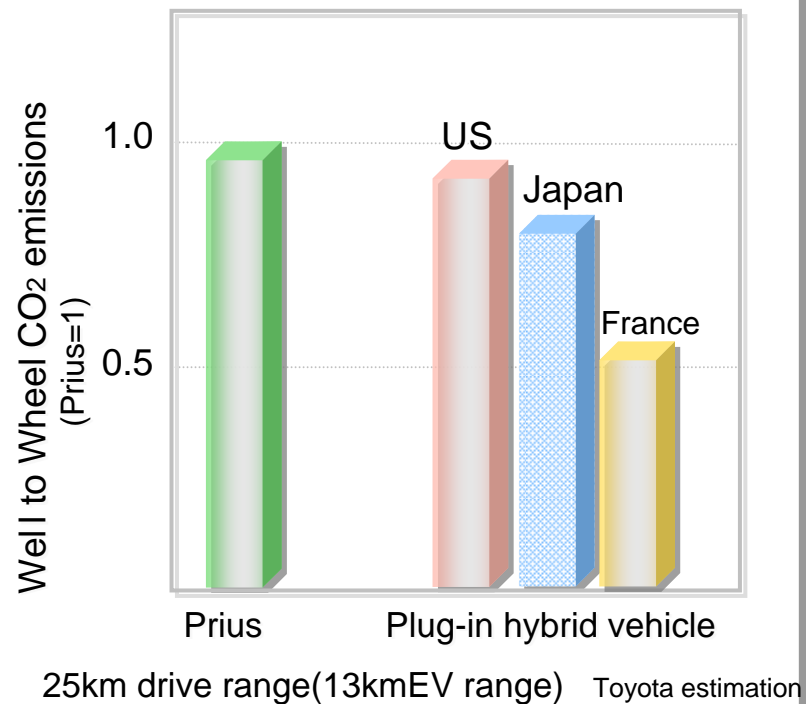
1) Energy diversity to cut oil



Electric generation in each country



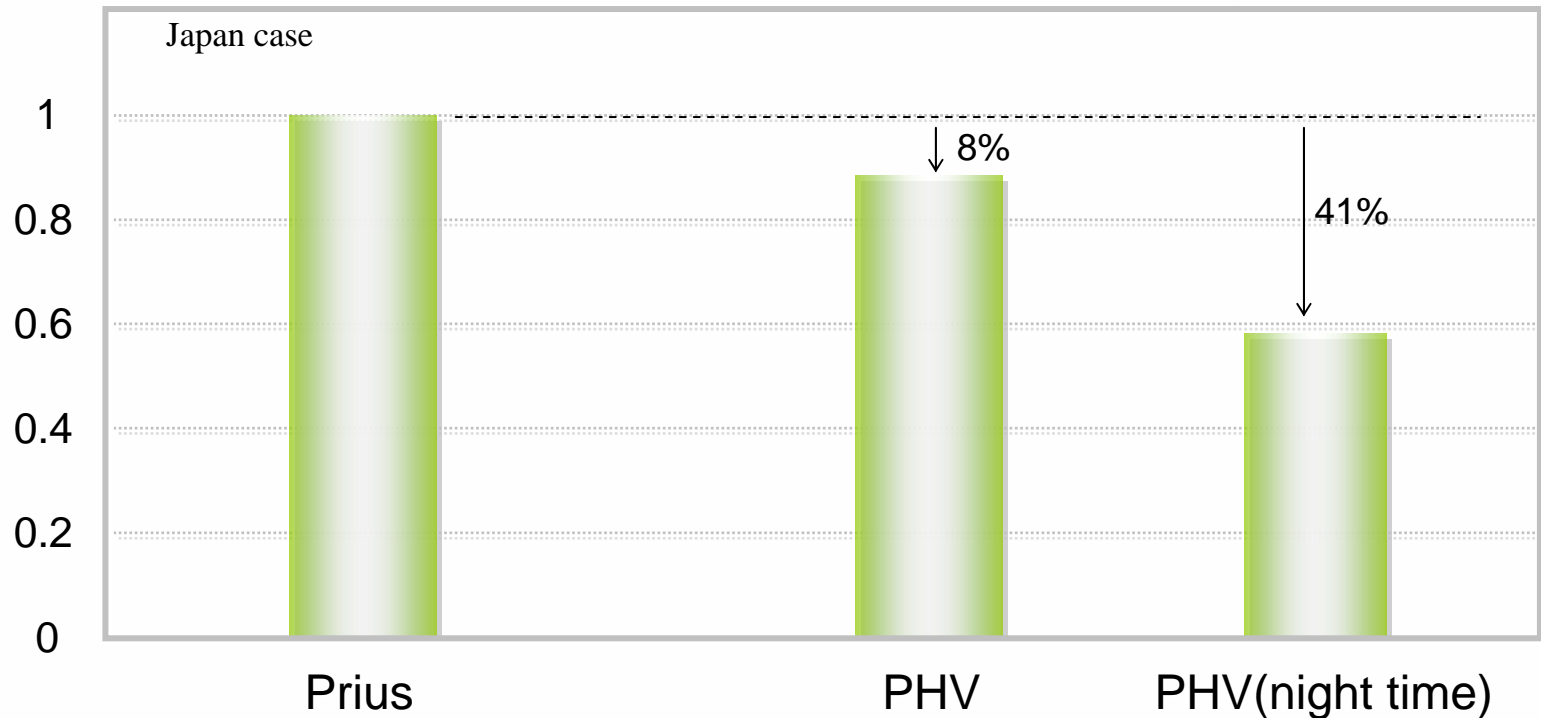
Well-to-wheel CO2 emissions



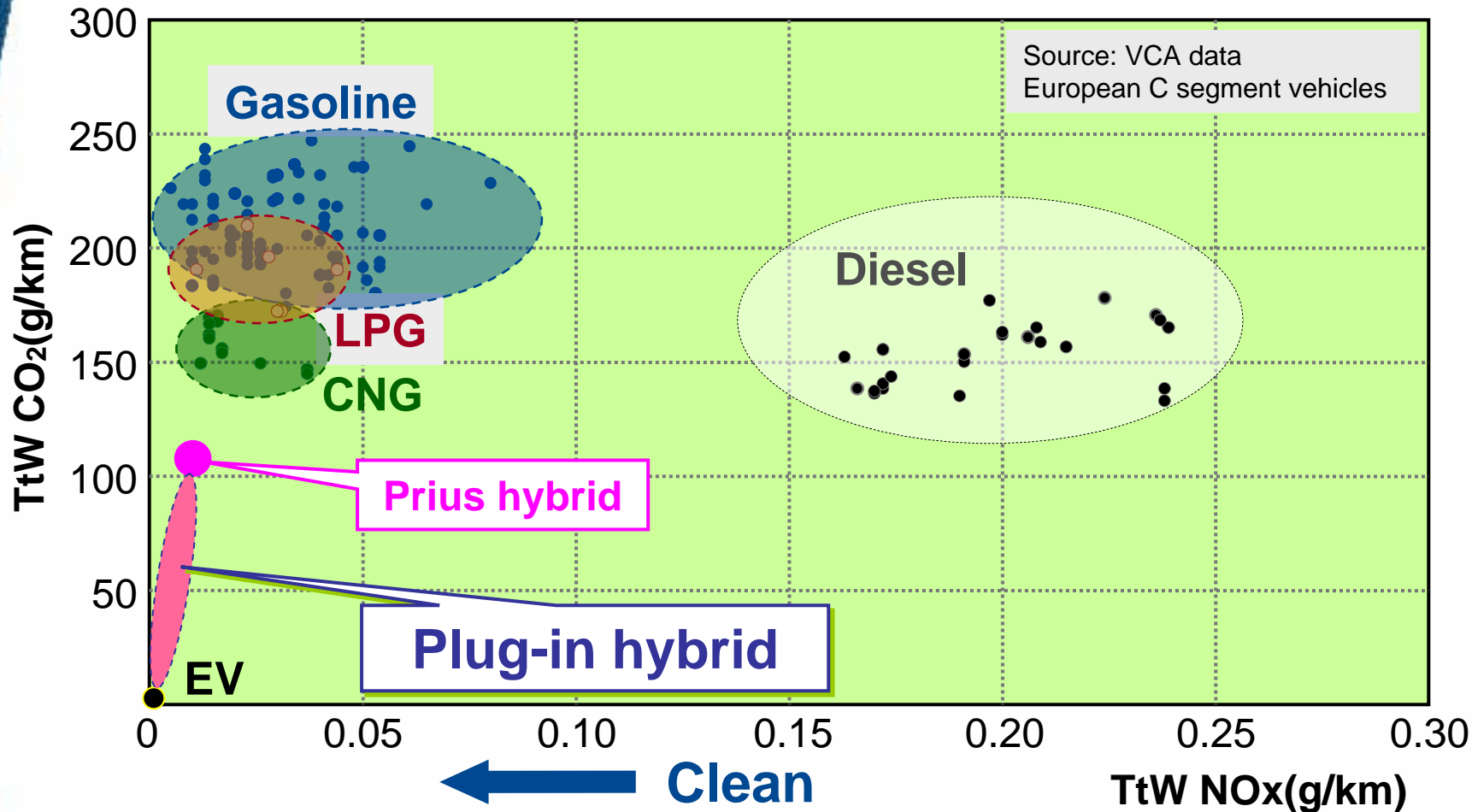
Environmental benefit: CO2 reduction in well-to-wheel

Running cost merit

Toyota estimation:
25km driving with 13km EV drive



Household electricity use cut fuel cost

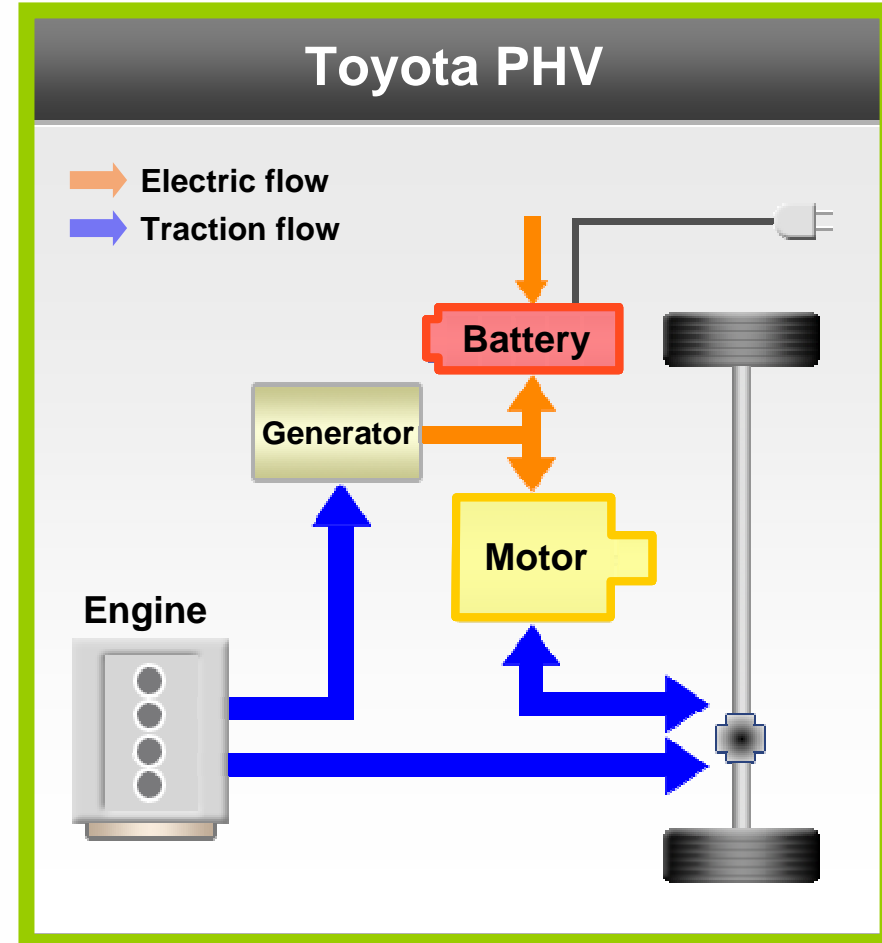
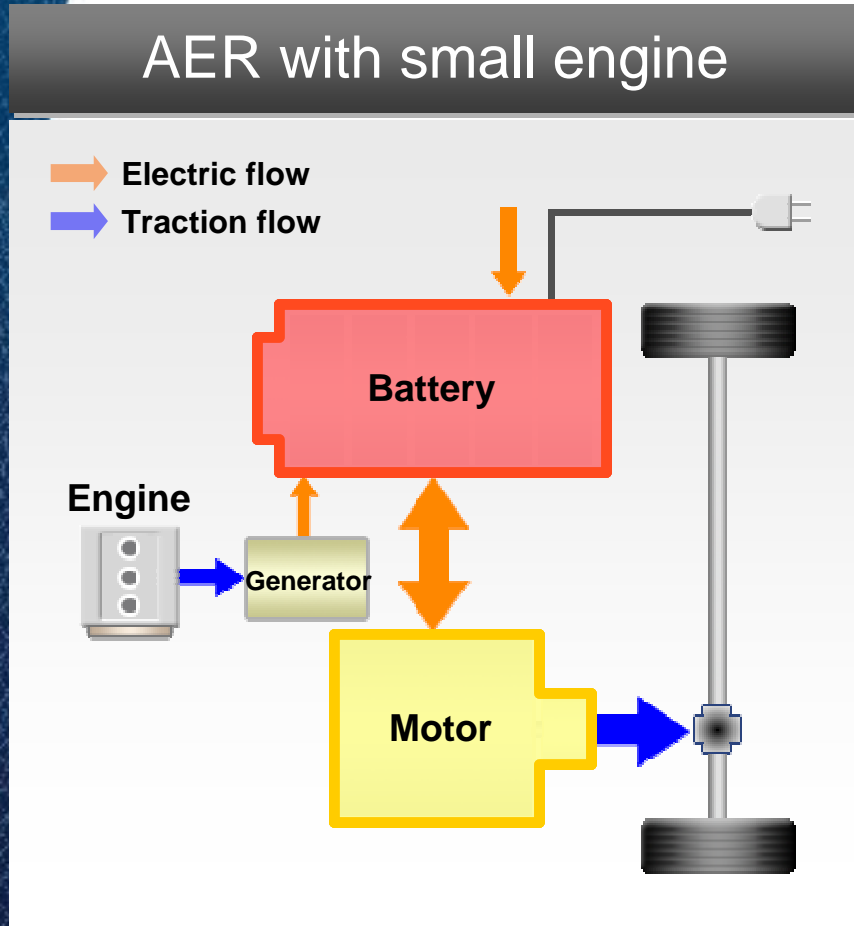


Plug-in technology can further enhance the environmental performance of hybrids both in CO₂ & pollutant emissions

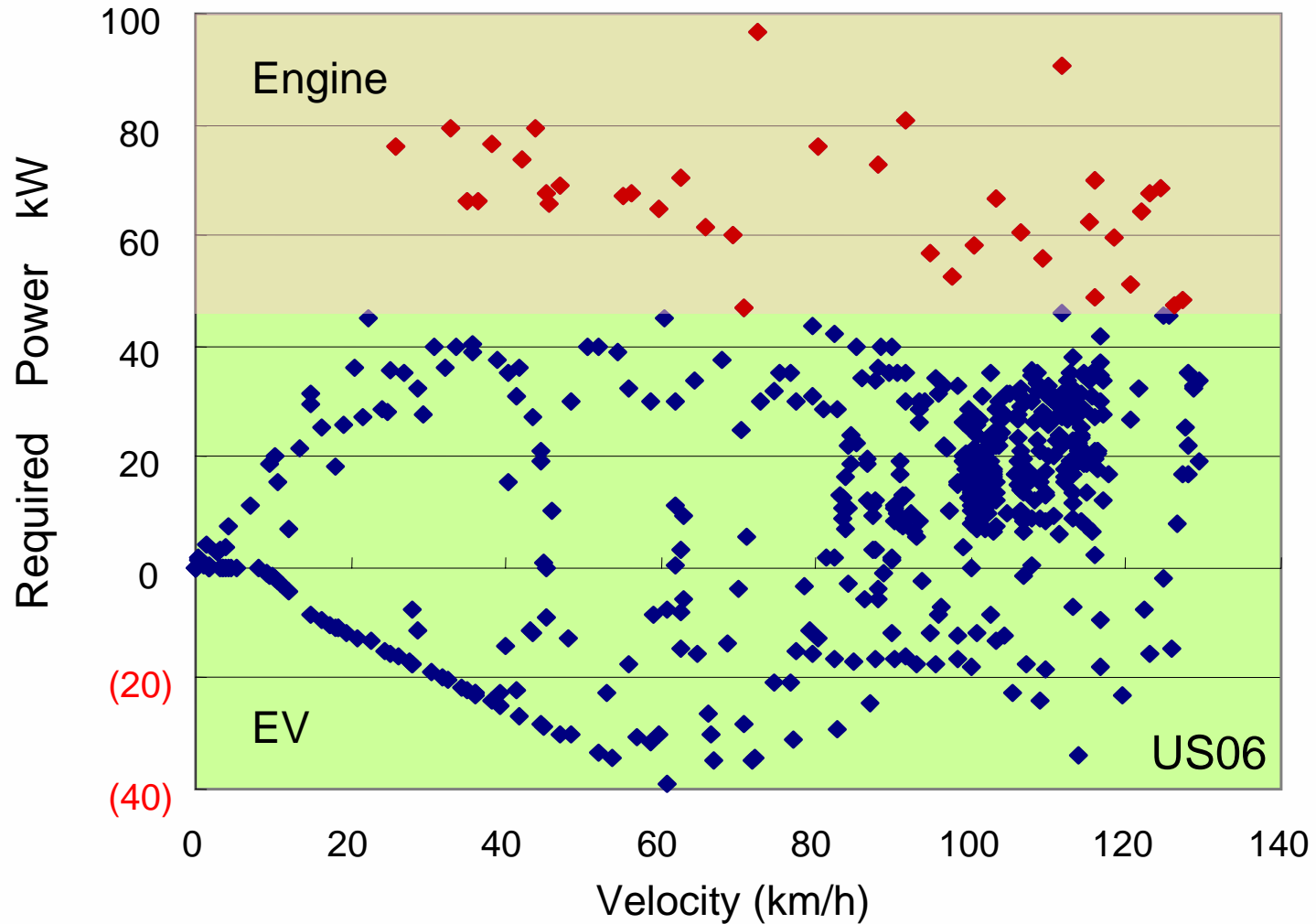
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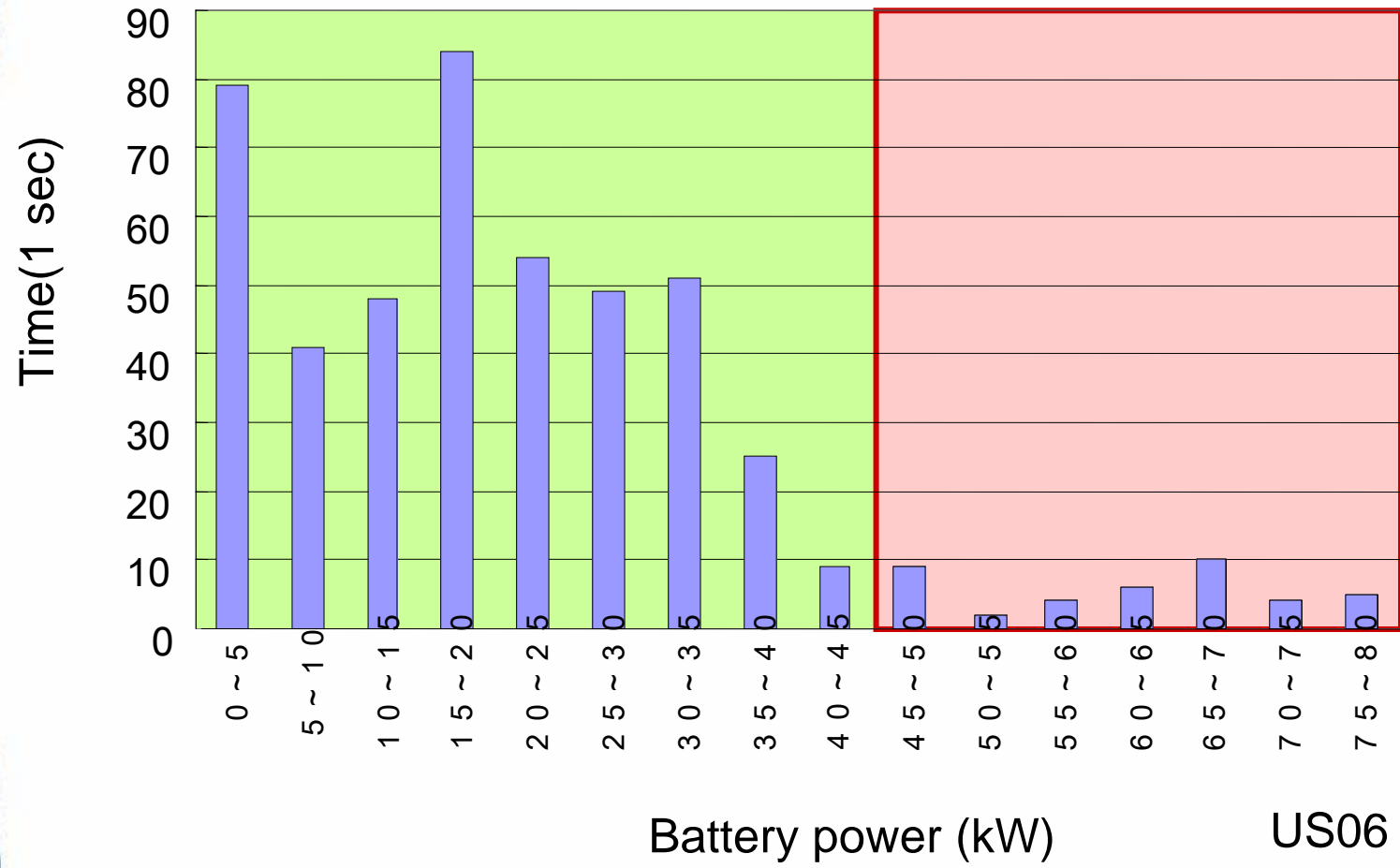
Concepts of PHV



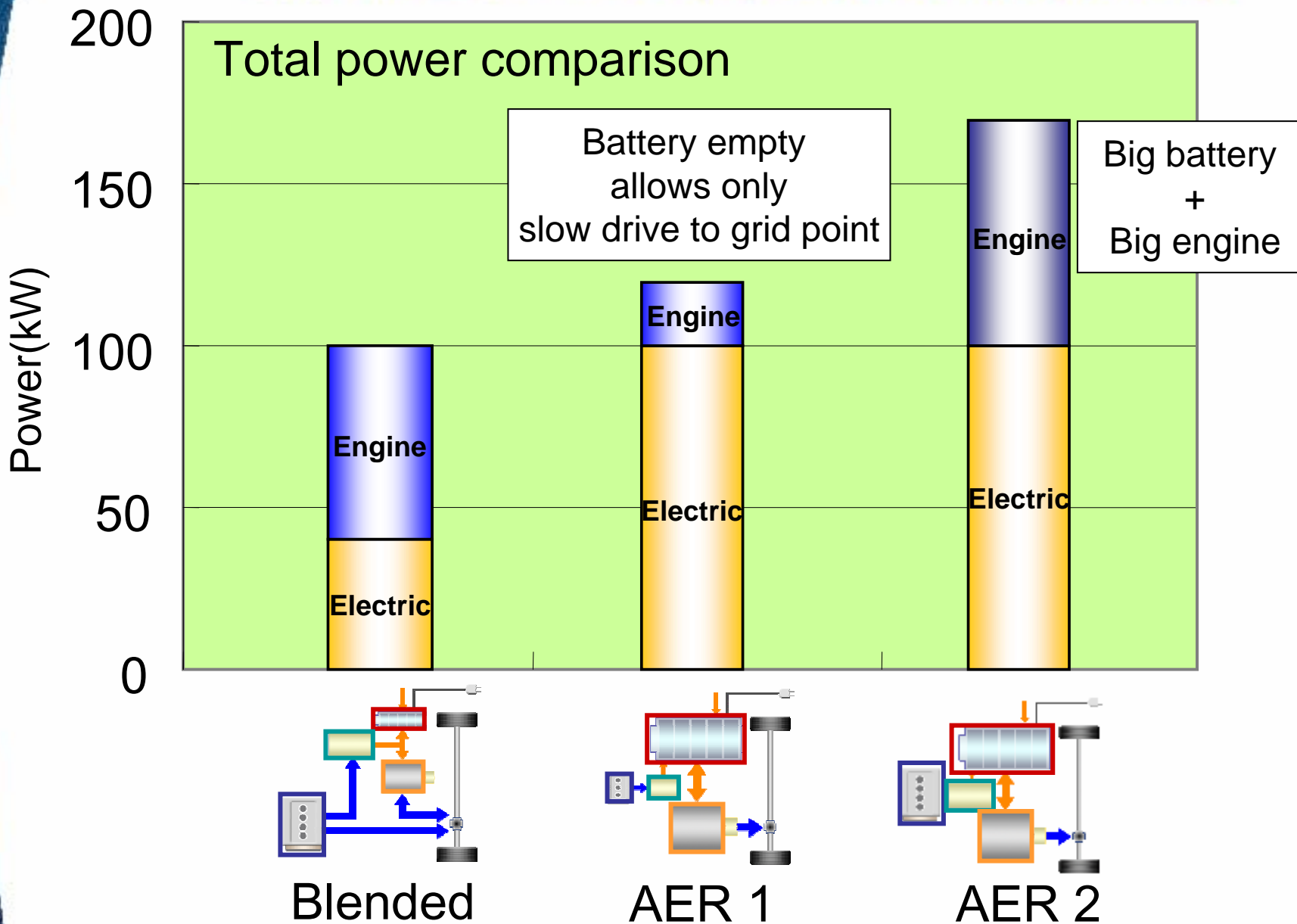
Distribution of Required Power



Frequency of battery power use



SUSTAINABILITY: THE FUTURE OF TRANSPORTATION



	EV	PHV (EV base)	PHV (HV base)	HV
CO2	++	+ / +++	+ / +++	+
Air quality	++	+ / +++	+ / +++	+
Range	-	+	++	++
Charge time	-	+-	+	++
Infrastructure	- (need)	- (need)	+ (on demand)	++
Cost	-	+-	+	++

Need to accommodate HV & EV merits

Contents

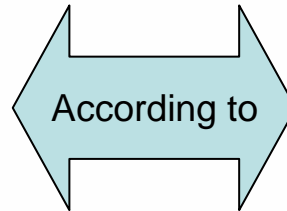
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Seek best balanced specifications

EV Range

X

Engine Range
(Power Range
Operated by Engine)



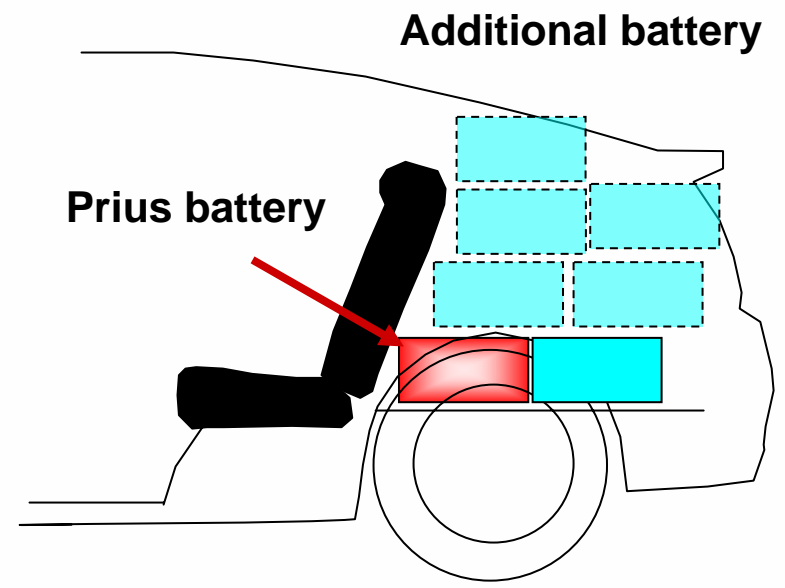
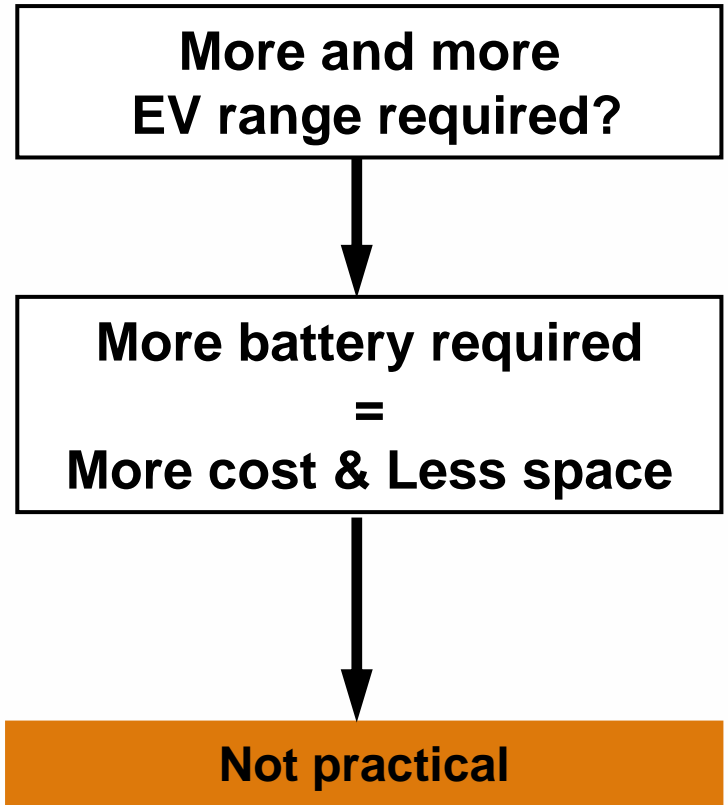
Variation of

Driving habits

Power grid mix

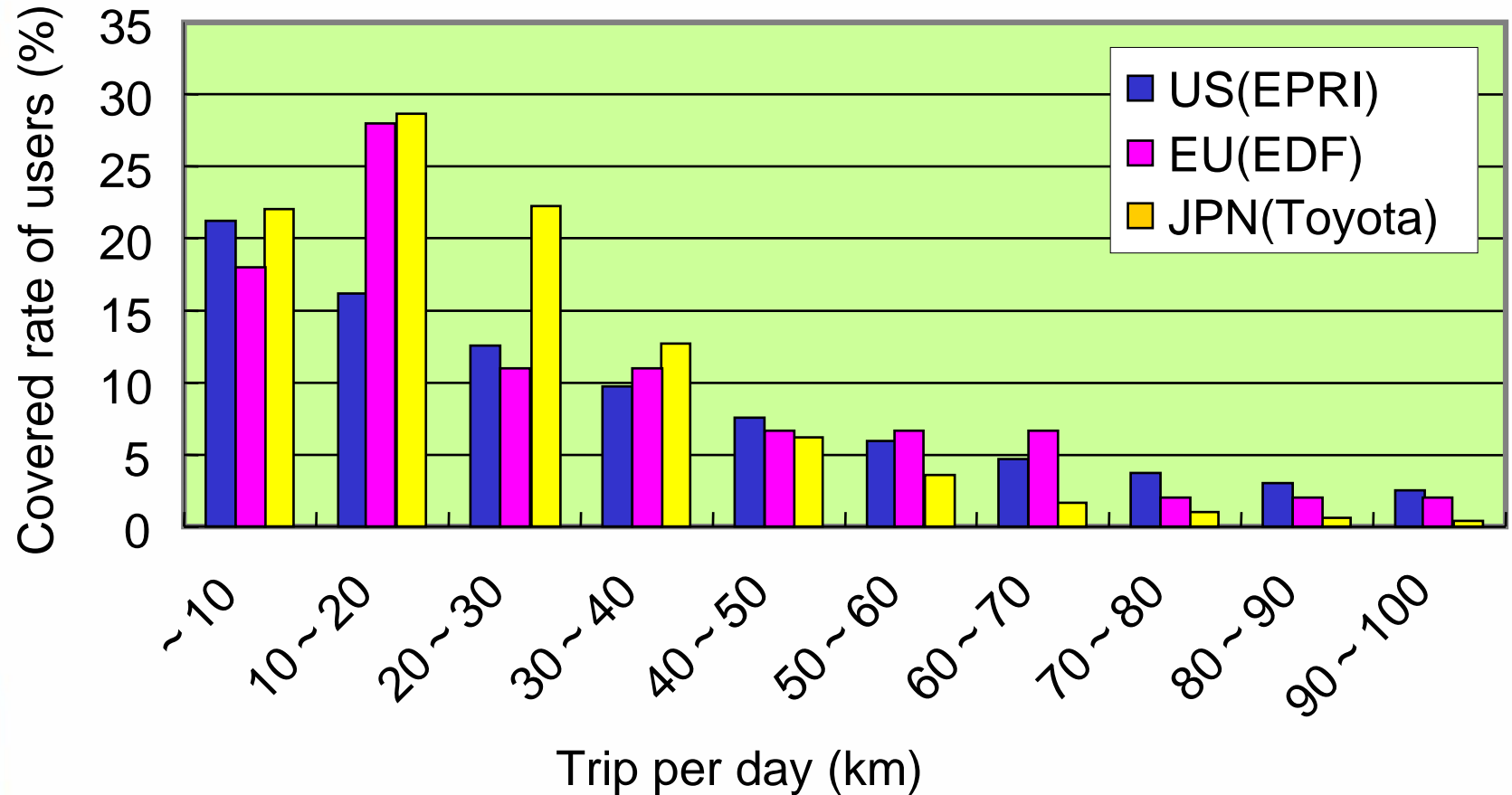
Fuel & Electricity Cost

To
Maximize User Benefits
Minimize CO2 and other emissions

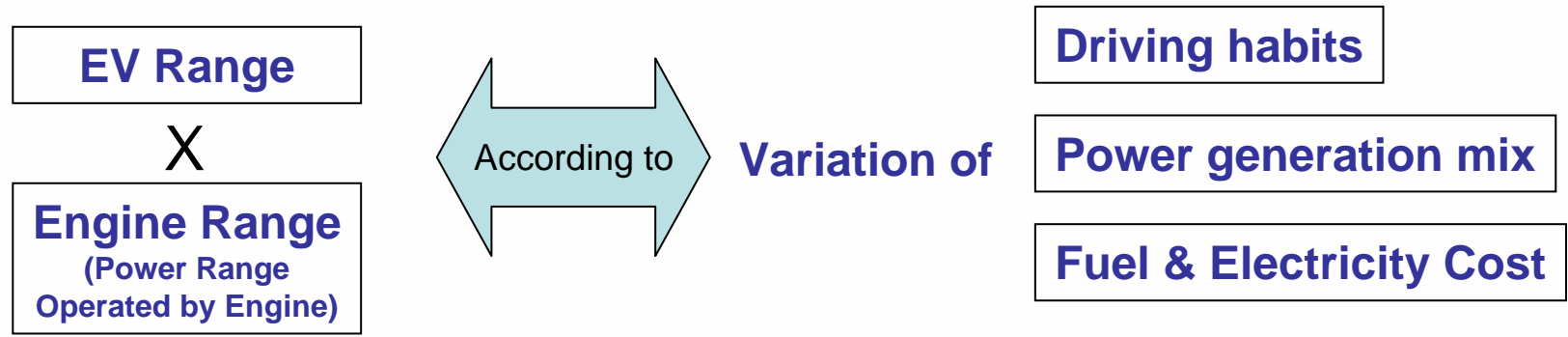


Important to choose not best but good EV range

Distribution of the daily travel distance



Seek best balanced specifications



To
Maximize User Benefits
Minimize CO2 and other emissions

The key is Battery

Cost

Size/Mass

Safety

Life

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Toyota's Plug-in Hybrid Vehicle Specifications

Engine displacement, output	1,496cc 57kW / 5,000rpm
Motor output	50kW / 1,200 - 1,540rpm
EV maximum speed	About 62 mph
Battery type and capacity	Nickel metal hydride, 13Ah
EV cruising range	About 7mile (LA#4 test cycle, TMC estimate)
Recharging source	Household electric outlet
Recharging time	1-1.5 hours at 220V; 3-4 hours at 110V

Purpose of Toyota's PHV demonstration

Verify benefits under real-world conditions

Help develop fuel economy and emissions standards

Collect data to promote popularization and to confirm customer acceptance like charging habits

	US	EU	JPN
Purposes	<ul style="list-style-type: none"> -Verify PHV benefits, like FE, CO2 and emissions -Help develop fuel economy and emissions standards -Confirm charging habits and customer acceptance 		
Partner Organization	University of California Berkeley, Irvine, (Davis)	EDF	Governmental Project, JARI (under consideration)
Area	Los Angeles Ann Arbor, etc	Belgium, France, England etc	Toyota city / Tokyo, etc
Pattern	<ul style="list-style-type: none"> City x Commuting, weekend Country x Commuting, weekend City x Fleet use 		

Conclusions

- **Toyota will continue and further expand the development of hybrid technology because we consider it as one of the important solutions for environmental and energy issues**
- **With plug-in hybrid technology Toyota develops today promising technology for the future, however, significant technical hurdles still exist and innovative battery technology is required.**
- **In the perspective of overall installed power, blended PHV systems have a good potential to make the PHV architecture simple.**
- **To decide the target EV range of a PHV for best usability for customers, detailed investigations on the benefit of increased battery mass and volume versus the increased EV driving range are needed.**



TODAY for TOMORROW