

Overview of Japanese Efforts on Plug-In Hybrid Vehicle

**METI Recommendations for Full-Scale Diffusion of Next-Generation Vehicles -
omnidirectional measures and partnership for early commercialization and diffusion -**

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Infrastructure Development WG**

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0. Background:

Challenges to Reduce Energy Consumption and CO₂

■ 2010 Target of Kyoto Protocol

- CO₂ has increased mainly in civilian and transport sectors from 1990.
- Energy conservation by “top runner” approach, eco-drive, improvement of traffic, etc.

■ Long-term Reduction of CO₂ and Oil Consumption

- Drastic technical measures: transformation of energy and drive train
- 2030 targets: 30% increase of energy efficiency, less than 80% oil dependence in road transport, 40% nuclear share of elec.power
- 50% reduction of CO₂ by 2050

■ Governmental reports which authorized the Specific Targets

- New National energy strategies, 2006/5
- Review of Ground Plan of Energy Policy, 2007/3
- Technology roadmaps update, 2007/3
- Initiatives for next-generation vehicles and fuels, 2007/5
- Revision of long-term energy supply and demand, 2008/3?



1 . Activities toward Full-Scale Diffusion of Next-Generation Vehicles

1. (1) Two Action Plans for Batteries and Positioning of the Infrastructure Development WG

- METI established “Study group on Next-generation Vehicle Batteries” in April 2006 to promote R&D of vehicle batteries.
- The study group summarized recommendations for the future of next-generation vehicle batteries in August 2006, and presented two action plans.
i.e., R&D of high performance batteries and Infrastructure developments for diffusion and promotion

< R & D STRATEGIES >

	Current status	Improved batteries (2010)	Advanced batteries (2015)	Innovative batteries (2030)
Vehicles expected to be realized	Small-sized EVs for power companies	Business use commuter EVs , high performance HEVs	Household commuter EVs, FCVs, PHEVs	Full-scale EVs
Performance	1	1	1.5	7
Cost	1	1/2	1/7	1/40
Development	Industry initiative	Industry initiative	Industry-government-academia collaboration	Universities and research institutes

1. (1) Two Action Plans for Batteries, and Positioning of the Infrastructure Development WG

< INFRASTRUCTURE DEVELOPMENT STRATEGIES >

Establishment of criteria, standards and guidelines

- Battery safety evaluation test method
- Battery performance evaluation test method
- Charging station standardization

Promotion measures

- Purchase incentives (vehicle and charger)
- Incentives in use (vehicle and charger)
- Edification and demonstration projects (vehicle and charging station)

Regulatory reform

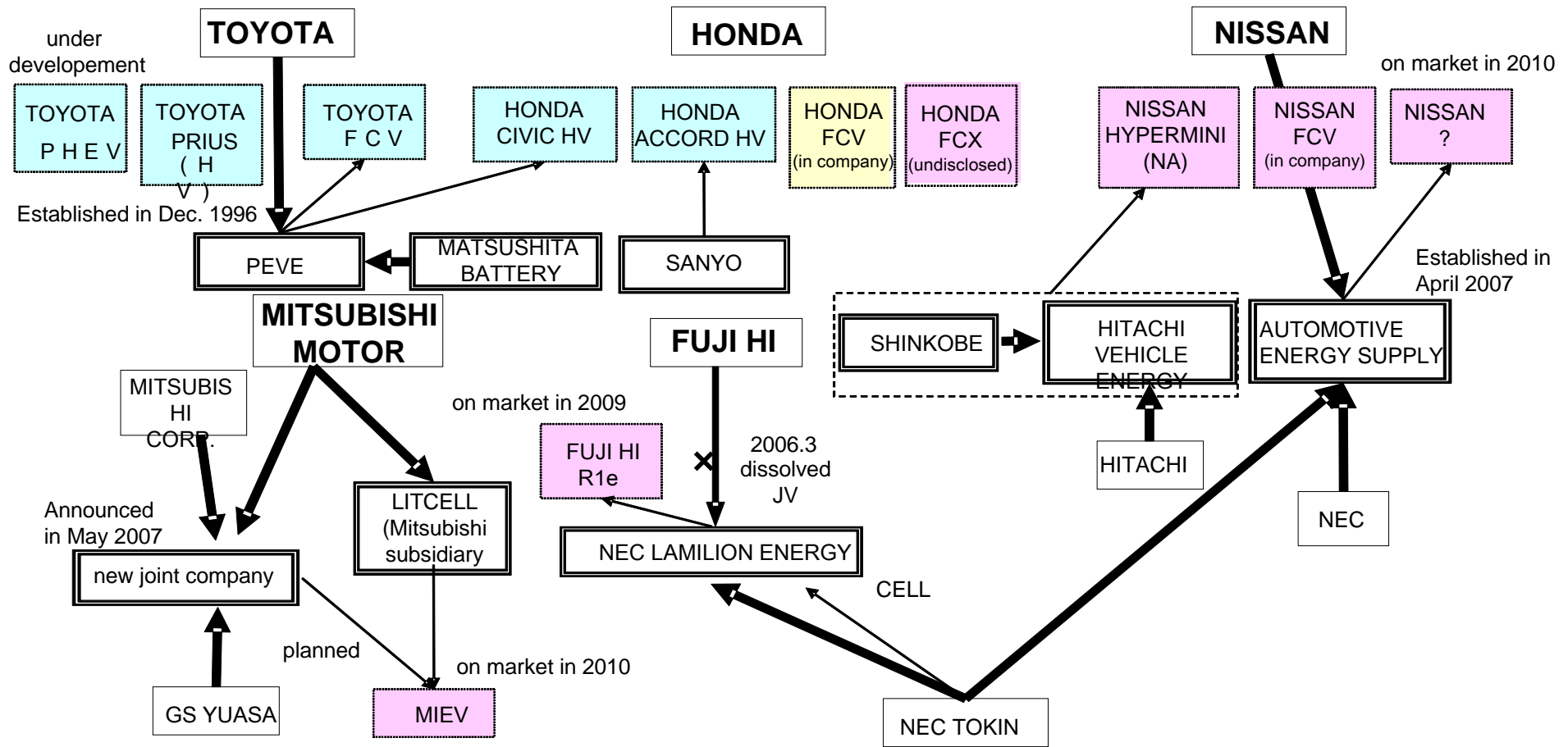
International transport regulations for Li-ion batteries

Securing of resources

Resource development and stock

1. (2) Movement toward diffusion of BEV and PHEV

- Nissan and NEC have established a joint company for vehicle battery production. Mitsubishi Motor and GS Yuasa launched consultations on joint company.
- Auto manufacturers including Fuji Heavy Industries, Mitsubishi Motor and Nissan plan to commercialize electric vehicles around 2010. Toyota and Nissan are in the process of developing plug-in hybrid vehicles toward the practical use.
- Tokyo Electric Power plans to introduce 3,000 electric vehicles for business use. Kanagawa prefectural government announced target to diffuse 3,000 electric vehicles in 5 years after their commercialization.





2. Globally Accelerating Development of Batteries and PHEVs

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The U.S.A., and European and Asian countries are accelerating the development of batteries and PHEVs. We enter a period of global competition for the development of batteries and next generation vehicles.

USA

FreedomCAR Project
R&D of batteries for EV, PHEV and HEV
(2007 budget request: \$40 million)

CA

PHEV is expected for commercialization in near future, while full-scale diffusion of BEVs is still regarded as difficult.

**US
BIG3**

- BIG 3 requested national funding for R&D of Li-ion batteries for next generation HEV and BEV. (\$550 million for 5 years)
- GM has been developing PHEV. Two Mode Hybrid is under joint-development by DC and BMW.

**US
BATTERY
SUPPLIER**

Li-ion battery for HEV is under joint-development by Cobasys, A123 Systems and GM.

EUROPE

ALISTORE

R&D project for new Li-ion battery
(\$7 million for 5 years)

KOREA

Large scale national project

Super high-capacity Li-ion battery and super capacitor are under development.
(\$9 million per year)

CHINA

868 Project

R&D for Ni-MH and Li-ion batteries for BEV, HEV and FCV

OTHERS

R&D of vehicle batteries by LG Chem, Samsung SDI, BYD(China), SAFT



3. Government Move toward Commercialization of Next Generation Vehicles

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- Next generation vehicle battery project started in April 2007.
- Next generation vehicle and fuel initiatives (Japan's environment and energy strategy for vehicles and fuels) formulated in May 2007.
- 2030 targets for 30% increase of energy efficiency and less than 80% oil dependence in transport sector, as well as 50% reduction of CO₂ by 2050

STRATEGY

1: BATTERY - Next generation vehicle battery project -

- R&D project for next generation battery technology (\$45 million x 5 years)
- Development of institutions for charging stations, safety, etc.
- Target: Diffusion of compact EV by 2010, PHEV by 2015, and BEV by 2030

2: HYDROGEN AND FUEL CELL- Development of FC and infrastructure -

3. CLEAN DIESEL VEHICLE - Refurbish its image for fuel-efficient and clean -

4. BIO FUEL - Secure, safe and fair expansion and 2nd generation bio -

5. WORLD'S MOST FRIENDLY MOTORIZED SOCIETY CONCEPT - Congestion free motorized society utilizing IT -

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4. Overall Strategy for Full-Scale Diffusion of Next Generation Vehicles

4. Overall Strategy for Full-Scale Diffusion of Next Generation Vehicles

- 3 strategies for full-scale diffusion of next generation vehicles: R&D, Institutional infrastructure development (Codes, Standards and Regulations), and promotion & edification
- Overcoming short-term conflicts and different interests from a long-term viewpoint, broad range of cooperation between stakeholders is indispensable to implementing the strategies.

R&D strategy

Promote R&D through the industry-government-academia initiatives for the solution of issues including battery performance and cost, resource restriction of motor materials, etc.

Institution development strategy

- Formulate standard test methods for evaluation of battery performance and safety, and secure effective R&D and safety.
- Establishment of international standards for global marketing, and easing of transport regulations of Li-ion batteries.

Promotion and edification strategy

- Provide incentives to bring initial and running costs down.
- Promote intensive development of infrastructure at model areas, and expand the boom throughout all of the country.



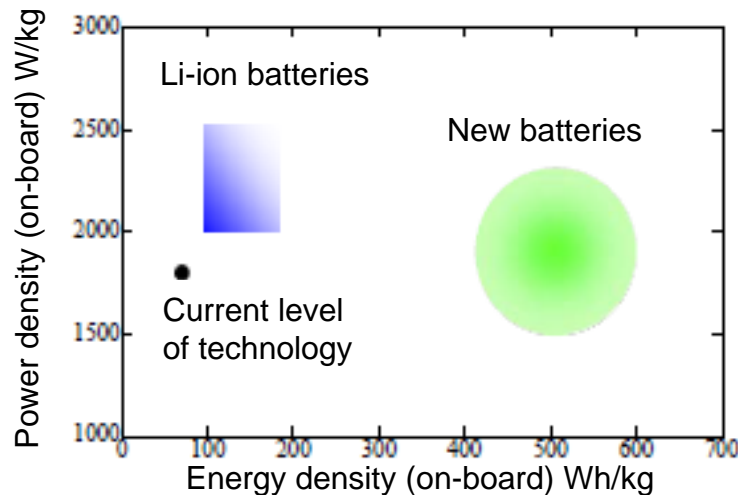
5. R&D Strategy for Upgrade and Cost Reduction of Battery and Motor

5. (1) R&D Project for the Next Generation Vehicle Battery

- Development of high-performance and low-cost batteries and peripheral devices to promote early commercialization of next generation vehicles including BEV, PHEV and FCV.

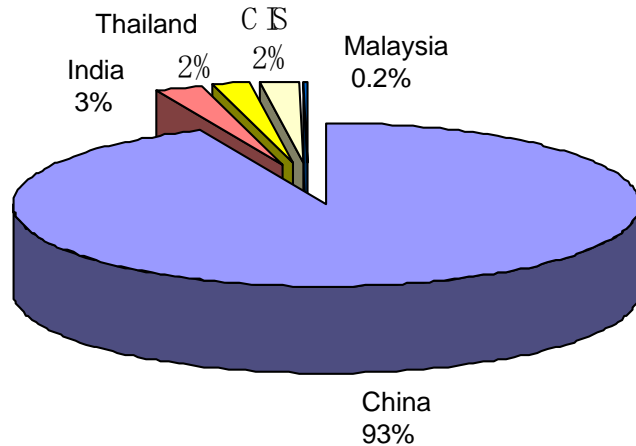
R&D ITEMS		TARGETS
1. Elemental technology development	battery materials, module, control device, motor, etc.	Energy density:100Wh/kg or more Power density:2,000W/kg or more Life cycle: 10 years or more Cost: \$370/kWh
2. Next generation technology development	new-concept positive- and negative-electrode materials, electrolytes, etc.	Battery materials enabling 700Wh/kg energy density, or design guide for such materials by 2030.
3. Fundamental technology development	battery life prediction, test method for durability and safety, analysis technique of reaction mechanism, etc.	Standard test methods for battery. Method to evaluate battery life in less than 1/10 of time. Battery degradation control method.

Budget: \$17 million in FY2007
Project term: 5 years

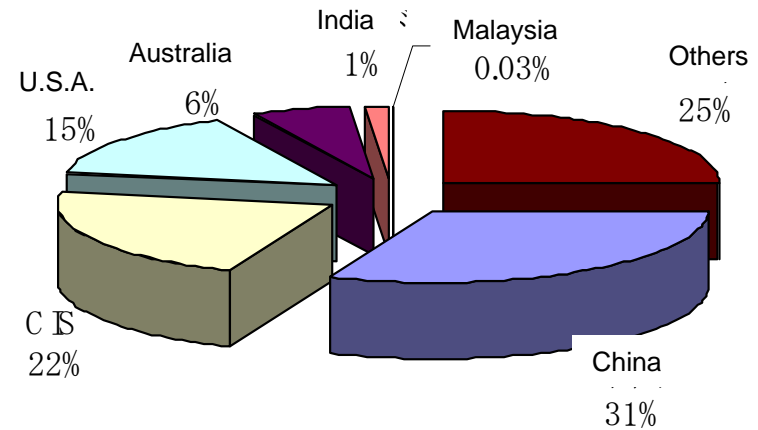


5. (2) R&D Project for Next Generation Vehicle Motor

- High performance motors use permanent magnet containing rare earth elements including neodymium and dysprosium. China holds a 90% share of the world's rare earth production, ranks first in its amount of deposits, and conducts strategic export control.
- Japan will promote upstream development for diversification of supply sources and increase of supply, development of permanent magnet motors using alternative or reduced rare earth, and non-permanent magnet motors (inductive motor, etc.)



Rare earth production



Rare earth reserves

Source: MINERAL COMMODITY SUMMARIES 2006

Price of rare earth (US\$/kg)

	Dec. 2003	Dec. 2005	Ratio to Dec.2003	Dec. 2006	Ratio to Dec.2003
Neodymium	7	14	+200%	31	+443%
Dysprosium	30	69	+230%	113	+377%

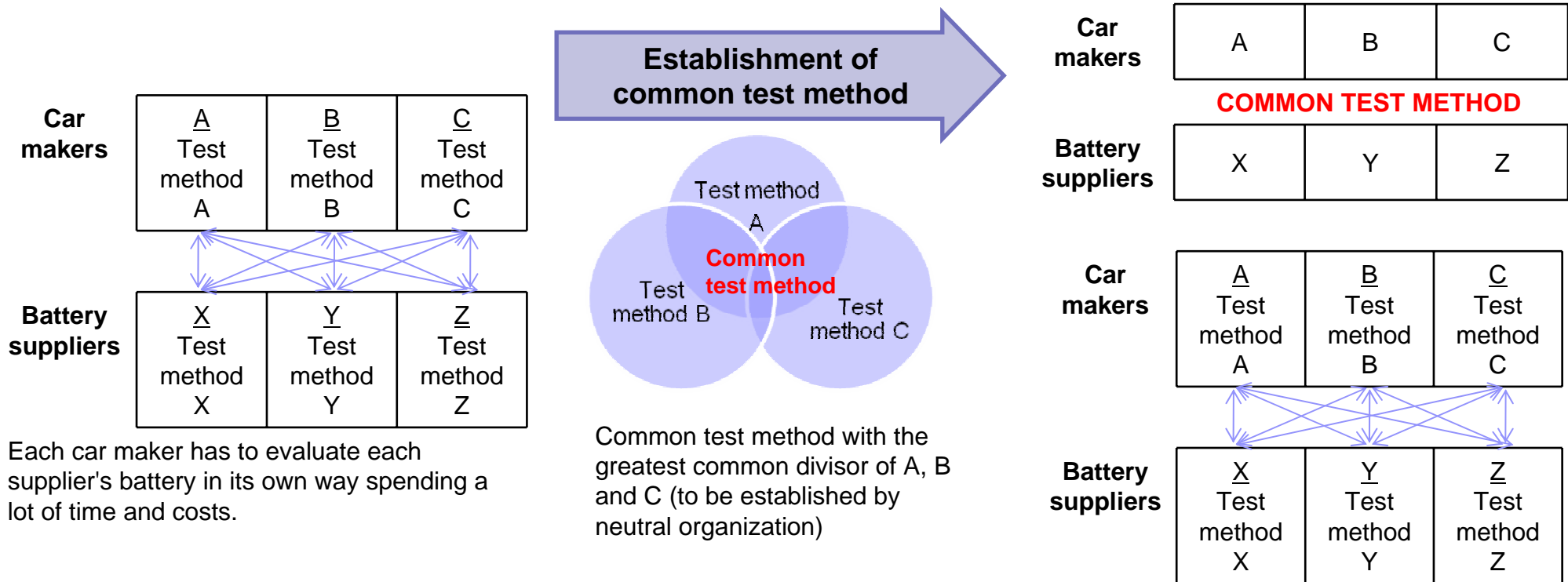
Source: METI



6. Institution Development Strategy to Remove Barriers to Commercialization and Diffusion

6. (1) Test methods for evaluation of vehicle battery performance and safety

- Early establishment of test methods for performance and safety evaluation is indispensable to sharing common direction in accelerating performance and safety advances.
- The common test methods will allow manufacturers to conduct effective and efficient R&D of batteries, and standardization of these methods will enhance their international competitiveness.



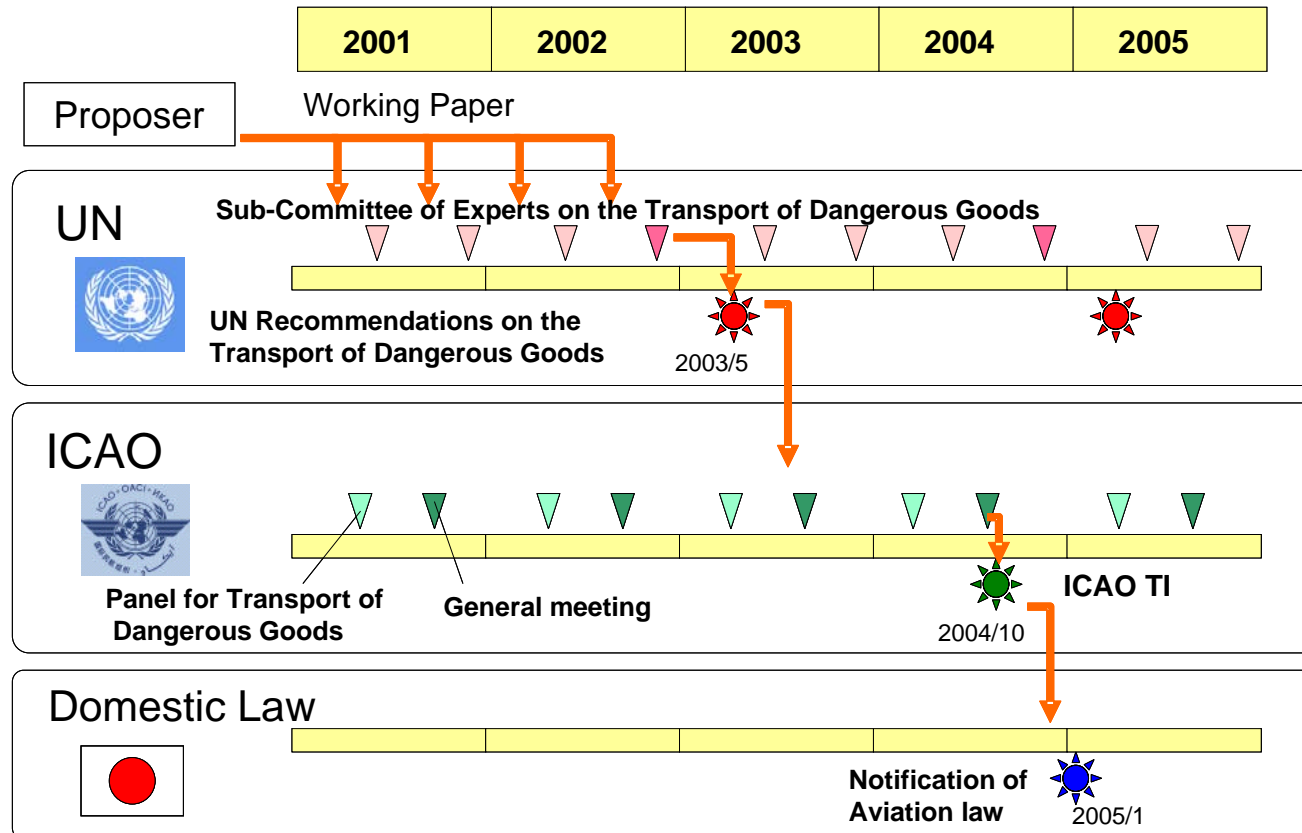
Each car maker has to evaluate each supplier's battery in its own way spending a lot of time and costs.

Common test method with the greatest common divisor of A, B and C (to be established by neutral organization)

The common test secure batteries a certain level of quality. Each car maker may evaluate batteries in its own way for items other than those included in common test.

6. (2) Regulatory Reform for International Transport of Li-ion Batteries

- For efficient international operations for Li-ion traction batteries, regulatory reform of the current U.N. transport regulations is necessary.
- It will take at least 3 years for relaxation of regulations, based on the coordination of multiple interested parties.
- Task force jointly formed by the battery and automobile industries will start operations for adjustment of Li-ion battery transport regulations for electric vehicles.





7. Promotion and Edification Strategy to Accelerate the Diffusion of Next Generation Vehicles

7. (1) Omnidirectional promotion measures for total cost-reduction

Provide electric vehicles with incentives to reduce their initial cost, and to increase advantages in use, and realize merits of total cost in comparison with gasoline vehicles.

Benefits in Purchase (subsidization and tax benefits)

Subsidization (Promotion project for clean energy vehicle introduction)

Subsidy for clean energy vehicle purchasers and establishment of fueling facilities

Clean energy vehicle

- (1) Object vehicle: Electric vehicle, hybrid vehicle (excluding passenger car), etc.
- (2) Object person: private business, etc.
- (3) Subsidy: up to half of price discrepancy

Private charging facility

- (1) Object facility: establishment of charging facility, etc.
- (2) Object person: person who newly installs a normal charging facility for personal use
- (3) Subsidy: up to half of establish costs

Green Taxation (FY2006-2007)

Reduction of automobile tax depending on emission and fuel efficiency

Electric vehicle (including FCV)	50% reduction ▲\14500
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Special exception of automobile acquisition tax for fuel efficient and low emission vehicles

(FY2007-2008)

Electric vehicle (including FCV), NGV, Methanol vehicle, hybrid truck & bus	2.7% reduction ▲\48600
Hybrid passenger car	2.2% reduction ▲\39600 (1.8% for 2008)

Special exception of fixed asset tax (FY2007-2008)

Preferential measure for fueling facilities including charging station.

2/3 base of taxation for initial 3 years

7. (1) Omnidirectional promotion measures for total cost-reduction

Advantage in Use - Running Cost-

	K-class vehicle (ICE)	Electric Vehicle
Driving range	600 km	150 km
Fuel/electricity efficiency	20 km/l	10 km/kWh
Fuel/electricity on board	30 L	15 kWh
Average travel distance per year	10000 km	
Average vehicle year	10 years	
Electric energy rate		¥10/kWh
Gas price	¥140/L	
Gas/electricity cost for 10 years	\$6,500	\$920

Other advantages in Use

- Special parking space at commercial facilities, etc.
- Discount on public and private parking fee
- Installation of free charging outlets
- Priority lane
- Special automobile insurance for next generation vehicle
- Low-interest loan for purchaser of next generation vehicle

■ 7.(2) Promotion based on EV· pHEV Town Concept

①

- To boom up EV promotion in specific areas by concentrated incentives and infrastructure development (EV, pHEV town), in collaboration with national and local governments, automobile and energy industries, local companies, etc., and then to expand it nationwide

■ To Remove Concern of Electricity Shortage

□ Normal Charging during Parking

- Shopping mall, Dept. Store, Hotels, etc
 - Giving CO2 credits etc. to such private entities
- Roadside and Public Parking places
 - Free charging (included in parking fare)

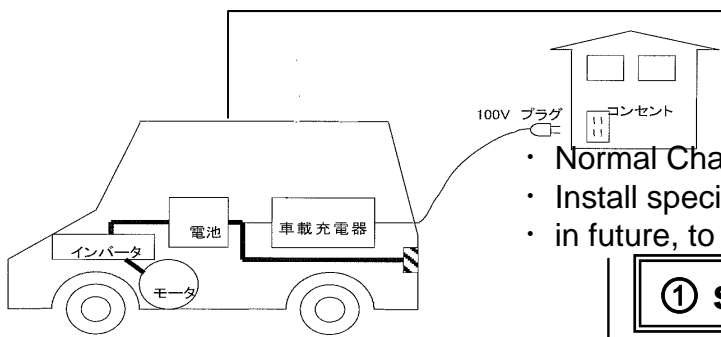
□ Quick Charging at Emergency

- Offices of Electric Utility Co., Car dealers, or Governmental buildings

■ Creation of Incentives to use Evs

- Priority Parking, or specified parking lot
- Free charging facilities
- Admission of drive into the buildings
 - Hospitals, shopping malls, stations etc.

Navigation to charging stations



- Normal Charging by nighttime discounted electricity
- Install special charging plug at garage
- in future, to take in maps, music and movies through PLC(power line communication)



- guide to the near by charging station
- monitoring SOC to avoid battery out by a car navigation system

① secure enough range

Normal Charging

Commercial facilities, Dpt. Store, hotels, malls



- Special parking lot for EV next to that for handicapped
- Free charging for 1 to 2 hours, from AC supply outlet

Public and private parking places



- special EV parking spaces
- free charging from charging outlet

Quick Charging

TEPCO, Car Dealers, Public buildings



- by additional 15min. Charging, the EV can run further 60km.

Drive into indoor public spaces (station, mall, or hospital by clean EVs)



② Creation of EV merit

Incentives to build special EV parking lots for private sectors or local government (subsidies, CO2 credits etc.)

7.(2) Promotion base on EV· pHEV Town Concept ②

- Creation of Incentives to Buy EV s
 - To establish Sales channel specified to Evs
 - Differentiation by specified EV design (cf. Prius)
 - To build attractive Charging stations?
 - Outreach Efforts to promote Evs
 - Exposure to the Media
 - Promotion to Celebrities

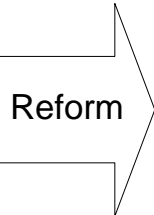
7. (2) EV and pHV Town Concept and Edification Project

3) Make consumer want to buy an EV

Specific sales outlet for EVs

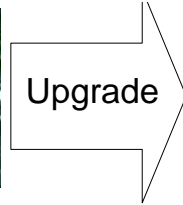


Sale at dealer shops



Sale at showrooms, theme parks, by internet, etc.

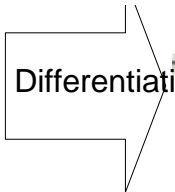
Smart charging stations



Special design for EVs



Same design as gasoline cars



Special body and interior

Increase media exposure, image strategy with celebrity



Envisaged Partners

- Auto manufacturers: Sale and lease
- Power companies: Development of charging facilities
- Local governments: Subsidization, tax incentives, EV parking incentives, establishment of fast charging stations and outlets, initiative introduction of EVs
- Department stores, retailers, etc.: EV parking space, charging outlets
- Building firms (homes with charging outlets), Developer: charging facilities, Insurance industry: EV special insurance, Banks: low-interest loan for EV purchaser

Envisaged stakeholders and their role sharing

- Car manufacturers: sales, leasing of BEVs
- Elec. Power Co.: to develop and install charging facility at home and Quick charging stations
- Local Govmt.: to establish Economic Support measures (Tax exemptions, public parking, self introduction of BEVs)
- Private commercial sectors (department stores, shopping malls etc.): Provision of Priority parking with charging facility
- Home builder: to provide Charging plugs for BEVs, regional arrangement for charging facilities etc.
- Financial sectors: discounted insurance, low-rate loans etc.