Hydrogen & Vehicle Technology Policy in Japan

May 18, 2009

Hydrogen & Fuel Cell Promotion Office
Agency for Natural Resources and Energy
Ministry of Economy, Trade and Industry

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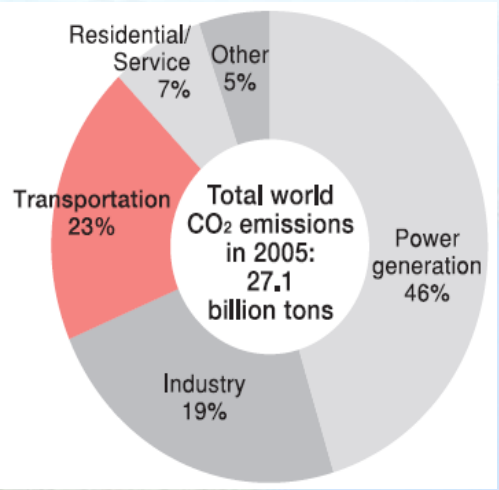
1. The environmental energy strategy on vehicles and fuels in Japan

～The Next-Generation Vehicle and Fuel Initiative～

The CO2 reduction of the transportation section which is an urgent problem

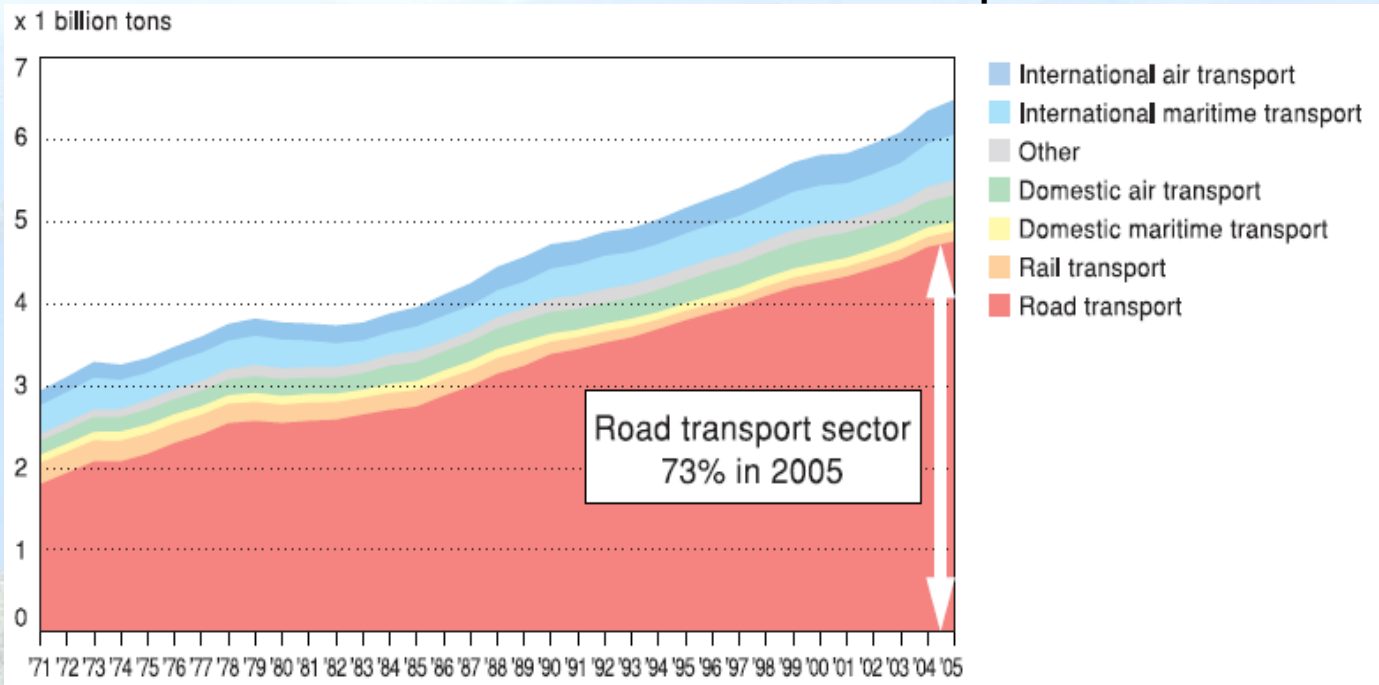
- Expanding motorization across the global has caused a steady increase in CO2 emissions in the transport sector, which accounted for about 23% of total worldwide CO2 emissions in 2005, of which roughly 73% was generated by road transport.

<World CO2 Emissions by Sector>



Source:CO2 Emissions from fuel combustion 1971-2005,International Energy Agency(2007)

<CO2 Emissions in the Global Transport Sector>



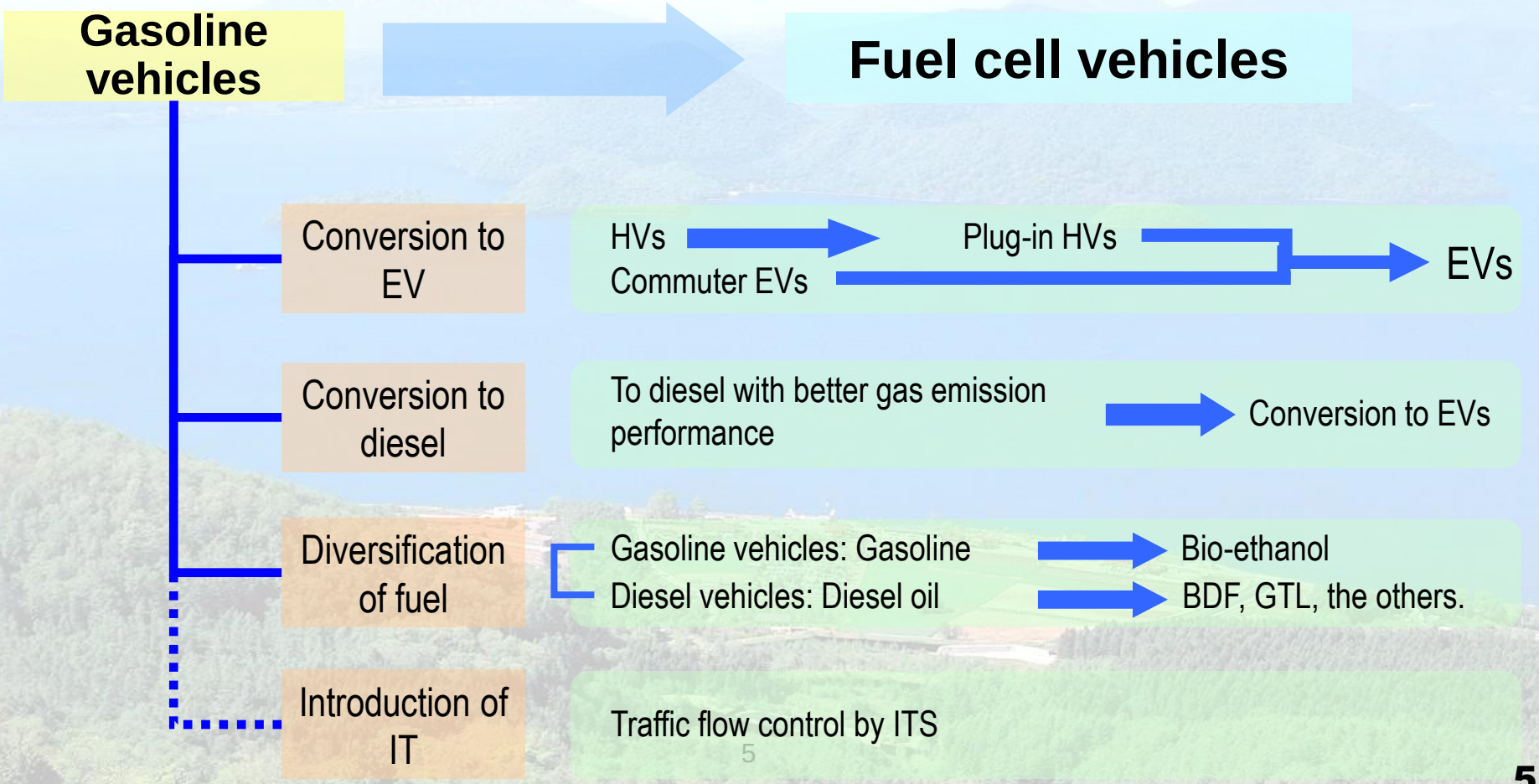
Notes: 1. The above emission volumes represent fuel combustion-generated CO_2 emissions only; they do not include electricity and heat end-use emissions.
2. "Other" includes CO_2 emissions from vehicles for off-road use, such as construction and ore transport equipment, and from oil/gas pipeline transport.

Source: CO_2 Emissions from Fuel Combustion 1971-2005, *International Energy Agency (2007)*

Diversified Technology Options

- Traditional single-track scenario was to realize fuel cell vehicles.
- However, rising interests in hybrids, clean diesels, and alternative fuels show how vehicle technology has diversified in recent years.

(1) Conversion to fuel cells (2) Conversion to EVs (3) Conversion to diesel (4) Diversification of fuel



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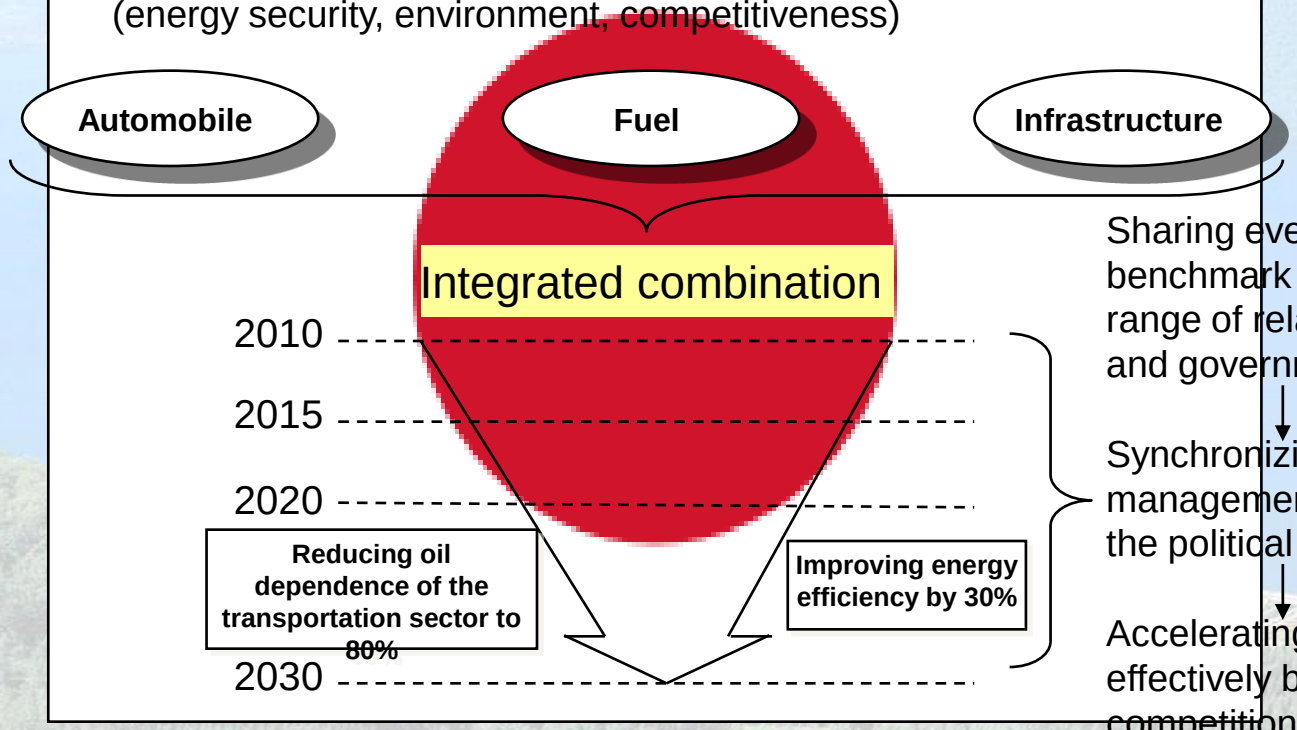
Concept of The Next-Generation Vehicle and Fuel Initiative

- The Next-Generation Vehicle and Fuel Initiative is the environmental energy strategy on vehicles and fuels in Japan.
- METI, the automotive industry, the oil industry agreed it in May 2007.

Strategy of Japan

Based on the three key words (cross-industrial, cross-ministries and agencies, benchmark sharing), realizing three innovations (automobile, fuel, infrastructure) and solving three problems (energy security, environment, competitiveness)



Sharing every 5 to 10 year-benchmark between a broad range of related industries and government agencies

↓

Synchronizing the management strategy with the political strategy

↓

Accelerating the innovation effectively by efficient competition

The Next-Generation Vehicle and Fuel Initiative is a milestone for Beautiful Star 50”

Current Status

- Gasoline vehicles and diesel trucks occupy 100%
- 100% oil dependence for fuel
- Congestion in traffic infrastructure in cities

Execution of The Next-Generation Vehicle and Fuel Initiative

- Realization of innovation by collecting Japanese technological strength

Industry collaboration | Government collaboration | Industry-government-academia Collaboration

High-performance hybrid vehicle

CO_2 emission : ▲1/2

Standard-sized electric vehicle

CO_2 emission : ▲3/4

Next-next generation fuel cell vehicle

CO_2 emission : ▲2/3

Biofuel such as biogasoline

CO_2 emission : ▲ 3%

* Equivalent to 3% bio-ethanol mixture

World’s most friendly motorized society without traffic congestion

CO_2 emission : ▲10%

The world “The Next-Generation Vehicle and Fuel Initiative” targets in 2030

- 80% oil dependence in transport sector
- 30% improvement of energy efficiency

Reduction of CO_2 in the world using Japanese technology, by developing the result of innovations

Outline-Achieving Innovations with Engines, Fuels and Infrastructure through Five Strategies

Innovation of Engine

Strategy 1：Battery - Next-generation vehicle battery project and model project

- Technology-development project for next-generation batteries [5.3 billion yen in FY2008 × 5 years]
- Enforcement of the spread promotion model project, System maintenance such as the establishment of the evaluation test method
- Aim to real diffusion of compact EVs in 2010, plug-in HVs in 2015, and standard-sized EVs in 2030

Strategy 2：Hydrogen/fuel cell - Technology development of fuel cells and infrastructure-building

- R&D project for fuel cells[29 billion yen for FY2008], scheduled to practice with the same amount in the future]
- Verification project for hydrogen/fuel cell(Testing for verification in consideration of future hydrogen infrastructure)
- Aim for price as low as gasoline vehicles by 2030

Strategy 3：Clean diesel - Completely new image of low fuel consumption and clean fuel

- Establishment of Clean Diesel Promotion Conference (Improvement of image and incentives for introduction is examined by Industry-government-academia collaboration)
- An innovative next generation low-emission vehicle synthesis technology development project [0.5 billion yen for FY2008], R&D on gas-oil type of new fuel (GTL [6 billion yen for FY 2008], hydrogenated bio gas oil, etc.)
- Aim for full-scale introduction of clean diesel vehicles into Japanese market in and after Sep, 2009, which has the strictest exhaust-gas control in the world

Innovation of Fuel

Strategy 4：Biofuel - “Secure, safe, and fair” expansion and second-generation biotechnology

- March, 2008 devise the bio fuel innovation plan that gathered a concrete aim, the road map of the cellulose system ethanol production technology development in a biofuel innovation conference
- A cellulose system ethanol production technology development project [13 billion yen in FY2008],Establishment of the system to secure quality and to prevent tax evasion
- Aim for 100 yen/lit. domestic next-generation biological material in 2015 (Biomass Nippon) Furthermore, aim for 40 yen/lit. (in case of technology innovation)

Innovation of Infrastructure

Strategy 5：The concept of the world’s most friendly motorized society

- Building the world’s most friendly motorized society by fully utilizing IT

- Energy ITS technology development project [0.9 billion yen for FY2008(New)]
- Enforcement of technology Development for practical use of automatic-controlling / file run file run
- Aim of doubling average speed in urban areas by 2030 (Current average speed: 18 km/h in Tokyo, 26 km/h in Paris)

Next-Generation Vehicle

	Gasoline	HEV	EV	PHEV
				
CO2	1	1／2	1／4	1／2～1／3
Cost	**1.5MYEN**	**2.3MYEN**	**Approx. 4MYEN**	**Prototype**
Fuel cost	**8.2YEN/km**	**4.2YEN/km**	**2.2 or 0.7YEN/km**	**3.8 or 2.5 YEN/km**
Range	**（900km）**	**（1600km）**	**< 160km**	**> 1600km**
Infrastructure	**OK (gasoline)**	**OK (gasoline)**	**electricity**	**Gas + Elec.**
Market	**available**	**available**	**FY2009~**	**FY2010~**

NOTE1 fuel cost = fuel price / gas millage.
Gasoline = 150 YEN/L
Electricity = 22YEN/kWh (day) 7YEN/kWh (night)

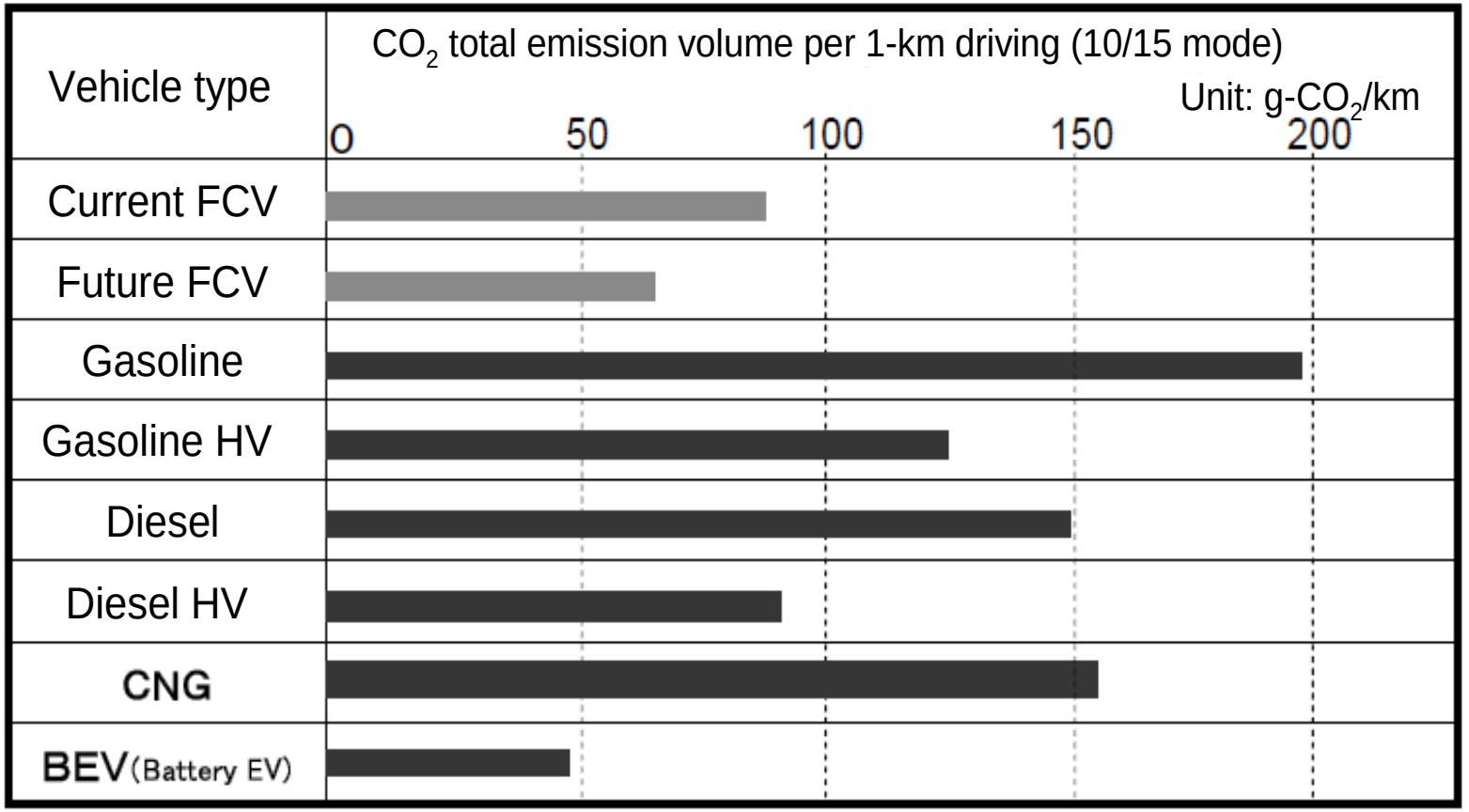
NOTE2 cruising range was estimated as follows;
Cruising range = Tank capacity x gas millage.

2. Strategy on next generation battery and depoyment of Evs and PHVs in Japan

The propulsion of electric road vehicles of the high CO2 performance

○ The propulsion of electric road vehicles such as EVs, FCVs, HVs, have overwhelmingly high CO2 performance, effluent gas performance, energy efficiency.

(Well-to-Wheel)



Current FCV: The "hydrogen station" and "FCV" data is calculated from the top values of the JHFC demonstration result, and other data is calculated from the top values in the technical literature.

Future FCV: Calculated from the FCV's future FC system efficiency of 60% and the top values in the technical literature

Power system: Average power system used in Japan

Source: JHFC total efficiency investigation result

Action Plan – R&D Strategies

○ Separate R&D strategies into the three phases of i. improvement, ii. advancement, iii. Innovation and clarify the development target for vehicle batteries.

	Current status	Improved batteries (2010)	Advanced batteries (2015)	Innovative batteries (2030)
Vehicles expected to be realized	Small-sized EVs for electric power companies	Business use commuter EVs More Fuel Efficient HVs	Household commuter EVs Fuel cell vehicles Plug-in hybrid vehicles	Standard-sized EVs
Performance	1	1	1.5 times	7 times
Cost	1	1/2	1/7	1/40
Development system	Industry initiative	Industry initiative	Industry-government-academia collaboration	Universities and research institutions

Now, promoting a technology-development project for next-generation batteries

Advanced Battery System Development for Next Generation Vehicles

Research Purposes

○Background

At present, the transport sector is nearly 100% dependent on petroleum.
We understand that we have to reduce this dependency by using energy more efficiently and by using alternative energy sources.We highly expect for the dissemination of fuel cell vehicles and electric vehicles as they would reduce petroleum dependency and decrease the environmental load.

○Purposes

We have to develop the advanced secondary batteries in order to speed the commercialization of next generation cars. Therefore, we are researching the elemental technologies, the next generation technologies and the basic technologies related to high performance storage battery system.

Research Contents

○Research development subjects

①Elements technology development :
To develop the advanced lithium ion battery and its structure materials related to progresses of energy efficient of ECF, HEV and EV, and peripheral instruments(motor, battery control device).

②Next generation technology development :
To develop the revolutionary batteries based on the new conception and those materials. And to develop the battery response control technology.

③Basic technology development :
To develop the way of testing the acceleration battery life on storage battery, to extract the factor of battery performance improvement and to settle on the safety standard and battery testing way standard.

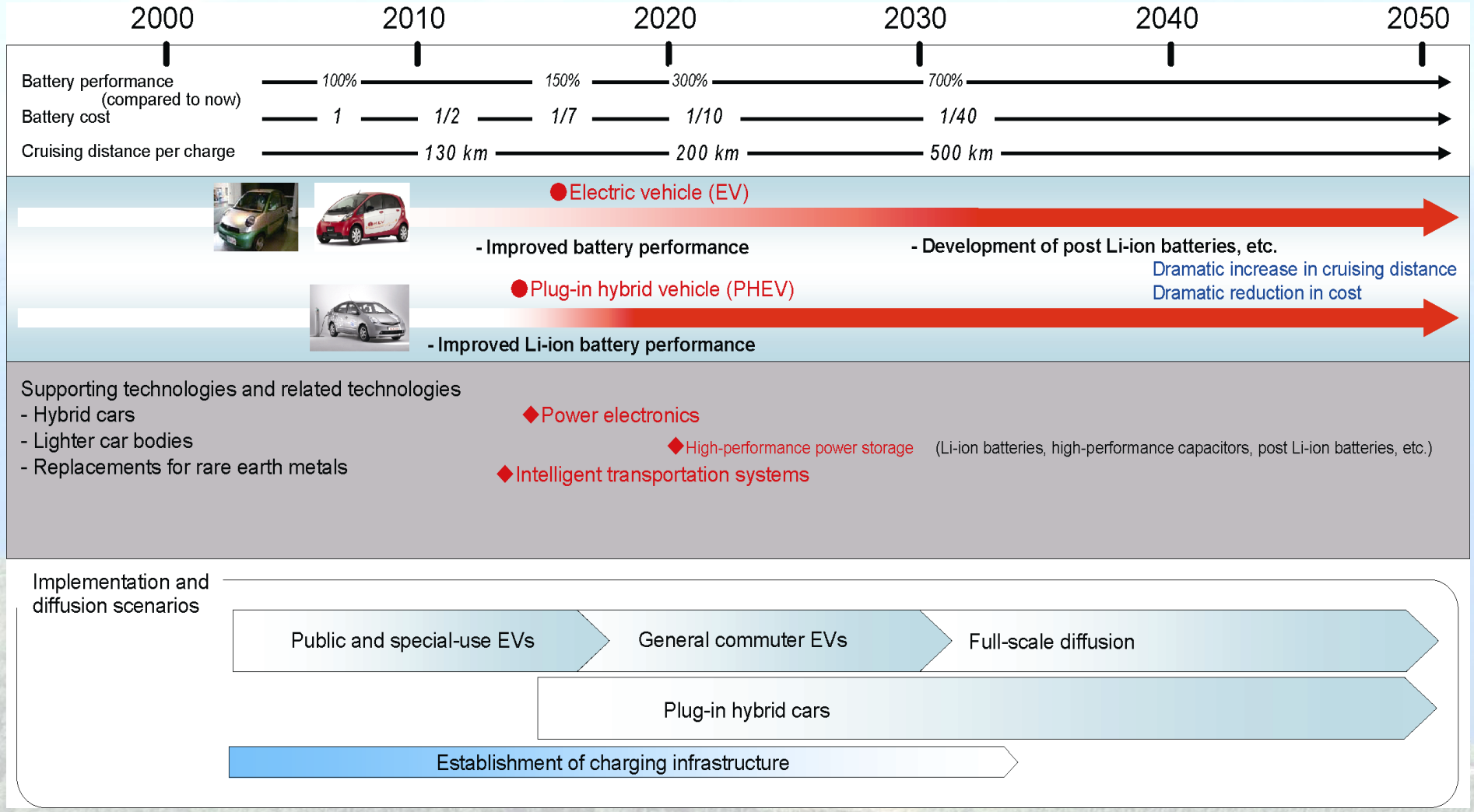
Scale of Project

○Budget and its research development period

FY 2008 budget : 2.9 Billion Yen FY 2009 budget : 2.6 Billion Yen period : 5 years(2007-2011)

Source: New Energy and Industrial Technology Development Organization

Roadmap on the spread of EVs and PHVs



3. Hydrogen／FCV Policy in Japan

Japanese Fuel Cell Vehicles(FCV)

Toyota, Honda and Nissan are developing Fuel Cell Vehicles.
The elongated cruising range was achieved through improved stack efficiency in FCX Clarity, while the FCHV-adv's cruising range exceed 500miles by introducing 70MPa high pressure hydrogen tank.

HONDA FCX Clarity

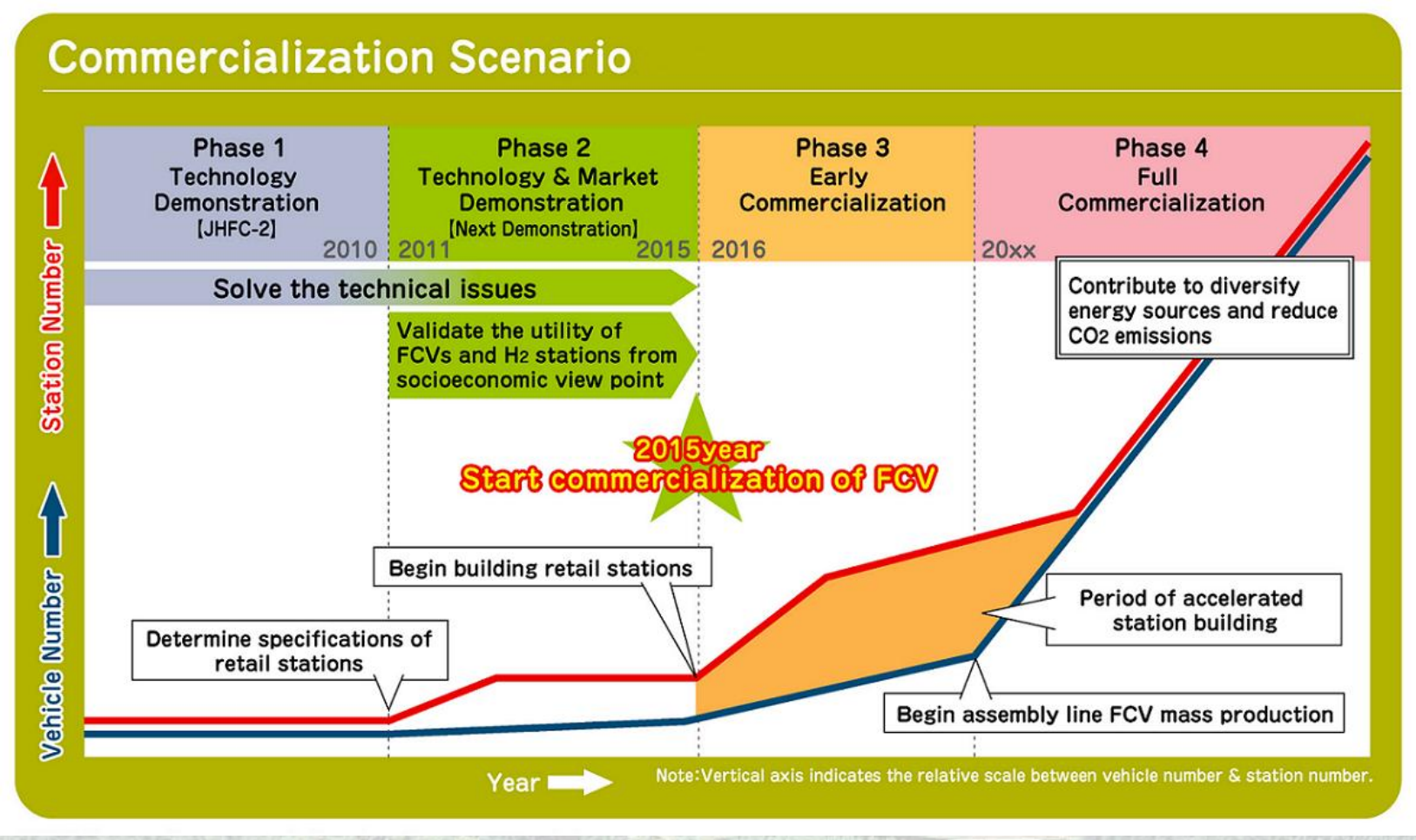
Cruising Range : 620km (390miles)
Fuel Cell Stack : 100kW
Top Speed : 160km/h (100mph)
Pressure of Hydrogen Tank : 35MPa

TOYOTA FCHV-adv

Cruising Range : 830km (520miles)
Fuel Cell Stack : 90kW
Top Speed : 155km/h (97mph)
Pressure of Hydrogen Tank : 70MPa

Commercialization Scenario of FCV and Hydrogen Stations

Leading automakers in and outside Japan and Japanese energy companies have agreed on a scenario which sees commercialization of fuel cell vehicles (FCVs) and hydrogen stations beginning in 2015.



Source : FCCJ, http://www.fccj.jp/pdf/20080704sks1e.pdf

Residential Fuel Cells

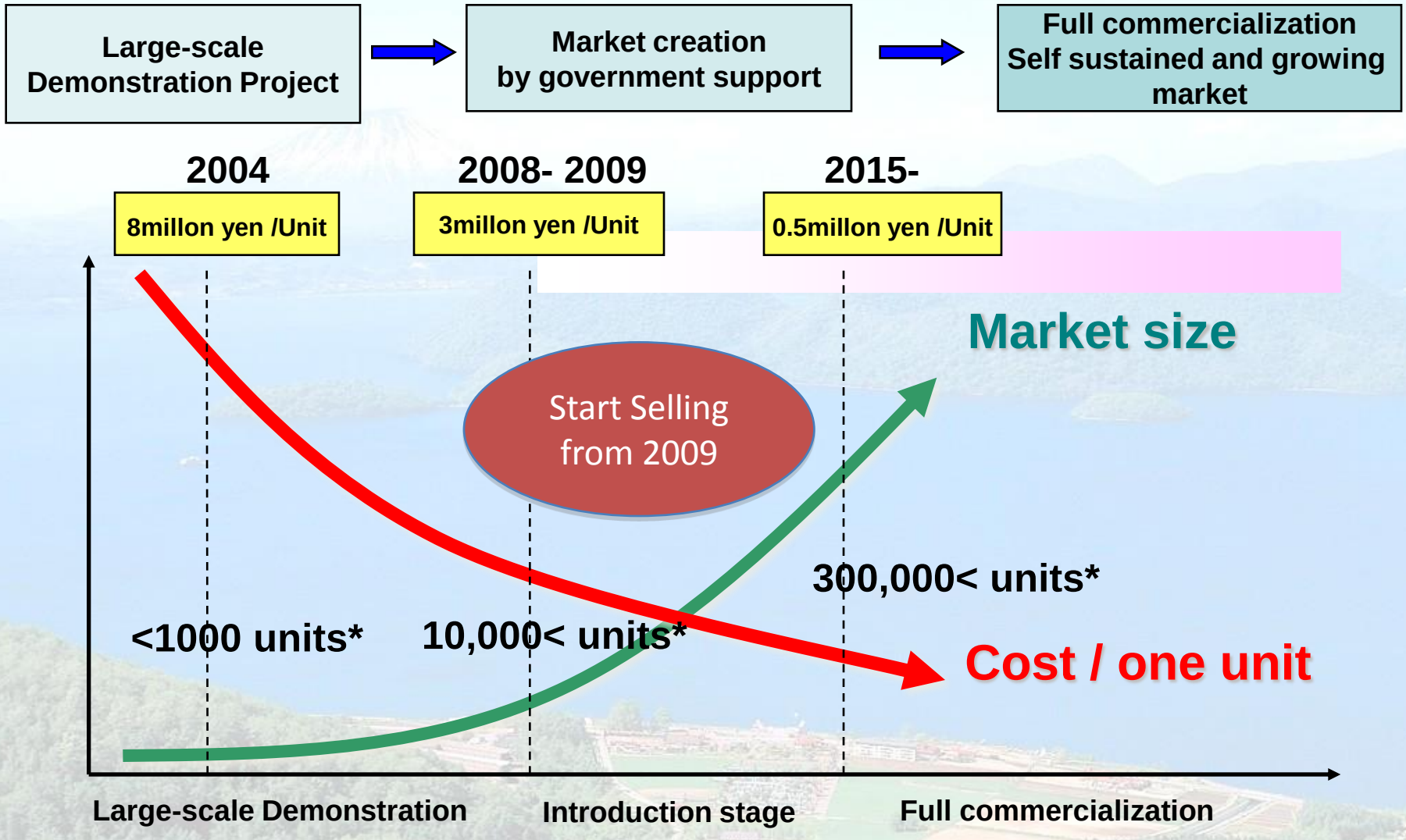
A naming ceremony

家庭用燃料電池コージェネレーションシステム
ENE·FARM
エネファーム

“ENE FARM” - The unified logo for Residential Fuel Cells

Price (included installation cost)
In 2009
About **3millon yen /Unit**

Scenario of Market Creation for Residential FC



Note: * means annual production rate

Promote the introduction of Residential Fuel Cells

Budget: 10.3 billion JPY for FY2009
(Project Period: 2009 ~ 2013)

Subsidy to promote the introduction of Residential FC co-generation system.

Summary

To stimulates the initial domestic market demand of the Residential Fuel Cells, “ENE-FARM”, a subsidizing scheme will be started from May 2009.

Requirements, etc.

The target system

(i) FC co-generation system which is capable to generate 0.5~1.5kW per unit.
(ii) FC co-generation system which equips the 150L or larger hot-water tank.
(iii) FC co-generation system which possess total energy efficiency of 80% or larger.

Amount of the subsidy

A half of the (Equipment and installation) expense.
（The upper limit per Unit : 1.4M JPY）

ENE・FARM
エネファーム

Total Budget for FC/Hydrogen in FY2009

Total Budget 36.8 billion YEN for FY2009
=about $ 370 Million (1$=100YEN)
(30.9BillionYEN for FY2008)

1. Promote the Introduction of Residential Fuel Cells (10.3 billion Yen)
   Subsidy to promote the introduction of Residential FC co-generation system.

2. Demonstration project toward commercialization (4.1 billion Yen)
   JHFC project(Japan Hydrogen and Fuel Cell Demonstration Project) (1.0 billion Yen)

3. Strategic R&D
   Strategic Development of PEFC Technologies for Practical Application
   (6.7 billion Yen)

   Development of production, transportation, and storage of hydrogen (1.4 billion Yen)

   Advanced Fundamental Research on Hydrogen Storage Materials (1.0 billion yen)

   Polymer Electrolyte Fuel Cell Cutting-Edge Research Center (0.9 billion yen)

   Research Center for Hydrogen Industrial Use and Storage (1.1 billion yen)

Supplementary budget FY2009 is included in the budget figure above
Supplementary budget FY2009 is under discussion in Diet

JHFC Project

Budget: 1.0 billion yen for FY2009

Project year: FY2006 - FY2010

Hydrogen Infrastructure

H_2

FCEV Demo. Project

Kansai Area

- New applications and H_2 station demo. (Wheelchairs, FC motor cycles).
- Emergency power source applications
- H_2 station suitable for cities.
- Conventional H_2 supply (Satellite stations).
- H_2 stations are under construction.

Common

- PR・Educational activities
  Initiate and join events
  JHFC park event
- PR・Long-term strategy
  Proposal for educational curriculums in school and social education

Tokyo Metropolitan Area

- Fleet demo. by third party.
- Verification of safety, reliability and performance improvements for various H_2 sources and production methods.
- Nine H_2 stations and fifty FCVs

Chubu Area

- FC bus demo.
- H_2 station test.
- Natural gas reforming and off-site hybrid H_2 station.
- Two H_2 stations and three FCVs.

Basic Research for profound understandings of Science in FC/H2 ; toward next step R&D

1. Advanced Fundamental Research on Hydrogen Storage Materials (FY2007~FY2011) (AIST)
HYDROSTAR, Fundamental Research on Hydrogen Storage Materials.
- Utilization of advanced probes such as synchrotron radiation and neutrons for fine structure analysis
- Collaboration with top class laboratories outside of Japan (**Los Alamos National I Laboratory.**
- Concentrative collaborations of 14 institutes in Japan including AIST as a core site.

2. Polymer Electrolyte Fuel Cell Cutting-Edge Research Center (FY2005~FY2009) (AIST) FC-Cubic, Fundamental Research on PEFC
- Detailed analysis and modeling of reaction mechanism inside fuel cells.
- 31 researchers from company and university.

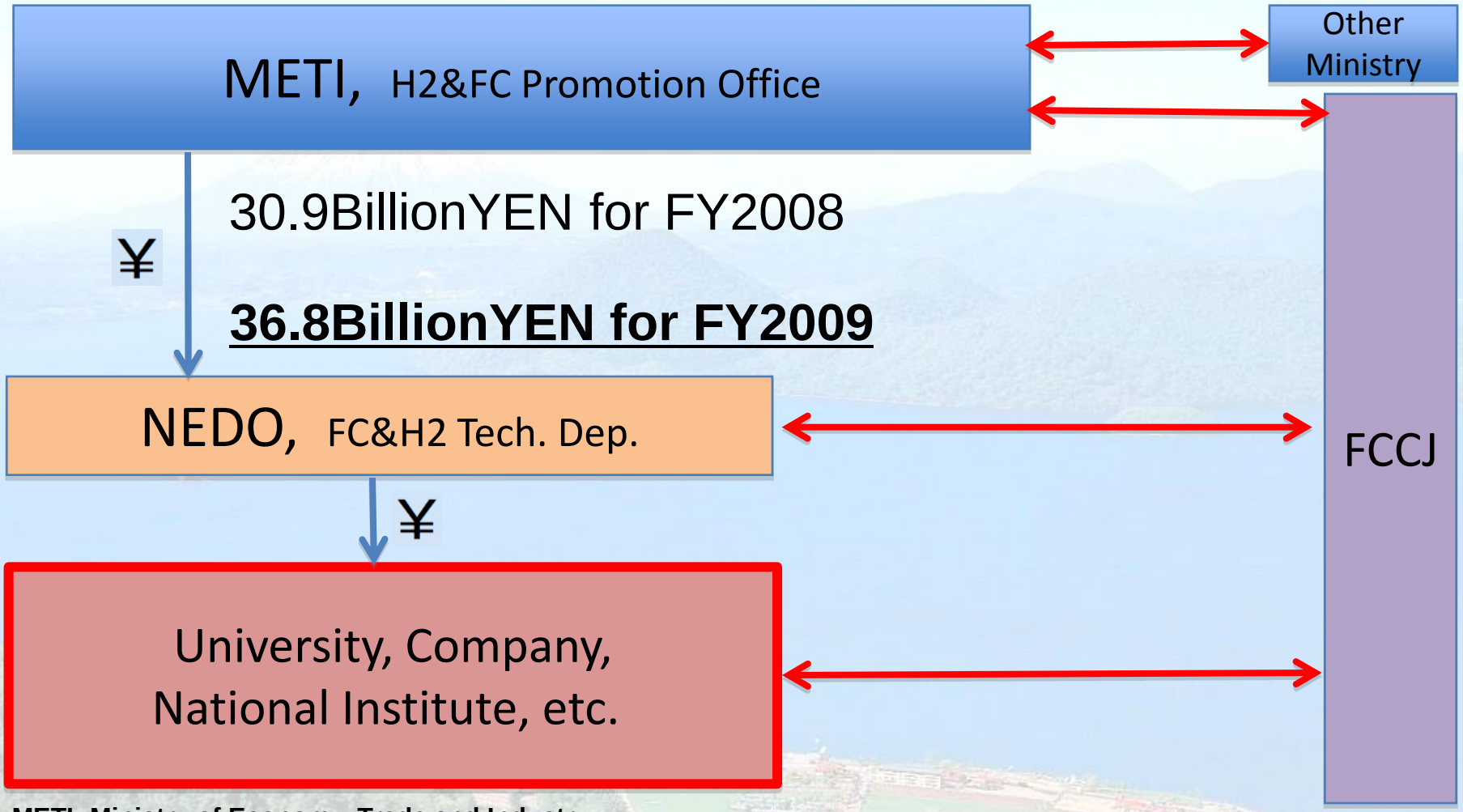

FC-Cubic (Est. 2005)

3. Research Center for Hydrogen Industrial Use and Storage (FY2006~FY2012) (Kyushu Univ., AIST) HYDROGENIUS, Basic research on materials used in hydrogen.
- Basic researches on materials embrittlement, hydrogen tribology.
- Participation of world class researchers (approx. 100 scientists)
(18 researchers from 9 countries including USA, France, China, Ukraine, Israel)


HYDROGENIUS Main building

4. Basic materials research for High Performance Fuel Cell (FY2008~FY2014) (Yamanashi Univ.)
HiPer-FC Project
- Development of high performance PEFC based on the state-of-the-earth science.
- Materials researches based on the advanced analysis of reaction and degradation with nanometer scale.

Framework for R&D for Hydrogen and Fuel Cells under METI



METI: Ministry of Economy, Trade and Industry

NEDO: New Energy and Industrial Technology Development Organization

FCCJ: Fuel Cell Commercialization Conference of Japan

4. Conclusion

Conclusion

- EVs, plug in HEVs are the effective means that can solve the global warming problem in the transportation section, the energy control, the air pollution problem at the same time.

- However, they have some technical, financial and social barriers including a performance enhancement and reduction in cost, spread of EVs, plug in HEVs enlightenment / spread promotion of the battery.

- Commercialization of Residential Fuel Cells started this month (in MAY, 2009), and Commercialization of FCV is scheduled to start in 2015 in Japan.

Thank you for your attention.

If you have any questions, please send e-mails to

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