The Japanese policy and NEDO activity for future mobility

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Representative office in Europe
New Energy and Industrial Technology Development Organization (NEDO)

1. What's NEDO – History and Missions

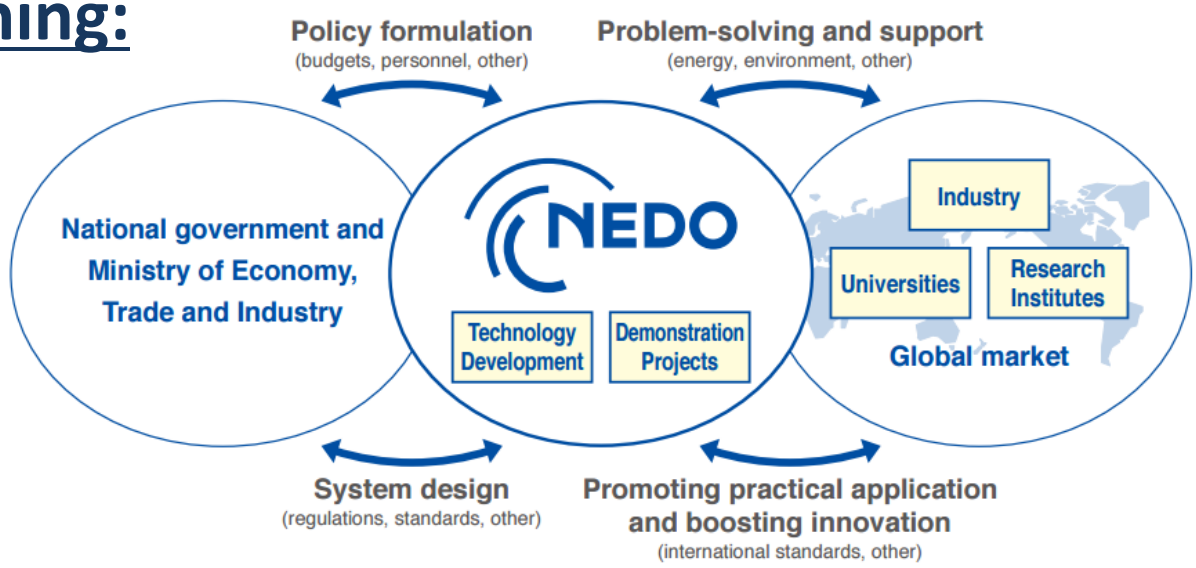
History:

1980 **New Energy Development Organization** established
1988 **Industrial Technology** research and development added

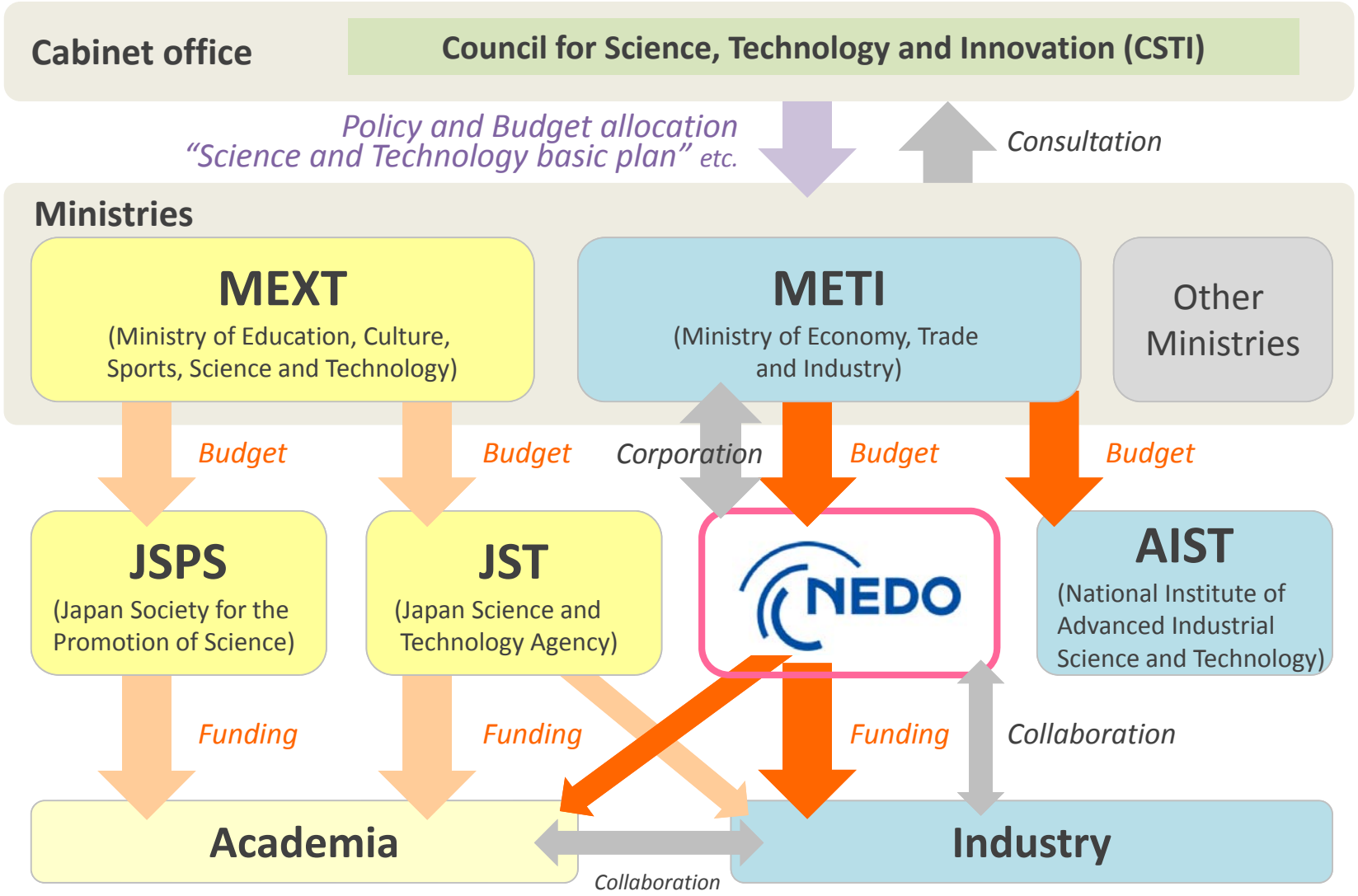
Two basic missions:

1. **Addressing energy and global environmental problems**
2. **Enhancing industrial technology**

Positioning:



1. What's NEDO – National STI Structure in Japan



1. What's NEDO – NEDO's Technology Development Fields

Covers a wide range of technology fields, necessary for the future

Energy and Environmental Fields

New energy


Clean coal technologies

Energy conservation


Rechargeable batteries and energy systems

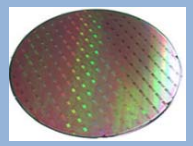

Global warming mitigation

Environment and resource conservation


Support for International expansion

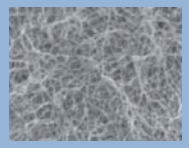
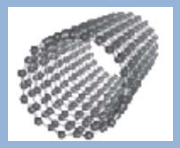
Industrial Field

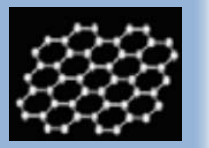
Electronics, information and telecommunication




New Manufacturing technology

Materials and nanotechnology



Crossover and peripheral fields

Robot technology



1. What's NEDO – Major impact of NEDO's R&D

Photovoltaic power generation

NEDO reduced the cost of cell module to 1/200.

New HYBRID™ photovolt

Solar cells can be installed to fit roof dimensions.

Concentrated photovoltaic power generation system

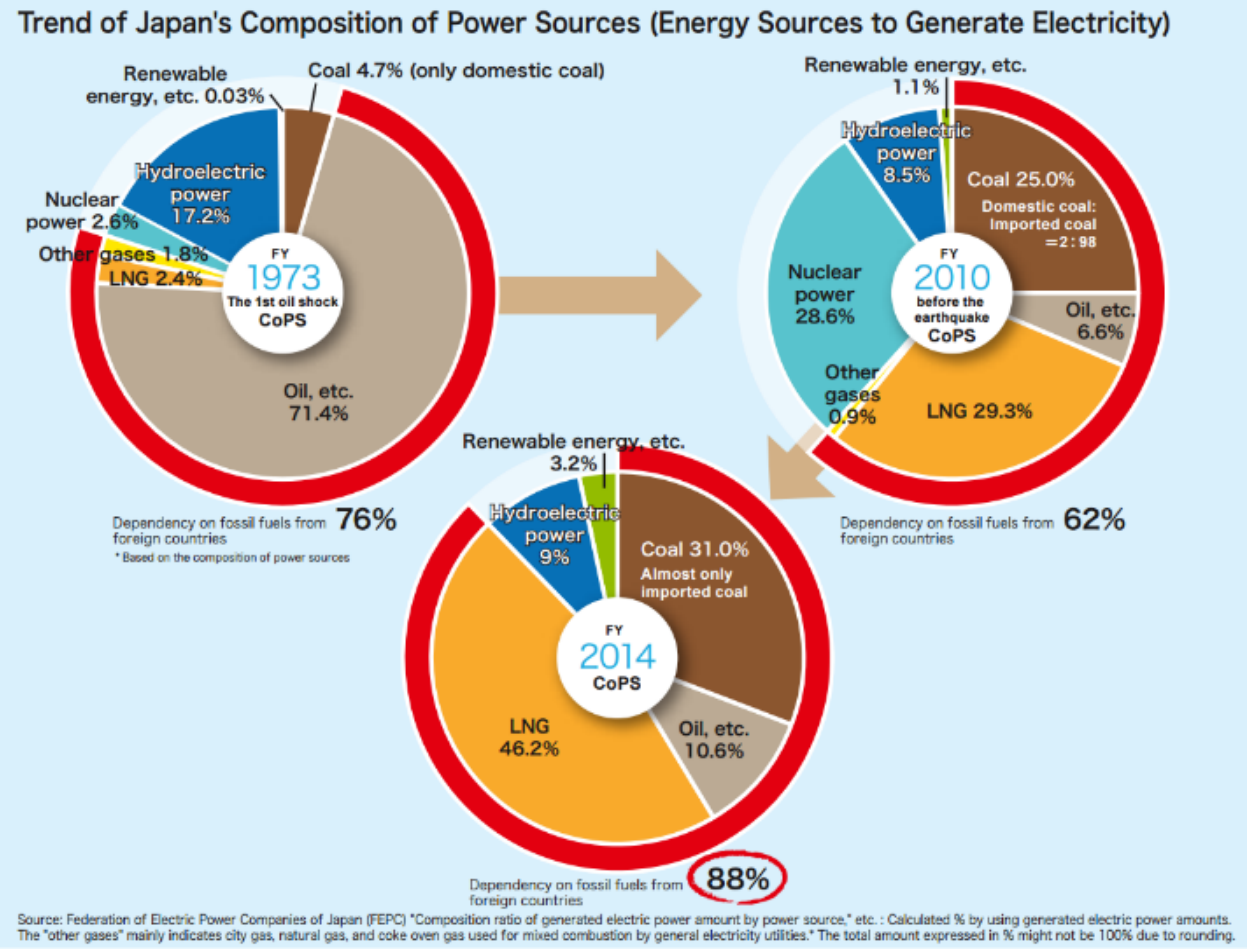
Fuel Cells for Household Use

NEDO developed and distributing fuel cells.

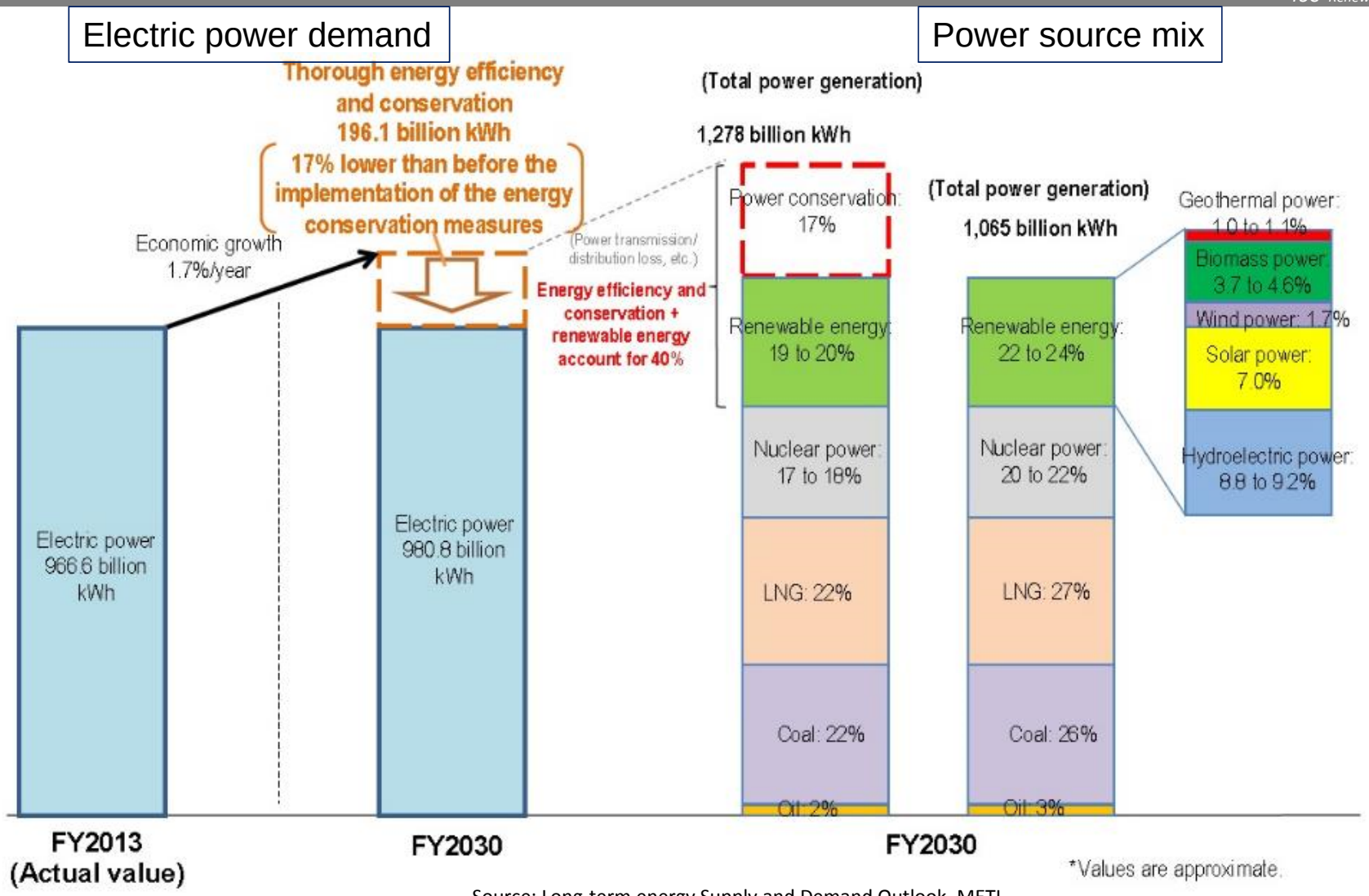
NEDO Success Stories *http://www.nedo.go.jp/english/publications_brochures_index.html*

2. Japanese Energy situations – Two major changes in 1970s and 2011

- Two major events had paved the way to the drastic improvement of energy efficiency in Japan



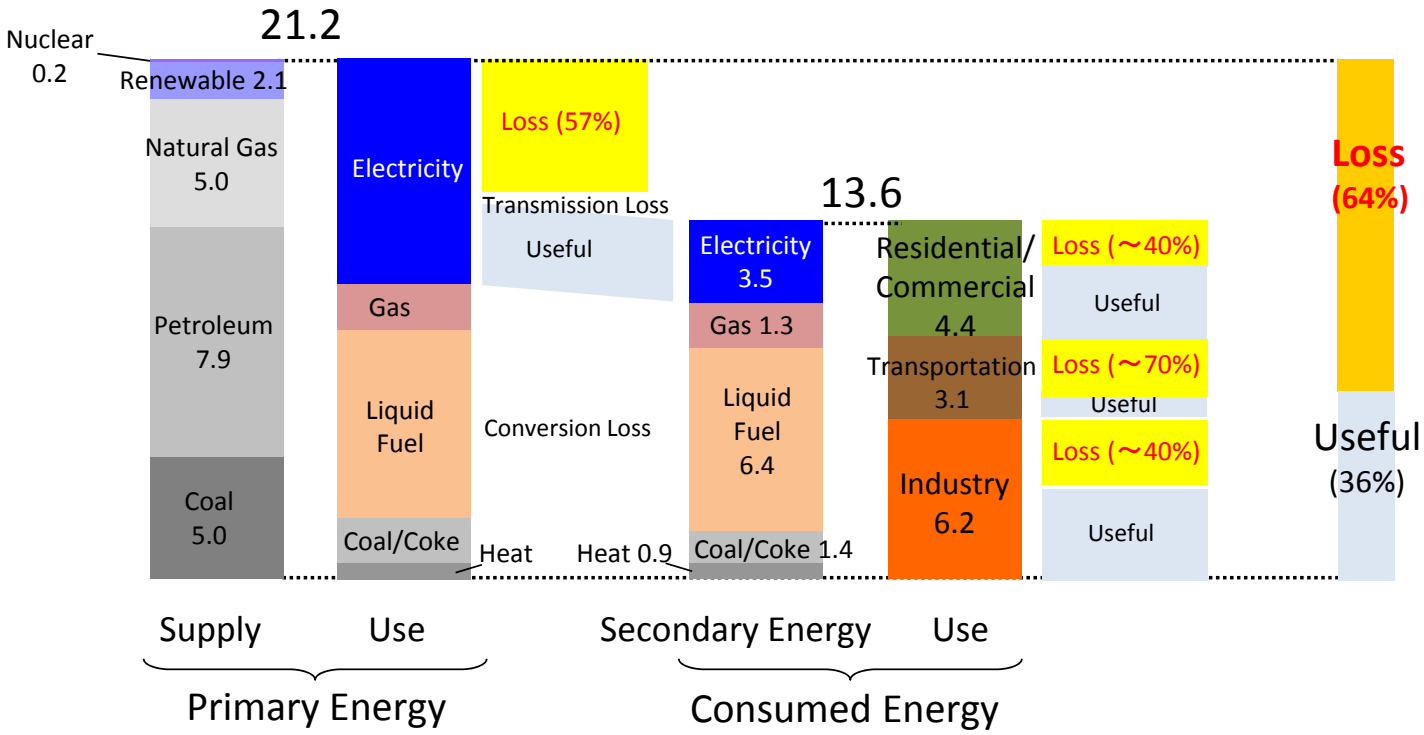
2. Japanese Energy situations – Long-term Energy outlook



Source: Long-term energy Supply and Demand Outlook, METI

2. Japanese Energy situations – Energy consumption overview

- Japan consumes 21 EJ of primary energy, and loses the 64% as waste heat.
- The major losses come from power generation and consumption in industry, transportation and residential/commercial sectors.



Energy Supply and Consumption in Japan（FY2016） Unit: 10^{18} J (EJ)

2. Japanese Energy situations – Primary drivers of Energy policy

Supply Side

- Electric Power Market Reform :
  Full liberalization of retail
- Mixed use of various resources while increasing RES

Demand Side

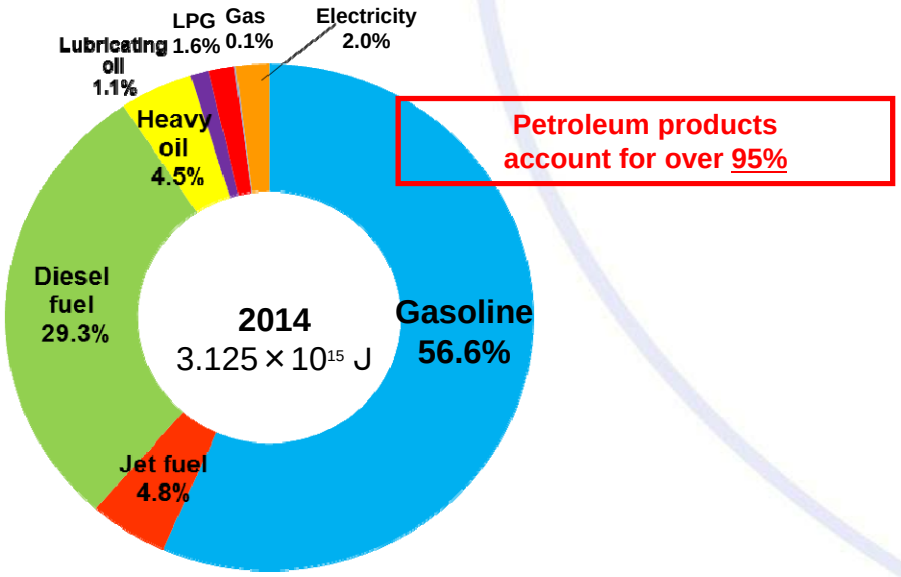
- Smart Energy Saving by xEMS
  → NET Zero Energy House / Building (ZEH / ZEB)

ZEH Target ⇒ more than half of newly construction @2020
Standardized for all construction @2030

- Battery, Storage
- Smart Demand : Demand Response
- Co-Generation（CHP）, FC
- Next Generation Vehicles (EV / PHV / FCV)

3. Next Generation Vehicle
– Reduction of dependence on fossil fuel and CO2 emissions

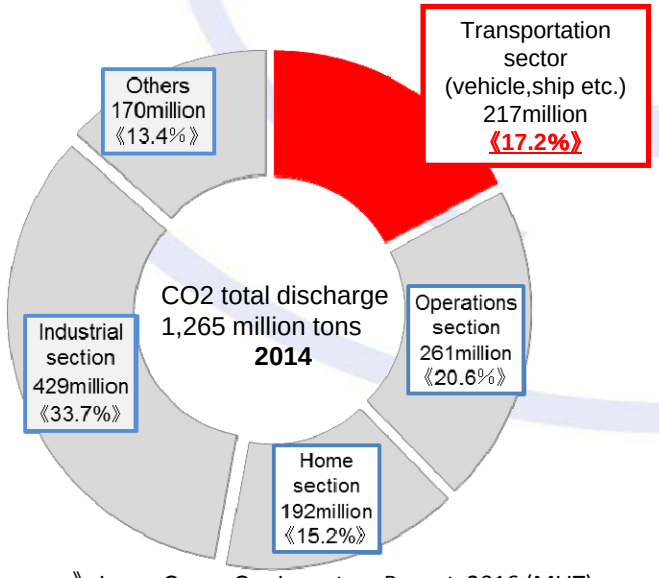
Dependency on fossil fuel (Transportation sector)



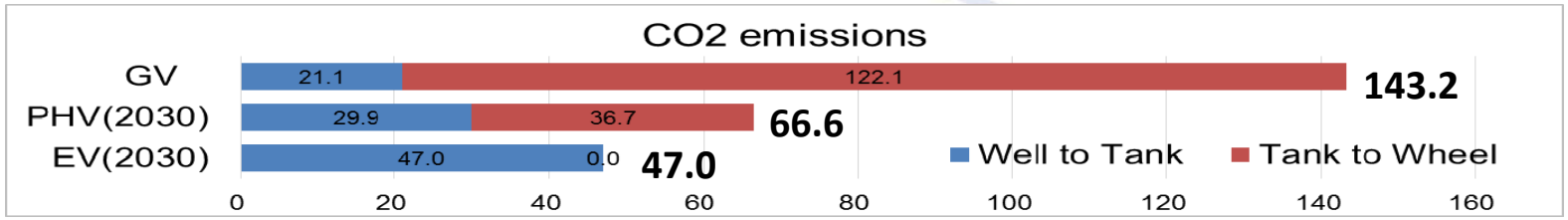
Petroleum products account for over 95%

《source》: Energy White Paper 2016 (METI)

CO2 emissions



《source》: Japan Green Gas Inventory Report 2016 (MLIT)



EVs could cut CO2 emissions by half compared to conventional vehicles, contributing to environmental benefits.
※In the case of considering Japan's future power generation portofolio.

3. Next Generation Vehicle – Target

The Japanese government is aiming at increasing the market share of Next Generation Vehicles among new car sales to between 50% and 70 % by 2030.

	2016（Result）	2030(Target)
Gasoline Vehicle	65.15%	30～50%
Next Generation Vehicle	**34.85%**	50～70%
Hybrid Vehicle	30.76%	30～40%
Electric Vehicle Plug-in Hybrid Vehicle	0.37% 0.22%	20～30%
Fuel Cell Vehicle	0.02%	～3%
Clean Diesel Vehicle	3.46%	5～10%

«Reference» New Passenger Car Sales : 4.146M Unit（2016）

【Source】 Next Generation Automotive Strategy 2010　Automotive Industrial Strategy 2014

3. (1) Electric Vehicle – Targets for Advanced Batteries

at present

Nissan Leaf

Driving range : 400km @JC08-Mode
Selling price : JPY 3.15 million

Battery pack

Capacity : 40 kWh, Weight : 300 kg
⇒ Energy density: 133 Wh/kg

TOYOTA
Prius PHV/Prime

Driving range : 68.2km @JC08-Mode
Selling price : JPY 3.26 million

Battery pack

Capacity : 8.8 kWh, Weight : 120 kg
⇒ Energy density 73 Wh/kg

Summary of NEDO's performance targets

EV

			2020s	2030s
Battery Pack	Energy density	Wh/kg	250	500
	Power density	W/kg	～1,500	～1,500
	Cost	JPY/ kWh	20,000	10,000
	Calendar life	years	10 ～ 15	10 ～ 15
	Cycle life	cycles	1,000 ～ 1,500	1,000 ～ 1,500
EV	Driving range *	km	250 ～ 350	500
	Selling price	Mil. JPY	200 ～ 230	190

* Battery usage rate of 100%

PHEV

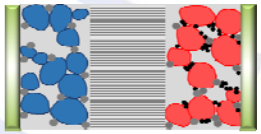
			2020s
Battery Pack	Energy density	Wh/kg	200
	Power density	W/kg	2,500
	Cost	JPY/kWh	20,000
	Calendar life	years	10 ～ 15
	Cycle life	cycles	4,000 ～ 6,000
PHEV	Driving range *	km	60

* Battery usage rate of 60% for EV traveling

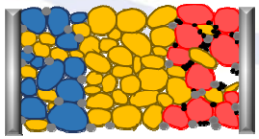
3. (1) Electric Vehicle – NEDO's Battery projects

Mission

1. Accelerate commercialization of novel cell components which contribute to high-performance, high-safety and cost reduction of LIB
2. Improve R&D efficiency of the Japanese battery industries and academia
3. Support for Japanese materials suppliers considering entry into the battery market



Liquid electrolyte LIB



All solid state LIB

Target

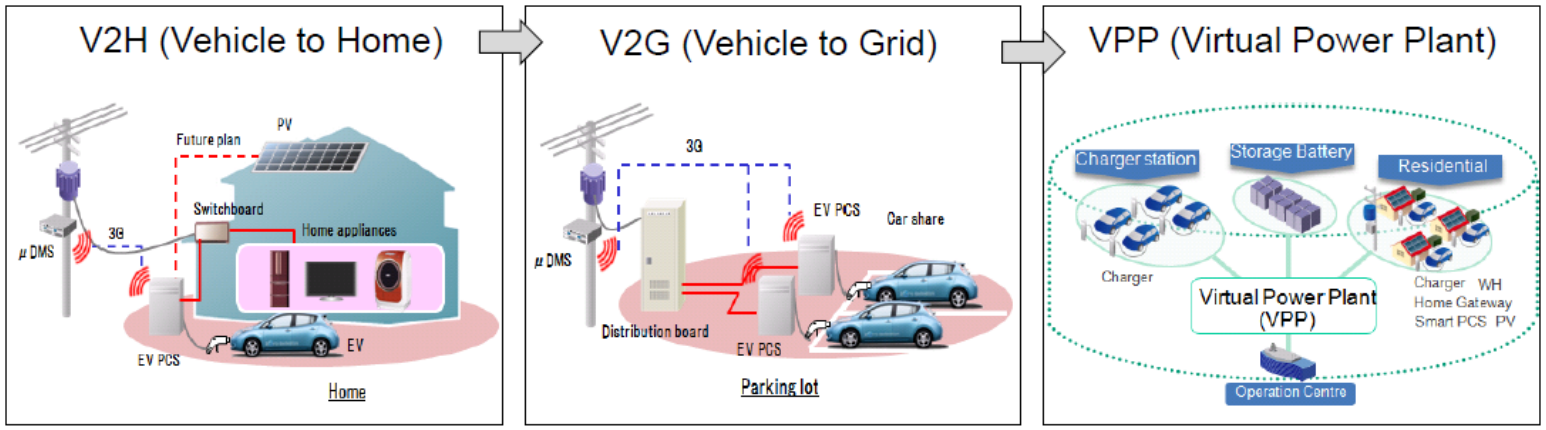
Develop materials evaluation techniques which will be utilized as a common validation(benchmarking) index for the Japan battery industries and academia

Timeline

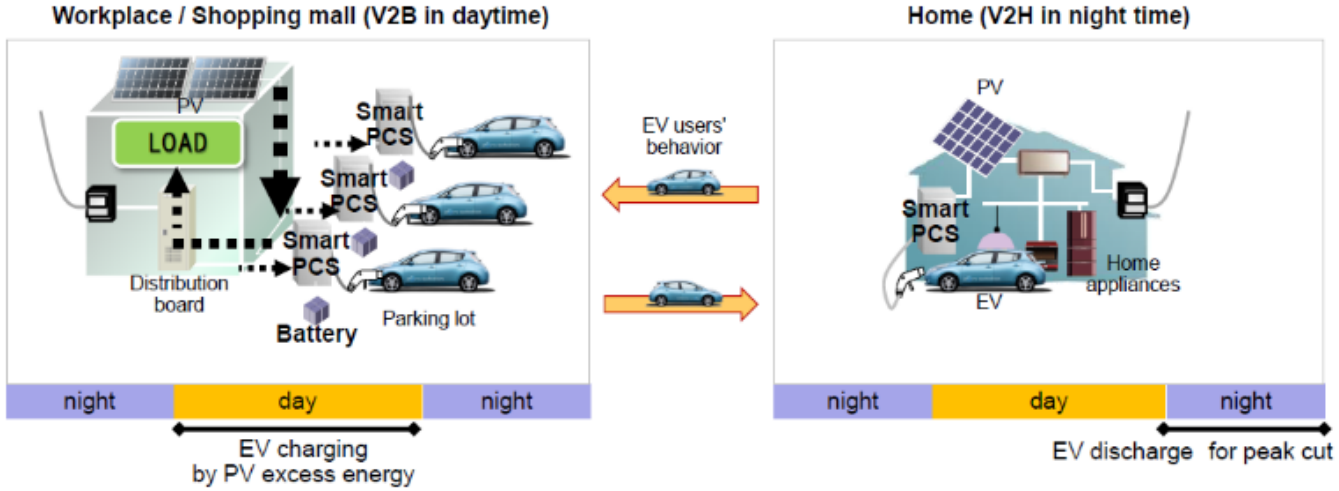
2010	2011	2012	2013	2014	2015	2016	2017	2018-2022
<The 1st work> Materials Evaluation Techniques for Current generation LIB								
	<The 2nd work>		*Materials Evaluation Techniques for Advanced LIB*					
			Materials Evaluation Techniques for All Solid State LIB					*<The 3rd work> Under planning*

3. (1) Electric Vehicle – V2X technologies

1） V2H/VPP



2） Strategic allocation for EV charging place



3. (1) Electric Vehicle
– Major examples of NEDO SCC demonstration projects

- NEDO is implementing a lot of demonstration projects in various regions and countries including these examples.

Ontario（Canada）
PV with Battery demonstration.

Manchester（UK）
Direct control & aggregation the electricity consumption of each household with the heat pumps

Lyon（France）
Positive energy building, EV car sharing and energy audit demonstration in re-developed city

Speyer（Germany）
Self consumption HEMS demonstration.

California（USA）
Inter city EV Quick Charger demonstration.

Indonesia
Power quality Management for Industrial Park.

Maui island（USA）
Direct control against EV, for absorbing large scale introduction of

California（USA）
Utility owns Battery Storage demonstration

Malaga（Spain）
EV charging infrastructure and driver navigation system

3. (2) Hydrogen Society and FCV – Why Hydrogen

- Hydrogen is attracting attention as a secondary energy that contributes to solve problems such as global warming and depletion of global energy resources.

● Abundant :

・Possible to produce from various energy sources

● Clean :

・Zero emissions

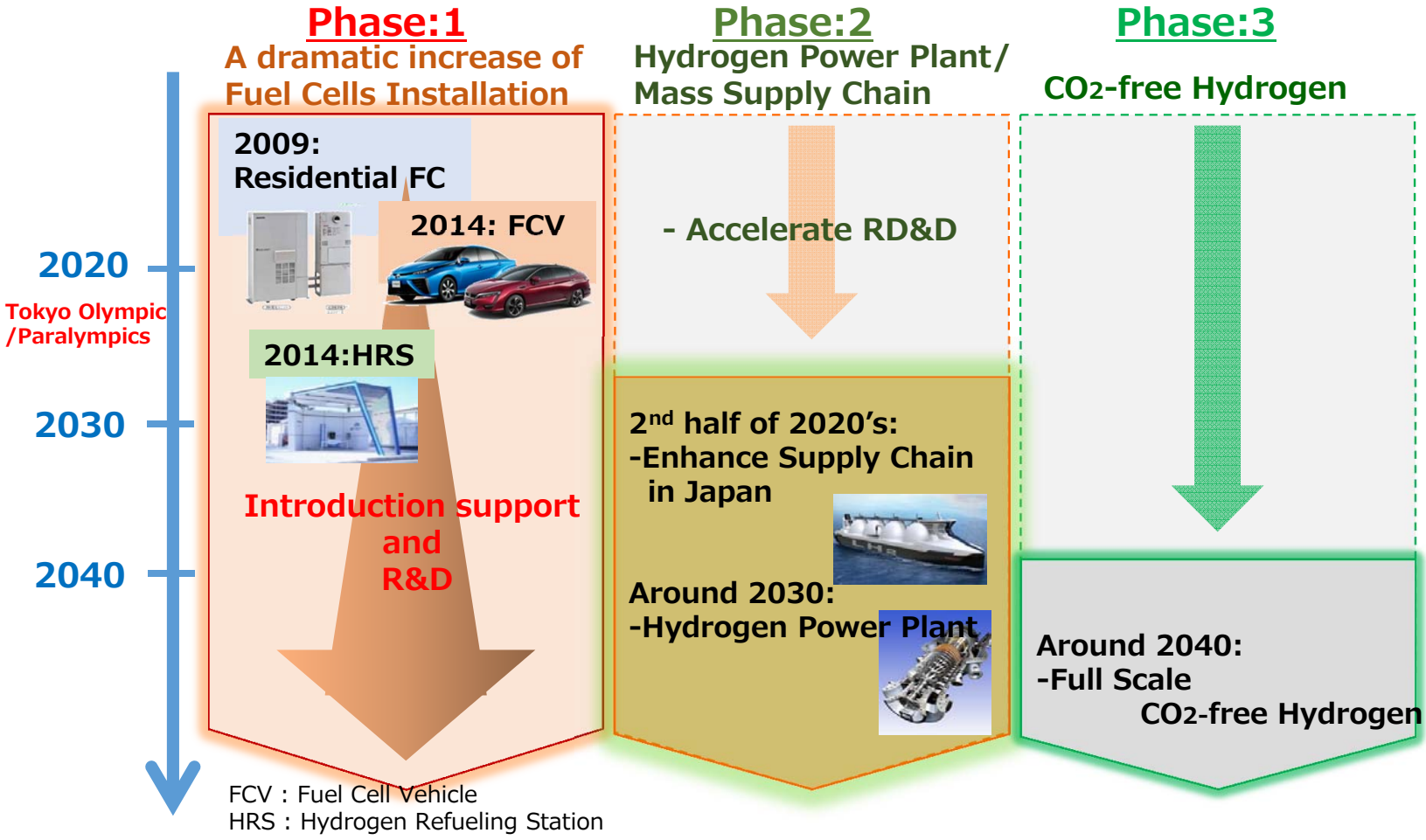
・High total energy efficiency by combining electric and thermal energy

● Flexible carrier :

・Achieves higher level of energy security

・Possible to store and transport every form such as gas, liquid and solid

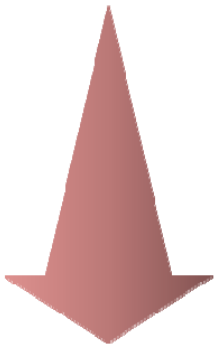
3. (2) Hydrogen Society and FCV – METI's Strategy Roadmap



3. (2) Hydrogen Society and FCV – Current status of FC application

Residential Fuel Cells

Marketed in 2009・・・



Around 212,000 units deployed

Targets

- 1.4 million units by FY2020
- PEFC : 800,000 yen (approx. $7,000) by FY2019
- SOFC : 1,000,000 yen (approx. $8,800)by FY2021

FCV & HRS

91 Stations Opened
(9 in process)

2,000 FCVs deployed

Targets

FCV
- 40,000 by FY2020
- 200,000 by FY2025
- 800,000 by FY2030

HRS
- 160 by FY2020
- 320 by FY2025

3. (2) Hydrogen Society and FCV – **New FC Application in 2017**

New Fuel Cell Bus w/ 70MPa H2 storage tank

Tokyo Metropolitan Gov.
Purchased 2 FC buses.
Plan to install over 100 by 2020.
(70 by Tokyo Metro. Gov.)

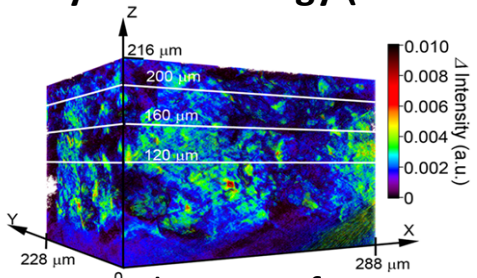
Fuel Cell Forklift (launched in 2016)

38 FC Forklifts market introduction as of July 2017

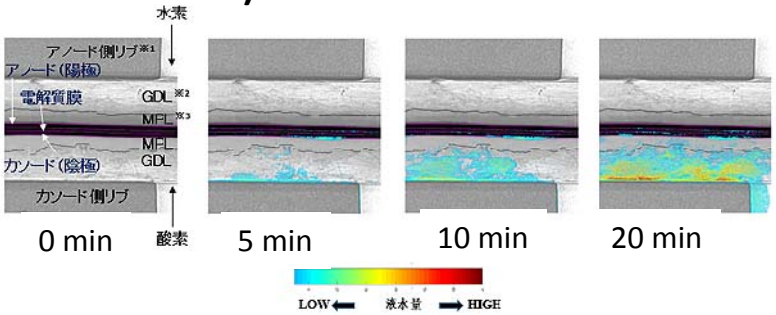
3. (2) Hydrogen Society and FCV
– Highlight of NEDO's Program (PEFC)

NEDO focused on basic research.

Analysis Technology (PEFC reaction mechanism)



3D visualization of PFEC anode catalyst degradation

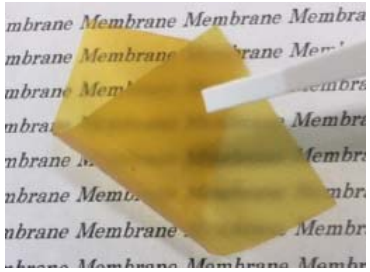


Water distribution in PEFC

PEFC performance evaluation

Material Design Concept

Catalyst



Membrane

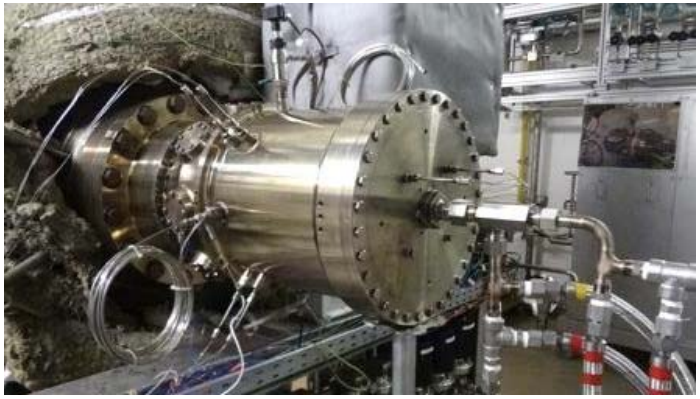
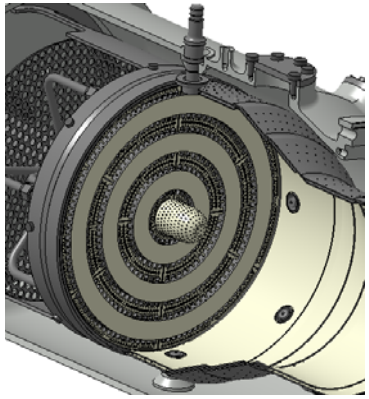
3. (2) Hydrogen Society and FCV
– Highlight of NEDO's Program (SOFC)

SOFC for commercial use: Demonstration Phase

Manufacturer	Denso	Miura	Fuji Electric	Hitachi Zosen	Mitsubishi Hitachi Power Systems (MHPS)
	Demonstration model				
Appearance					
Output	5 kW	5 kW	20 kW	50 kW	250 kW
Electrical generation efficiency (target value)	(under consideration)	50 %	50 %	50 %	55 %
Total efficiency (target value)	(under consideration)	90 %	(under consideration)	80 %	73% (hot water) 65% (steam)
Major envisioned demand	Barbers and hair salons, small stores, family restaurants		Gym, welfare facilities, hospitals, small buildings		Data centers, large buildings, and hotels

3. (2) Hydrogen Society and FCV
– Highlight of NEDO's Program (H_2GT)

Developing combustor for H_2 gas turbine


Demonstration project / H_2 gas turbine


3. (2) Hydrogen Society and FCV
– Highlight of NEDO's Program (Supply Chain)

Mass & Long Distance Transport

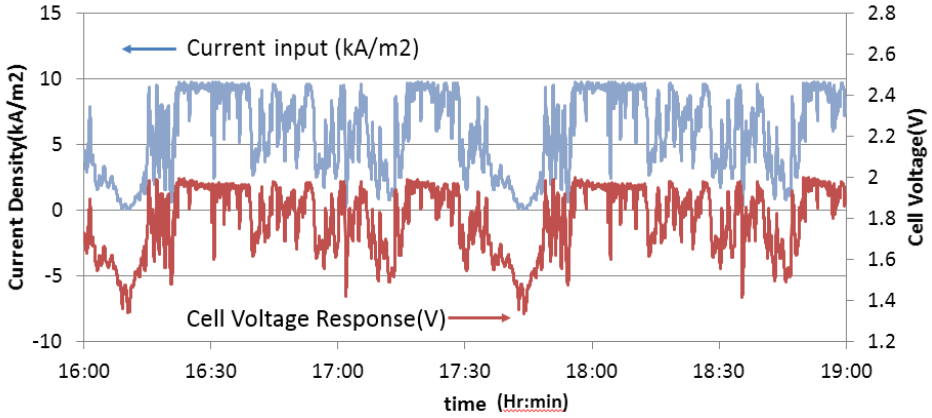
Image of liquefied H2 tanker

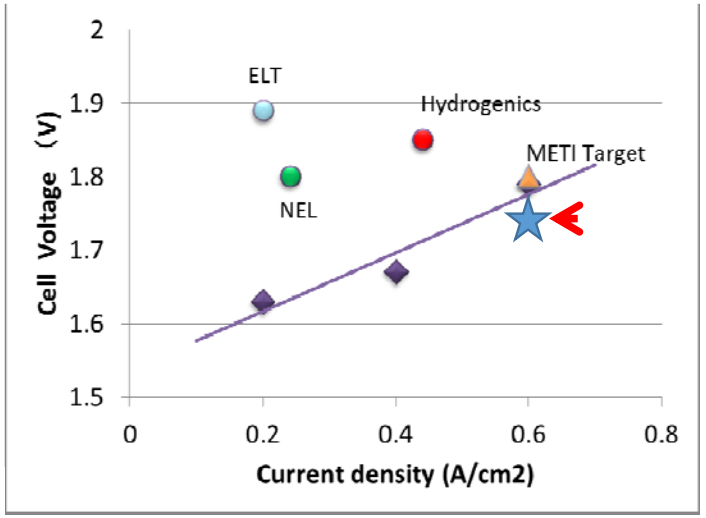
1000 Nm3 tank test facility

3. (2) Hydrogen Society and FCV
– Highlight of NEDO's Program (electrolysis)

R&D on Electrolysis : Alkaline, PEM, SOEC, etc.
(scale-up (MW class), durability, load following, performance)

Large Scale Alkaline Electrolysis





Performance of Alkaline Electrolysis (120kW)

3. (2) Hydrogen Society and FCV
– Highlight of NEDO's Program (Power to Gas)

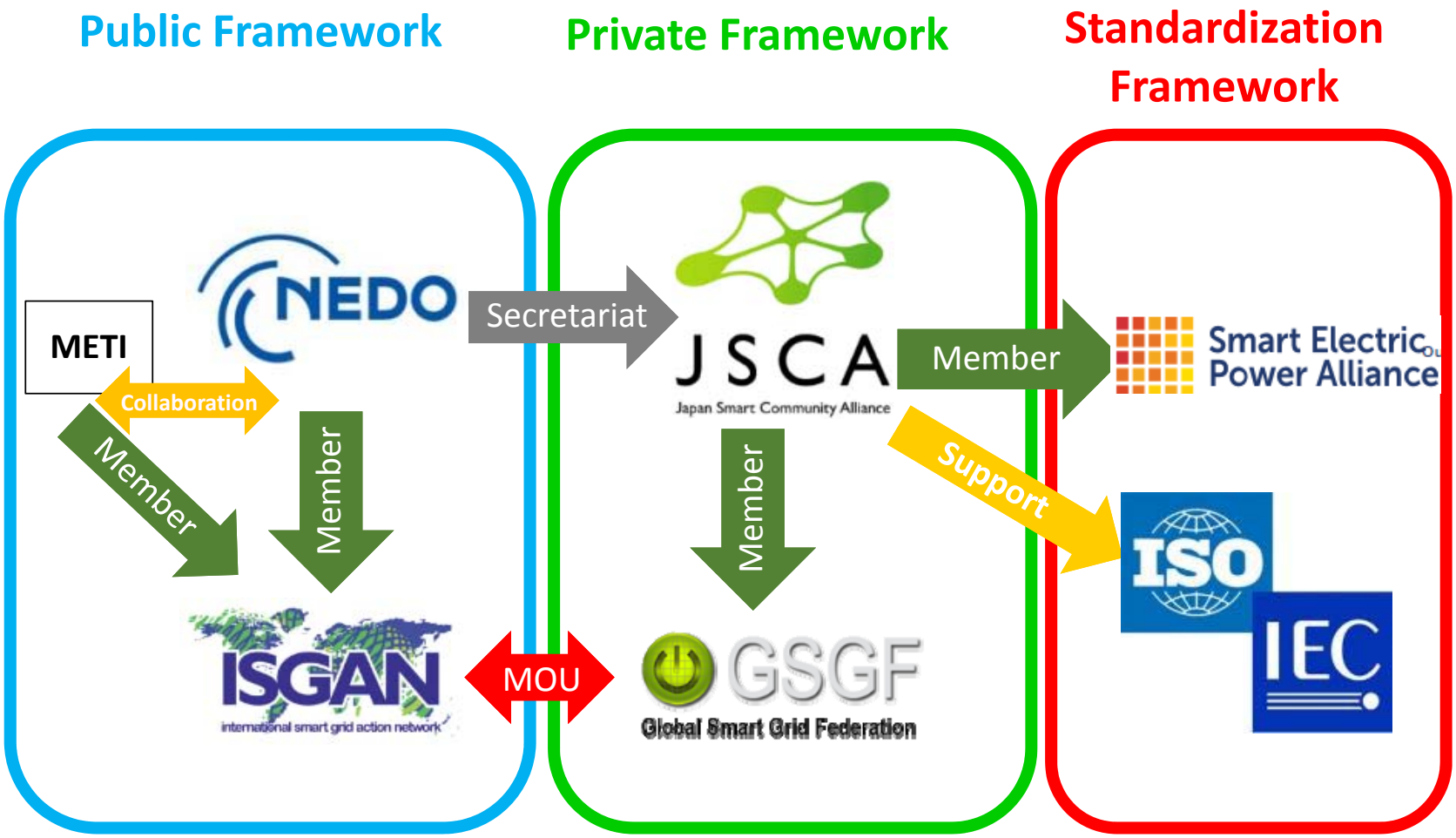
@ Sendai city
(Water purification plant)
PV + 24kW electrolysis
- Enhancing PV capacity factor
- Emergency power supply

@ Tomamae town, Hokkaido
WT + 135kW electrolysis
- Enhancing WT capacity factor (excess electricity to H2)
- Thermal energy (H2 boiler)

3. (2) Hydrogen Society and FCV
– Highlight of NEDO's Program (Power to Gas)

@ Fukushima Pref.　10MW electrolysis

4. International Cooperation – Smart Grid technologies



4. International Cooperation – Hydrogen technologies

INTERNATIONAL PARTNERSHIP FOR
HYDROGEN AND FUEL CELLS IN THE ECONOMY

iea Energy Technology Network
Technology Collaboration Programmes

HYDROGEN IMPLEMENTING AGREEMENT

Technology Collaboration Programme on
Advanced Fuel Cells

5. Conclusion

- *Need for improving Vehicles*
  - *cost down*
  - *driving range*
- *Need for providing useful infrastructures*
  - *deployment of easy-to-find and fast chargers*
  - *contribution to stabilize renewable energies using V2X technologies*
  - *establishing of efficient supply chains*
- *Need for international cooperation*
  - *information exchange*
  - *standardization*