



Japan's Hydrogen Policy and Fuel Cells Development in NEDO

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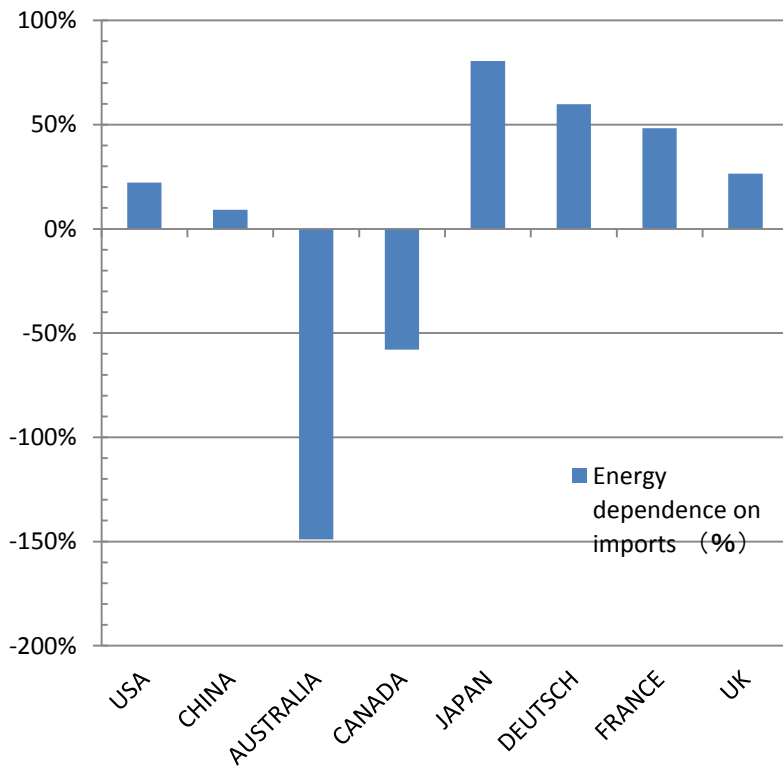
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International Partnership on Hydrogen and Fuel Cells in the Economy (IPHE)

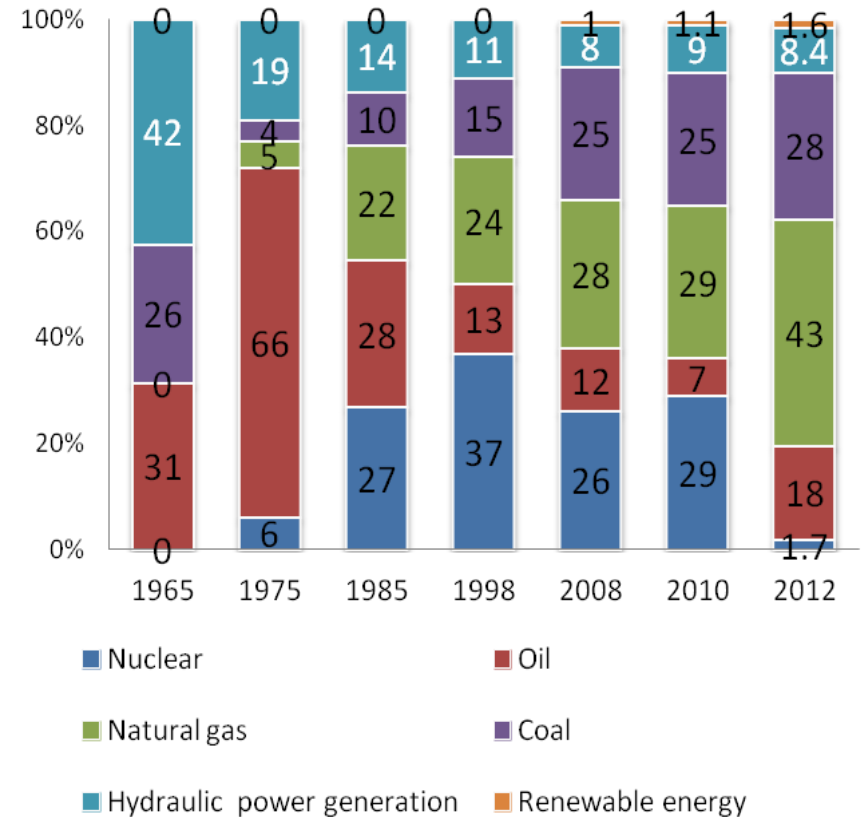
WHY HYDROGEN?

Japan's Vulnerable Energy Supply

Energy import dependencies in major energy consumer countries

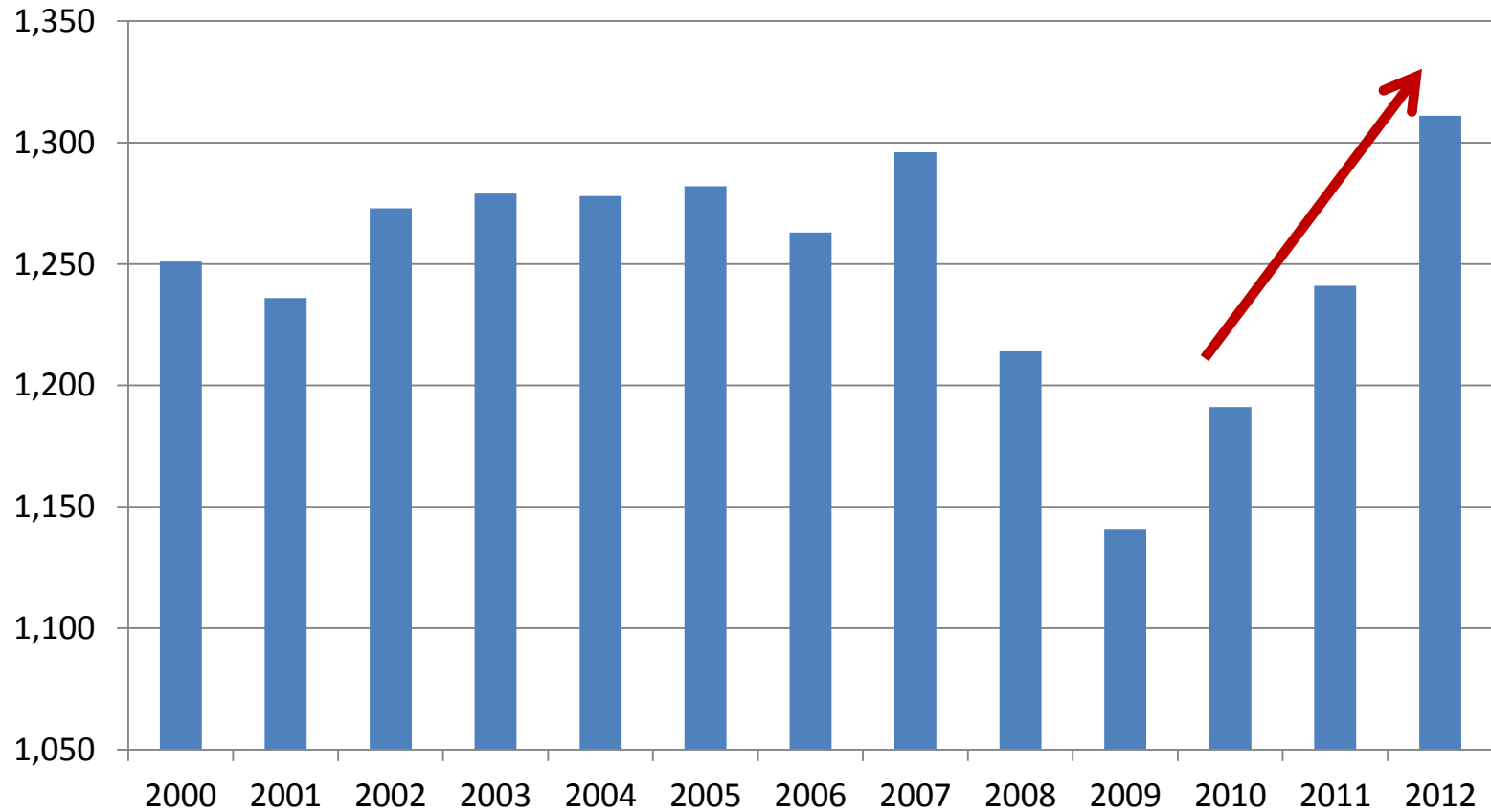


Power generation mix in Japan



Increasing CO2 emissions

CO2 Emissions in Japan
[a million tons- CO2 equivalent]



Clean Transport: Future of Automotive Industry

HV・PHV



TOYOTA 「PRIUS」

EV



NISSAN 「LEAF」

FCEV



HONDA CLARITY



NISSAN TERRA



TOYOTA MIRAI

Why Hydrogen?

- **Clean energy**: achieving higher level of energy security and zero emission
- **Flexible energy carrier**: made from various energy sources and used for many energy demand
- **Long experience in H2 development**: Japan has more than 30 years experience in H2 R&D including commercial sale of FC system

ENE-FARM

ENE FARM

- 700W FC cogeneration system for households
- NG/LPG dual fuel
- Total efficiency 95%, 10 years warranty
- Commercial sale since 2009
- 50% capex subsidy by government
- More than 113,000 installations by March 2015



History of ENE-FARM development

~2000年

2001~2004年

2005~2008年

2009年~

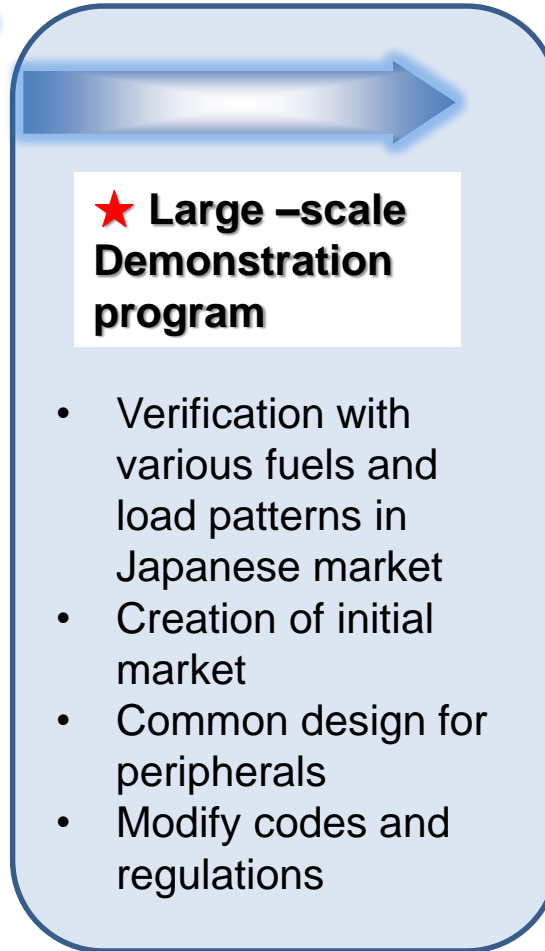


★ Basic R&D phase
for PEM (1992~)



★ Developing small
scale co-generation
system using PEFC

- Improving cell stack efficiency
- Reducing system cost
- Proving system durability
- Develop commercial model of PEFC system



★ Large -scale
Demonstration
program

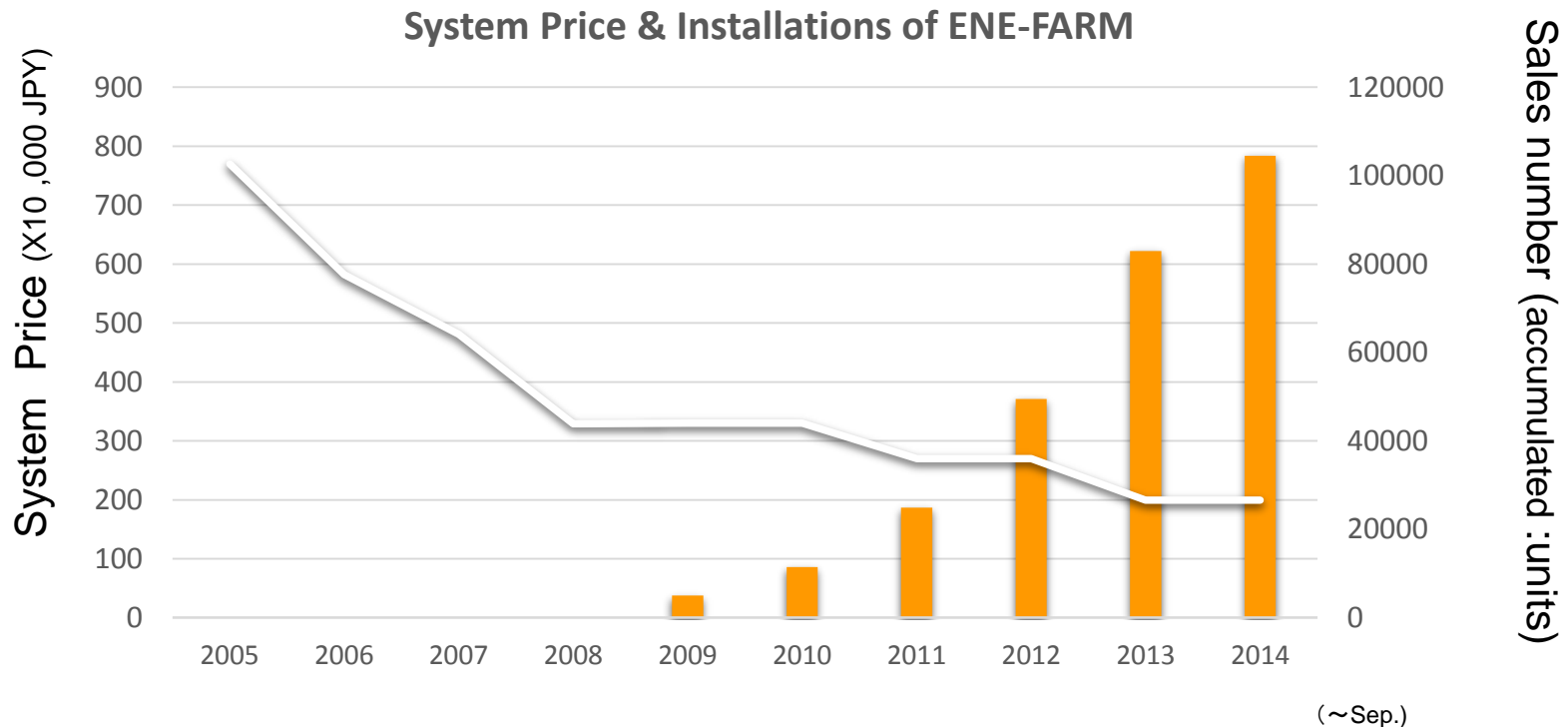
- Verification with various fuels and load patterns in Japanese market
- Creation of initial market
- Common design for peripherals
- Modify codes and regulations



★ Commence
commercial sale
in 2009

System Price Reduction

- In six years after 2009, more than 100,000 units were installed.
- Market expansion significantly reduced system price to below 2M yen which is $\frac{1}{4}$ of its beginning.



(Source) Sales Number : Advanced Cogeneration and Energy Utilization Center JAPAN.
Sales Price : NEDO.

PEFC DEVELOPMENT FOR FCV

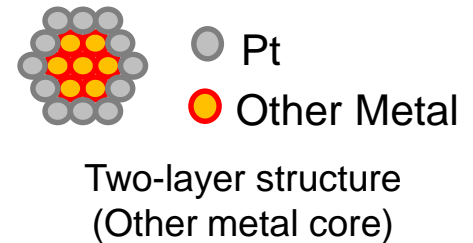
NEDO's role in FCV development

In Japan, Car manufacturers take initiative in development of fuel cell technologies for vehicle, while NEDO provide support in developing scientific knowledge and generic technologies.

- Catalyst research for reducing platinum use
- Developing common evaluation method for fuel cell
- Providing highest time and space resolutions in electrochemical reactions analysis

Catalyst Research

- Improving Platinum Activity by using Core-Shell Structure (reduce Pt usage to 1/10)
- Improvement of Higher dispersion catalyst by using:
 - Developing common cell evaluation technique
 - Highest time and space resolutions in electrochemical reaction and mass transfer analysis of MEA materials.

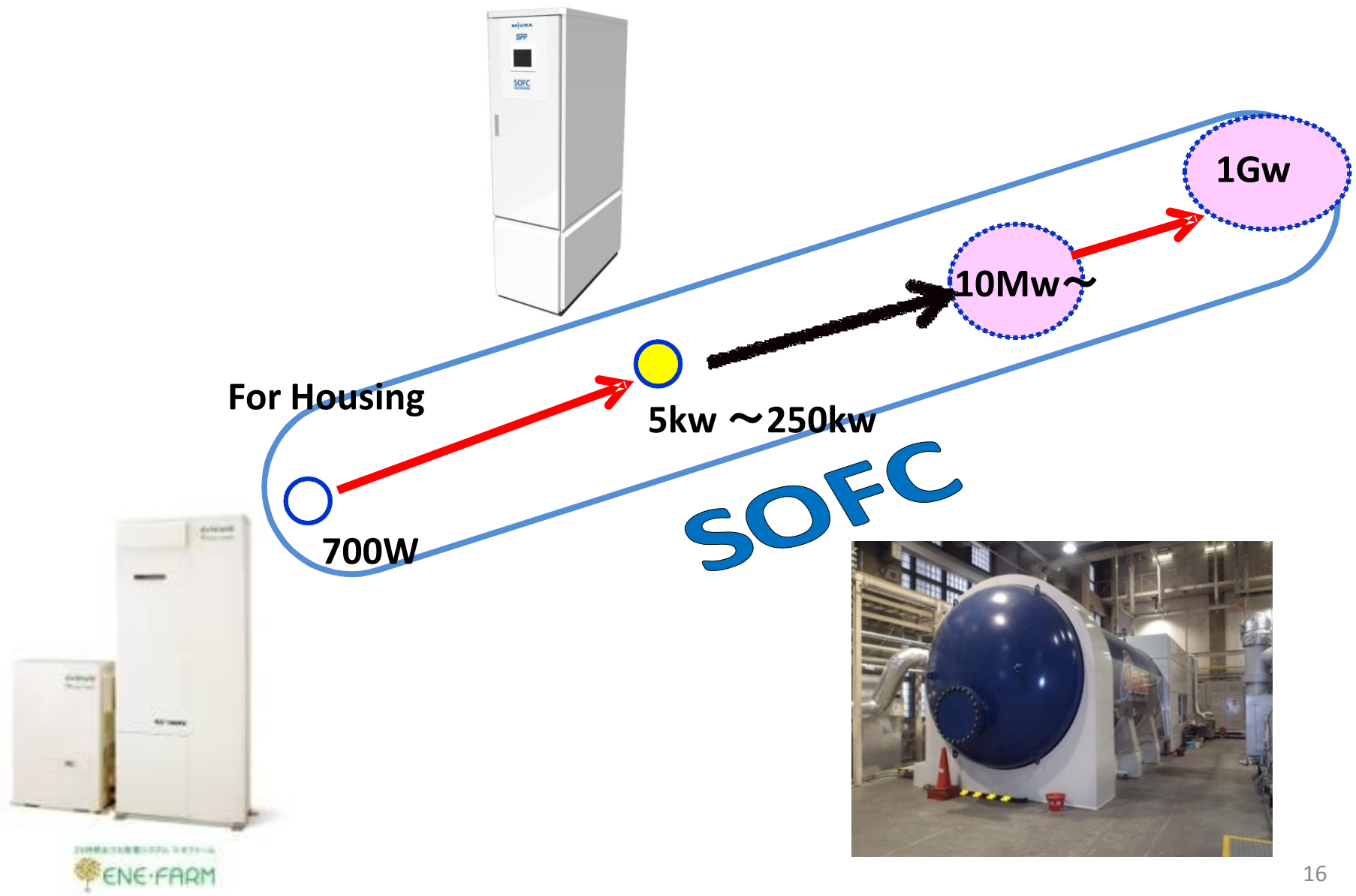


Next Five Years' Project

- Continue research of Catalyst for reducing platinum amount and increasing durability.
- New approach in evaluation: both output power density and the durability are considered.
- New target:
 - Cell Stack power density: 4kW/L
 - Durability: 50,000hrs and 600,000 cycle (for use in commercial vehicles)

NEDO'S PROGRAMME FOR SOFC

NEDO Development on SOFC

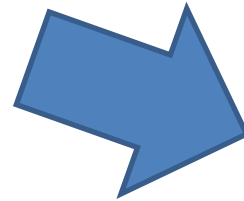


Hybrid SOFC System



250kW hybrid system of tubular SOFC and gas-turbine system

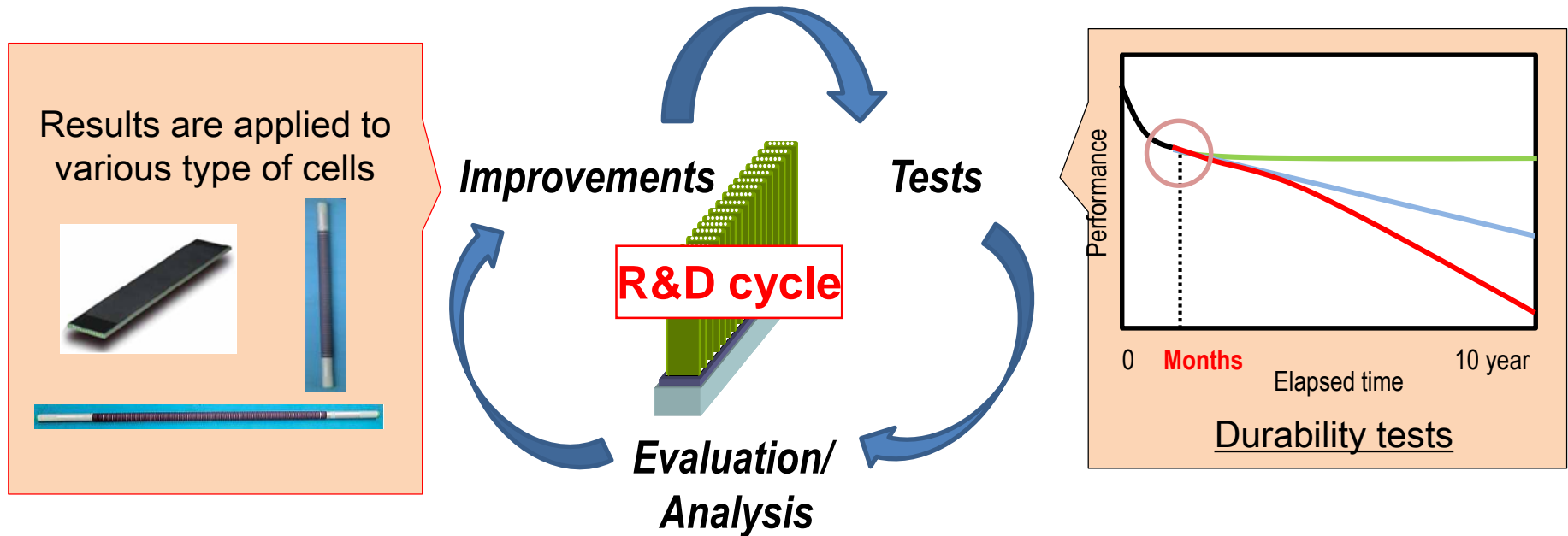
Output: 206kW (183 + 23)
Power Efficiency: 55%+
Total efficiency: 73%+
Durability: 5000 hrs



Pre-commercial model
In the process of 8000hrs test



Rapid Evaluation Method for SOFC Durability



Forecast 90,000 hour durability with short term data by using thermodynamics, chemical and mechanical analyses

Conclusion

- H2 is useful not only as zero emission fuel but also flexible energy carrier that contribute to energy security. Additionally, H2 is hopeful as a new industrial sector that will boost national economic growth
- Japan has been successful in developing residential FC CHP system. Key of the success was the cooperation of suppliers and energy providers in launching market.
- Further FC developments are ongoing in order to expand the use of FCV and also stationary use of FC in power and heat supply.



Thank you for your attention

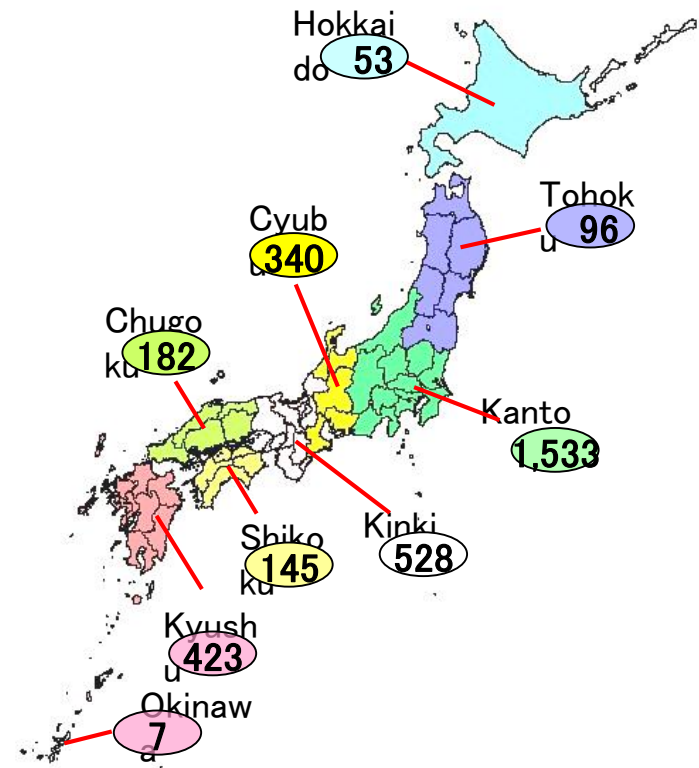
www.nedo.go.jp

Large-scale Demonstration programme (FY2005-2008)

- 3,307 units installed broadly in Japan
- System performance verified under various fuels and load patterns in Japan
- System suppliers and energy providers worked together which contributed to establish new market

*

Manufacturer	LPG	CH4	Kerosene	Total
ENEOS Celltech	1,062	191	0	1,253
Ebara Ballard	0	396	314	710
Toshiba FCP	552	196	0	748
Panasonic	0	520	0	520
Toyota	0	76	0	76
Total	1,614	1,379	314	3,307



Common Specifications for Peripherals

Solenoid valves



Pressure transducers



Flow meters



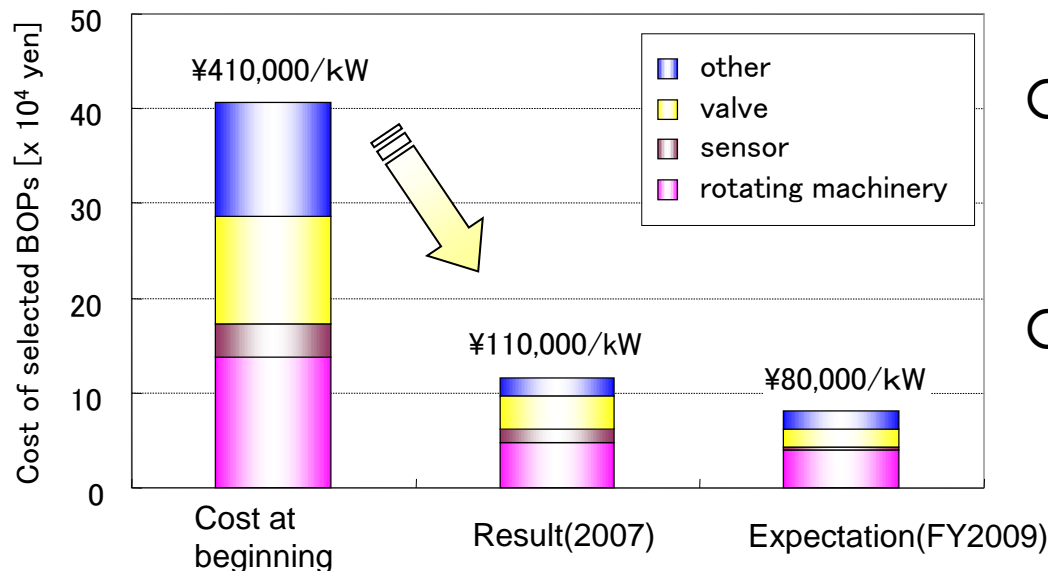
Blowers



Precision pumps



- System manufacturers agreed to develop common designs for some peripherals in PEFC co-generation systems
- Peripherals suppliers participated in the development of common designs
- Contributed standardize the performance, durability and further reduced cost.



○ As a results of this programme (06~07)

¥410,000/kw ⇒ ¥110,000/kw

○ Suppliers further continued efforts to ¥80,000/kw (2009)

Expanding market for ENE-FARM

ENE-FARM to Europe!



VIESSMANN / Panasonic
model

Senertec / Toshiba
model



ENE-FARM for Apartment housing

