

The Japanese experience in micro CHP for residential use

May 29th, 2008

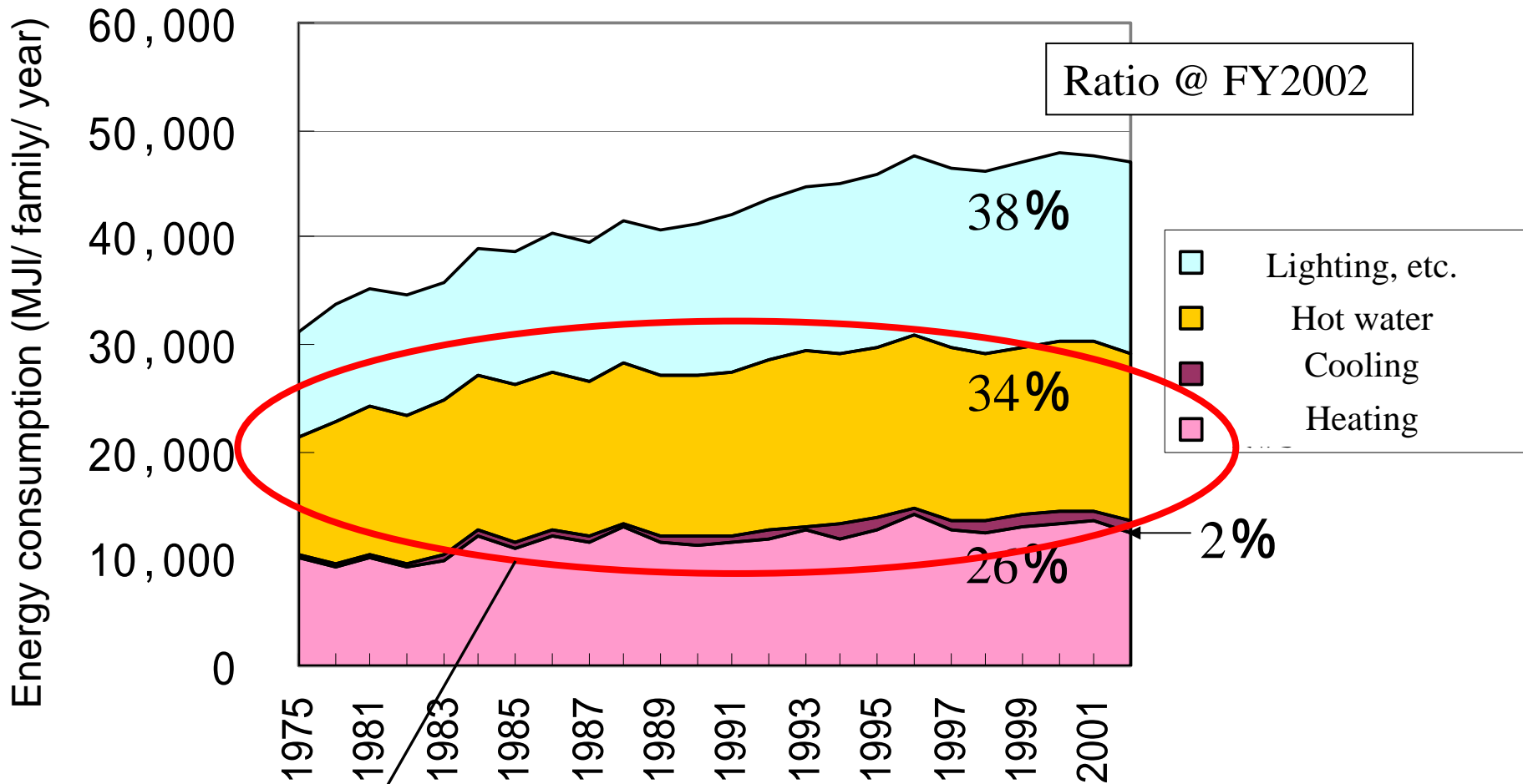
Gas Industry Micro CHP Workshop 2008

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2. Polymer Electrolyte Fuel Cell (PEFC)
3. Solid Oxide Fuel Cell (SOFC)

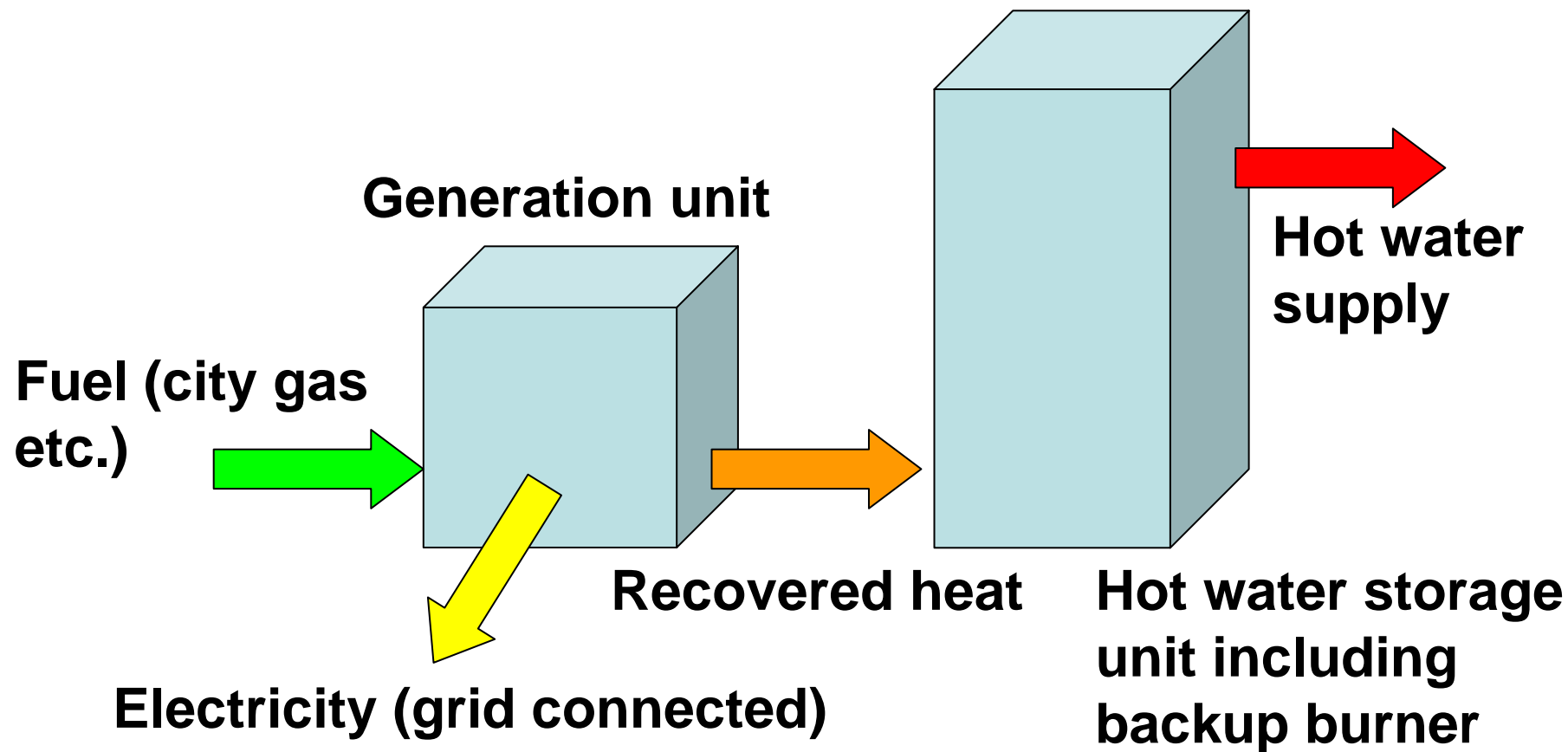
Transition of energy consumption rate in Japanese residential sector



Large amount of energy for hot water

Jukankyo Research Institute Inc.

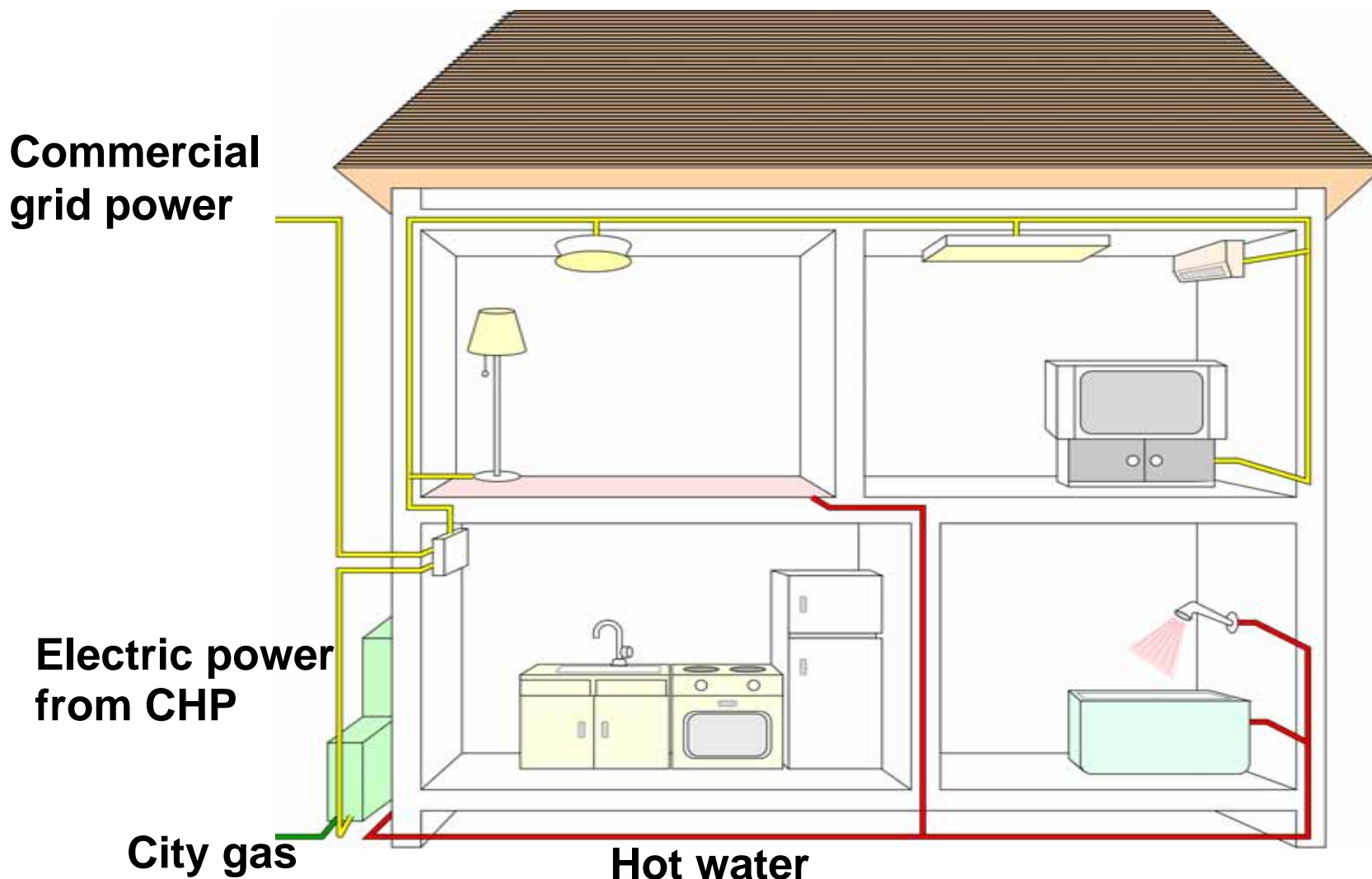
What's residential CHP in Japan?






>Rated power: 1kW class

>Recovered heat used as hot water

Schematic Image of residential CHP for Connections



Residential CHPs in Japan

	Gas Engine	PEFC	SOFC
Efficiency E / H (%LHV)	22.5 / 63	37 / 50	45 / 30
Operation	Start & stop	Start & stop	Continuous
Stage	Commercial	Limited market entry	Field trial
			

PEFC: Polymer Electrolyte Fuel Cell, SOFC: Solid Oxide Fuel Cell

Gas engine based residential CHP - *Ecowill* -



エコウィル
ECO WILL

Rated power : 1kW

Efficiency (LHV) :

Generation : 22.5 %

Heat : 63.0 %

Overall : 85.5 %

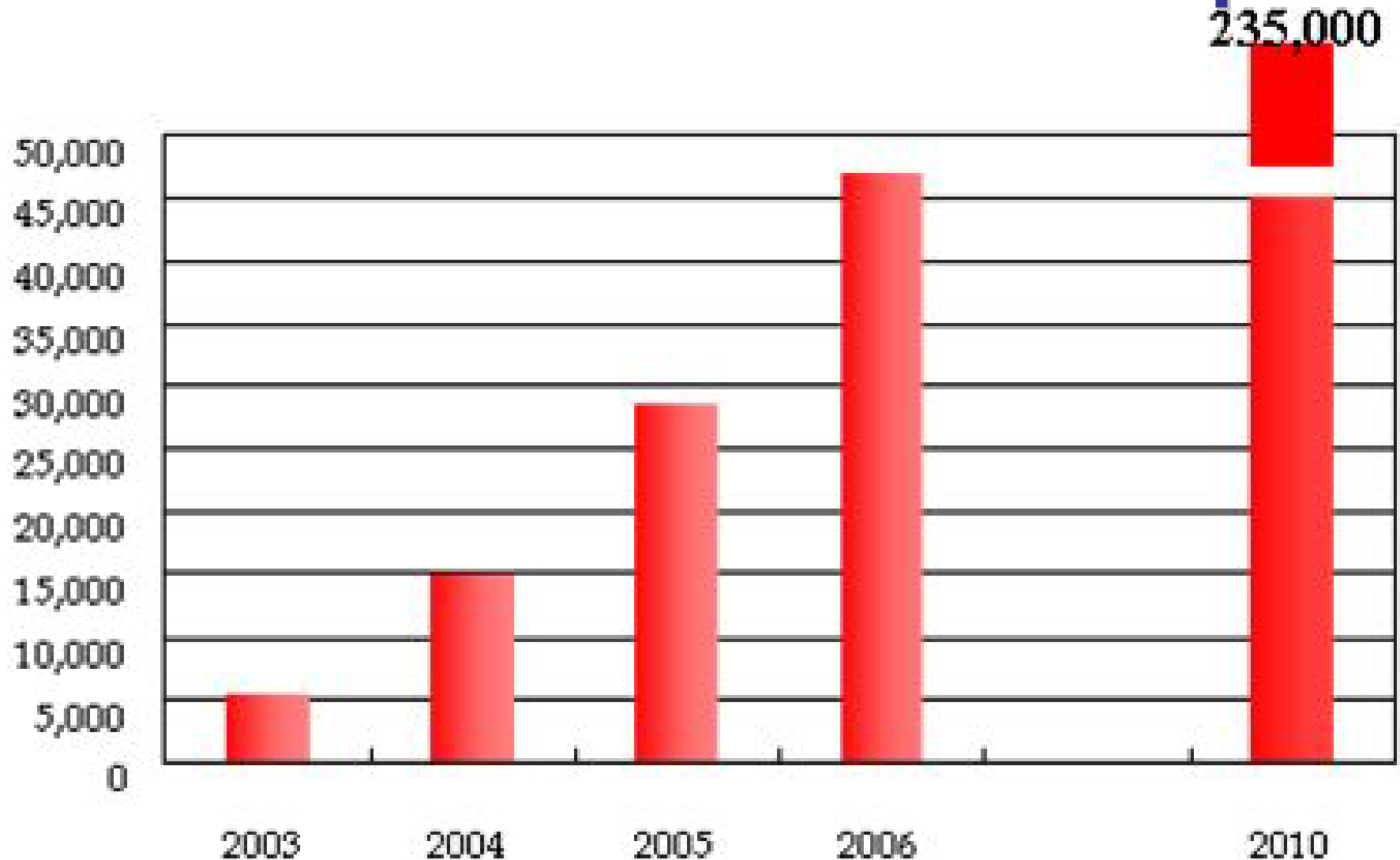
Manufacturer :

Honda (engine unit)

Noriz or Chofu

(hot water storage unit)

Cumulative number of gas engine based residential CHP in Japan



PEFC based residential CHP

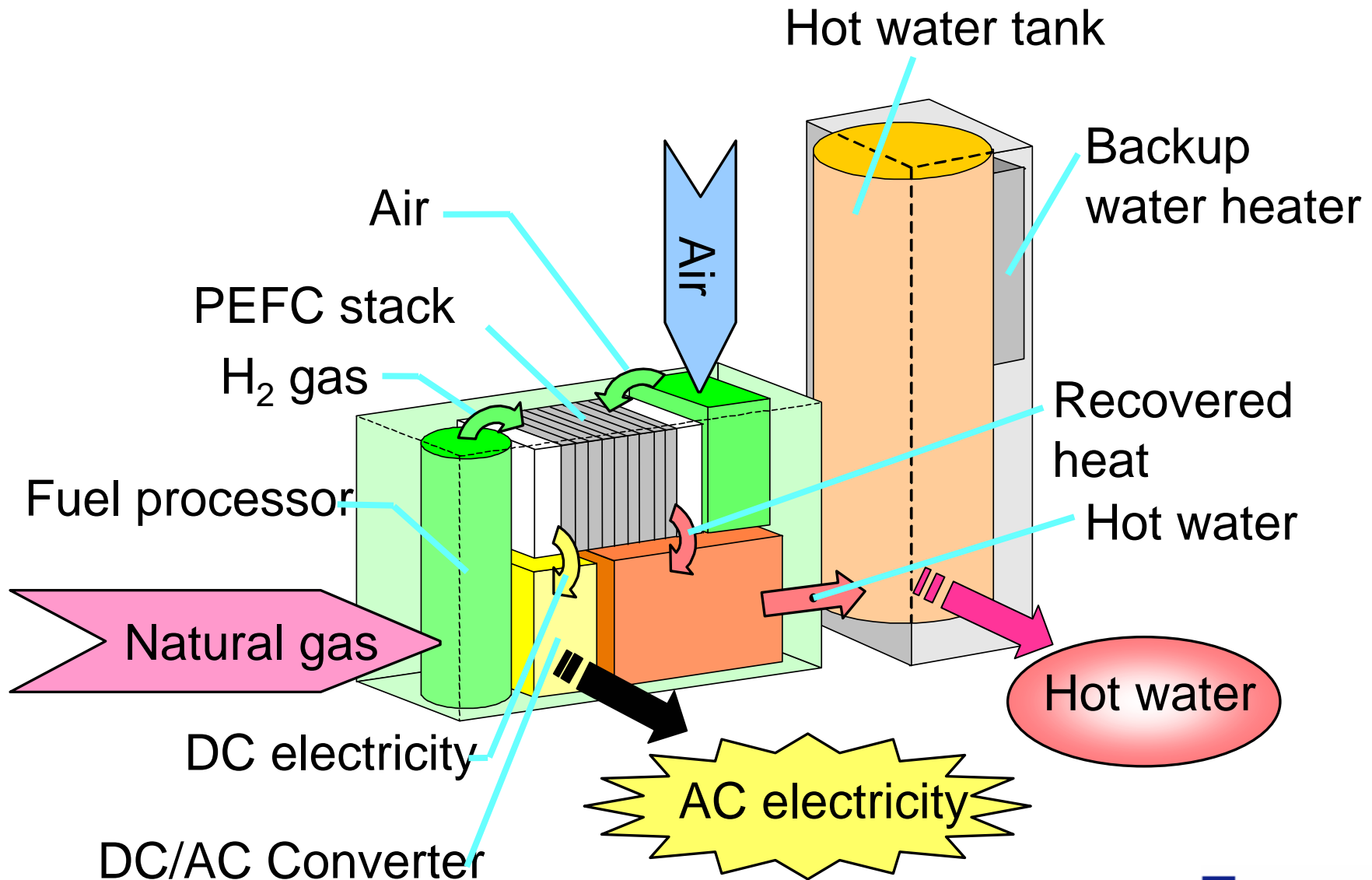
- Higher electrical efficiency
 - Primary energy saving, CO₂ reduction
- Lower noise, lower vibration, cleaner exhaust
- Common technology with FCV

Strong support by the government

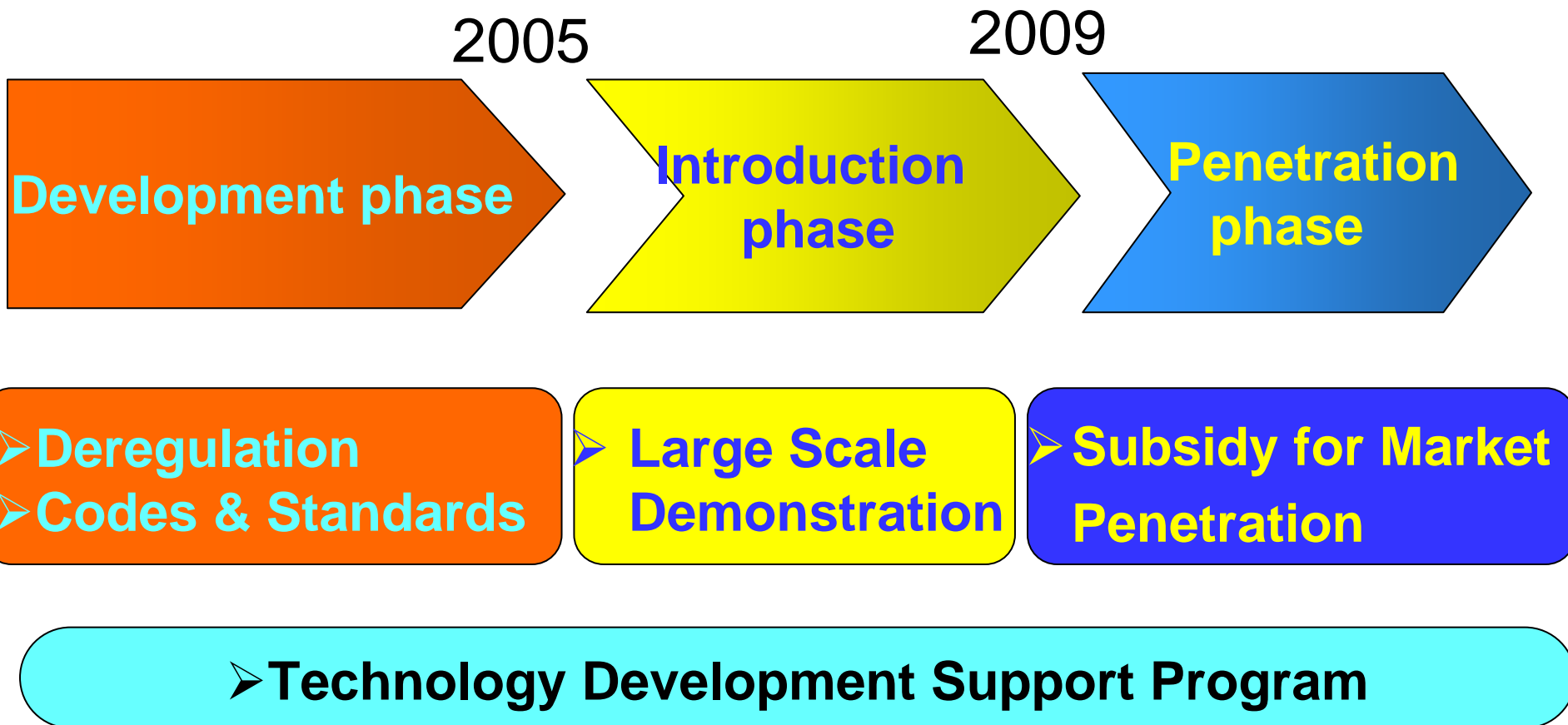
Aggressive development by
manufacturers and energy companies

in Japan

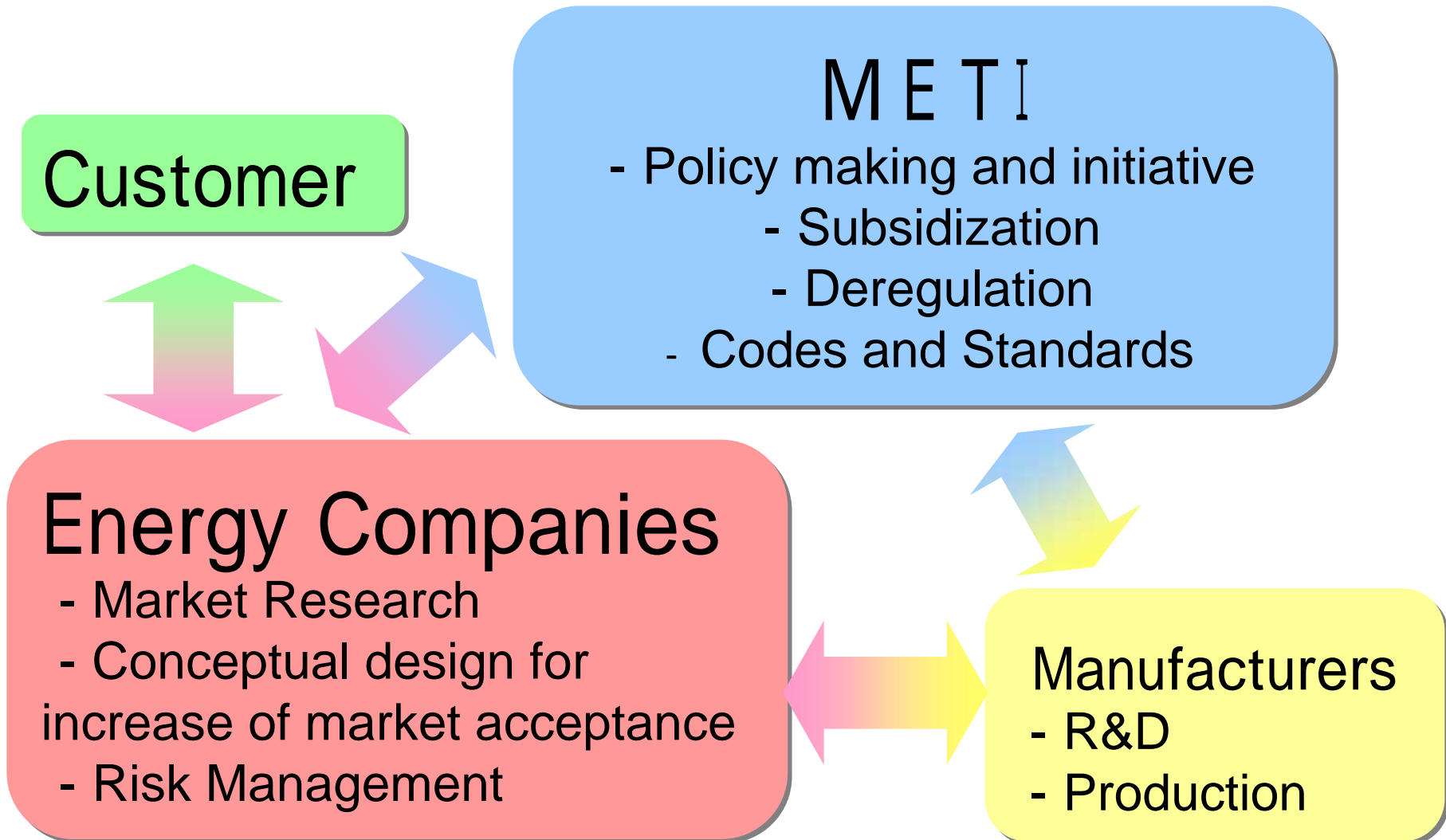
Components of residential PEFC



Road Map of Residential PEFC Development



Development Initiative

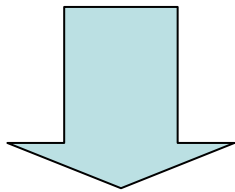


JGA's stationary PEFC testing program

"Millennium project" (2000 -) subsidized by NEDO

JGA: Japan Gas Association

PEFC systems testing related to safety, performance etc.



>Deregulation

>Codes and standards



Test Facility

Large-Scale Stationary Fuel Cell Demonstration Project (JFY 2005-2008) conducted by METI/NEDO/NEF

> Demonstrator

Pair of a PEFC manufacturer and a fuel supplier

> Applicable fuel cells

1kW class fuel cells

> Subsidy

JFY	2005	2006	2007	2008
¥/system	6 million	4.5 million	3.5 million	2.2 million

> Total number of demonstration

JFY	2005	2006	2007	2008
Total	400	777	930	1120
TG	150	160	210	276

Players in the Large-scale demonstration project (JFY2005-2007)

		Ebara	Pana-sonic	Eneos Celltech (Sanyo)	Toshiba	Toyota	Total
City Gas	Tokyo gas	265	255				520
	Osaka gas		4	114	106		224
	Toho gas	25	13			52	90
	Saibu gas	20	13				33
	Hokkaido gas	20					20
	Nippon gas				6		6
	subtotal	330	285	114	112	52	893
LP Gas	Nippon oil			610			610
	Other 9companies			25	433		458
	subtotal			635	433		1068
Kero-sene	Nippon oil	221					221
	Cosmo oil	5					5
	subtotal	226					226
Total		556	285	749	545	52	2187

Residential PEFC CHPs



**ENEOS celltech
(former SANYO)**

Natural gas
/ LPG
750W



TOSHIBA FCP

Natural gas
/ LPG
700W



EBARA

Natural gas
/ Kerosene
1,000W



**MATSUSHITA
(Panasonic)**

Natural gas
1,000W



TOYOTA

Natural gas
1,000W

Source : NEF Home Page

Specification of residential PEFC of Tokyo Gas *-LIFUEL-*

Rated power: 1kW

Efficiency*(electricity): 37%

(heat recovery): 50%

(overall) : 87%

Turndown ratio: 30%

Hot water storage: 200L

Fuel: City gas (13A)



***LHV basis Matsushita Electric Industrial Co. Ebara Ballard Corp.**

Role of Tokyo Gas in Residential FC Development

Establishment of
social platform

Technical support for deregulation,
codes & standards, etc.

Product
development

Establishment of concept and specification

In-house R&D: Fuel processor, Operation control

Evaluation through operation tests and field trials

Easy installation, Maintainability, User manuals, etc.

Customer
support

Trouble shooting, Maintenance

Durability Test of the Systems



Remote Controller of LIFUEL



わが家の電力事情 Live
 ※ : 1.0kW 舎 : 0.6kW
 FC 0 HOME
 1 1

今日の電気情報 (KWH)

※ 発電電力量 : 8.2
 舎 家庭電力量 : 9.8

つぎの発電開始は
 午前 8 時頃を
 予定しています。

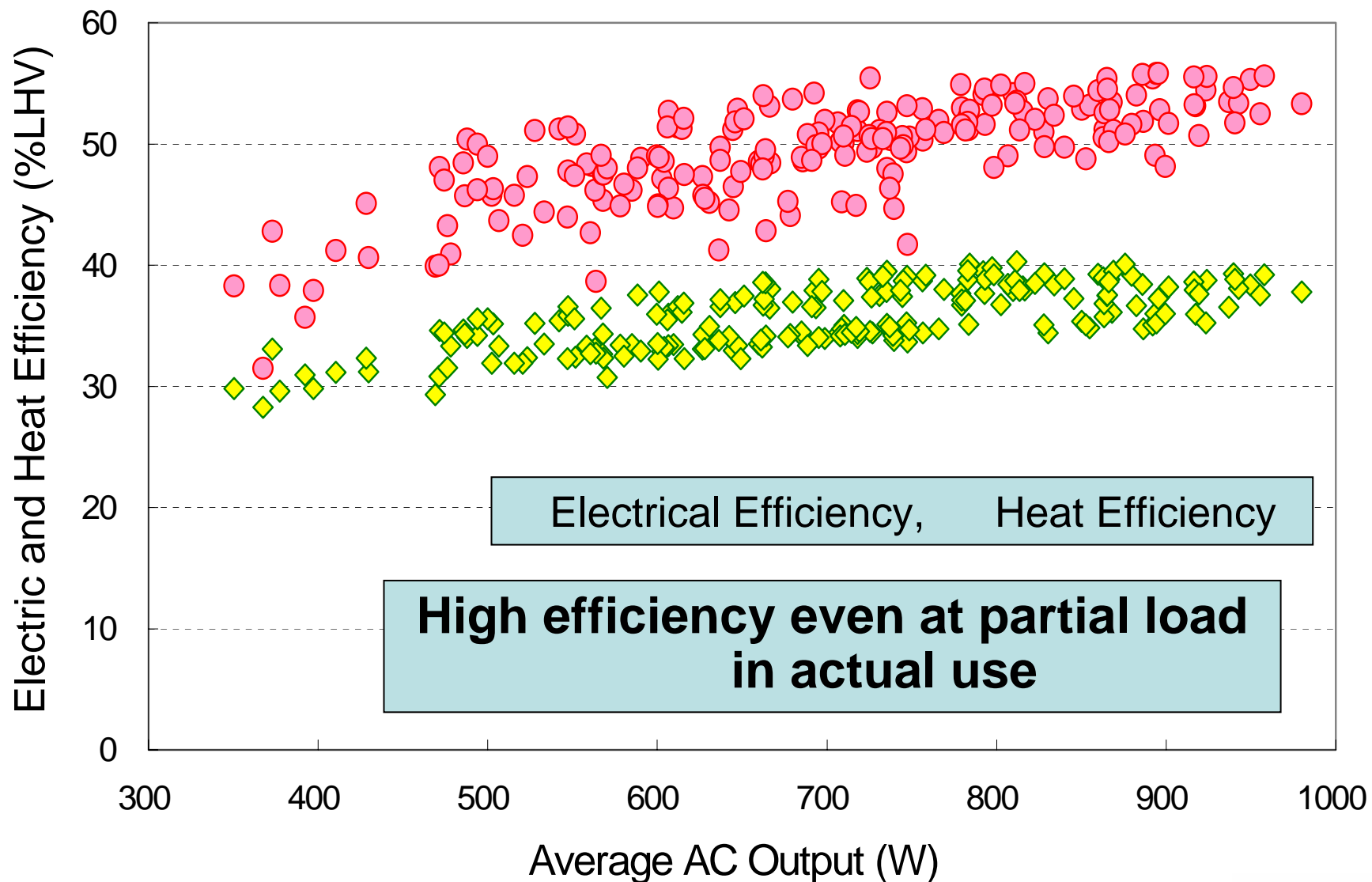
Installation of LIFUEL



Installation of LIFUEL



Electric and Heat Efficiency



Summary of the Operation Results

		205 Total	Average(/day)
Generation time		1015928 h	13.6 h
Supplied electricity	Amount	629 MWh	8.4 kWh
	Contribution ratio	34 %	
Supplied heat	Amount	937 MWh	12.5 kWh
	Contribution ratio	78 %	
Primary energy saving	Amount	743 MWh	9.9 kWh
	Ratio	25 %	
CO₂ emission reduction	Amount	263 t-CO ₂	3.5 kg-CO ₂
	Ratio	38 %	

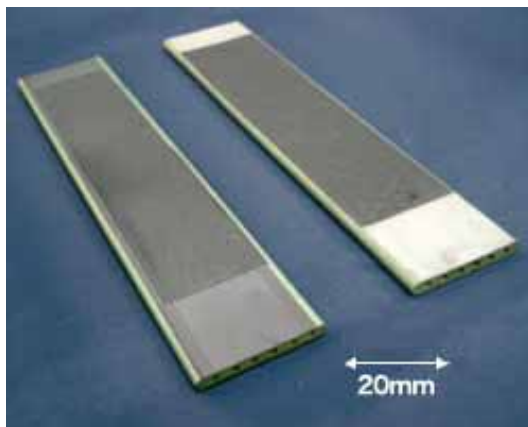
SOFC based residential CHP

➤ Higher electrical efficiency

Target Electrical Efficiency

:>45%LHV (@ rated power)

Flat tubular Cell



700W(AC) SOFC Unit

by Kyocera

 TOKYO GAS

SOFC Demonstration Research Project (JFY 2007-2010) conducted by MET/NEDO/NEF

>Objectives

Clarification of the issues including durability through actual usage

>Budget

¥765million for JFY2007, ¥800million for JFY2008

>Players in JFY2007 (Operator / Manufacturer)

Osaka Gas / Kyocera: 20 sites

Tokyo Gas / Kyocera: 3 sites

Saibu Gas / Kyocera: 1 sites

Hokkaido Gas / Kyocera: 1 sites

Nippon Oil / Nippon oil: 2 sites (LPG, Kerosene)

TOTO / TOTO: 2sites (small commercial, 2kW)



For the children of the future