

Performance of New Residential PEFC Cogeneration System

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Agenda

1. Introduction
2. Specifications
3. Operating Results
4. Summary

Outline

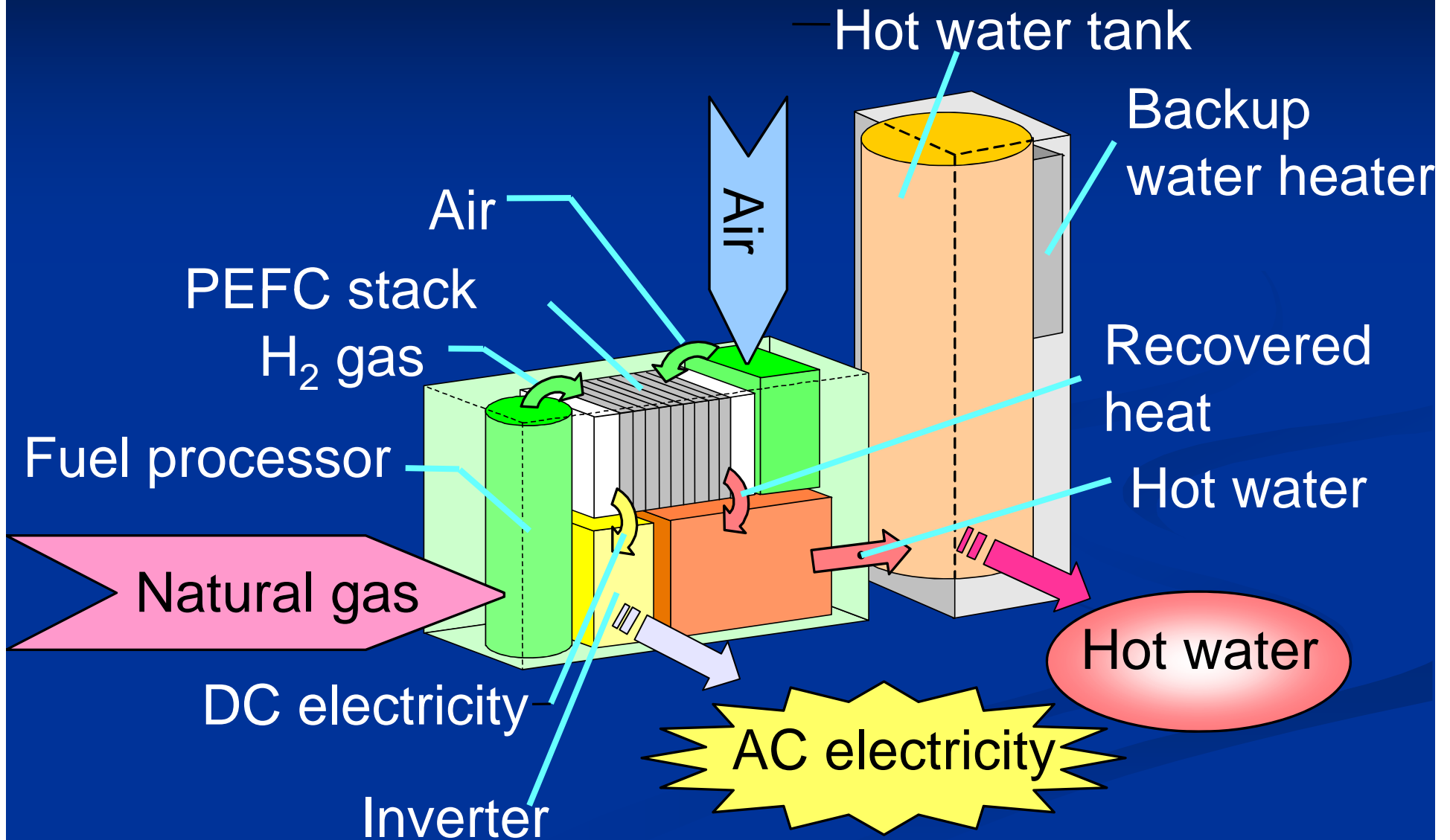
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The World's First Commercial PEFC Cogeneration Systems for Residential Use in Feb 2005



First systems were installed at the Prime Minister's Official Residence
(Ceremony for the first units on 8th April 2005)

Components



Features of Tokyo gas Residential PEFC Cogeneration System

- #1) Generates electricity following the electric demand
- #2) Heat is used for hot water (inc hot bath) because the heat recovery temperature is not high enough for heating systems
- #3) System is installed outside houses

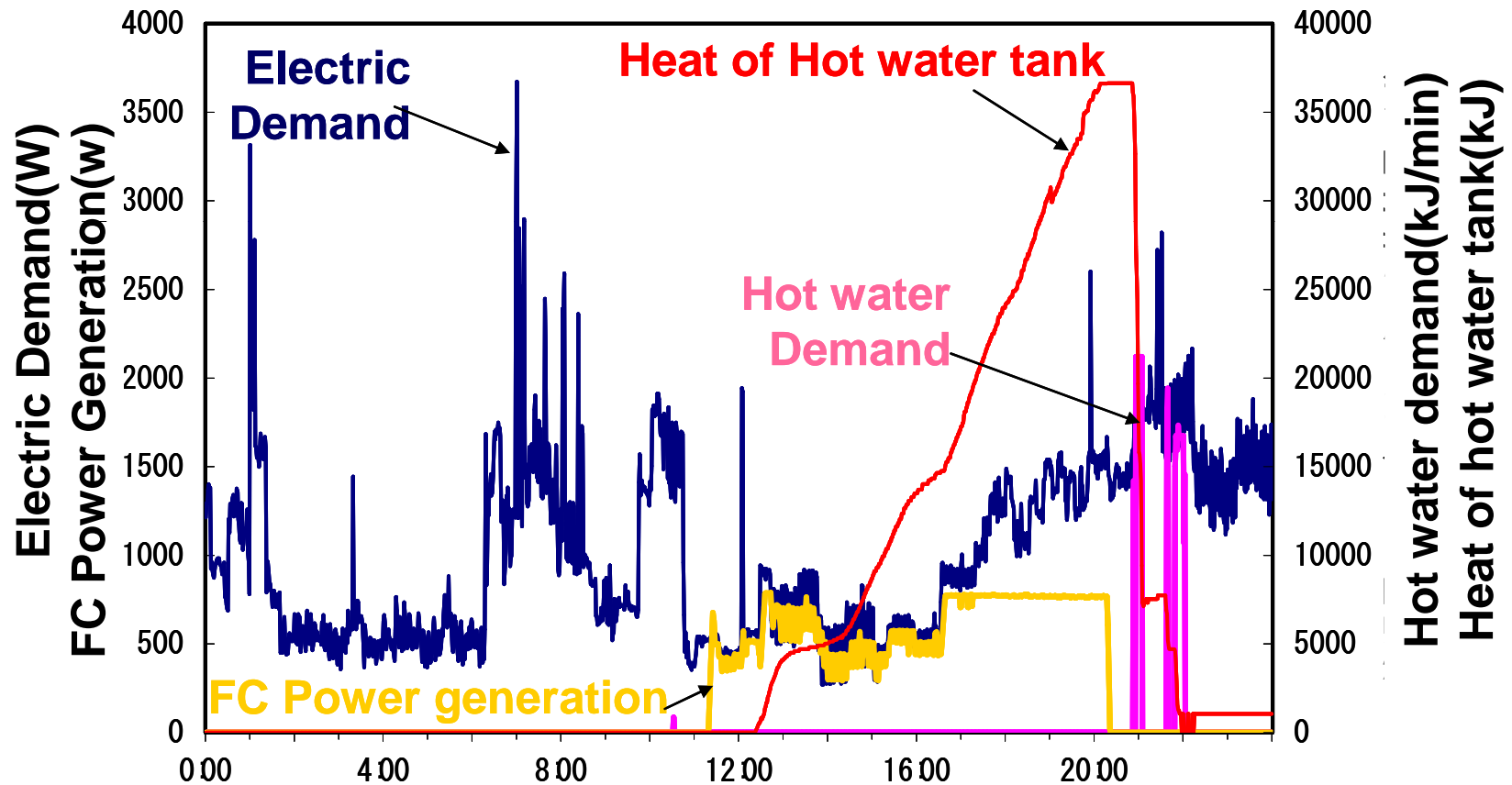
Concepts of Tokyo gas Residential PEFC Cogeneration System

- # System aims at the least primary energy consumption
- # Stops power generation when heat is fully stored in the hot water tank

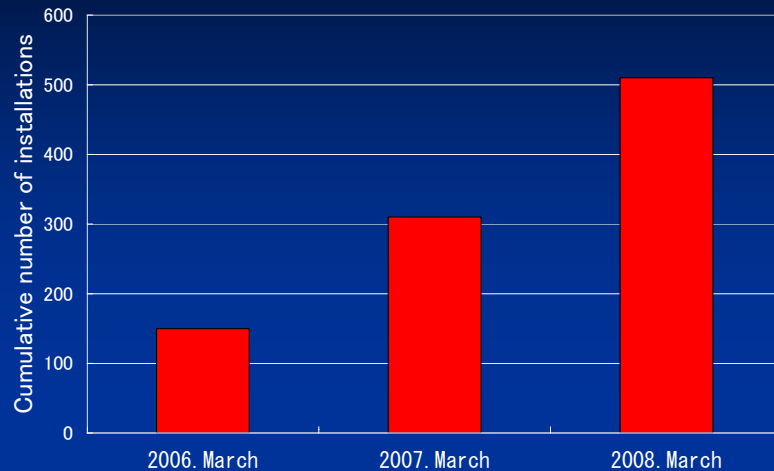
Step of the intelligent control

- #1) forecasts future demand using the past data.
- #2) calculates different primary energy consumptions of different potential operations
- #3) selects the operation that consumes the least primary energy

An Example of the Operation



Performance of the previous models



520 site operated and analyzed between Jun.2005 and Sep.2008

	Cumulative value
Generated electricity	3.14 GWh
Generated hours	4,588,109 h
Supplied electricity	2.80 GWh
Supplied heat	4.19 GWh
Primary energy saving	2.92 GWh
CO ₂ emission reduction	1070 t-CO ₂

Marginal power generation:36.9 % HHV,
Gas-fired water heater:78 % HHV

Marginal power generation:0.69 kg-CO₂/kWh, Natural gas:0.005125 kg-CO₂/MJ

Ceremony for the same name “ENE-FARM” for Japanese PEFC cogeneration was assigned on 26th Jun. 2008

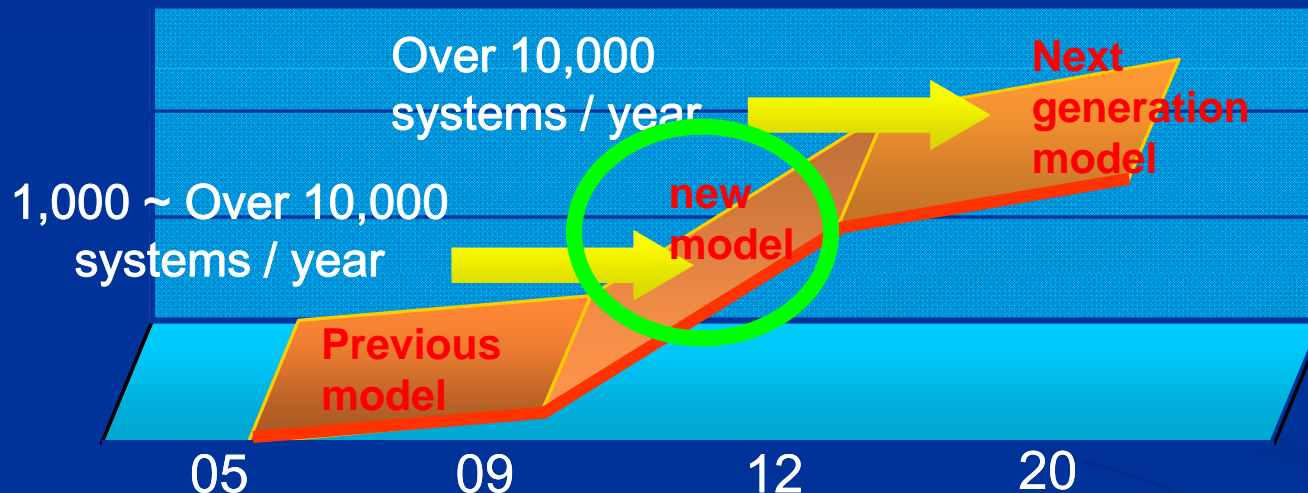


2009 Fuel Cell Seminar

Prospect of Stationary PEFC cogeneration Market by Tokyo Gas

2005- Introduction phase
2009- Penetration phase

All Japan



Tokyo gas area

	2009	⋮	2013
Sales target	2100 units		Cumulative number of installations 42000 units

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Concepts of the development of the new model

<Keep the Basic performances of the previous model>

electrical efficiency, heat recovery efficiency, output range, etc.

<Improve Durability, Reliability>

<Improve User abilities>

Installation, Maintenance, User-friendliness

<Reduce Cost>

Specifications (Basic performances)

	New model	Previous model
Output range	300W to 1kW	300W to 1kW
Electricity efficiency (at 1 kW)	> 37 % LHV	> 37 % LHV
Heat recovery efficiency (at 1 kW)	> 52 % LHV	> 50 % LHV
Heat recovery temperature	60degC	60degC
Tank capacity	200 L	200 L

Improved Specifications

Durability: 40000hs / 4000 SS-cycles / 10 years

Reliability: target 5%

Installation: Depth of installation space 0.9m

Maintenance:

Reduced the time and the skill for maintenance

User-friendliness:

Advanced control device to enjoy the power generation and to be more eco-conscious

Cost: Priced at 3.3 million Yen (\$30K)
(inc. 10-year maintenance fee)



Panasonic

Installation situations



Depth of installation space



Improved Specifications

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Panasonic

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Samples of Operating Results

New model

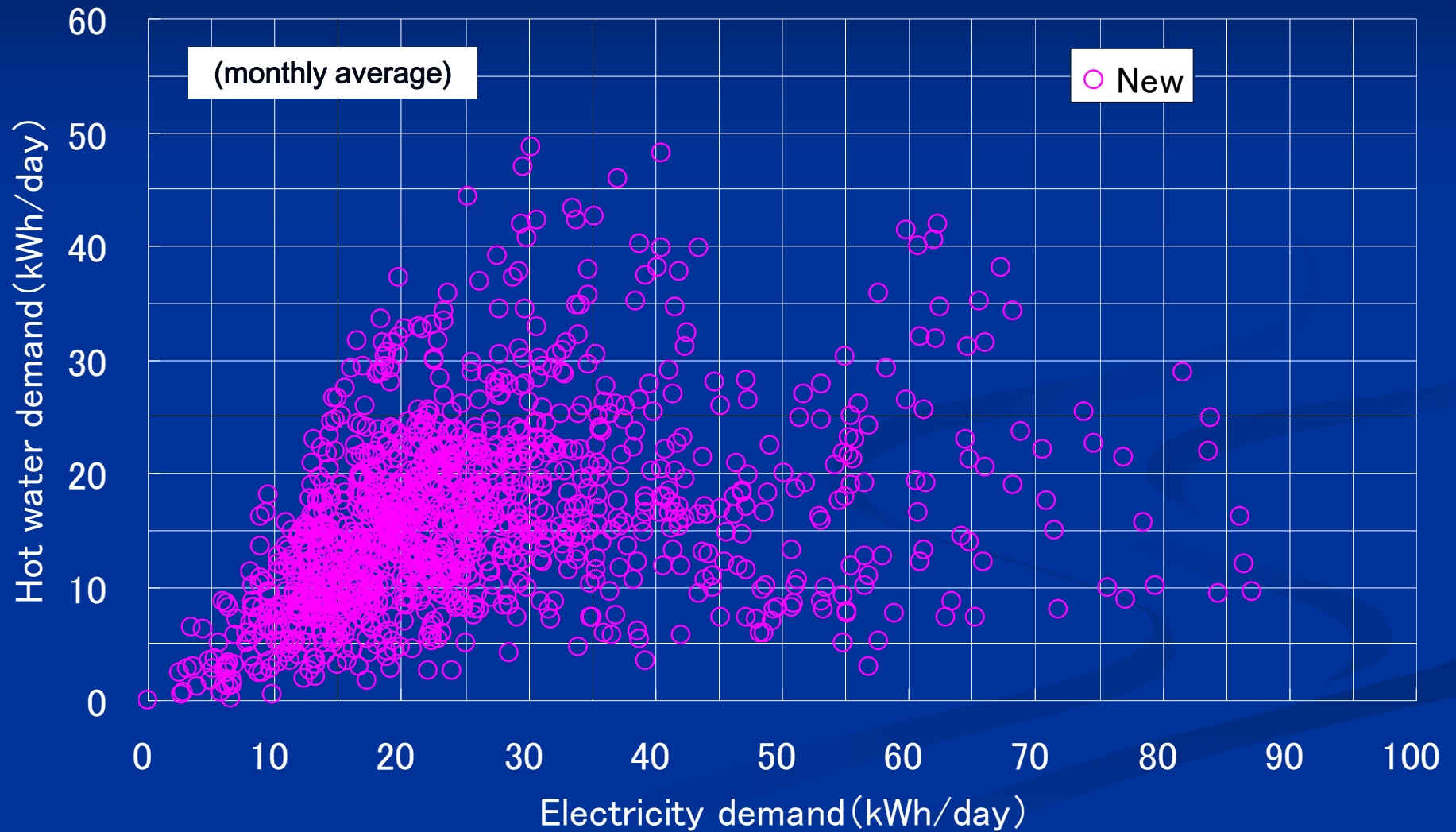
225 systems operated and analyzed between
Jul. 2008 and Mar. 2009

(We introduced the new model limitedly to the
customers in 2008)

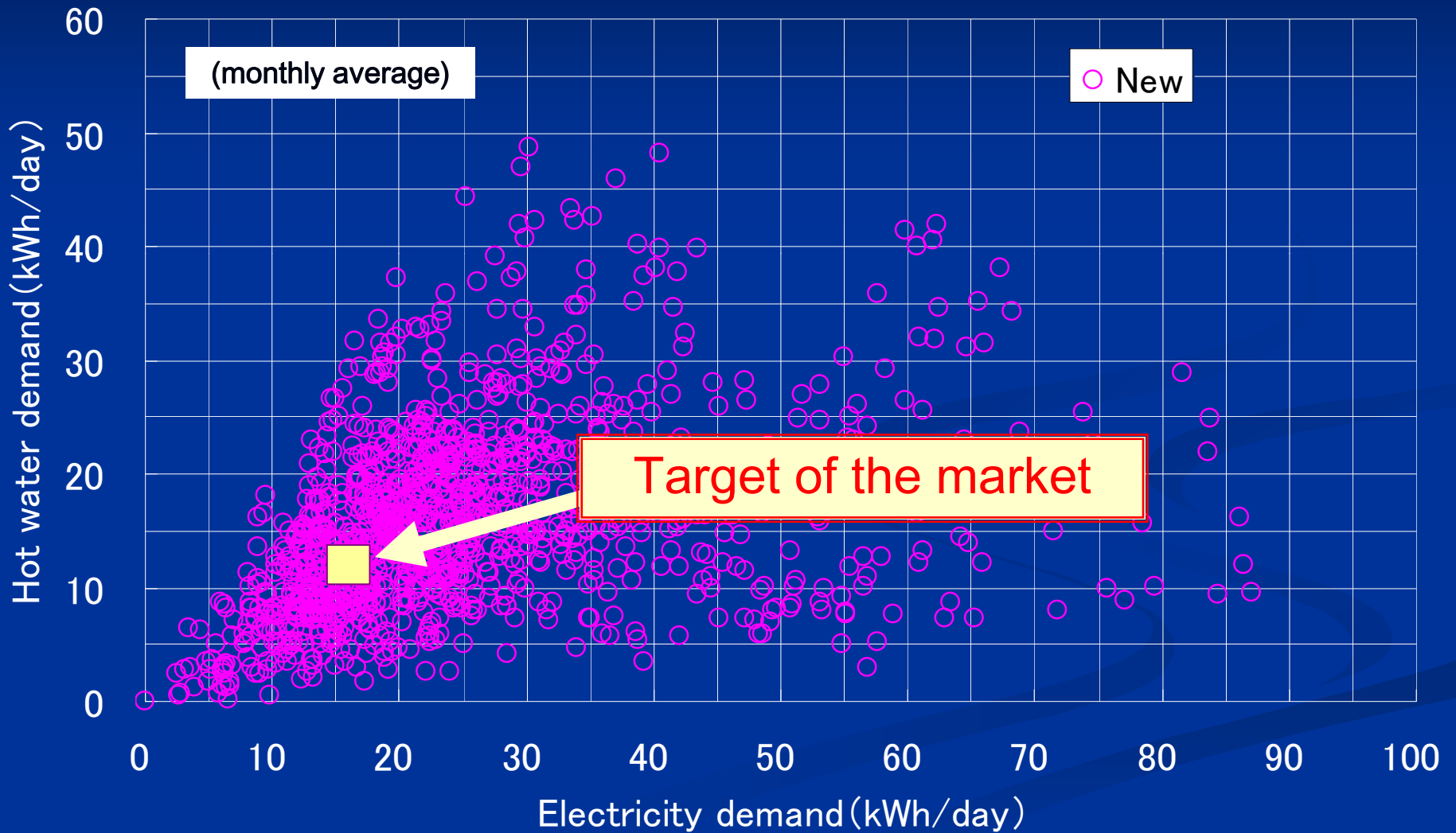
Previous model

299 systems operated and analyzed between
Jan. 2007 and Dec. 2007

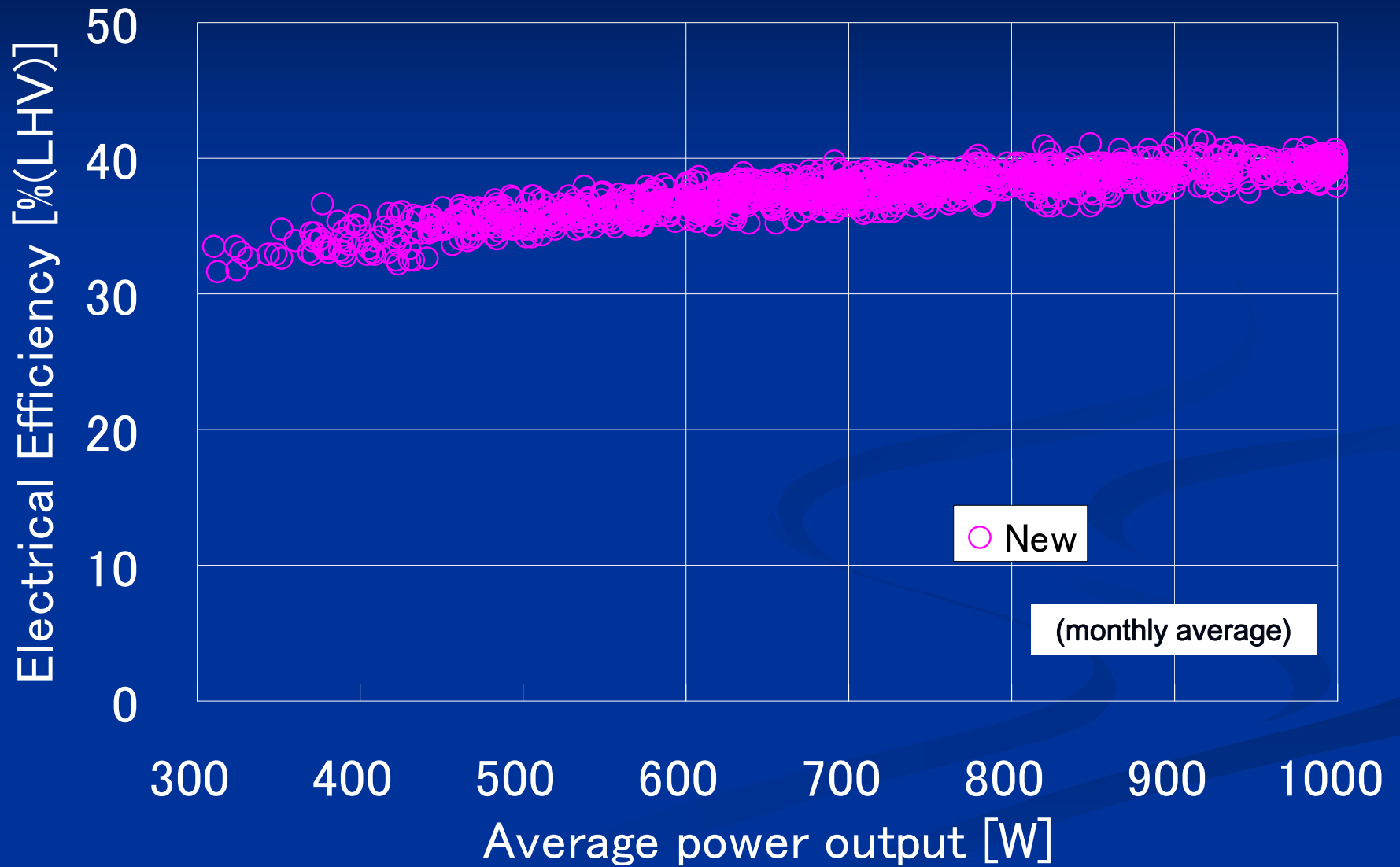
Electricity and Hot Water Demand



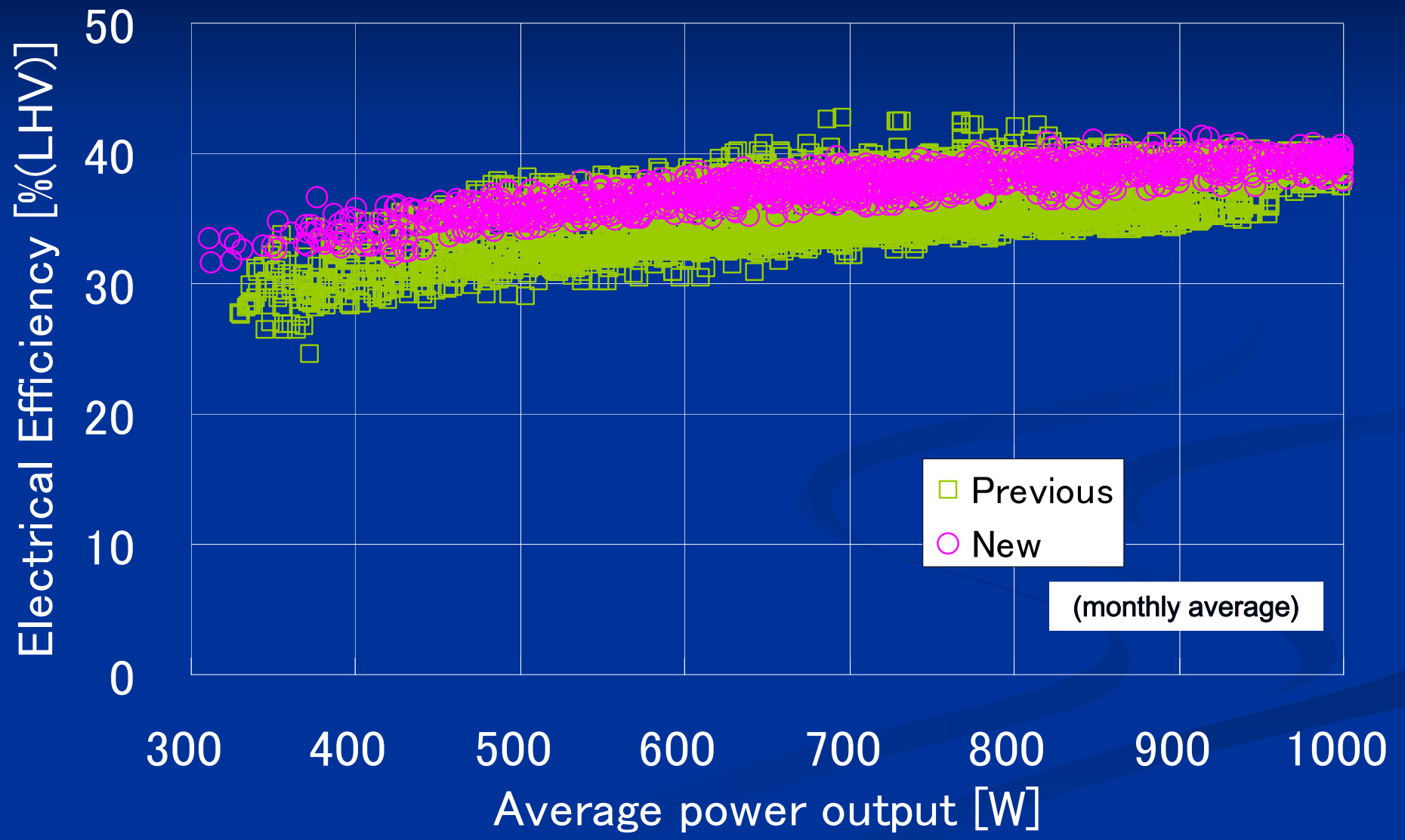
Electricity and Hot Water Demand



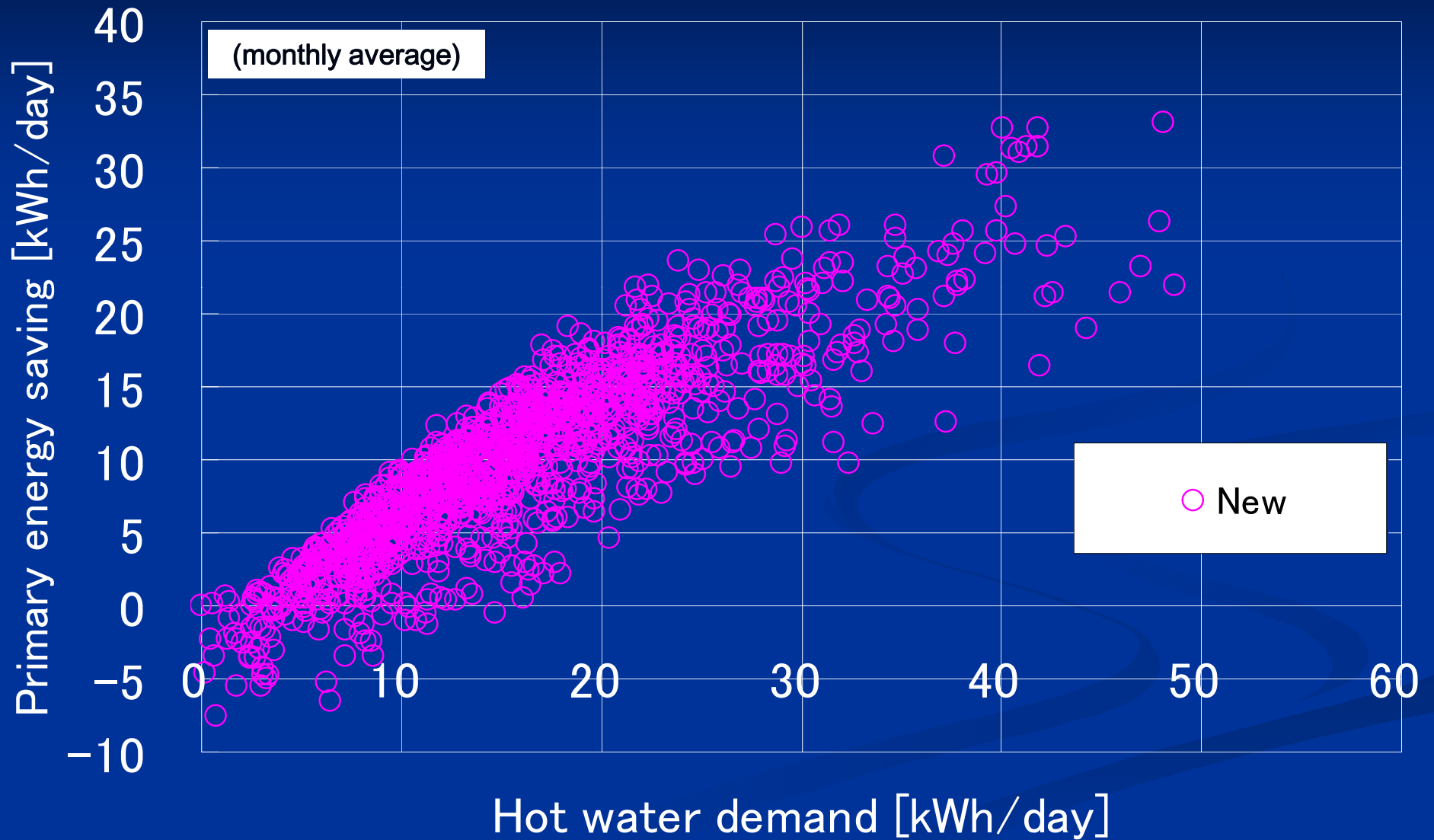
Electrical Efficiency



Electrical Efficiency



Primary Energy Saving



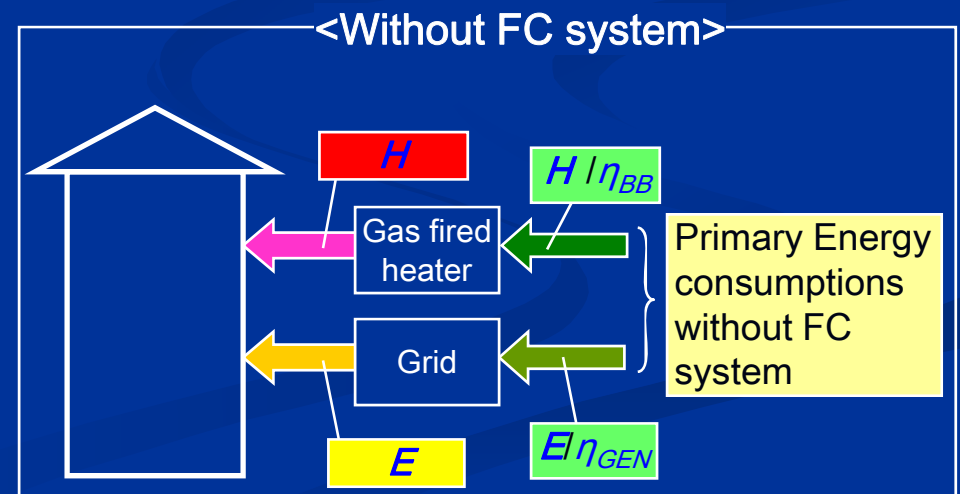
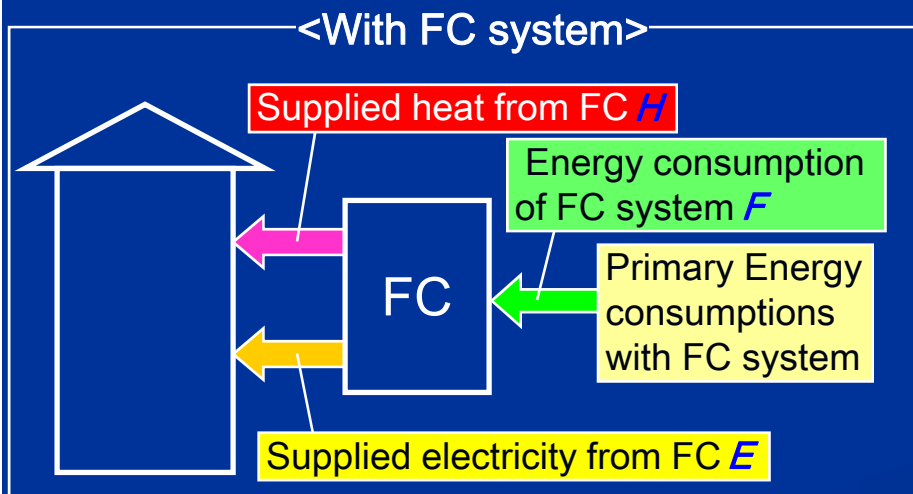
Calculation of the primary energy saving

Primary energy savings

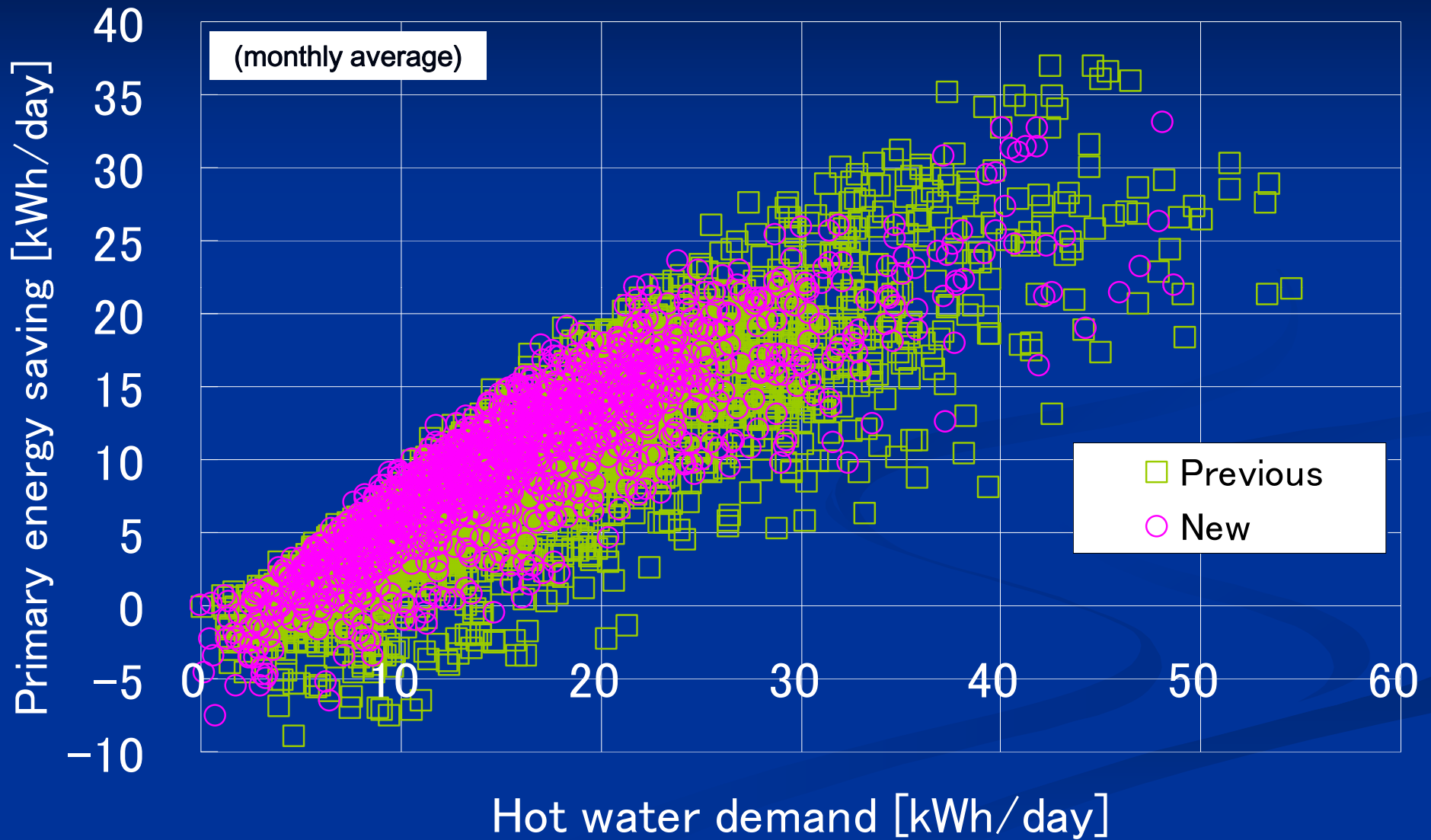
$$= \text{Primary Energy consumption without FC system} \\ - \text{Primary Energy consumption with FC system} \\ = (H / \eta_{BB} + E / \eta_{GEN}) - F$$

η_{GEN} : Efficiency of marginal power generation, 36.9 % HHV

η_{BB} : Efficiency of Gas-fired water heater, 78 % HHV



Primary Energy Saving



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Summary

#1) Tokyo Gas succeeded in developing the new model of residential PEFC cogeneration system, which went on sale on May 1st 2009.

#2) The new model is designed to have longer durability, higher reliability, user-friendly interface, to be easier to install and maintain, and to be much cheaper .

#3) It is verified that the new model has a better performance than the previous one which was already very good at reducing the primary energy consumption.

Thank you !

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