

# International Gas Union Research Conference 2014

## Development of New Model Residential PEMFC micro-CHP Systems

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- 1. Introduction**
- 2. New model for apartment buildings**
- 3. Optional units for power outage**
- 4. Summary**

# 1. Introduction

2. New model for apartment buildings

3. Optional units for power outage

4. Summary

# 1. Introduction

## Residential Fuel Cell “ENE-FARM”

First model  
(2009~10)



Second model  
(2011~12)

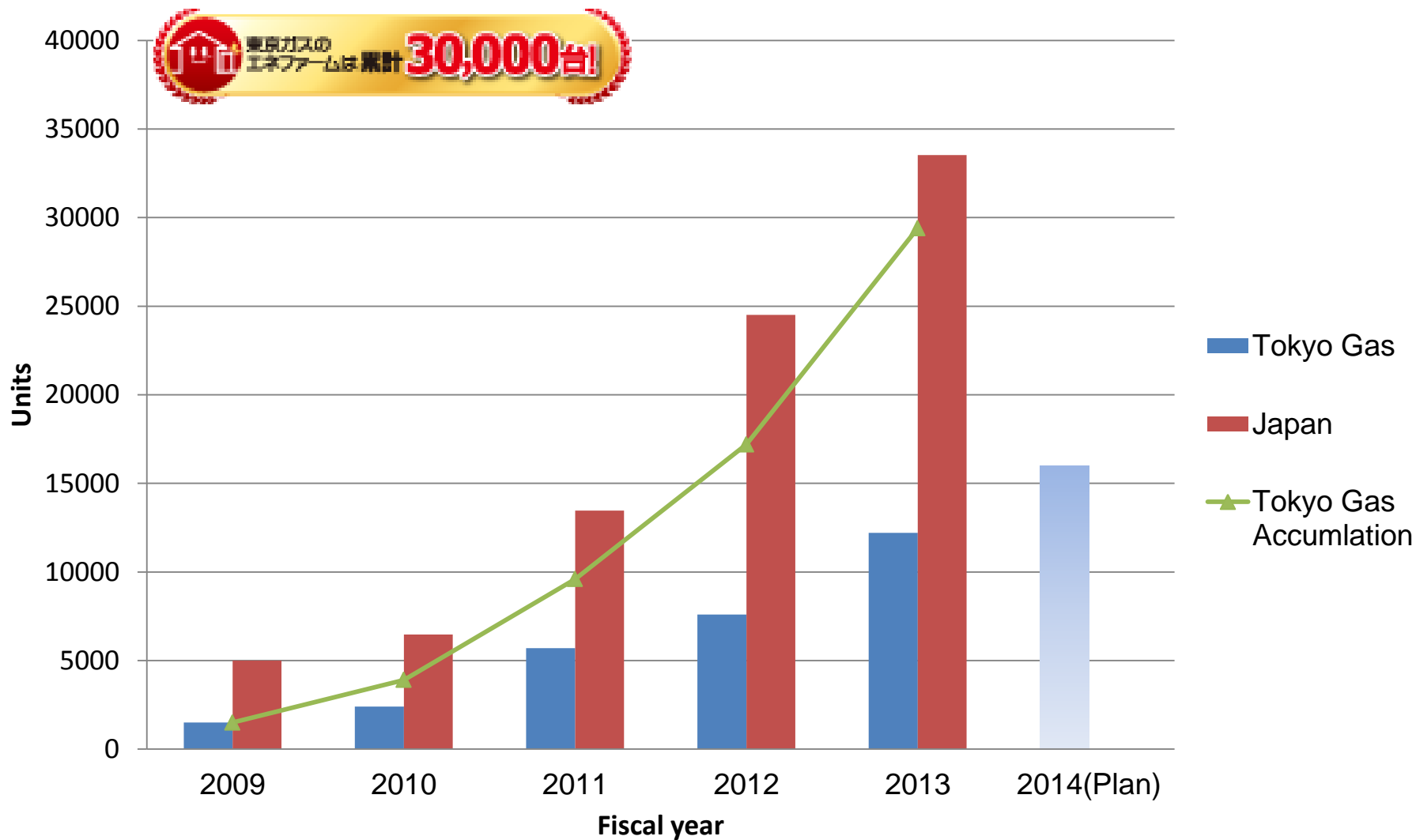


Third model  
(2013~)



Total efficiency(LHV)	89%	90%	95%
Installation space (depth)	3.9m <sup>2</sup> (1,100mm)	2.0m <sup>2</sup> (900mm)	2.0m <sup>2</sup> (750mm)
Display Panel of user interface	B/W (2 inch)	B/W (3.5 inch)	Color (4.3 inch)
Durability	40,000hrs 4,000 times SS	50,000hrs 4,000 times SS	60,000hrs 4000times SS
Fixed price (tax excluded)	JPY 3,300,000	JPY 2,630,000	JPY 1,900,000

# 1. Introduction



**Total sales 30,000 achieved in April 2014**

# 1. Introduction

To promote ENE-FARM sales

## Cost Reduction

- Technology development
  - > Reduction of device cost
  - > Reduction of number of components
- Mass- production

## Expanding market potential

- Installation to apartment buildings

## Product Appeal

- User interface
- Meets users' concern
  - > Optional units for power outage

1. Introduction

**2. New model for apartment buildings**

3. Optional units for power outage

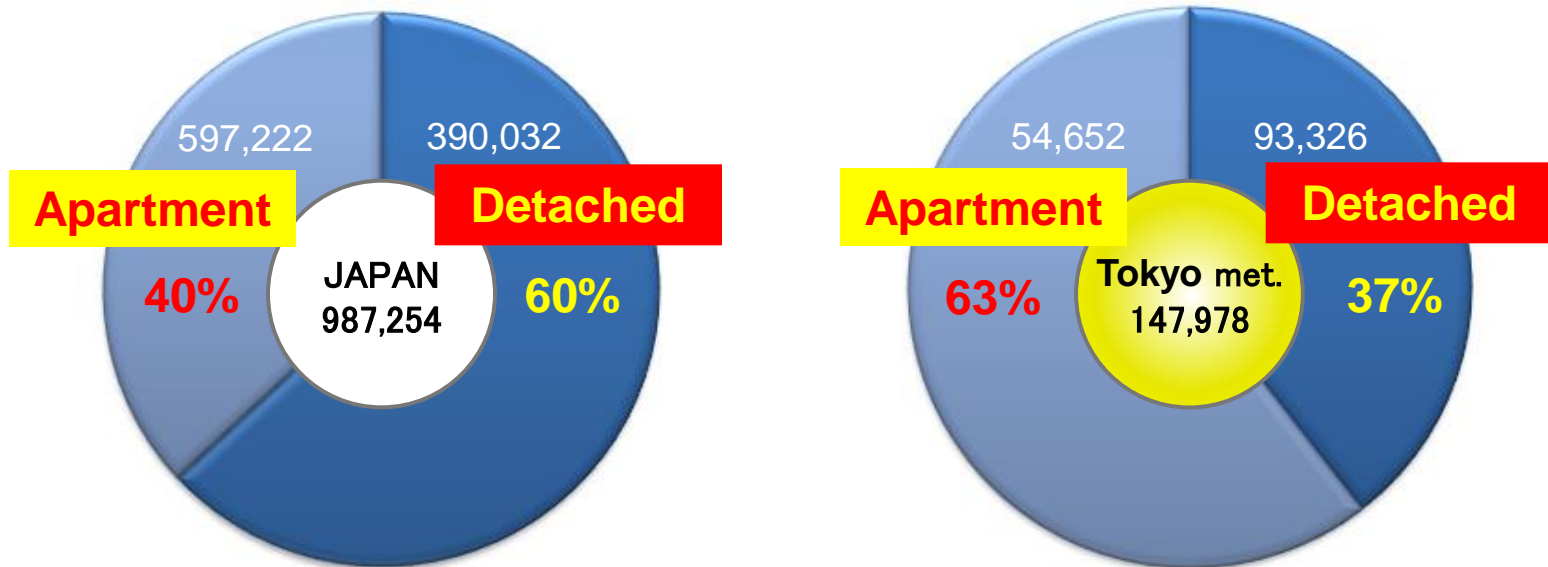
4. Summary

## 2. New model for apartment buildings

### # High ratio of apartment residences in Tokyo area

#### 【 New house construction in 2013 】

Calculated using residence statistic report by the Ministry of Land, Infrastructure, Transport and Tourism, Japan



Apartment model is essential for market expansion in Tokyo area



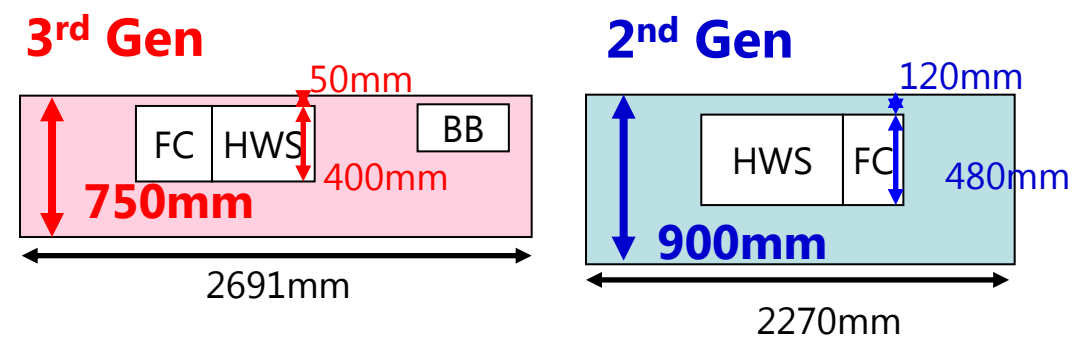
# 2. New model for apartment buildings

Developed based on 2013 detached house model

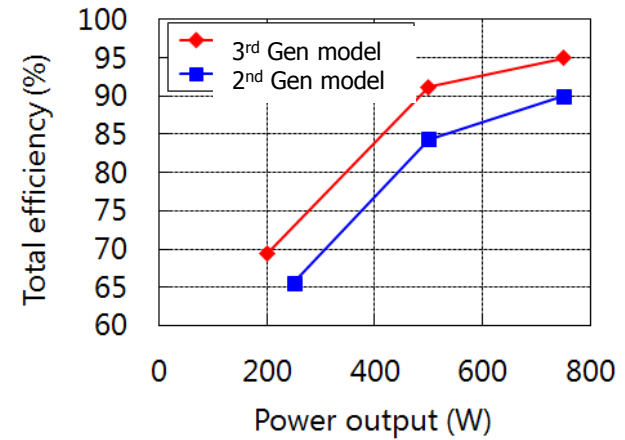
## # Feature of 2013 (3<sup>rd</sup> Gen) detached house model

(1) Improved installability

- Reducing depth of installation space (Key in Tokyo area)
- Flexible layout



(2) Higher efficiency



(3) More user-friendly



# 2. New model for apartment buildings

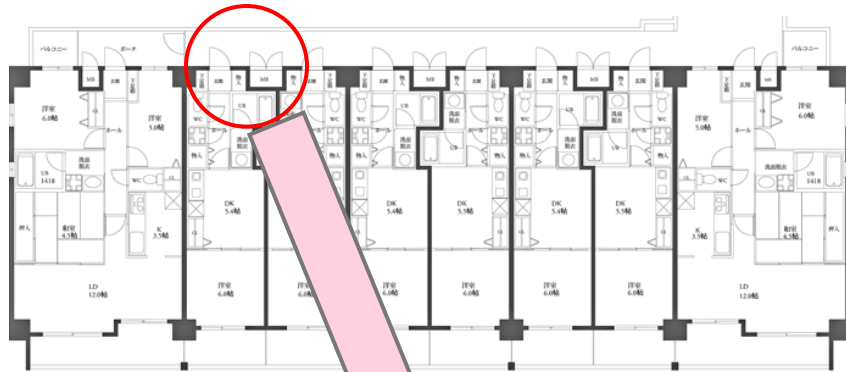
## Specifications of the previous model and the new model

		Apartment building model	Detached model
Performance	Power generation output	200W-750W	←
	Electrical efficiency	39.0%LHV / 35.2%HHV	←
	Heat recovery efficiency	56.0%LHV / 50.6%HHV	←
	Overall efficiency	95.0%LHV / 85.8%HHV	←
	Tank capacity	147L	←
Dimension	Fuel cell unit	H 1,750mm W 399mm D 395mm	H 1,850mm W 400mm D 400mm
	Hot water storage unit	H 1,850mm W 400mm D 560mm	H 1,850mm W 560mm D 400mm
Dry weight	Fuel cell unit	99kg	90kg
	Hot water storage unit	54kg	55kg
Life time		60,000hrs and 4,000times SS	←

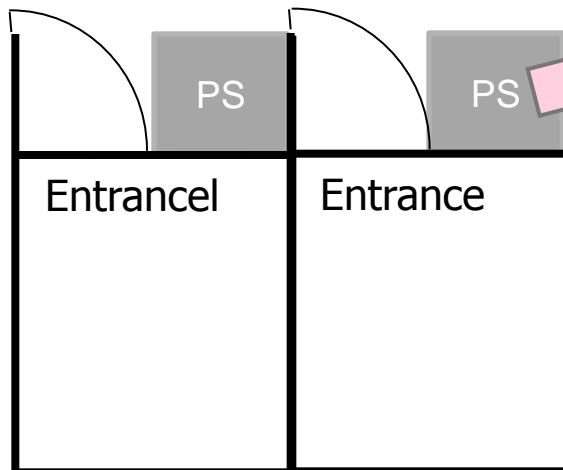
# 2. New model for apartment buildings

## Image of apartment buildings in JAPAN

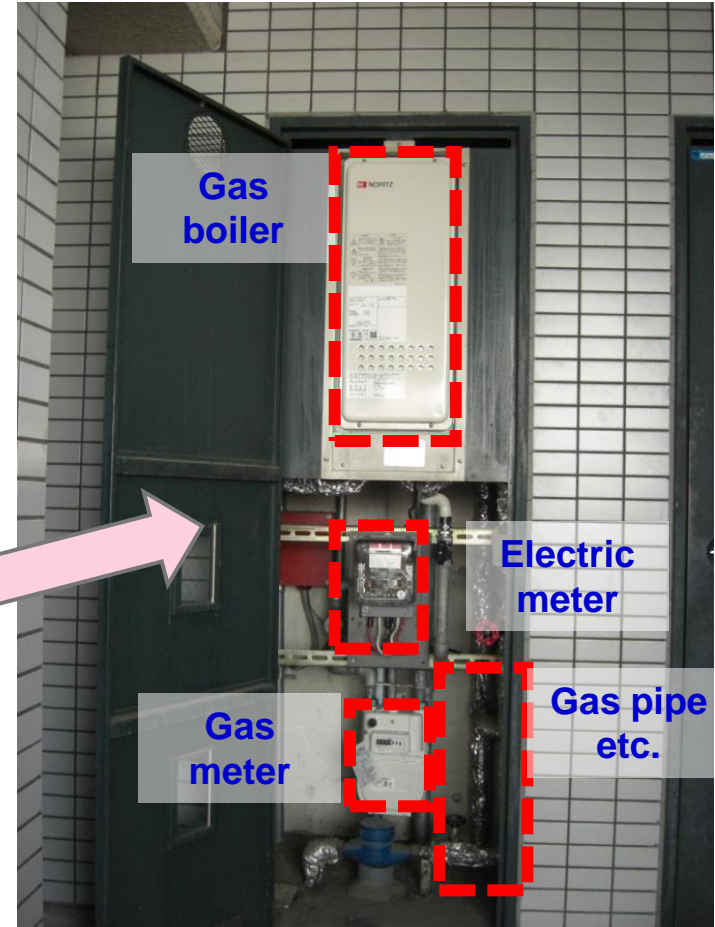
Example of one floor in apartment buildings



Corridor



Example of pipe shaft





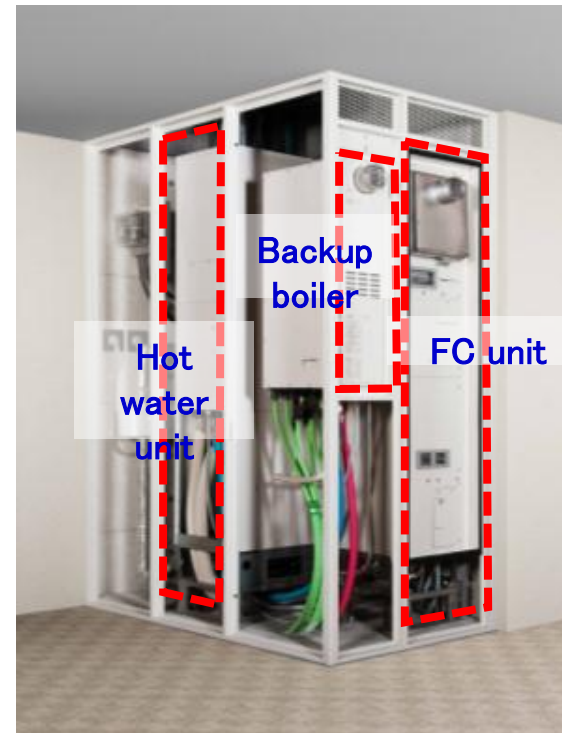
# 2. New model for apartment buildings

## Overview of New model

(1) Installable in pipe shaft

(2) Complies with requirements for apartment installation

(3) Enables layout flexibility

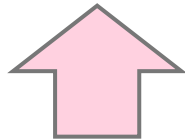


## 2. New model for apartment buildings

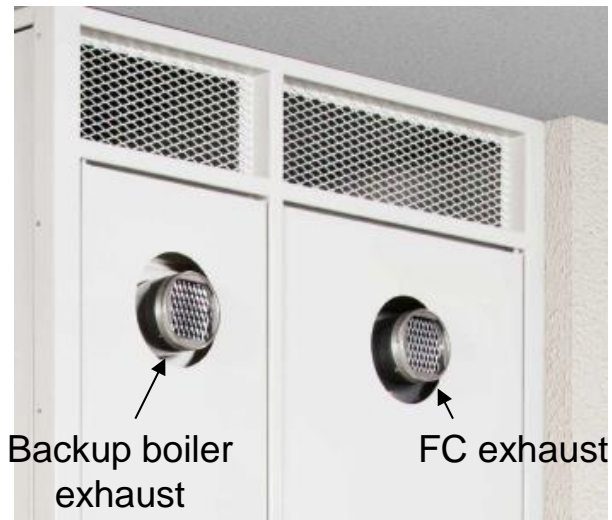
### (1) Installable in pipe shaft

# Increasing air tightness of FC unit

# Increasing thickness of the external panel (0.6mm → 0.8mm)



To meet authorized requirement for installation in pipe shafts in Japan based on fire protection law



# 2. New model for apartment buildings

## (2) Complies with requirements for apartment installation

### # Earthquake resistance

- Strengthening legs anchoring units using larger anchor bolts to meet building installation regulation in Japan
- Confirming no toppling at 1.0G





# 2. New model for apartment buildings

## (2) Complies with requirements for apartment installation

### # Wind resistance

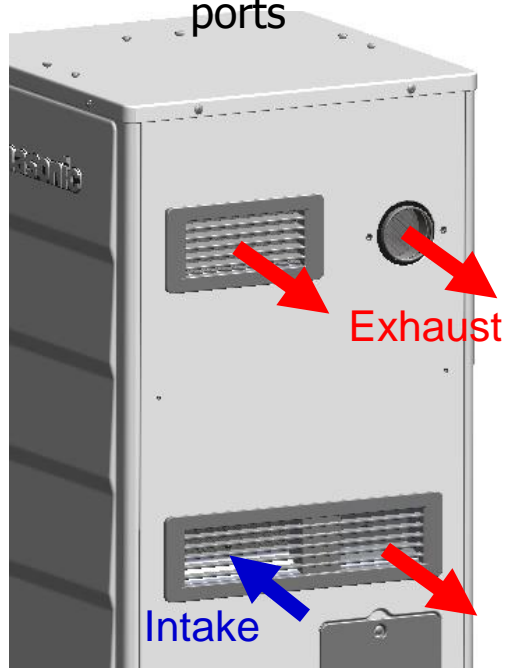
• Confirming stable operation under 30m/s wind (necessary for buildings over 100m in height)

(a) Improving composition of intake and exhaust

(b) Mitigating the effects of wind pressure on the internal components

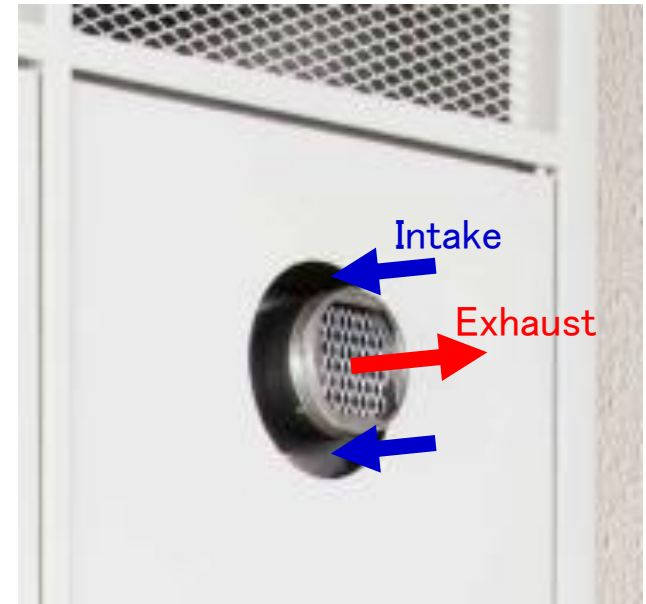
【Detached houses model】

Distributed intake and exhaust ports



【apartment buildings model】

Aggregate intake and exhaust ports

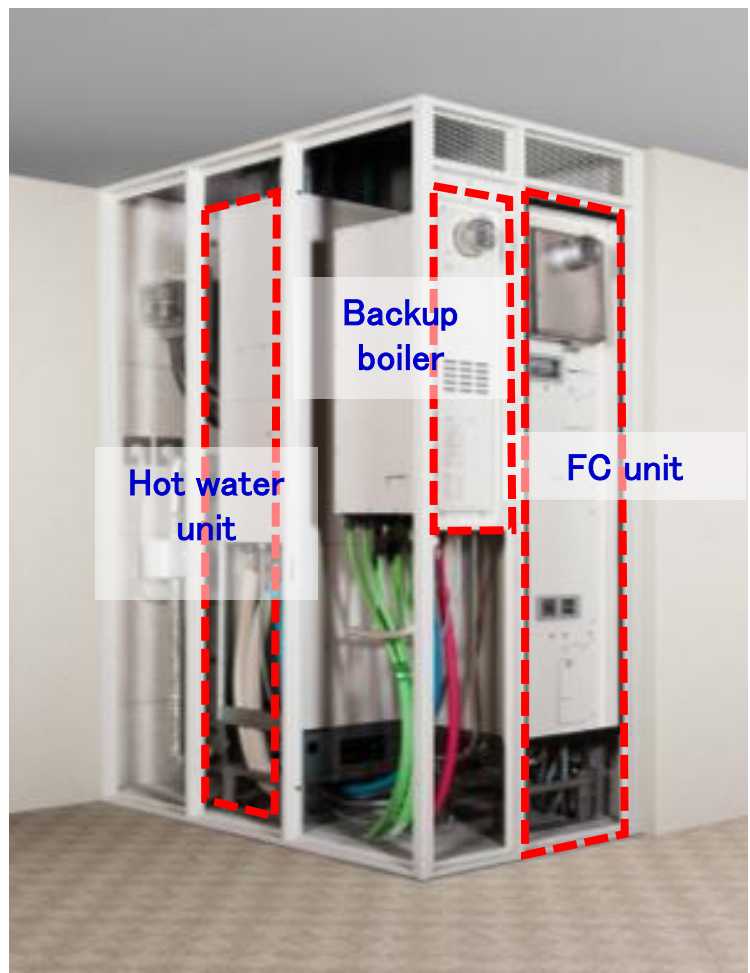




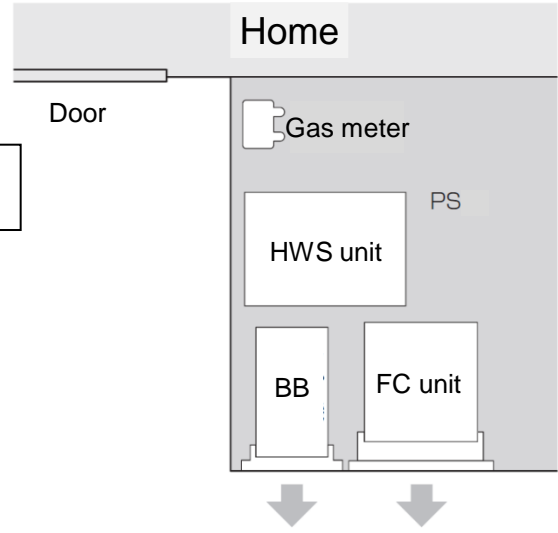
# 2. New model for apartment buildings

## (3) Enables layout flexibility

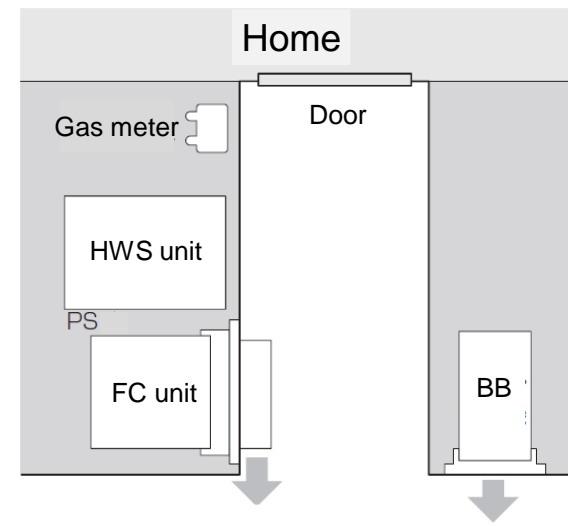
### # Examples of installation in pipe shaft



System installed in one space



System installed in separated space



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### 3. Optional units for power outage

# After 2011 Earthquake, user demand of operating ENE-FARM during power outage became apparent

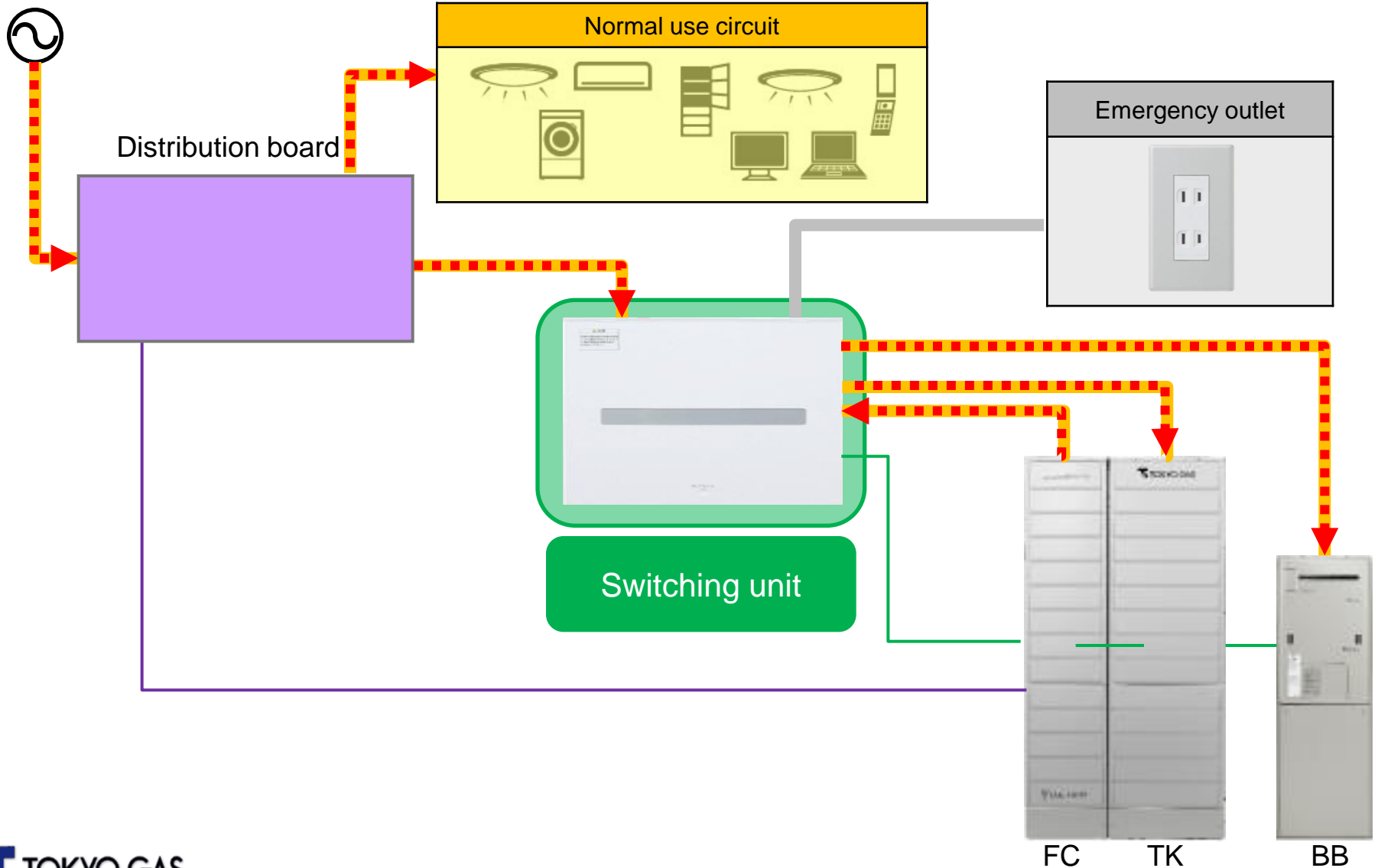


	Option A	Option B
Unit name	Switching unit	(1) Power supply unit (with Li ion battery) (2) Switching unit
Continuing FC generation	○	○
Starting up FC	×	○
Max. power output on grid power outage	FC : 700W	FC : 700W Power supply unit : 500W (Including 1000Wh Battery)
Max. available power on grid power outage	Approx. 700W	Approx. 1200W
Approx. supply duration on grid power outage	Max. 4 days	Load until 700W : Max. 4 days Load until 900W : Max. 10 hours Load until 1200W : Max. 2 hours
Fixed price (tax excluded)	JPY 130,000	(1) JPY 472,000 (2) JPY 143,000

# 3. Optional units for power outage

## # Operation with Option A

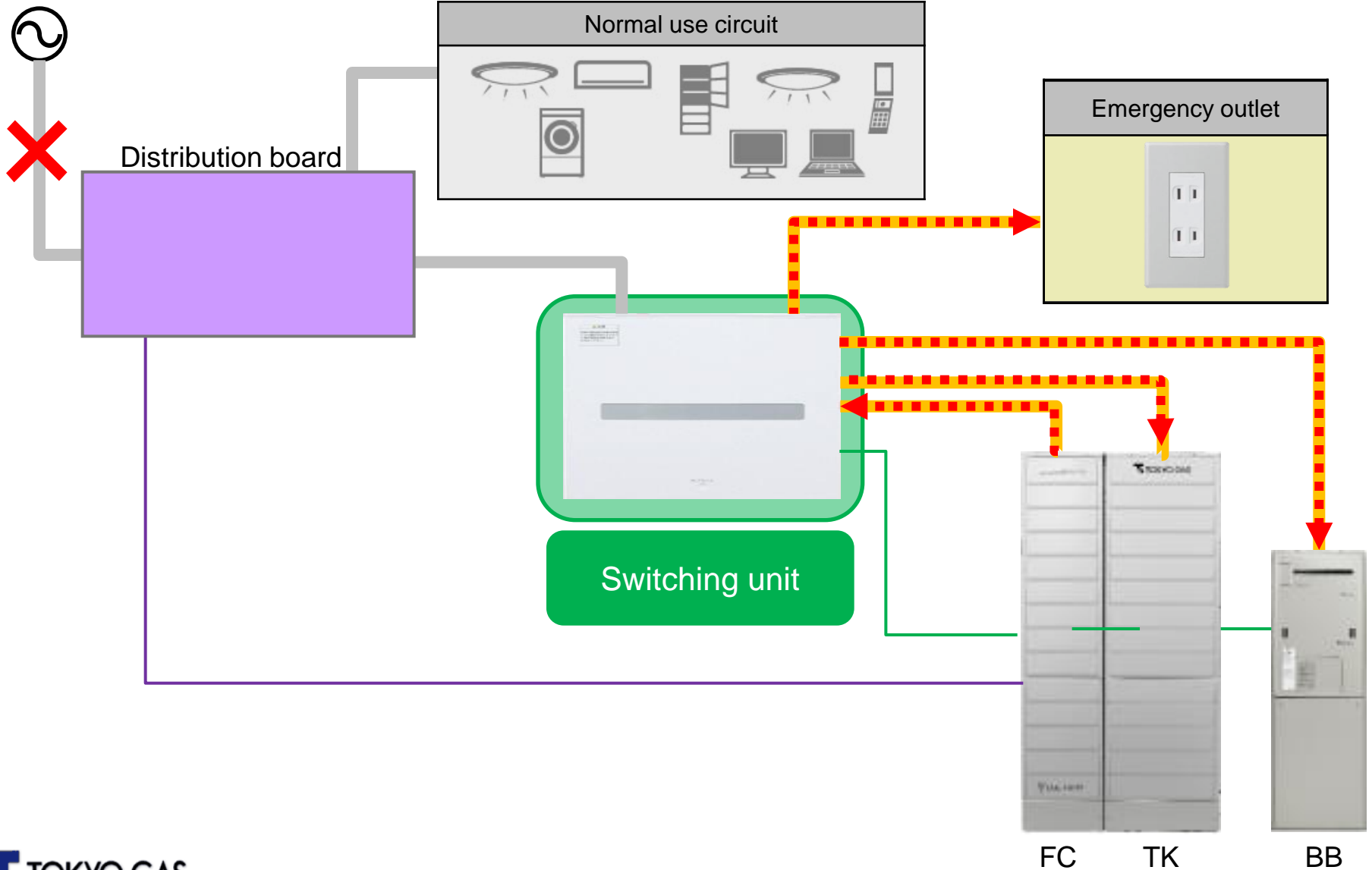
**(Normal use)**



# 3. Optional units for power outage

# Operation with Option A

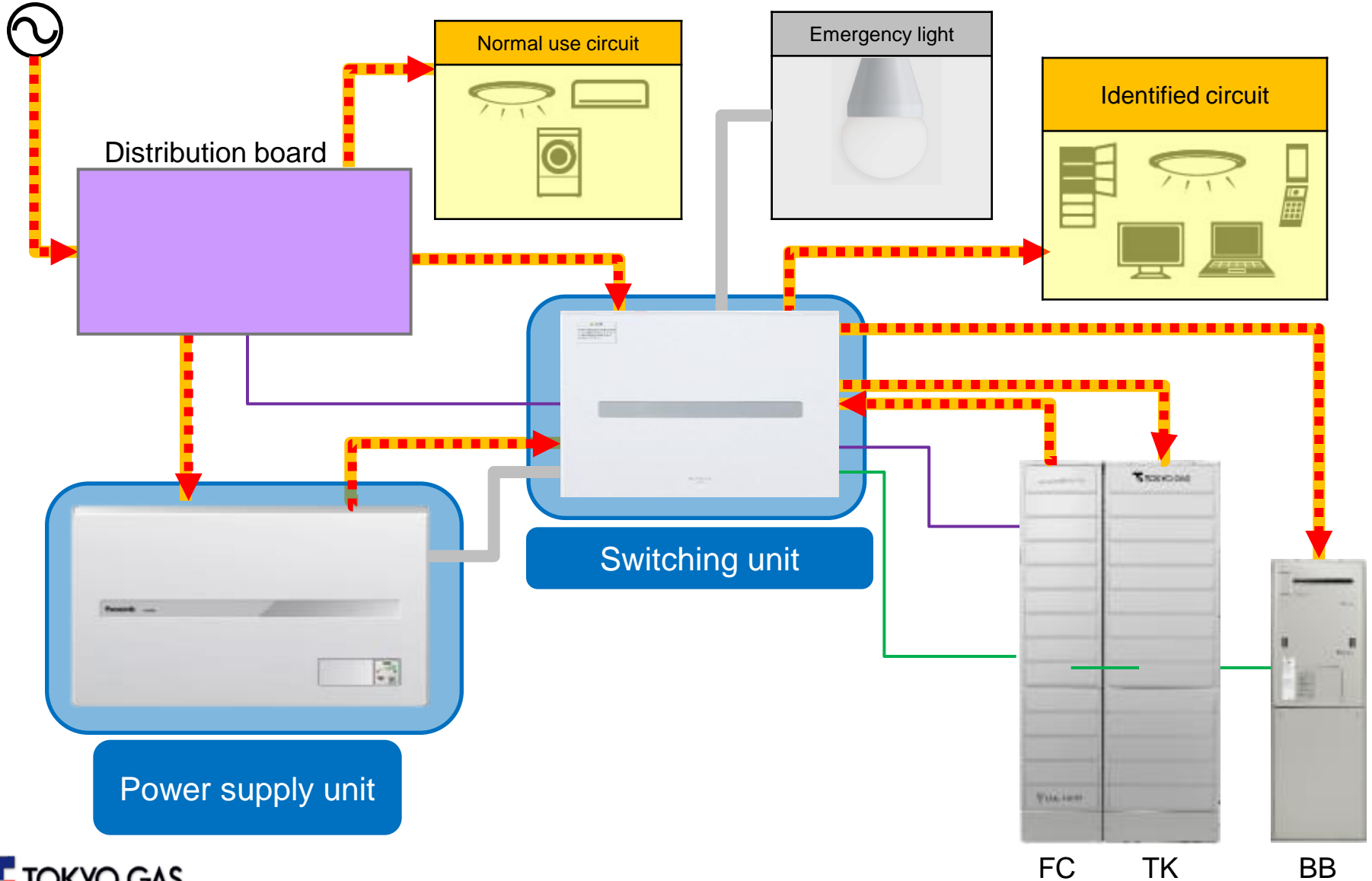
**(Grid power outage)**



# 3. Optional units for power outage

## # Operation with Option B

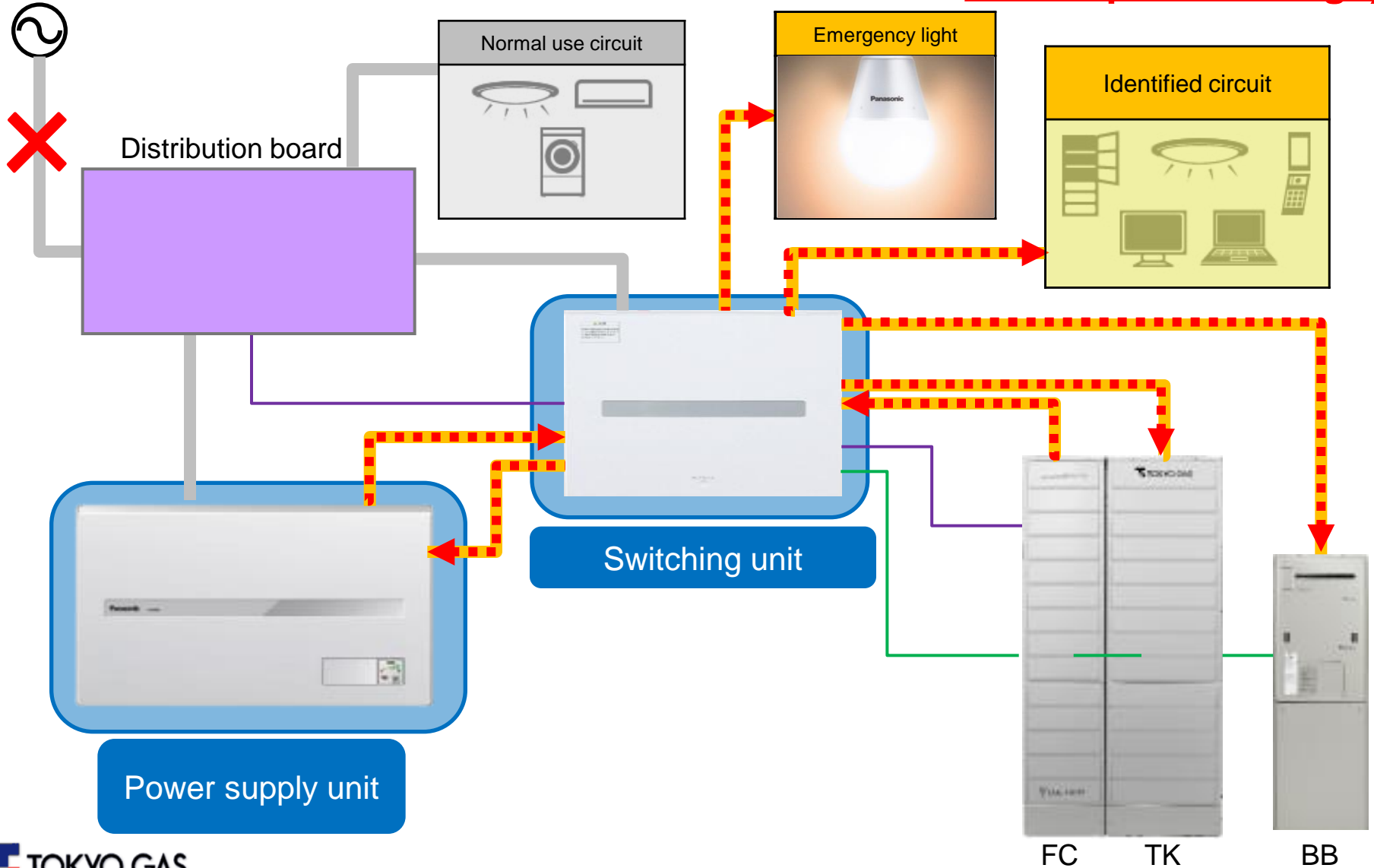
**(Normal use)**



# 3. Optional units for power outage

## # Operation with Option B

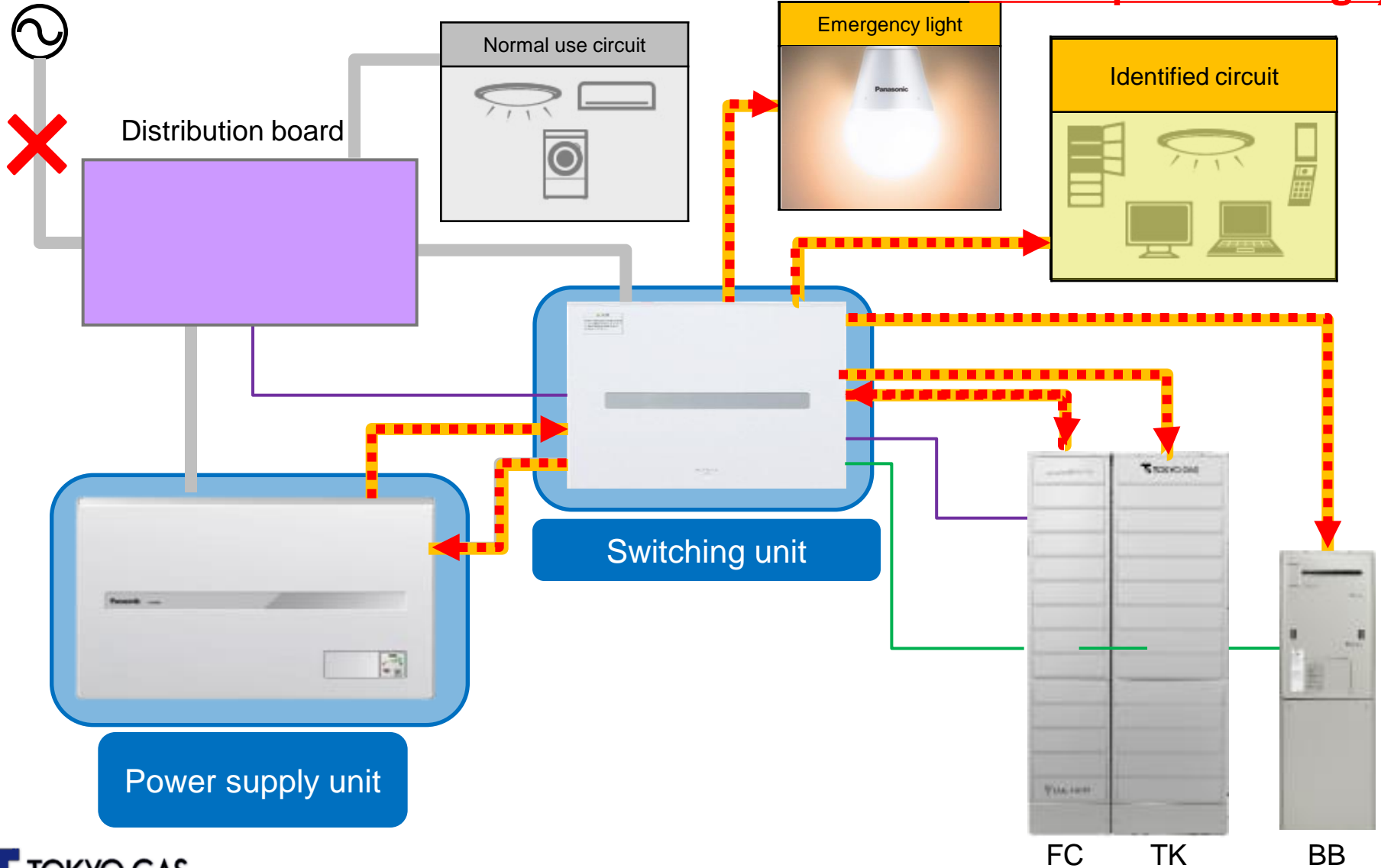
**(FC in operation at Grid power outage)**



# 3. Optional units for power outage

**(FC NOT in operation at Grid power outage)**

# Operation with Option B





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# 4. Summary

## # Development of ENE-FARM for apartment buildings

[released in April 2014]

- Installable in pipe shaft
- Complies with earthquake and wind resistance requirements for high-rise buildings
- Fit to variety of installation configurations

## # Developing optional units for power outage

- Option A: to make ENE-FARM “survive”

[released in April 2014]

- Option B: not only for survival, but also “start up” ENE-FARM  
[to be released in October 2014]



# Thank you for your kind attention

Part of this work was supported by NEDO (New Energy and Industrial Technology Development Organization) and METI (Ministry of Economy, Trade and Industry) of Japan.

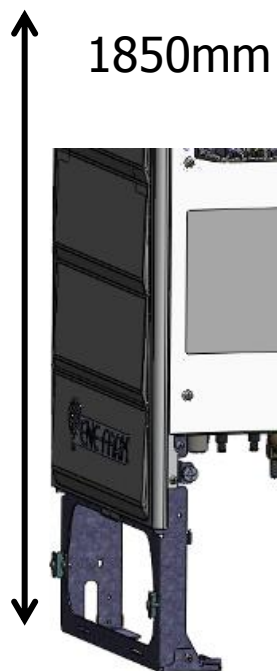
# Government subsidies

Year	Subsidy(JPY)	Sales units In Japan	Amount(JPY)
2009	1,400,000	4997	6,995,800,000
2010	1,300,000	6469	8,409,700,000
2011	1,050,000	13460	14,133,000,000
2012	700,000	24517	17,161,900,000
2013	450,000	33531	15,088,950,000
2014	380,000		

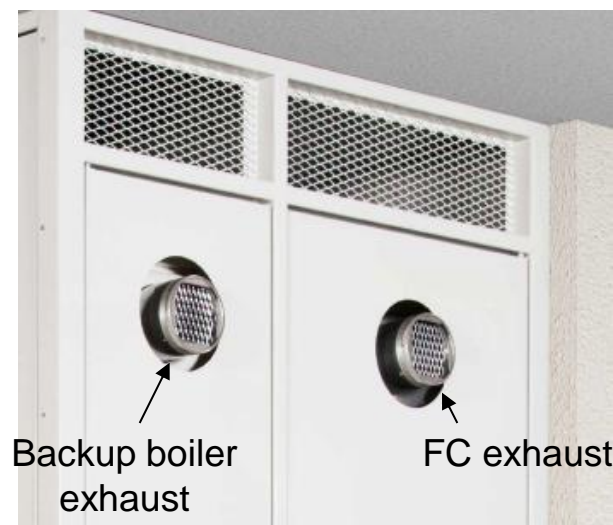
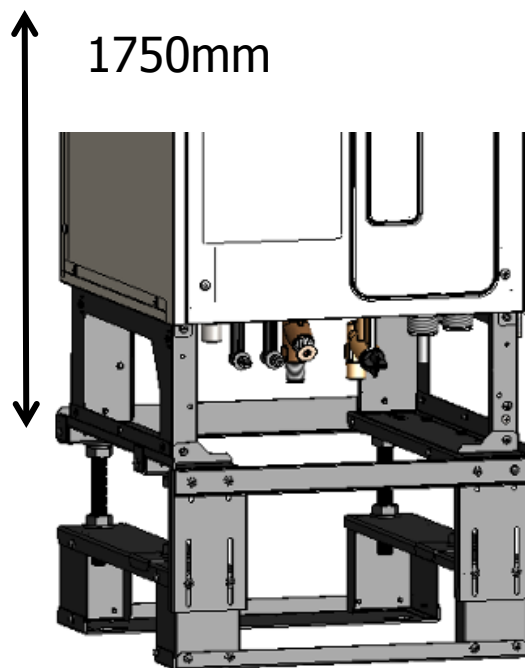
【Detached houses model】

【Apartment buildings model】

TOP

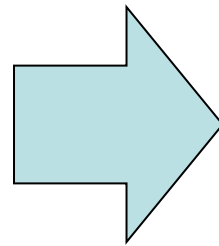
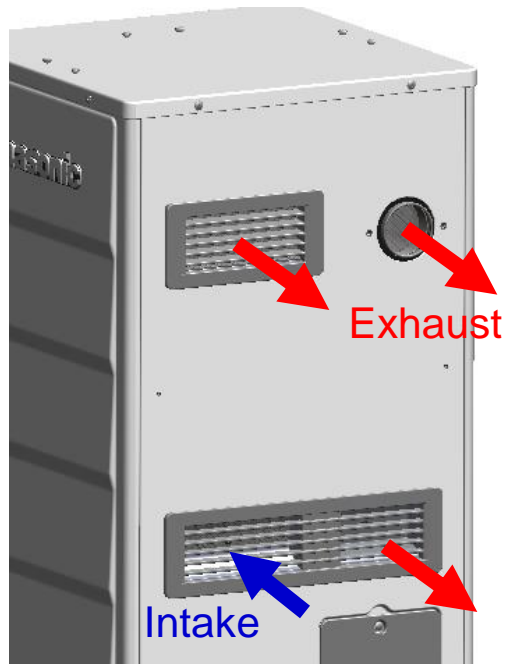


TOP



Adjusting stand

【Detached model】  
Three place exhaust



【apartment model】  
One place exhaust



# Economy/Environment/Saving Energy

	Apartment buildings model	Detached house model
Comparison with a conventional energy supply system of CO <sub>2</sub> emissions (Rated power)	49% decreasing	←
Reduction of CO <sub>2</sub> emissions for year	1.0t	1.3t
Comparison with a conventional energy supply system of Primary Energy consumption volumes (Rated power)	37% decreasing	←
Reduction of Primary Energy consumption volumes for year	10.7GJ	14.4GJ
Utility costs for years	JPY 30,000-40,000 reduction	JPY 50,000-60,000 reduction

This is supposition case.

Detached house mode is used electric, 5900kWh, for year.(residential space120 m<sup>2</sup>, family consisting of four)  
 Apartment buildings model is used electric, 3600kWh for year(residential space from 70 to 80m<sup>2</sup>, family consisting of 2 or 3)

		Option A	Option B
Parts description	Unit name	Switching unit	(1) Power supply unit (2) Switching unit
	Dimensions / weight	H325 × W485 × D155 / 13kg	(1) H350 × W605 × D155 / 20kg (2) H325 × W485 × D155 / 14kg
	Installation location	Indoor wall-mounted	←
Retail price		JPY 130,000	(1) JPY 472,000 (2) JPY 143,000



## Using gas and electric for a year

	Apartment buildings model	No ENE-FARM
Buying power	1,098kWh	3,644kWh
Using gas	1,160m <sup>3</sup>	740m <sup>3</sup>

※residential space is 80Sq m, family is consisting of three, using floor warmer , calculated by Tokyo gas.

## Utility cost for a year

	Apartment buildings model	No ENE-FARM	Total
Gas fee	13. 1	10. 8	2. 2
Electric fee	3. 6	9. 7	▲6. 0
Total	16. 7	20. 5	▲3. 8

(Ten thousand / year)

※residential space is 80Sq m, family is consisting of three, using floor warmer , calculated by Tokyo gas.

