

ANTWERPEN, 16 - 19 JUNE



## ENERGY SAVING AT STATION

- TRIAL OF DEMAND RESPONSE AND ECO-STATION -

*East Japan Railway Company*

*Energy Efficiency, the best fuel to move our trains!*

# OUTLINE

◆ Background

◆ “ECOSTE” - eco station –

◆ Demand response

◆ Future prospect of energy management



# OUTLINE

## ◆ Background

## ◆ “ECOSTE” - eco station –

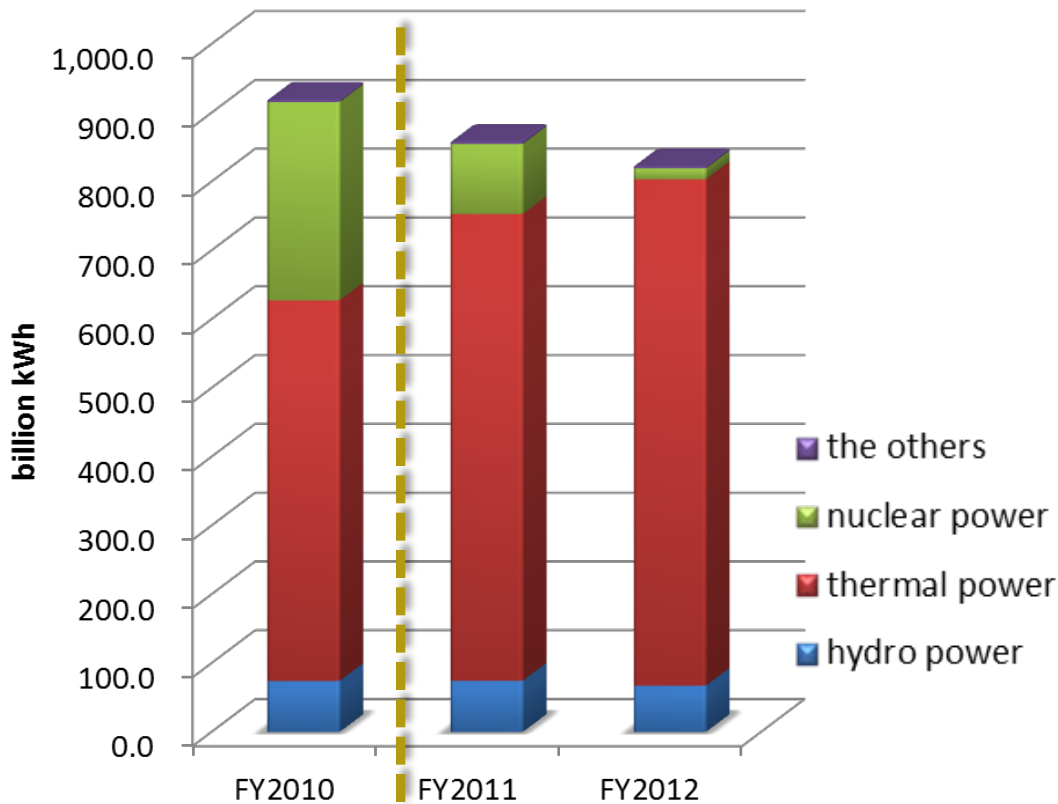
## ◆ Demand response

## ◆ Future prospect of energy management

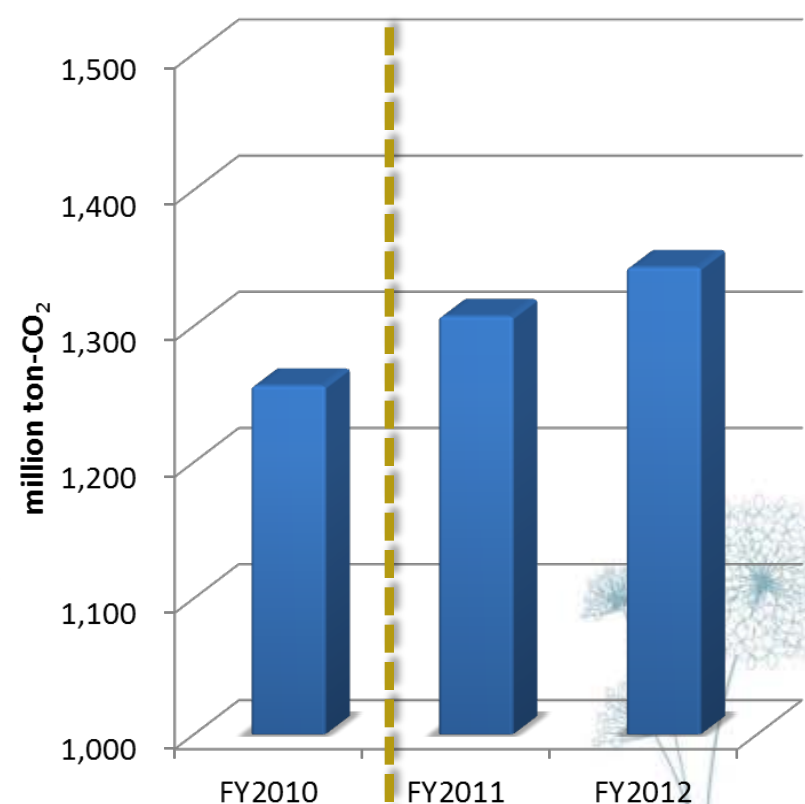


# Actual condition of electric power supply in Japan

## Composition ratio of power source in Japan



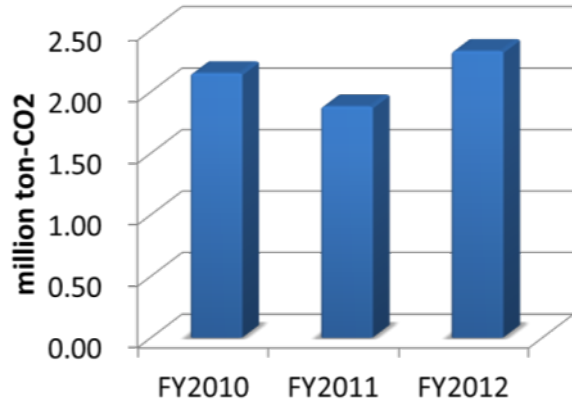
## Total CO<sub>2</sub> emission in Japan



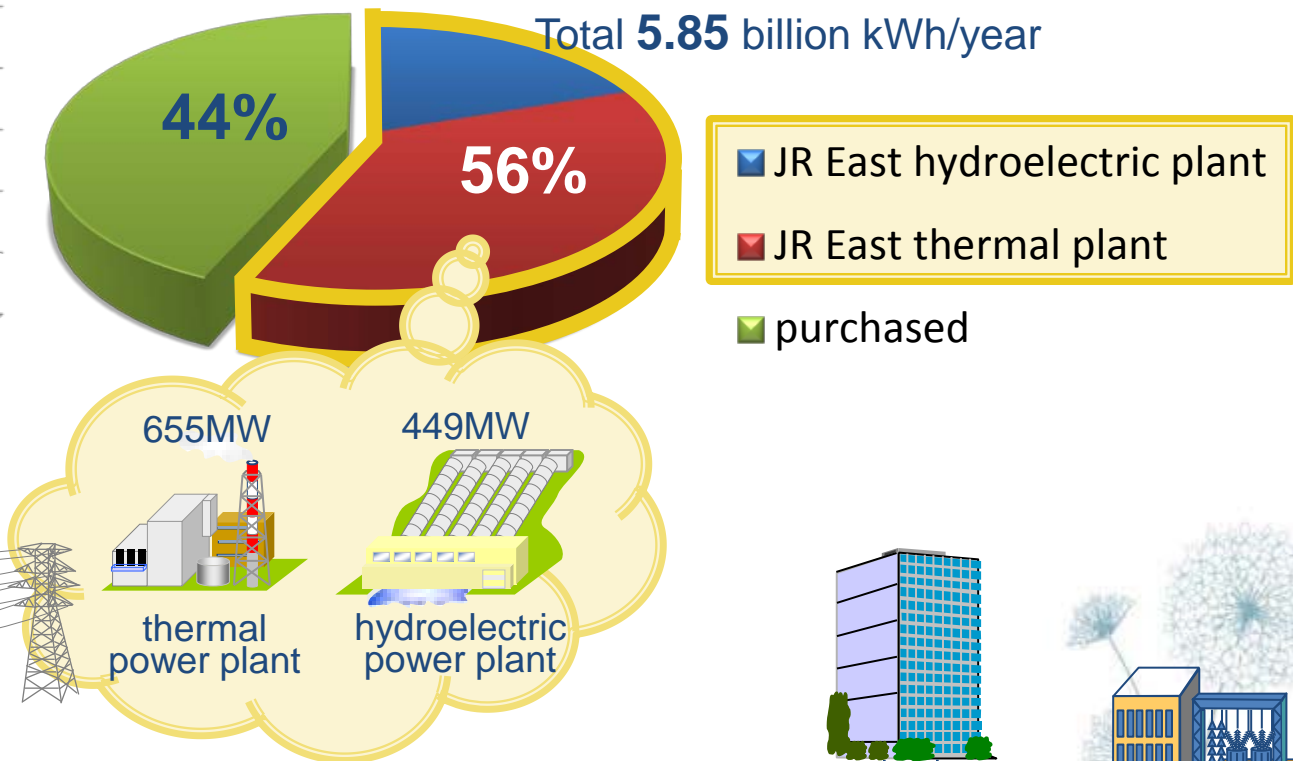
The Great East Japan Earthquake

# JR East power network

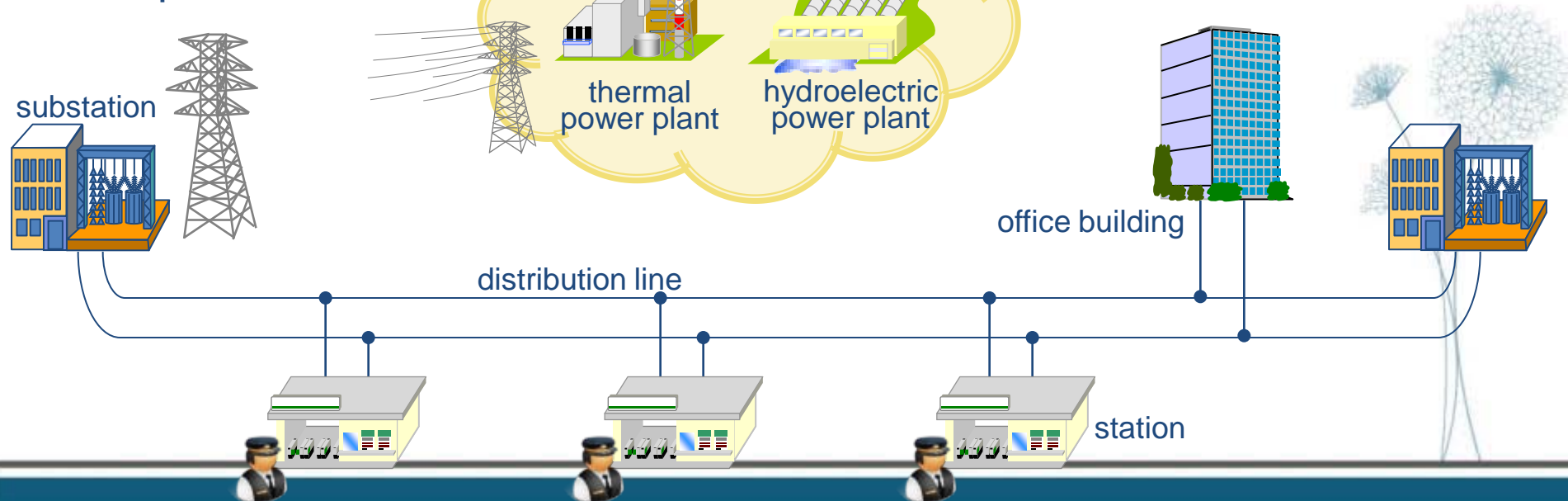
## CO<sub>2</sub> emission in JR East



## Power proportion in JR East



## JR East power network



# Composition Ratio of Power Consumption in JR East

Total 5.05 billion kWh/year



## non traction energy

office building

1.8%

stations, rolling stock centers

17.8%



19.6%

80.4%

■ office building

■ stations, rolling stock centers

■ conventional line operation

■ shinkansen line operation



## electric traction energy

conventional line operation

56.0%

shinkansen line operation

24.4%



# OUTLINE

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# Ecoste (eco-station)

environment earth conscious station of east japan railway company

## The four key concept of “ecoste”

### ◆ Energy conservation

Promotion of one-step advanced energy saving

### ◆ Energy creation

Active introduction of renewable energy

### ◆ Eco-awareness

Installation of facilities in which customers can be aware of “eco” initiative

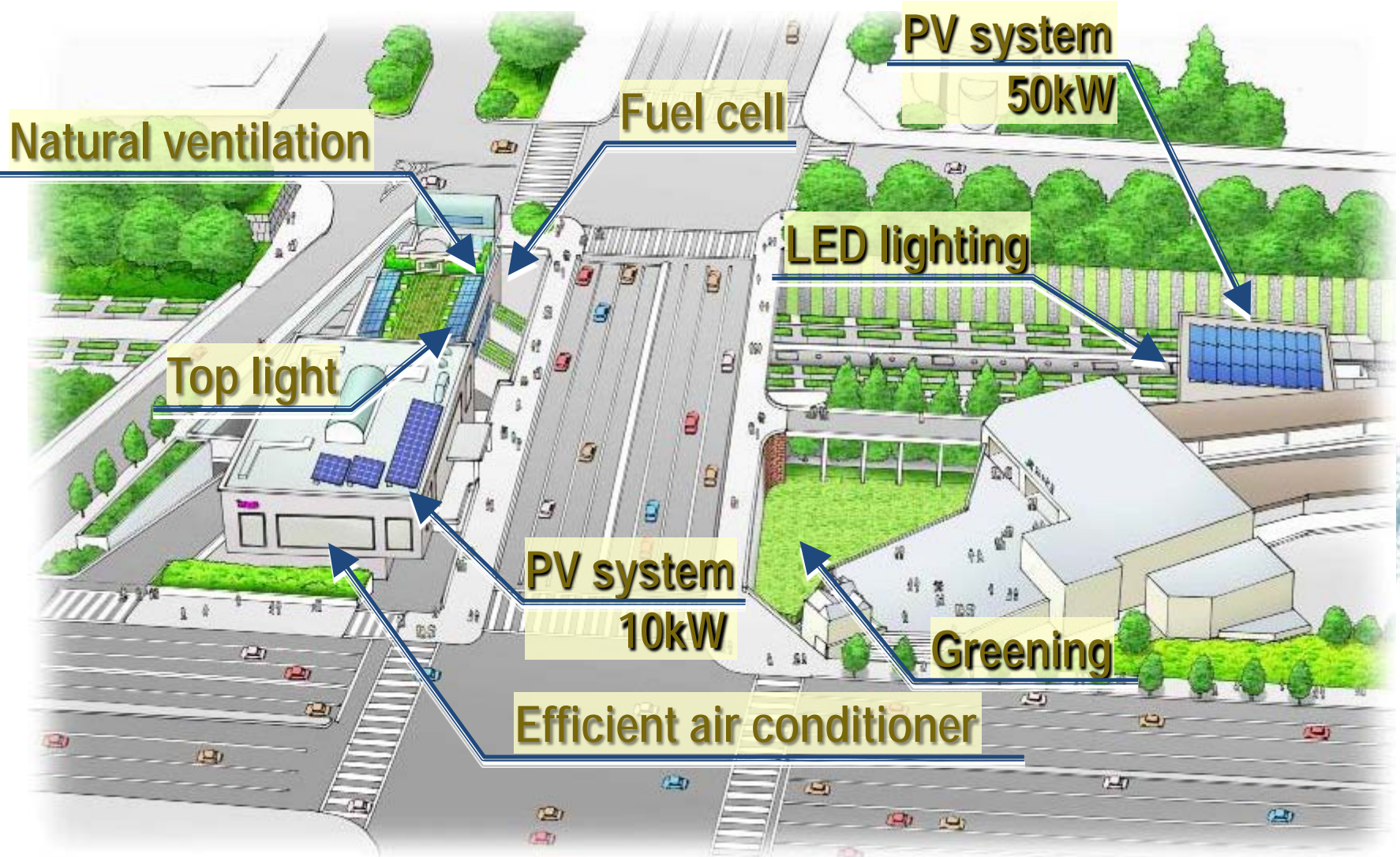
### ◆ Environmental harmonization

Provision of a lively atmosphere in stations by creating harmony between people and environment

## Ecoste model stations





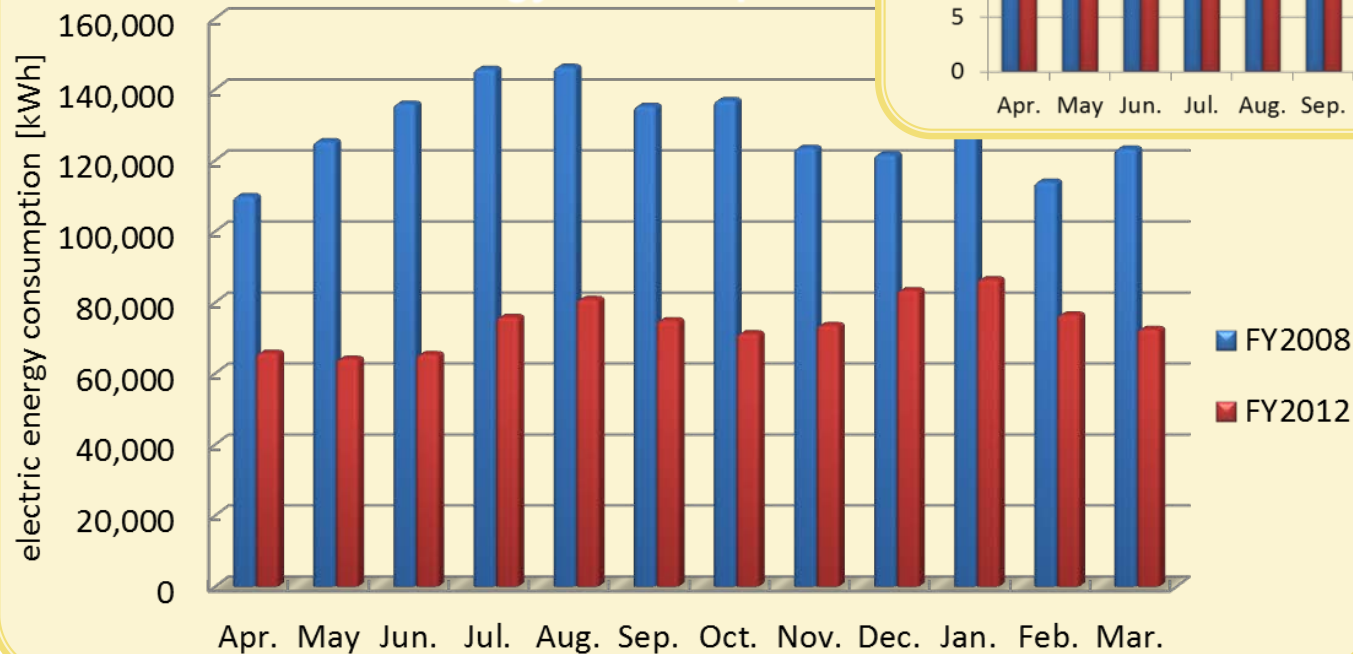


# Ecoste model station (YOTSUYA)

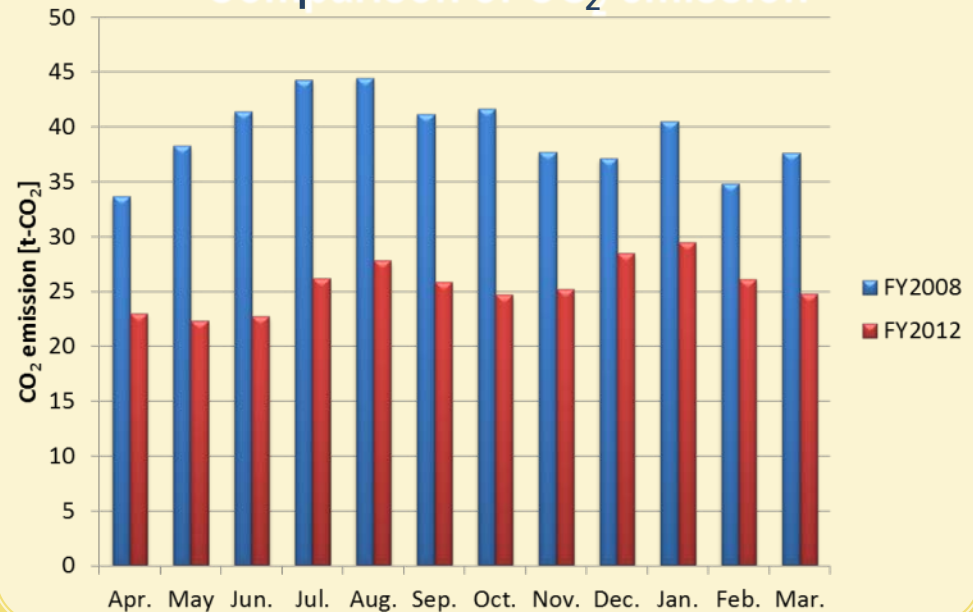
## The effect of "ecoste" in YOTSUYA station

- Energy consumption : cut by **43%**
- CO<sub>2</sub> emission : cut by **35%**

### Comparison of electric energy consumption



### Comparison of CO<sub>2</sub> emission





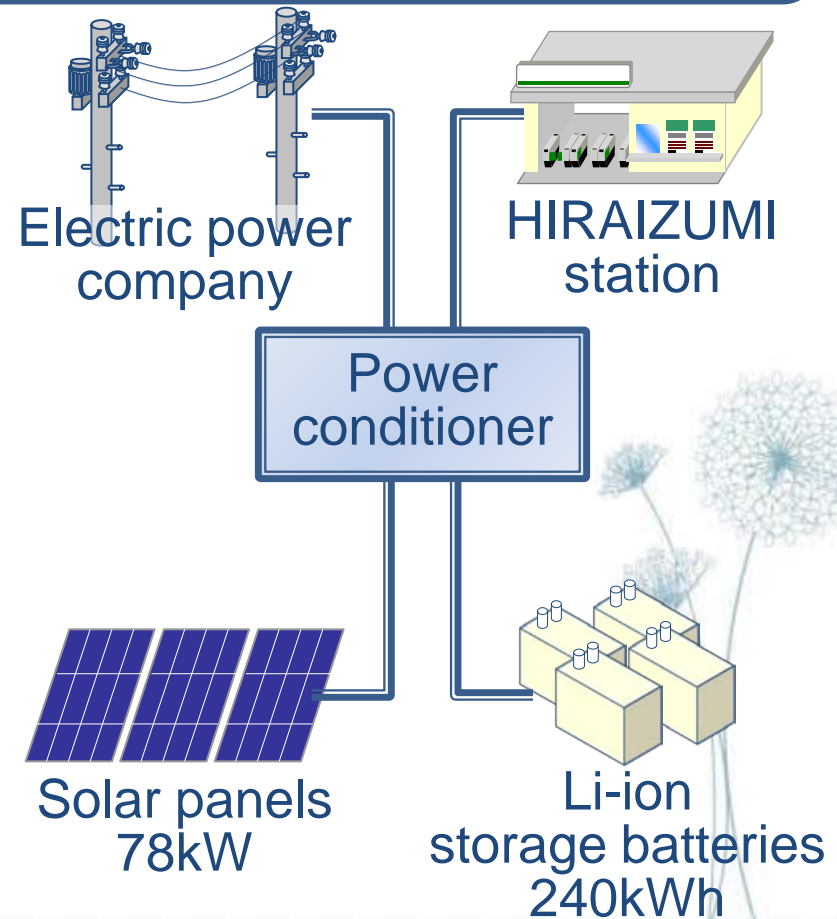
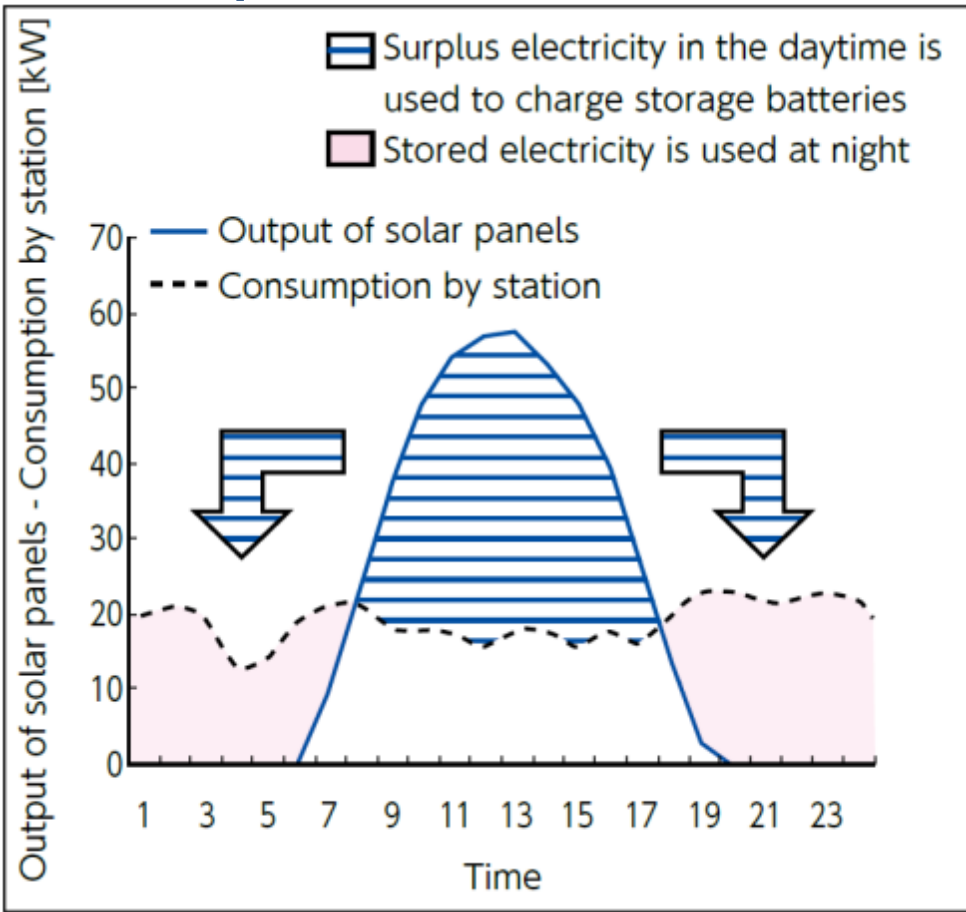


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## ZERO Emission Station

"ZERO Emission Station" generates more electricity than it consumes on fine weather days through the use of solar panels and storage batteries.

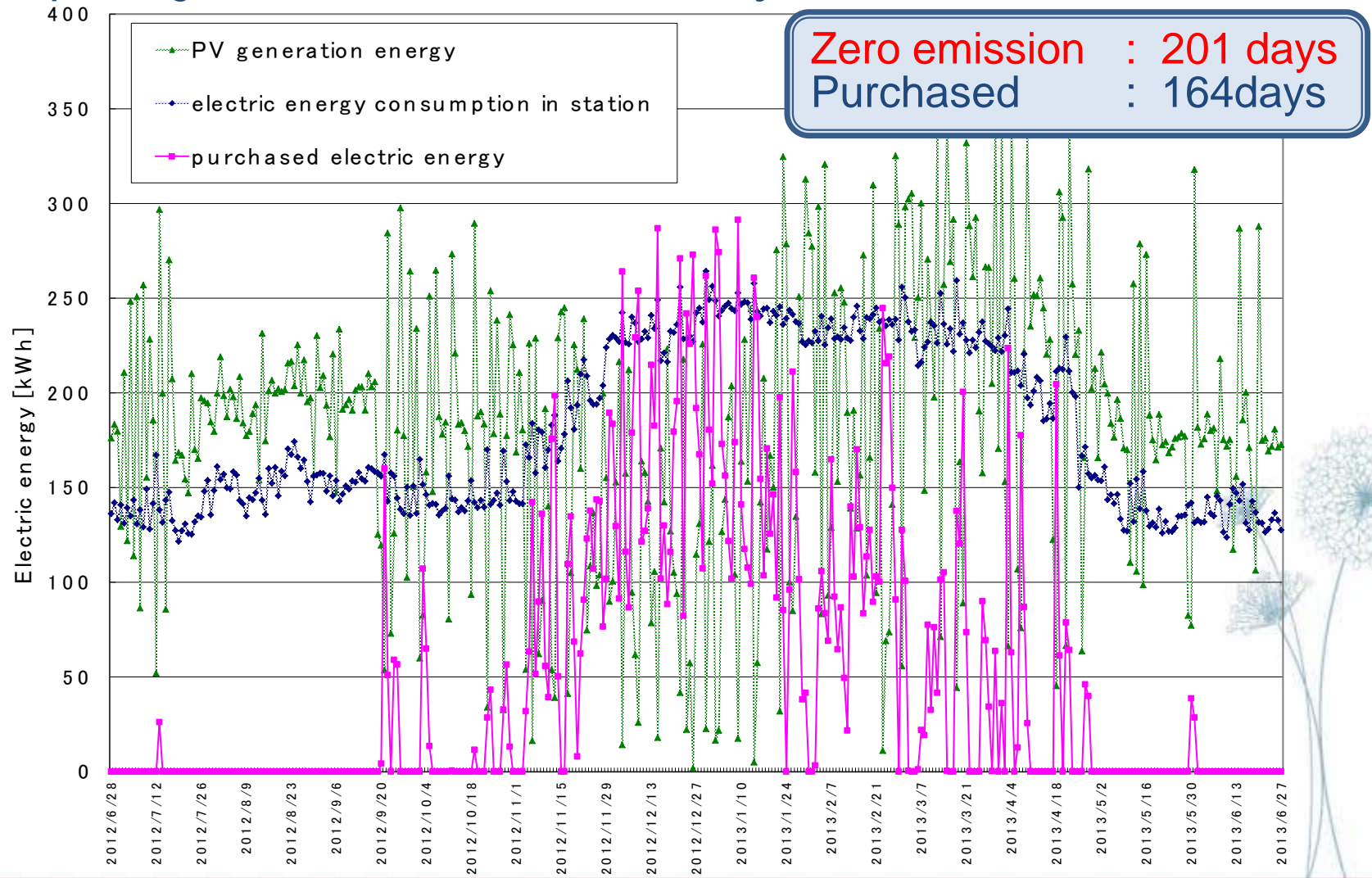
### Concept of zero-emission station

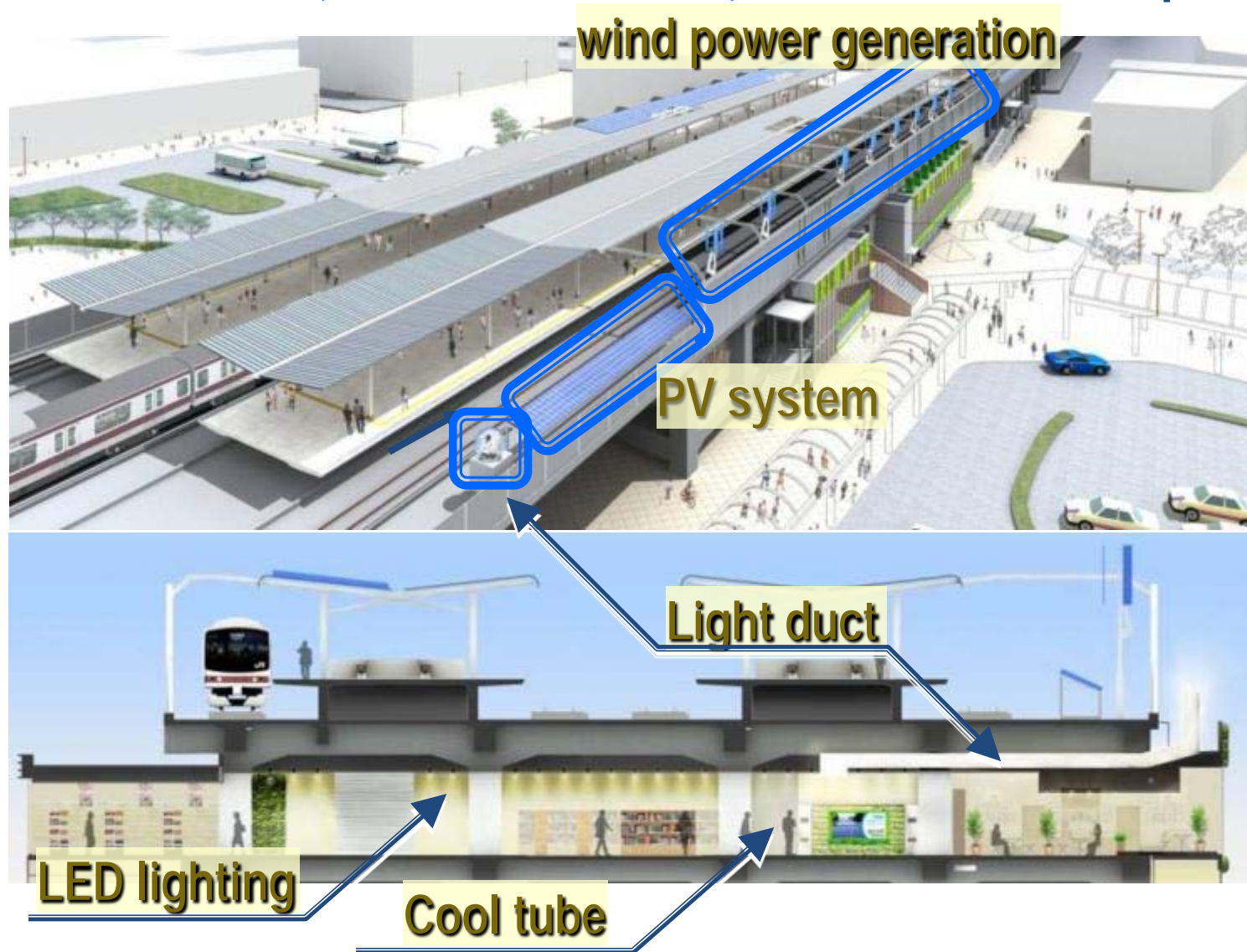




# Ecoste model station (HIRAIZUMI)

## Operating state of zero emission station (1 year)







# OUTLINE

◆ Background

◆ “ECOSTE” - eco station –

◆ **Demand response**

◆ Future prospect of energy management



# Trial use of demand response

Oct. 2012~

Change of the purpose of energy management

Energy saving for CO<sub>2</sub> reduction  
(environmental measure)

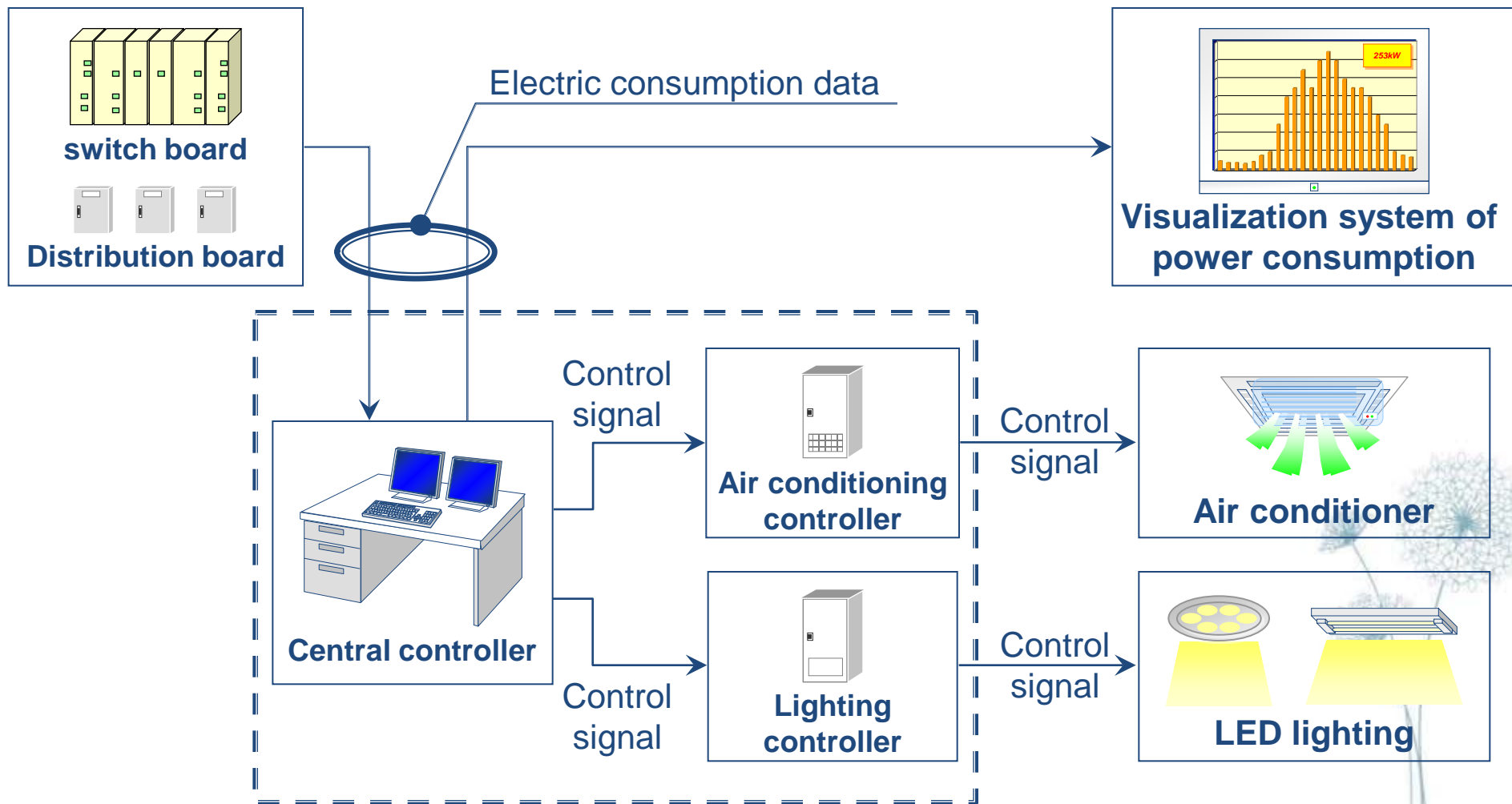
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(increase in power rate)  
(tight electric power supply and demand)

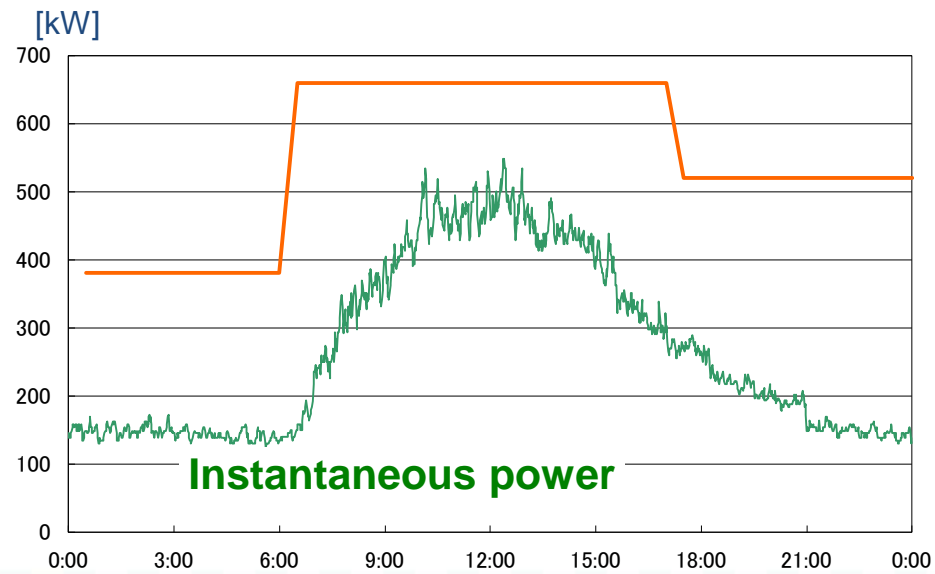
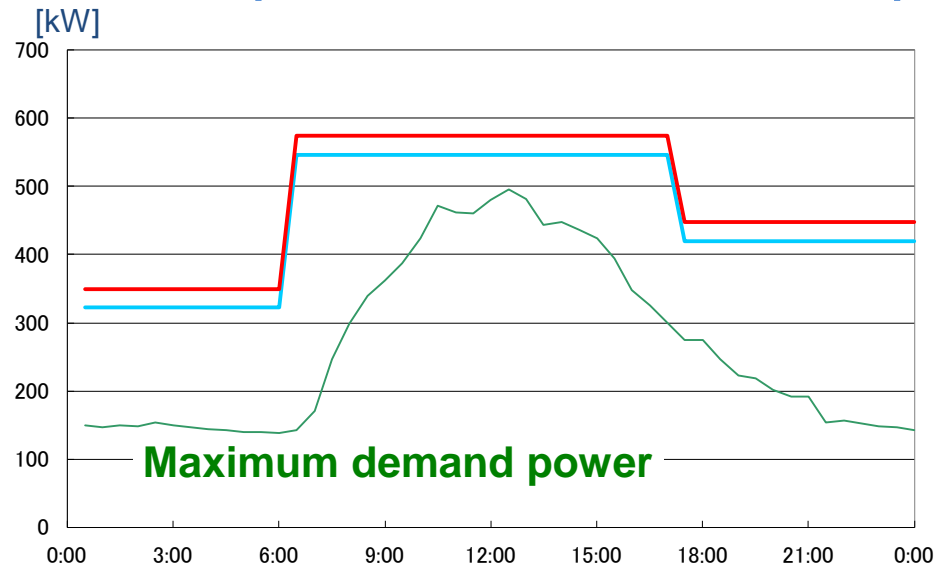
Trial of demand response in JR East Chiba branch office



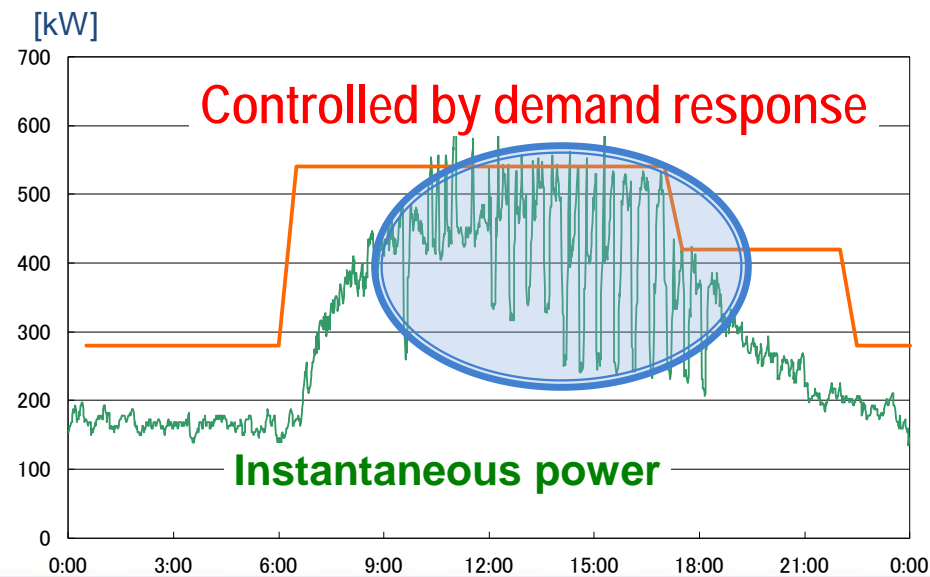
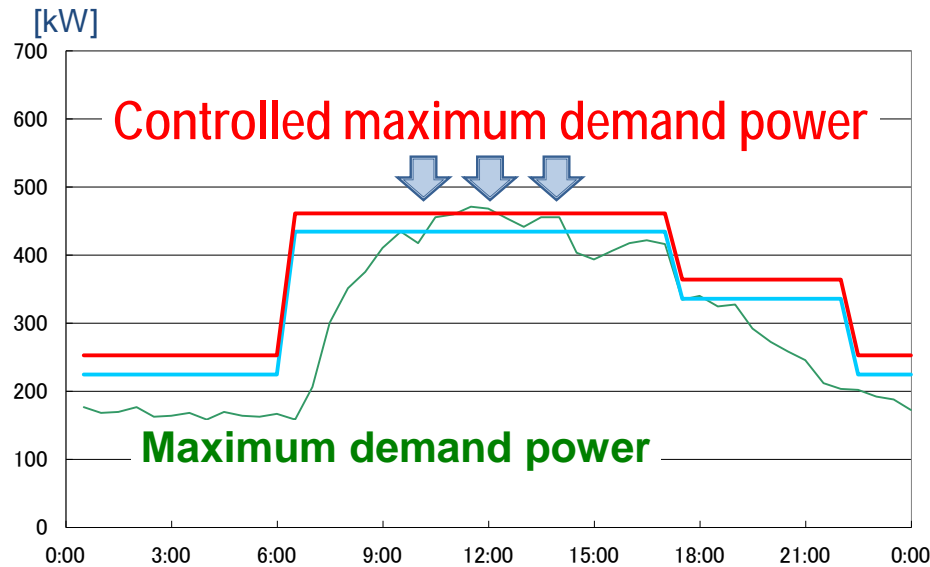
# System configuration of demand response



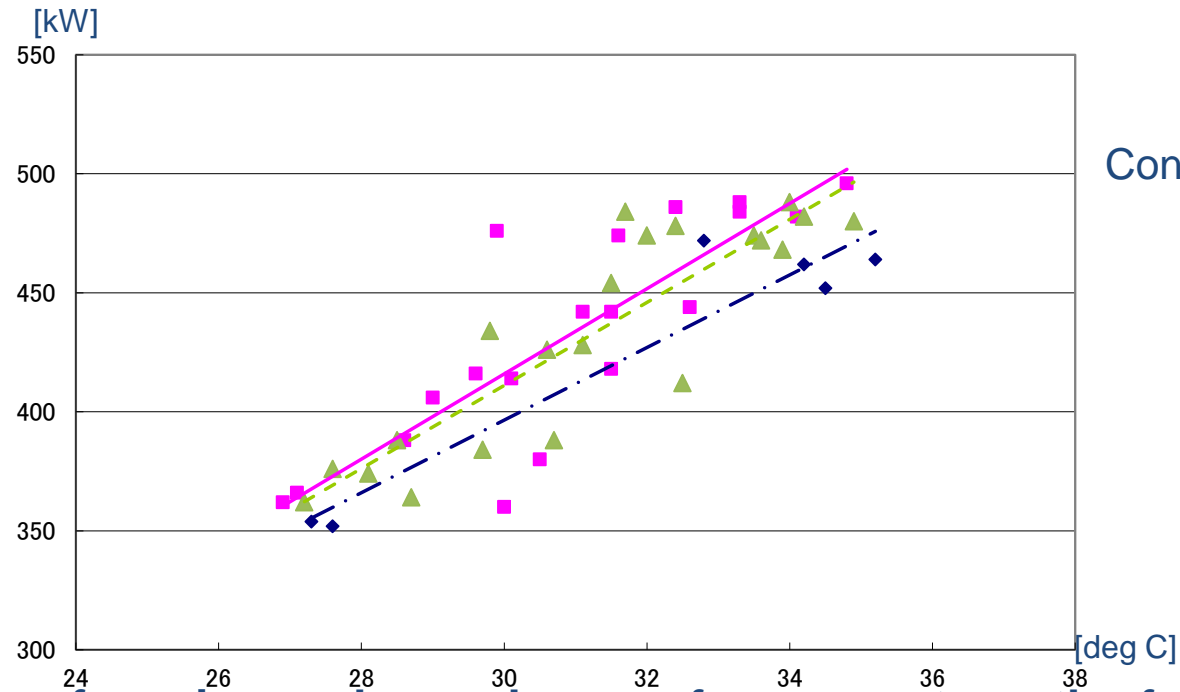
# Time shift of power consumption without demand response



# Time shift of power consumption with demand response



# Assessment of the effectiveness of demand response



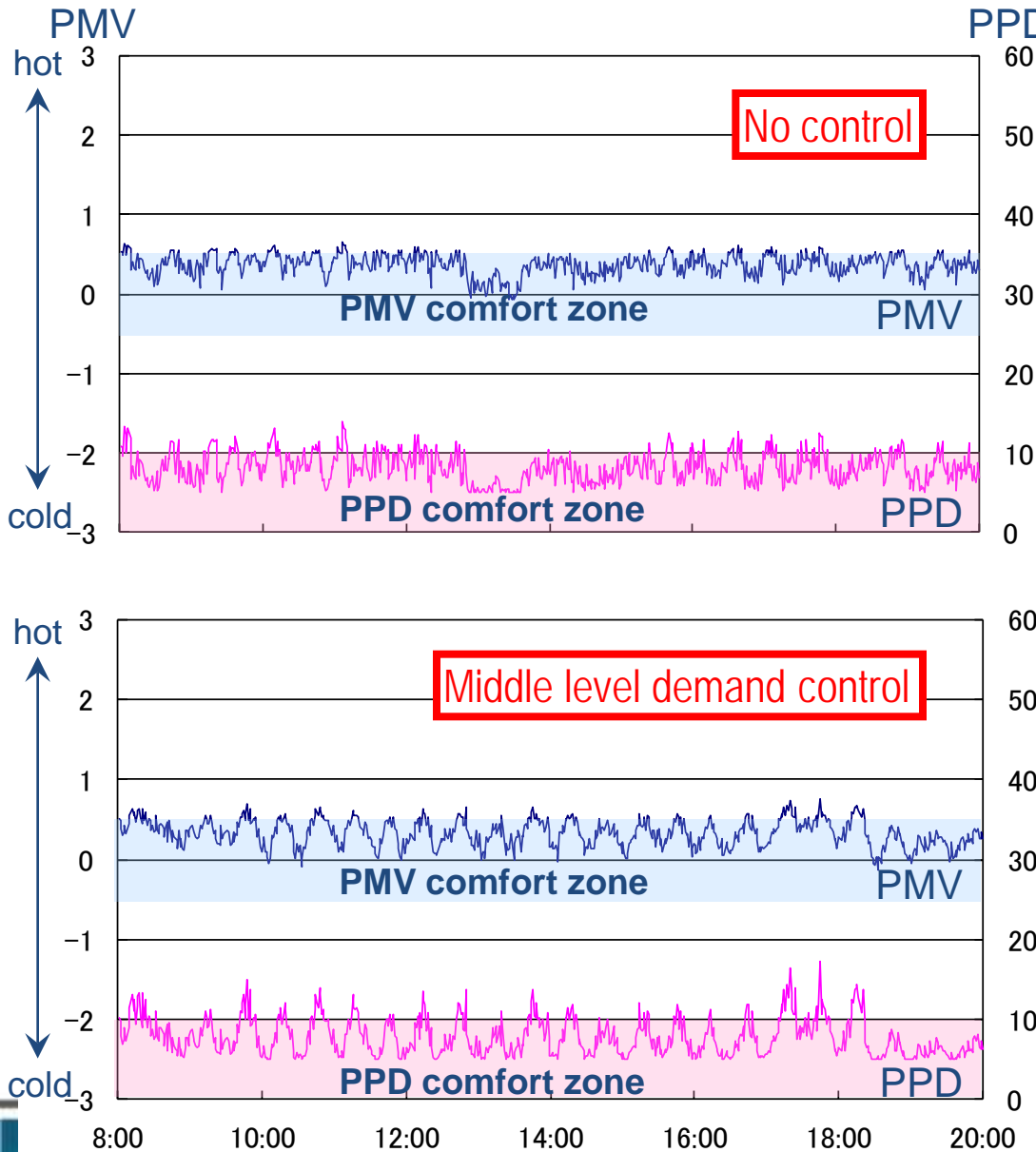
**The tendency of maximum demand power for every strength of control**

## **Comparison of maximum power demand**

Control Level	Maximum Power demand	Ratio	Reduction rate
Low (no control)	496 kW	100.0 %	-
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# Time shift of indoor thermal environment



## PMV (Predicted Mean Vote)

the index for evaluating man's thermal comfort  
(Prescribed by ISO7730)

## PPD (Predicted Percentage of Dissatisfied)

thermally dissatisfied persons' percentage  
(computed by PMV)

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◆ Demand response

◆ Future prospect of energy management



# Future prospect of energy management in non traction energy

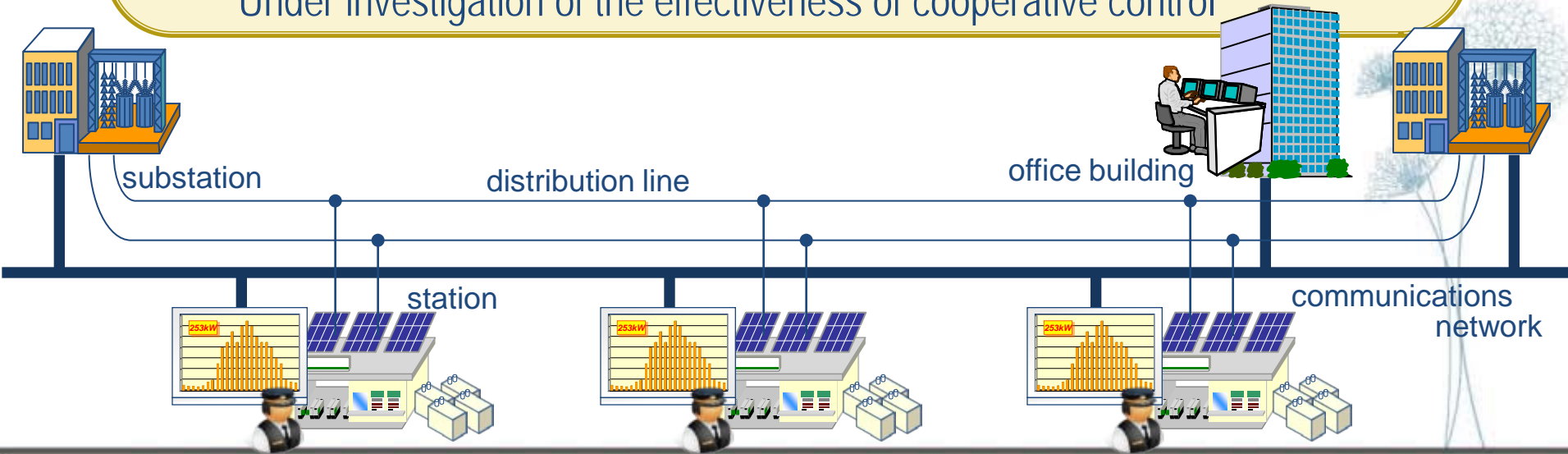
## Energy management in stations



The key point for controlling non traction energy

### Energy management in non traction energy

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Installation of visualization system to about 200 stations (~2013)
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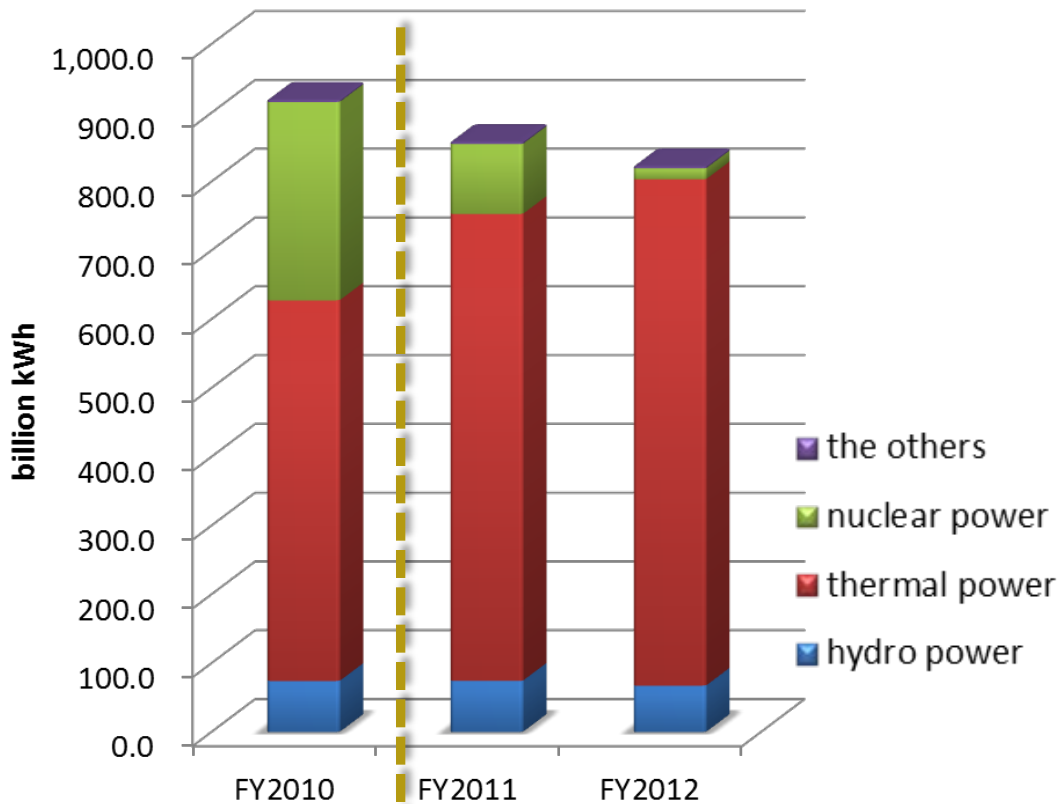
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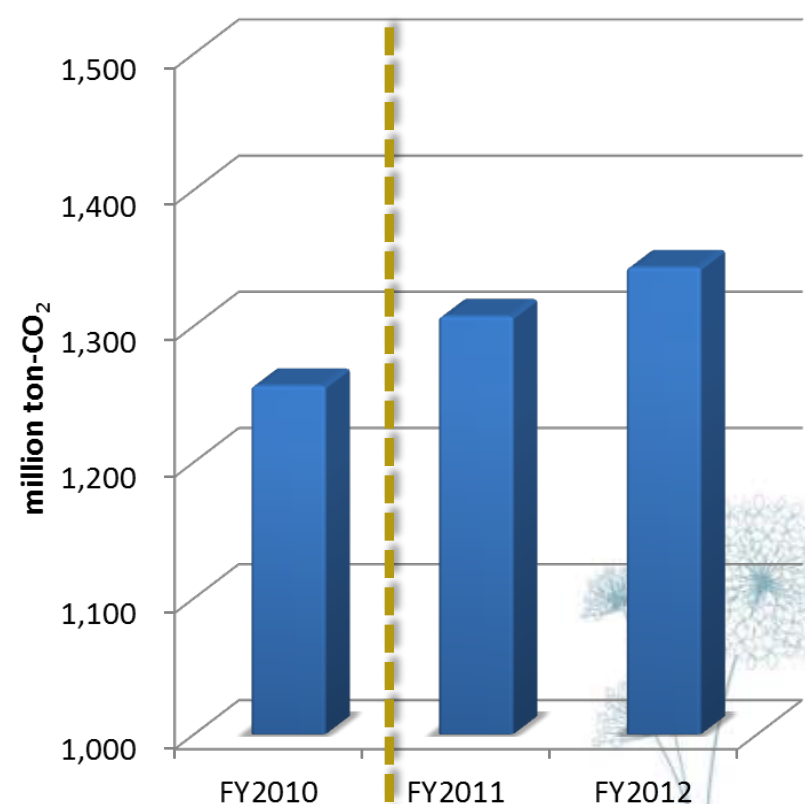


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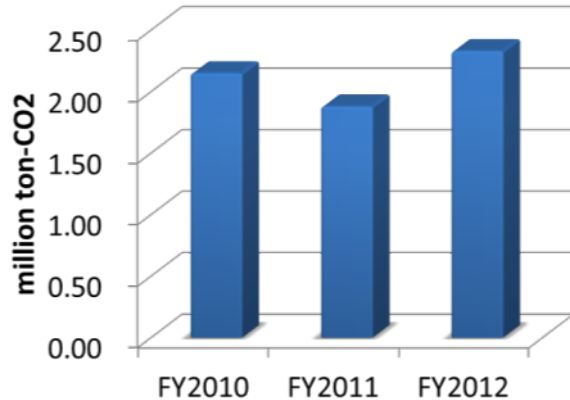
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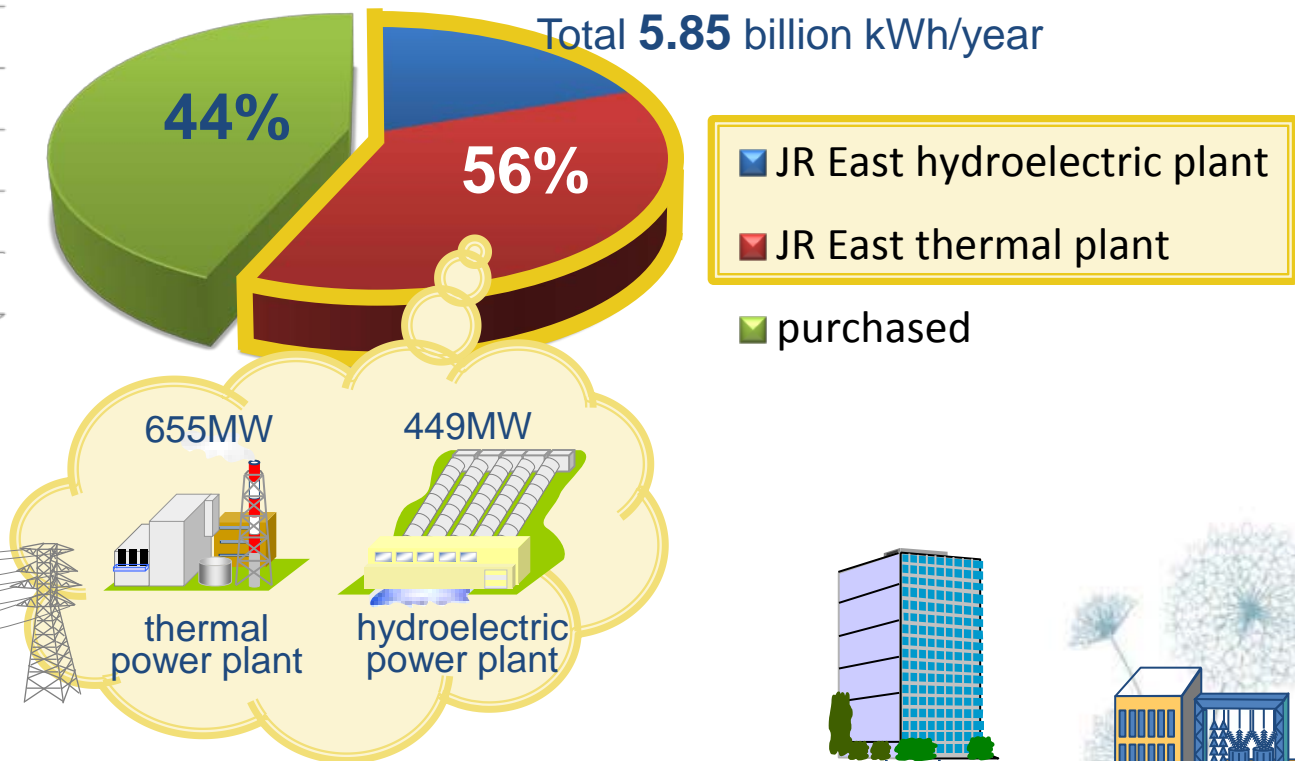
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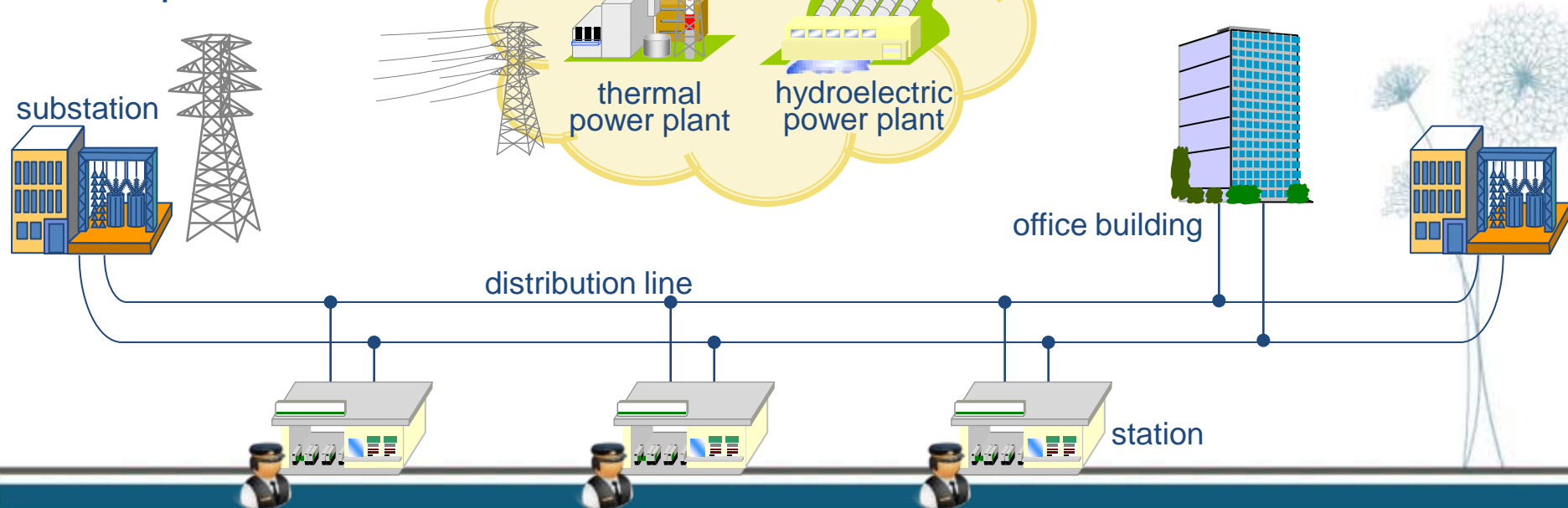
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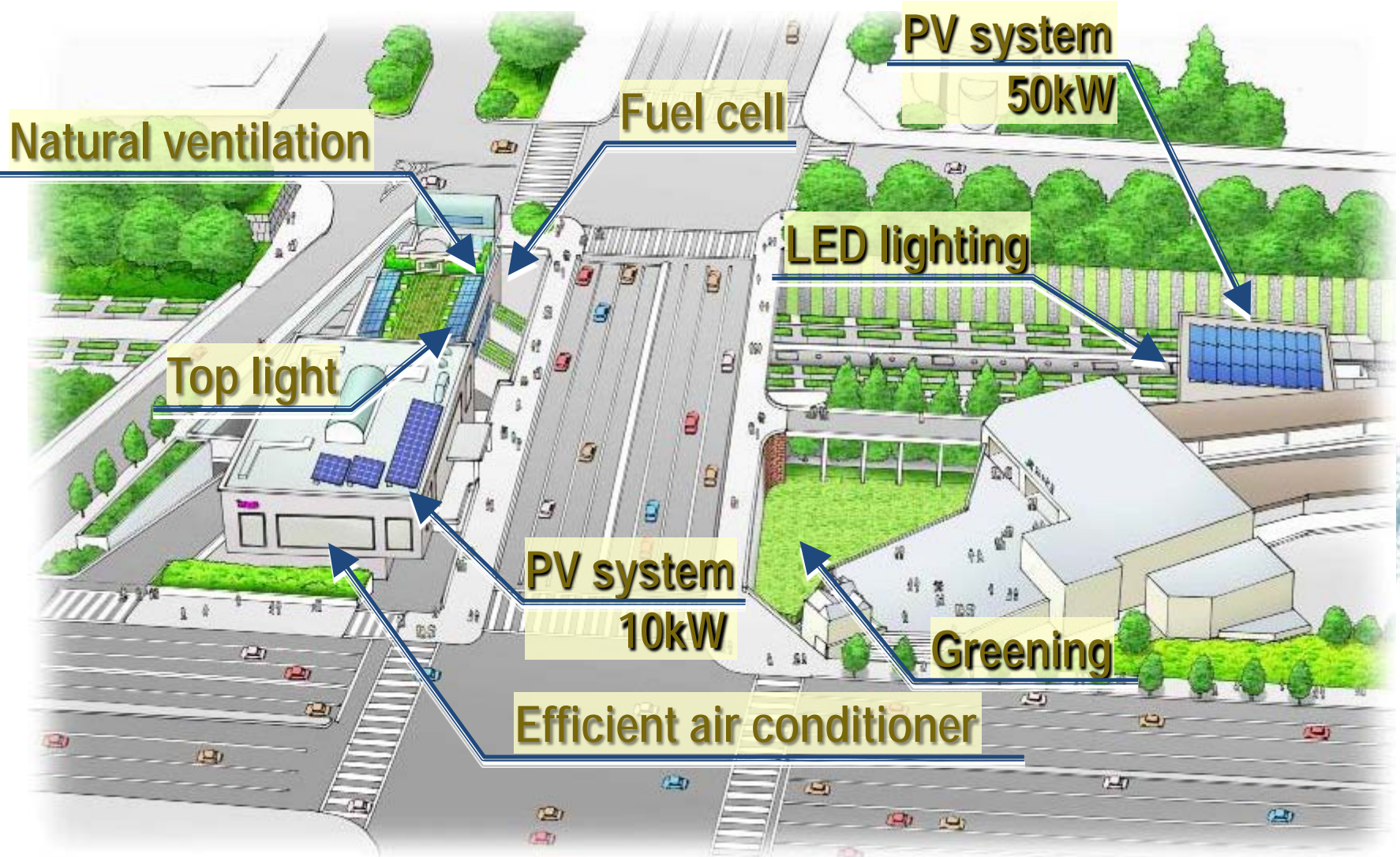
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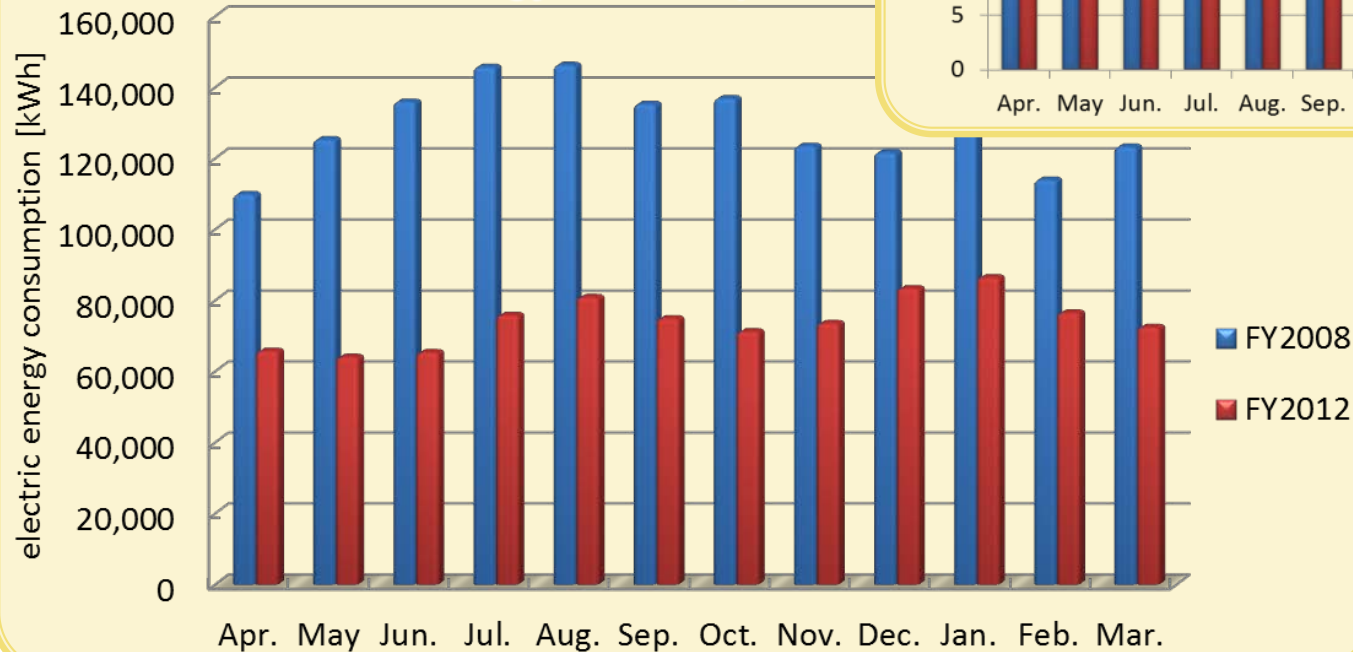


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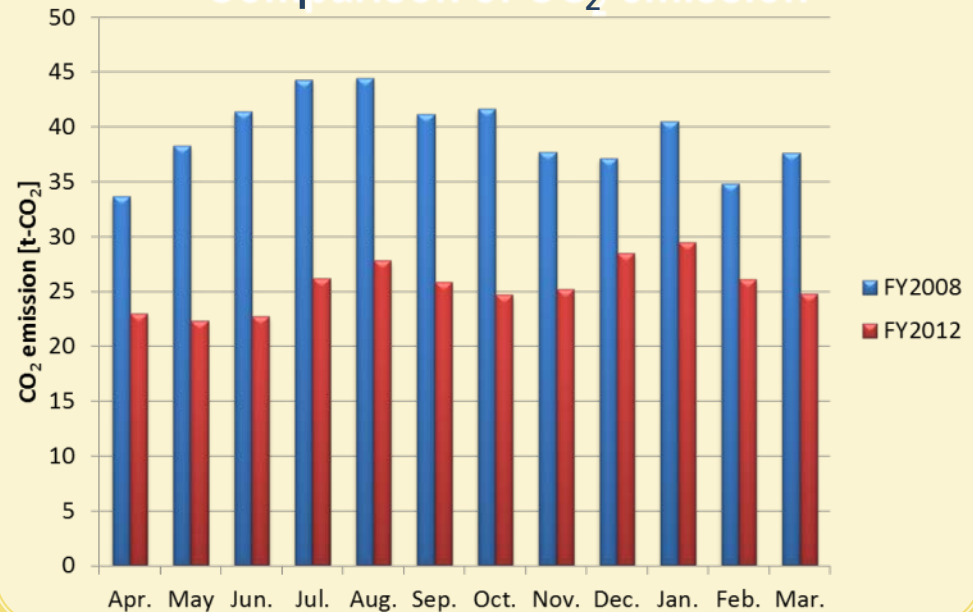
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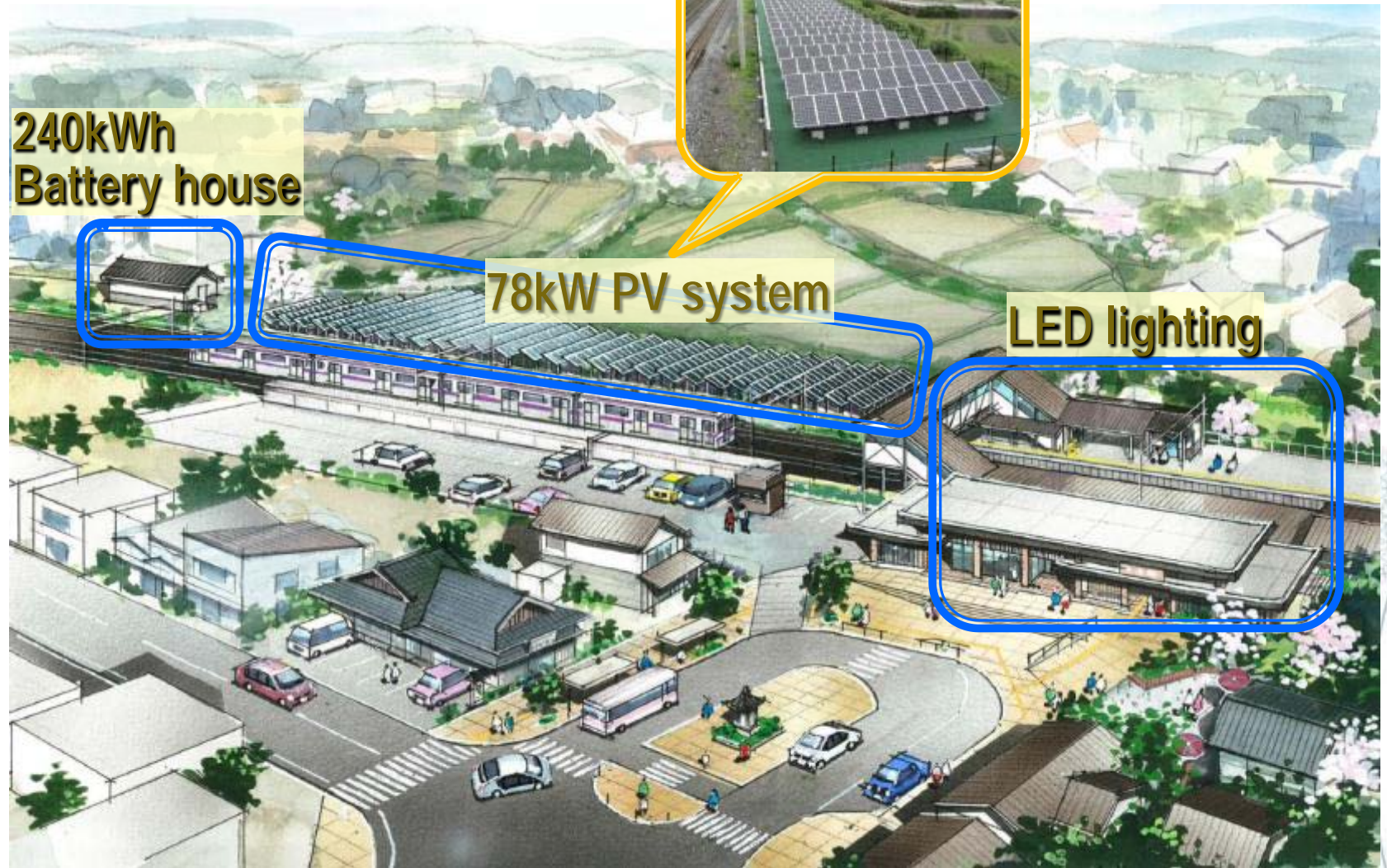
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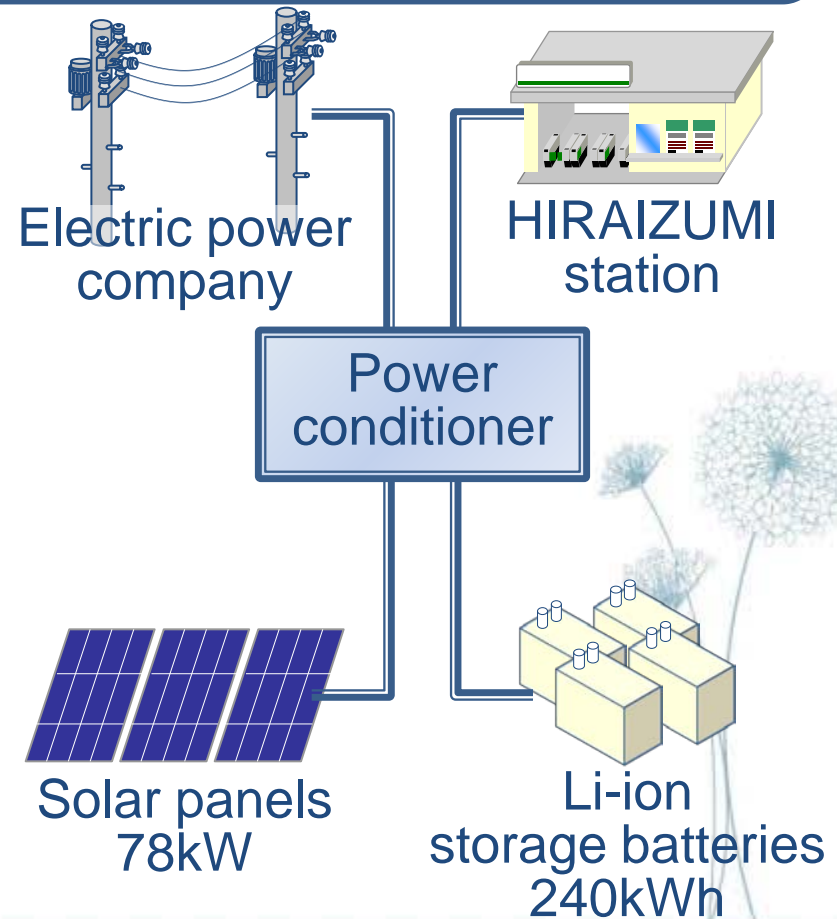
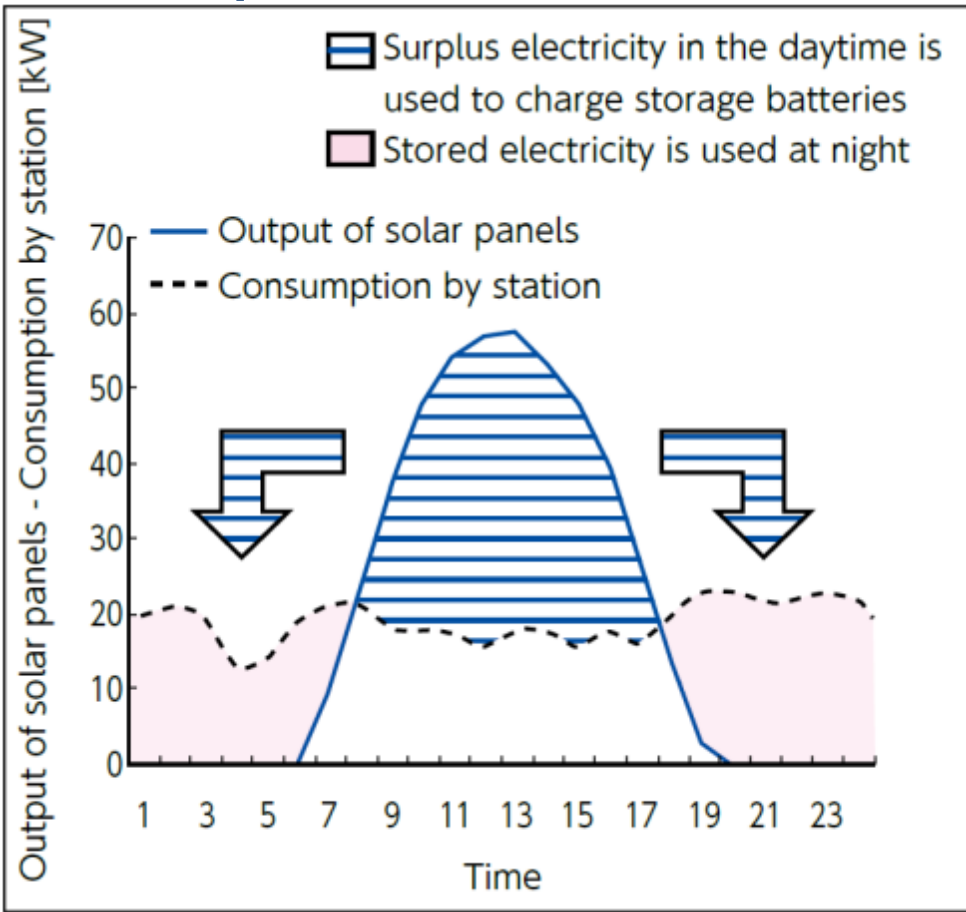


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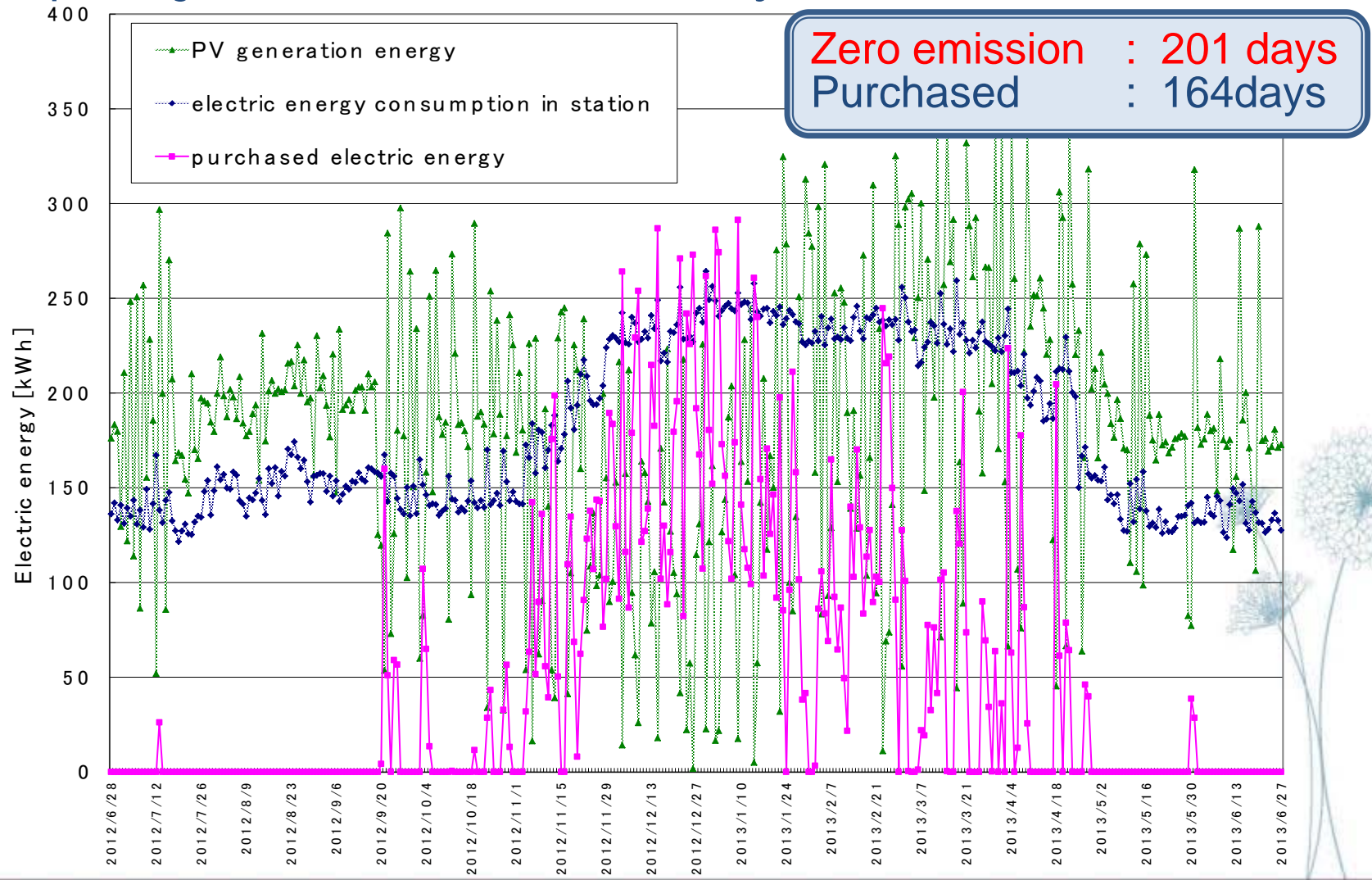
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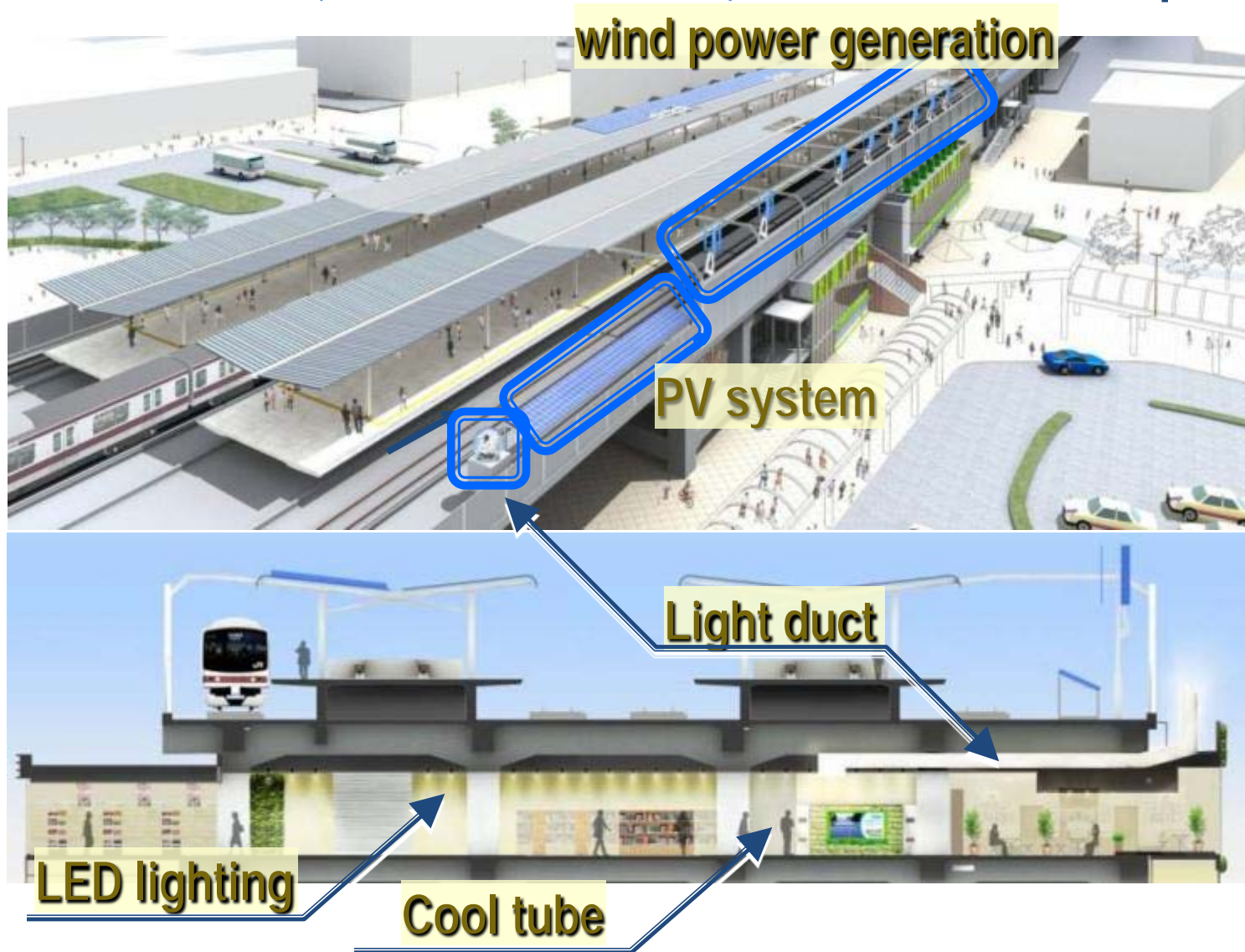
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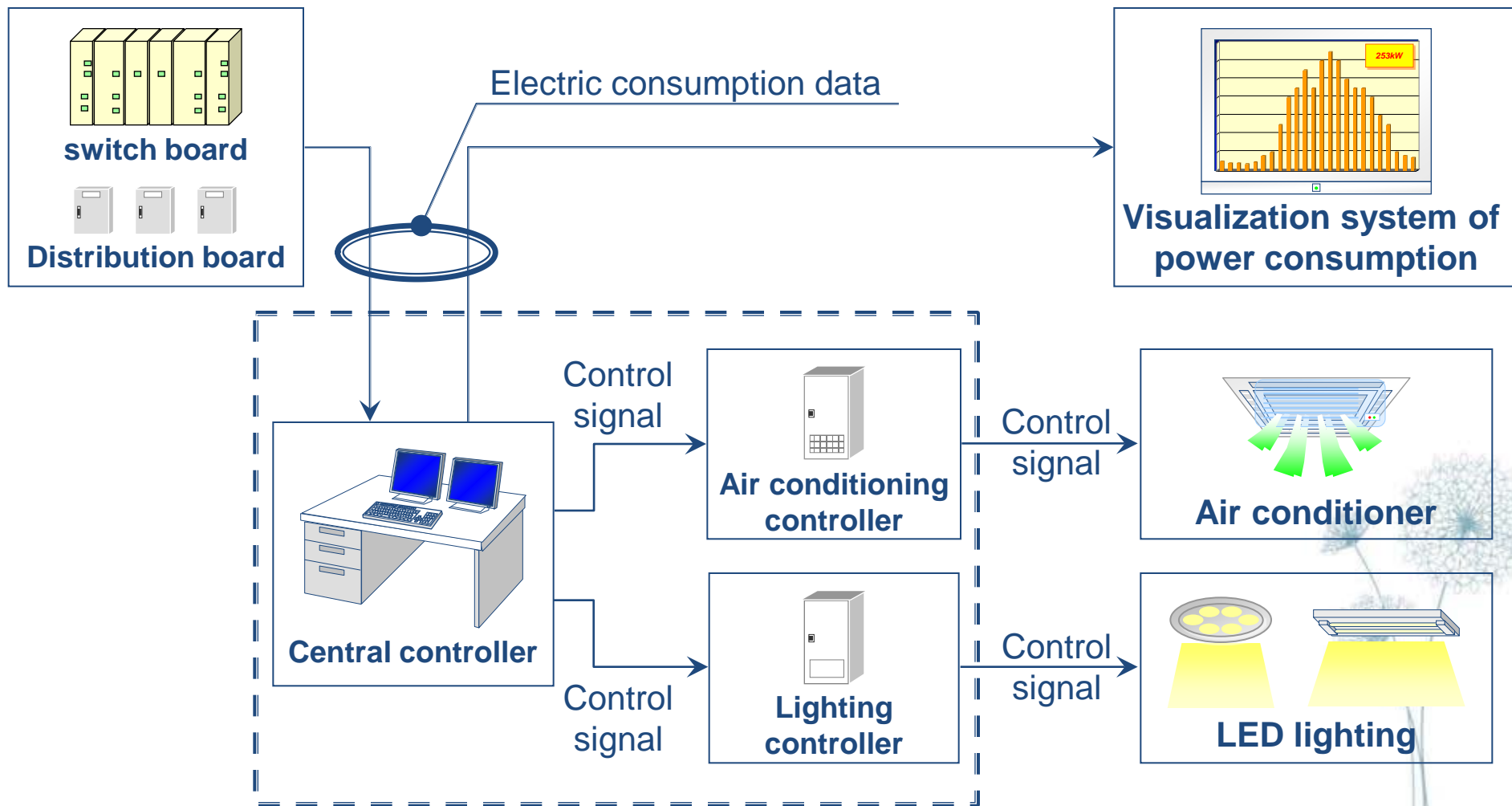
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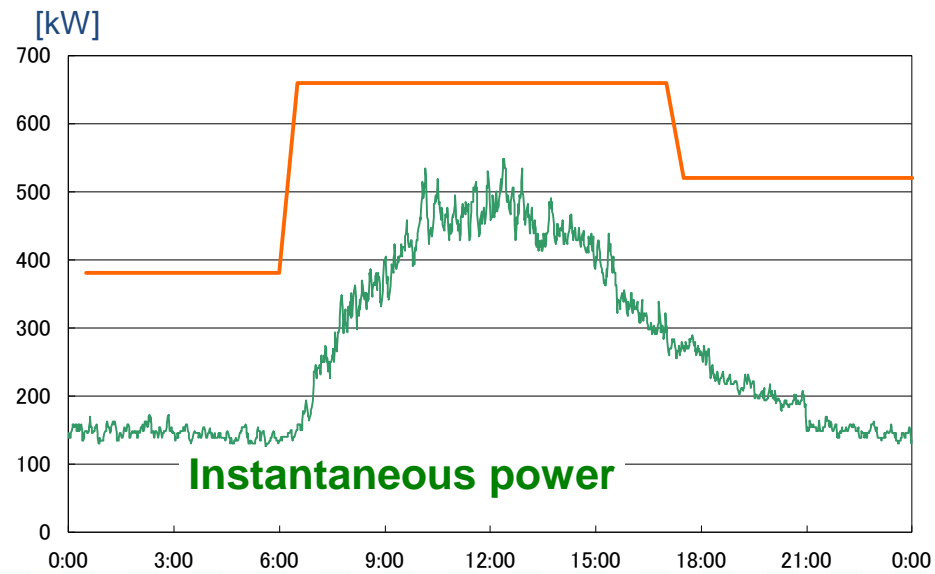
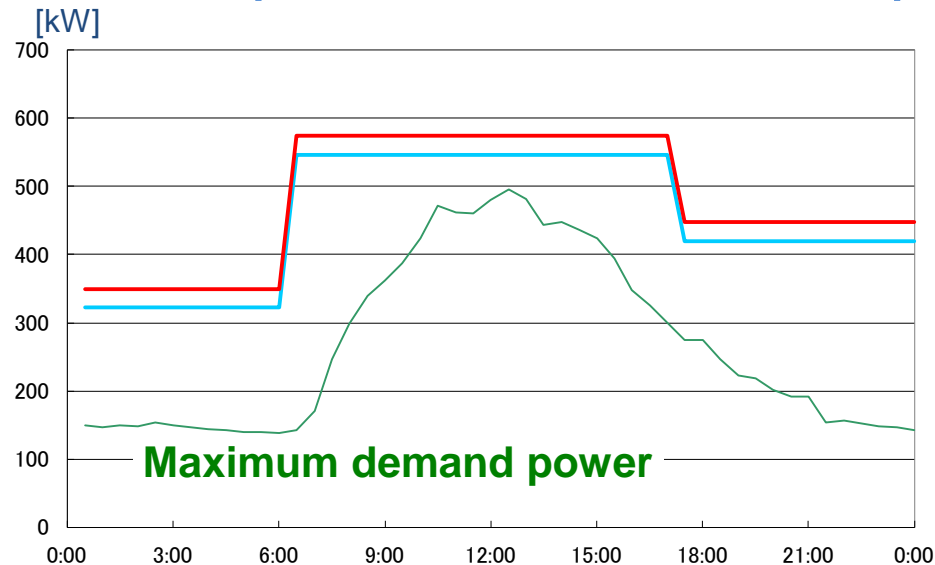




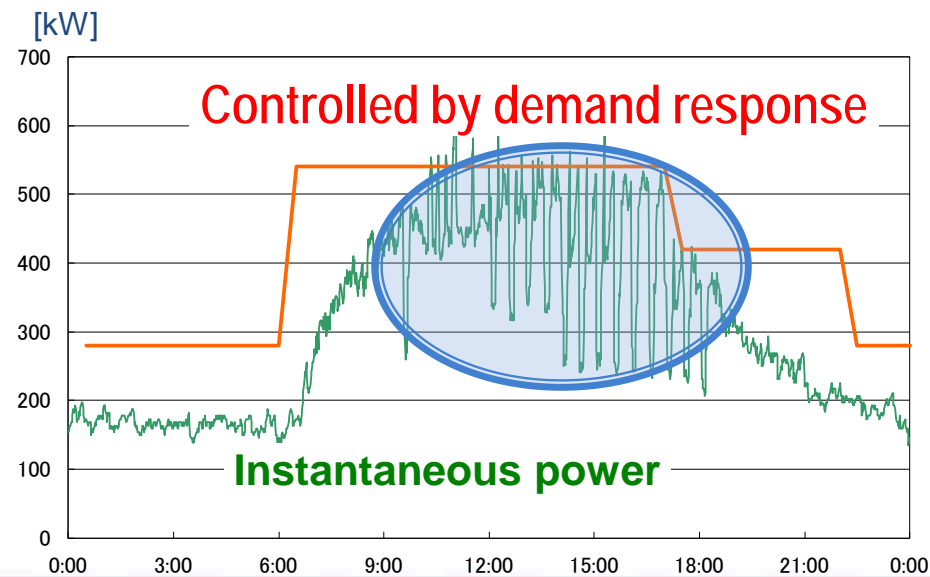
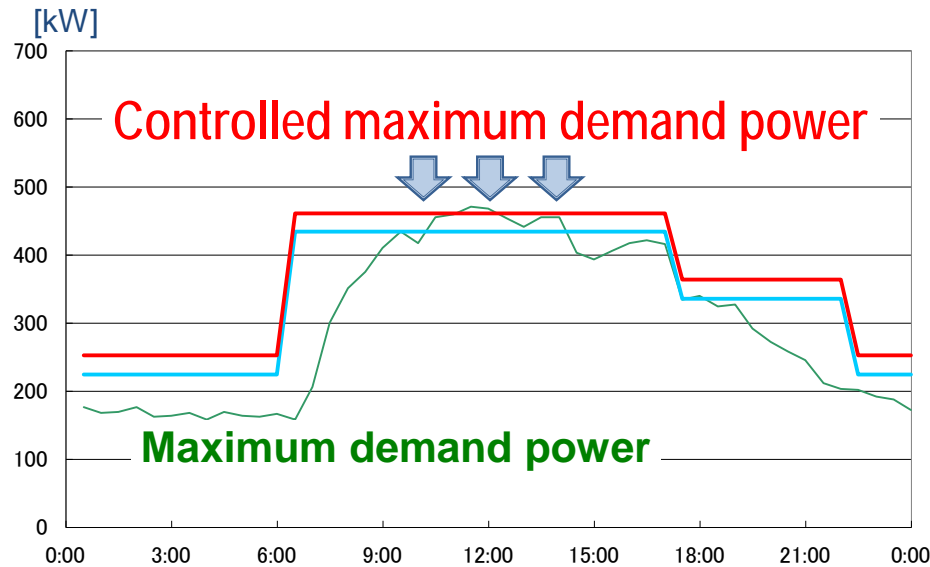
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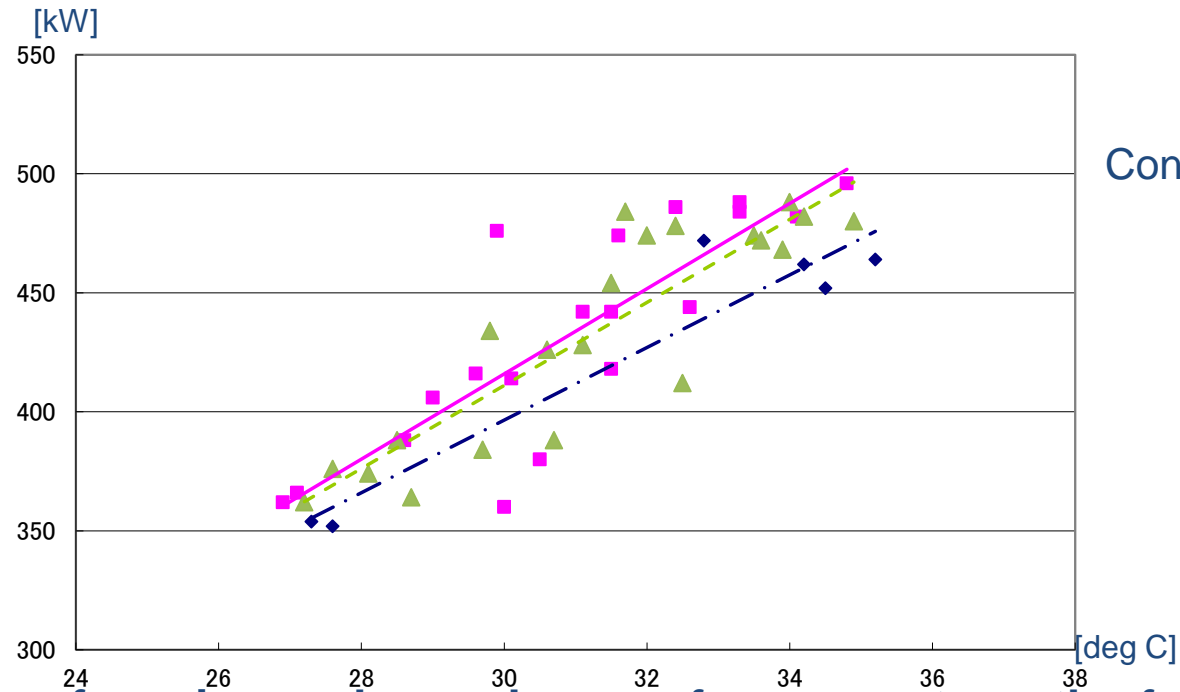
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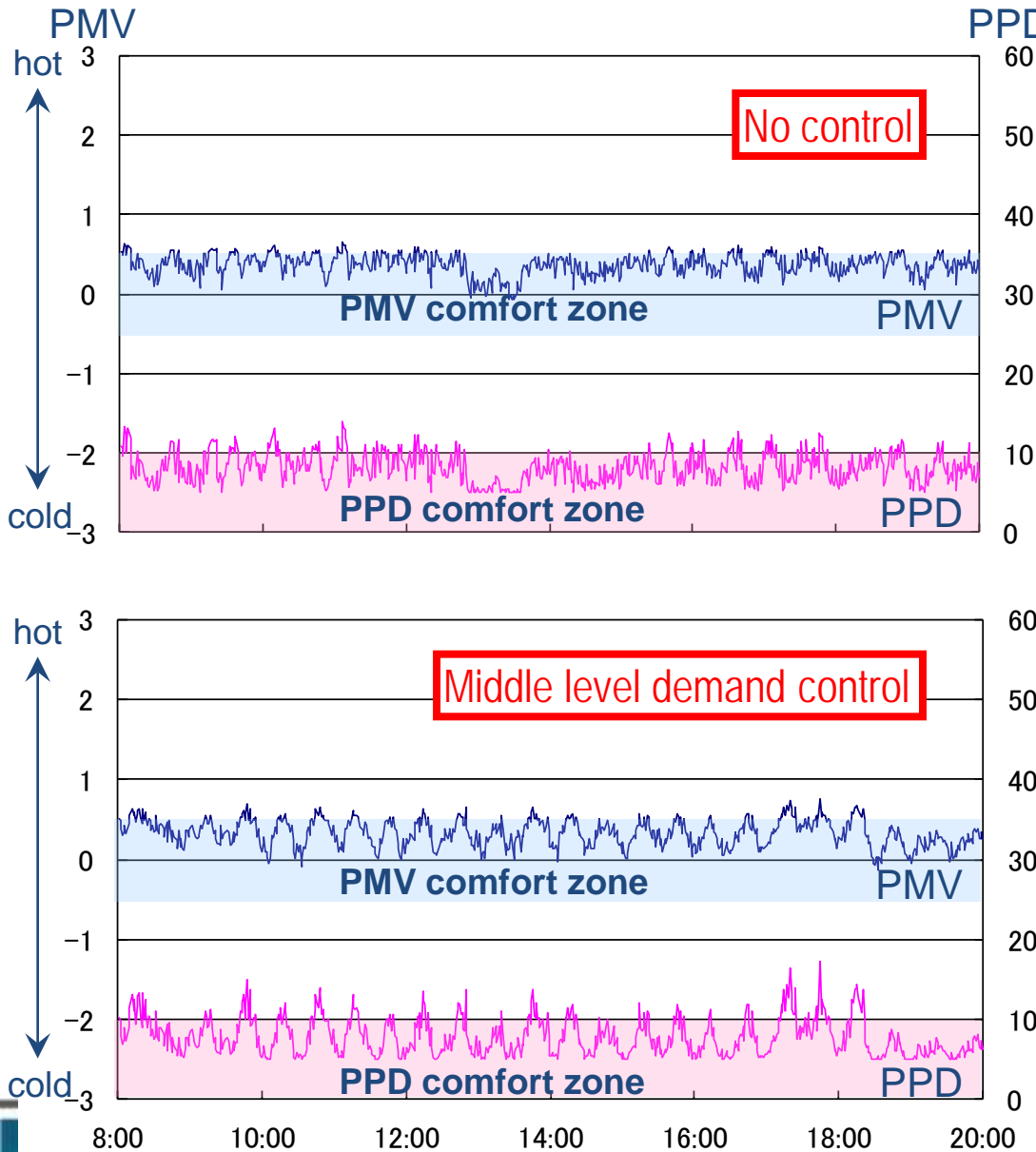


**The tendency of maximum demand power for every strength of control**

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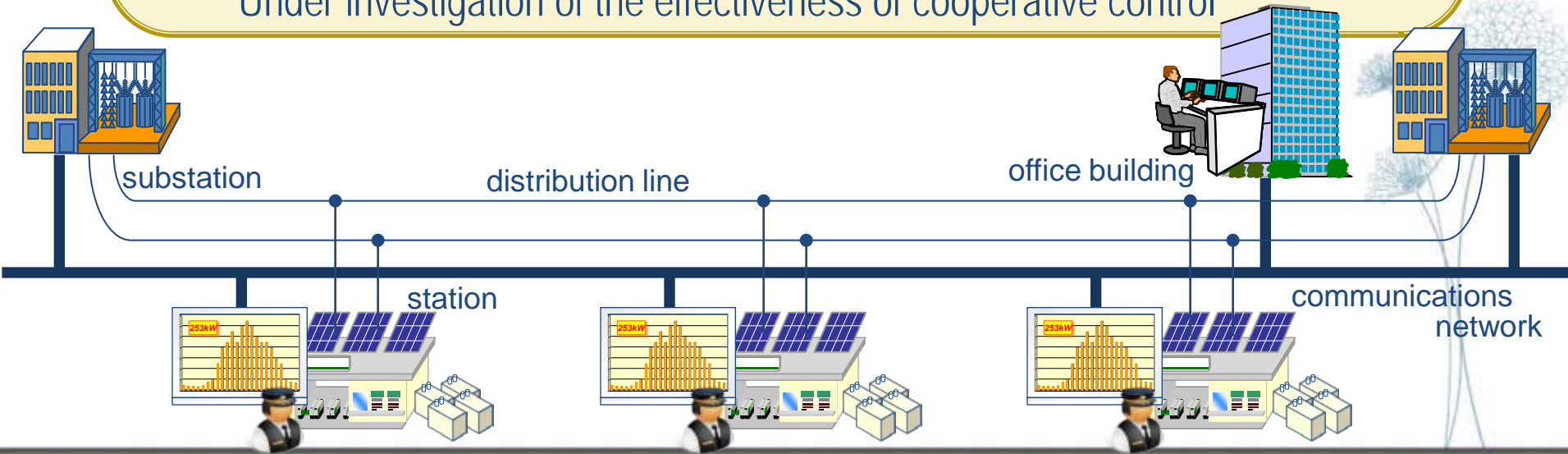
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The key point for controlling non traction energy

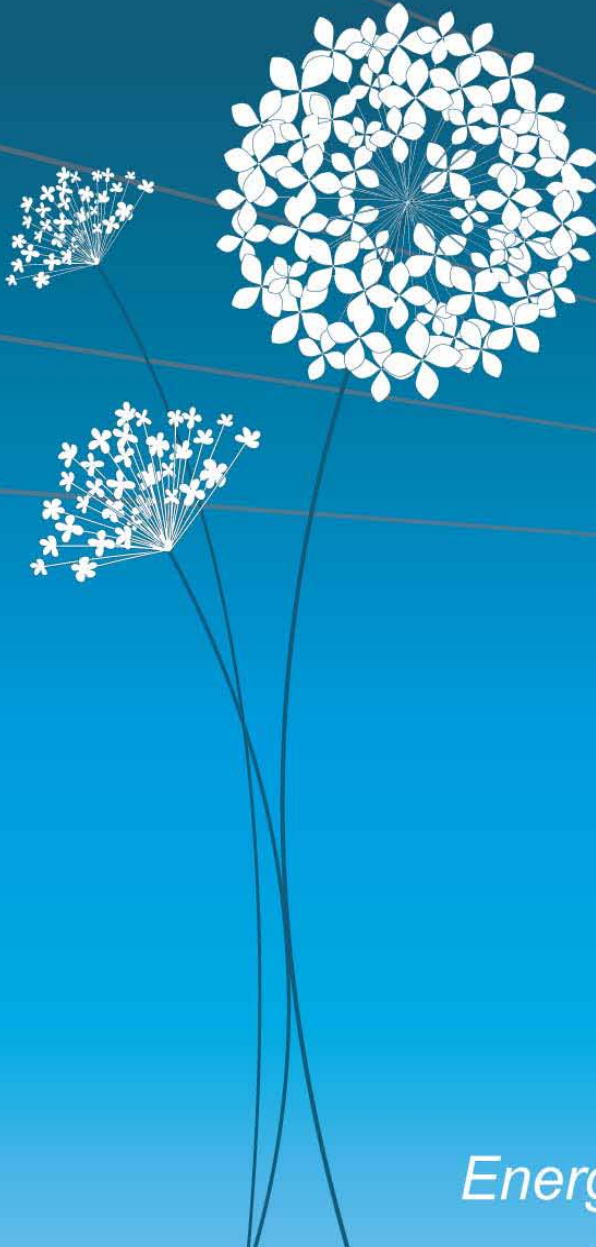
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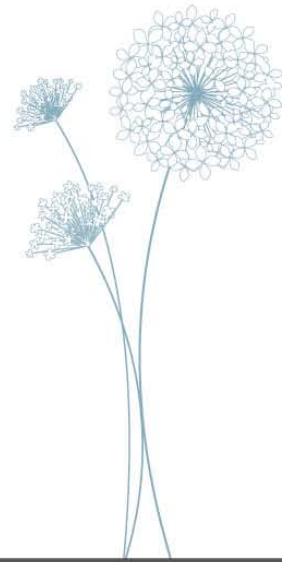
## ENERGY EFFICIENCY AND RENEWABLE GENERATION IN THE MAINTENANCE FACILITIES AT TRENITALIA

*FRANCESCO TARDIA*  
*ENERGY MANAGER ASSISTANT AT TRENITALIA*

*Energy Efficiency, the best fuel to move our trains!*

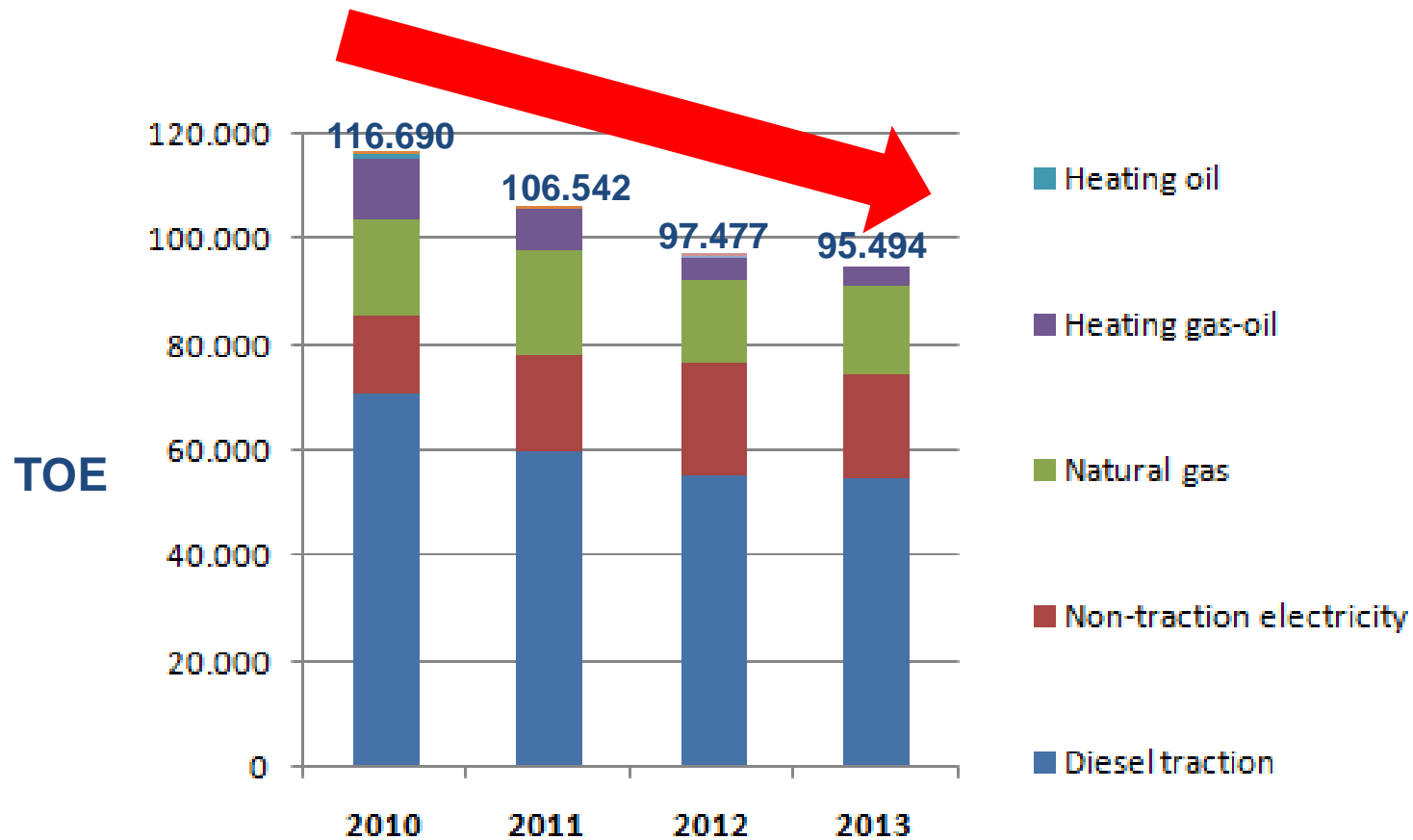
# AGENDA

- Energy consumption at Trenitalia
- « Green Plant »: an overview of Trenitalia non-traction activities
- Energy Audits
- White Certificates mechanism
- Remote Smart Energy Metering
- Solar Photovoltaic generation



# CONSUMPTION TREND AT TRENITALIA

In Italy the FS Group it is the organization with more demand for electricity.  
The main consumption (~ 4TWh/year) is for electrical rail traction included in RFI energy balance.

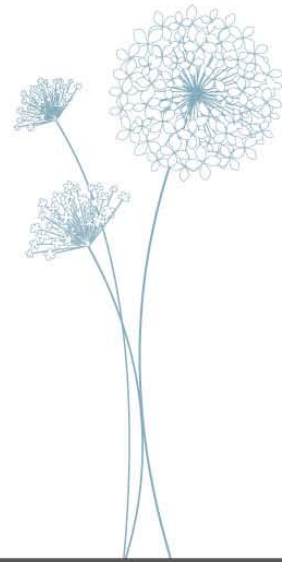


# NON-TRACTION ENERGY: GENERALITY

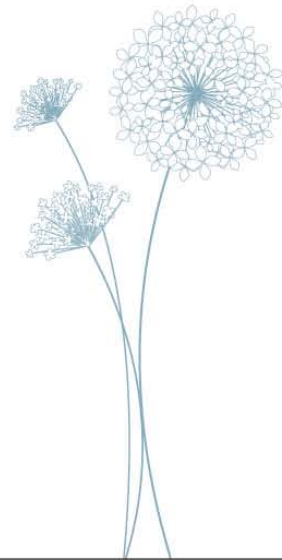
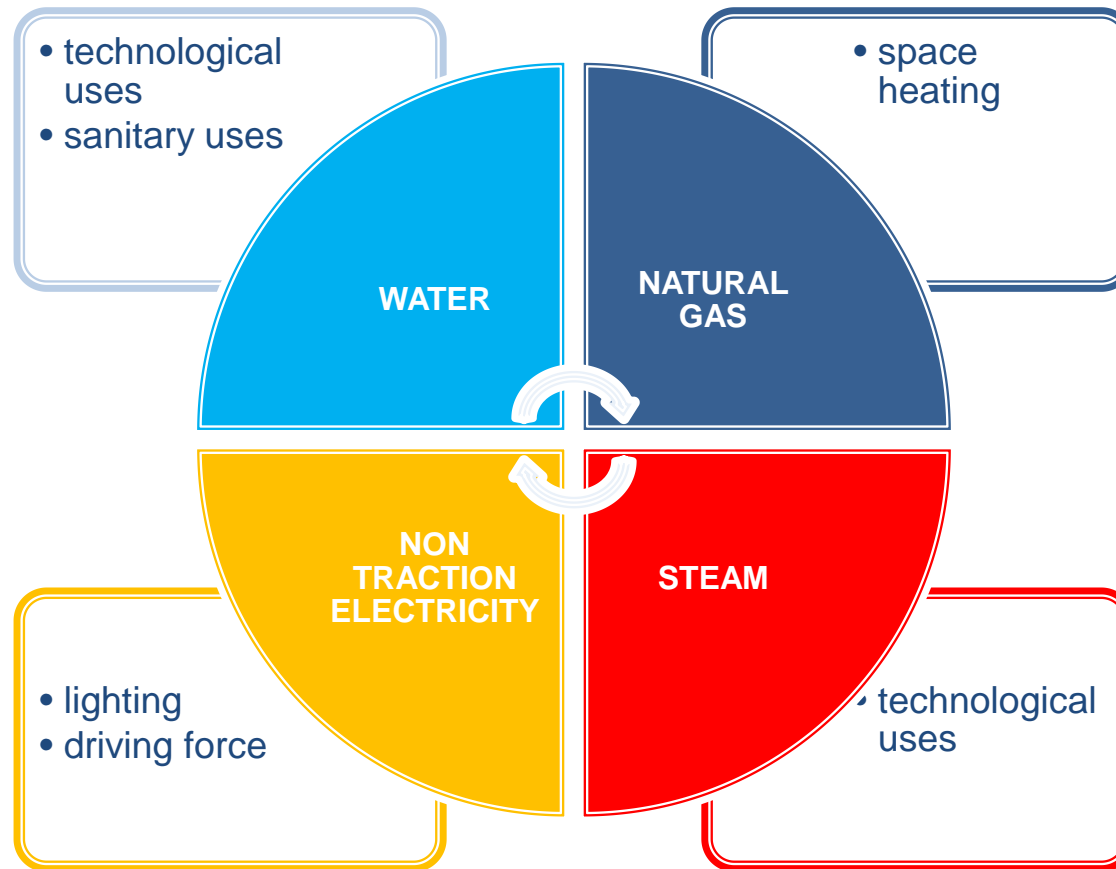
- Trenitalia, besides providing passengers and freight services, is responsible for the maintenance of the rolling stock through:
  - *cyclical maintenance*
  - *current maintenance*
- The overall maintenance system is structured within **90** industrial facilities, which are categorized by divisions (Long Haul, Regional transportation, Freight and Technical Services) as shown below:

DPLH	DPR	Cargo	DT
16	52	12	10

- The areas occupied in the various industrial sites add up to:
  - 8,676,053 square meters of total area
  - 1,803,480 square meters of covered area.

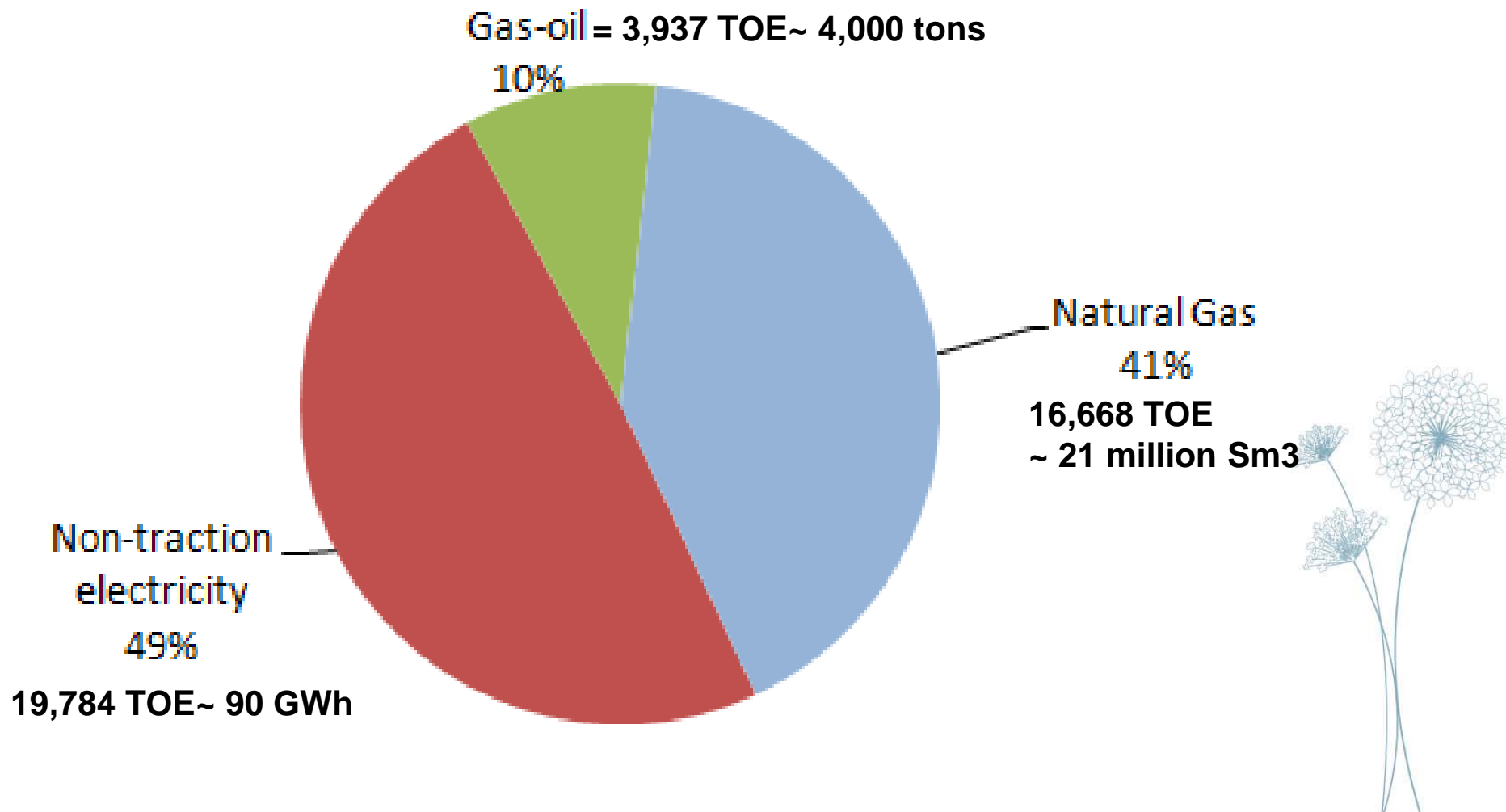


# THE ENERGY VECTORS IN THE MAINTENANCE FACILITIES

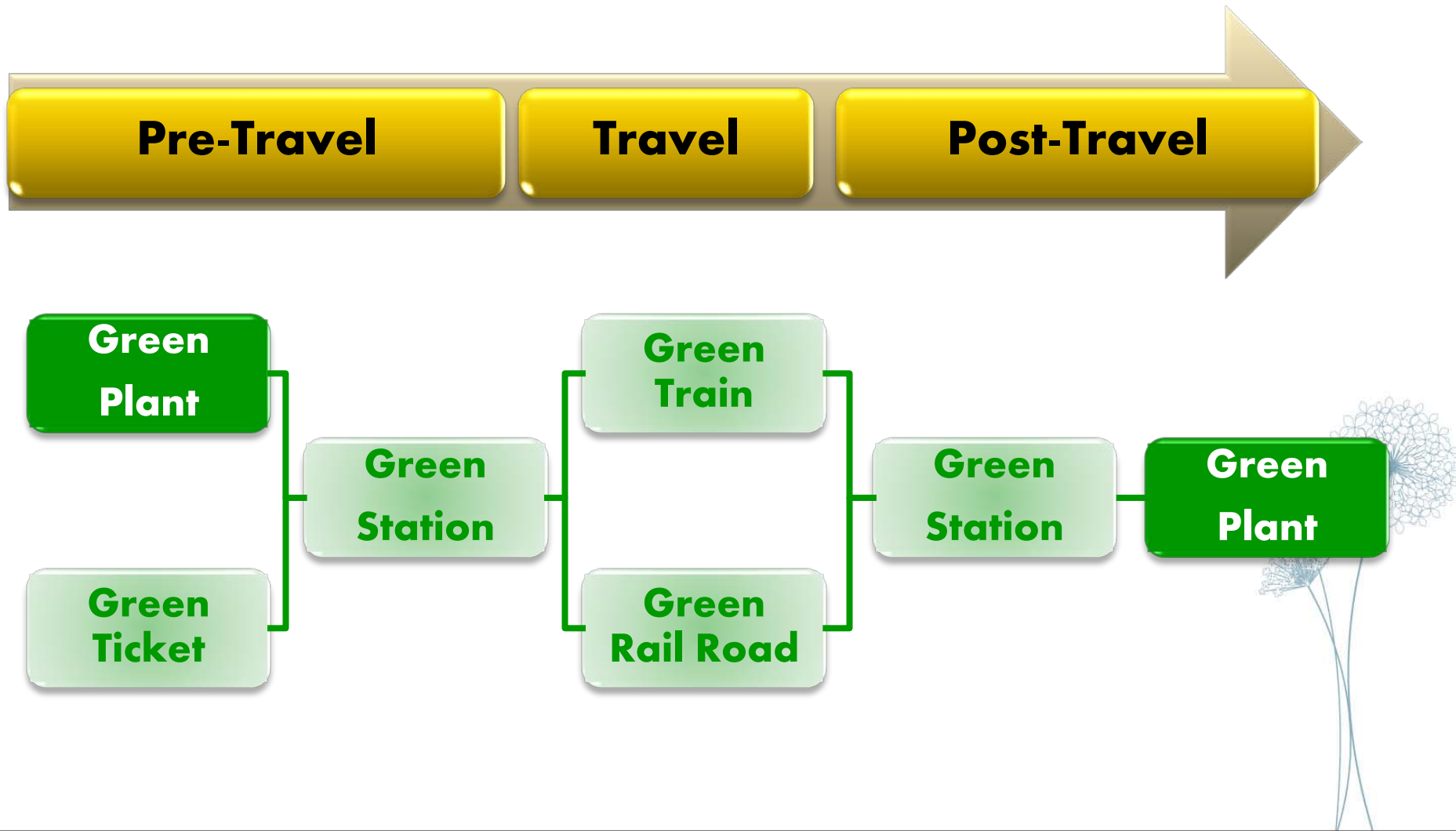




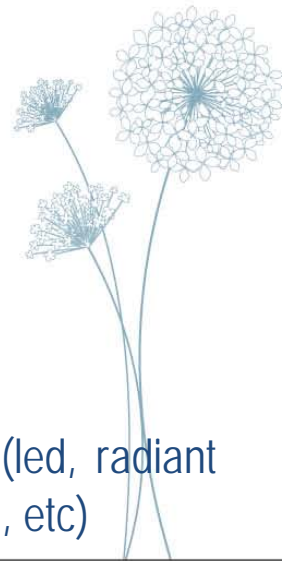
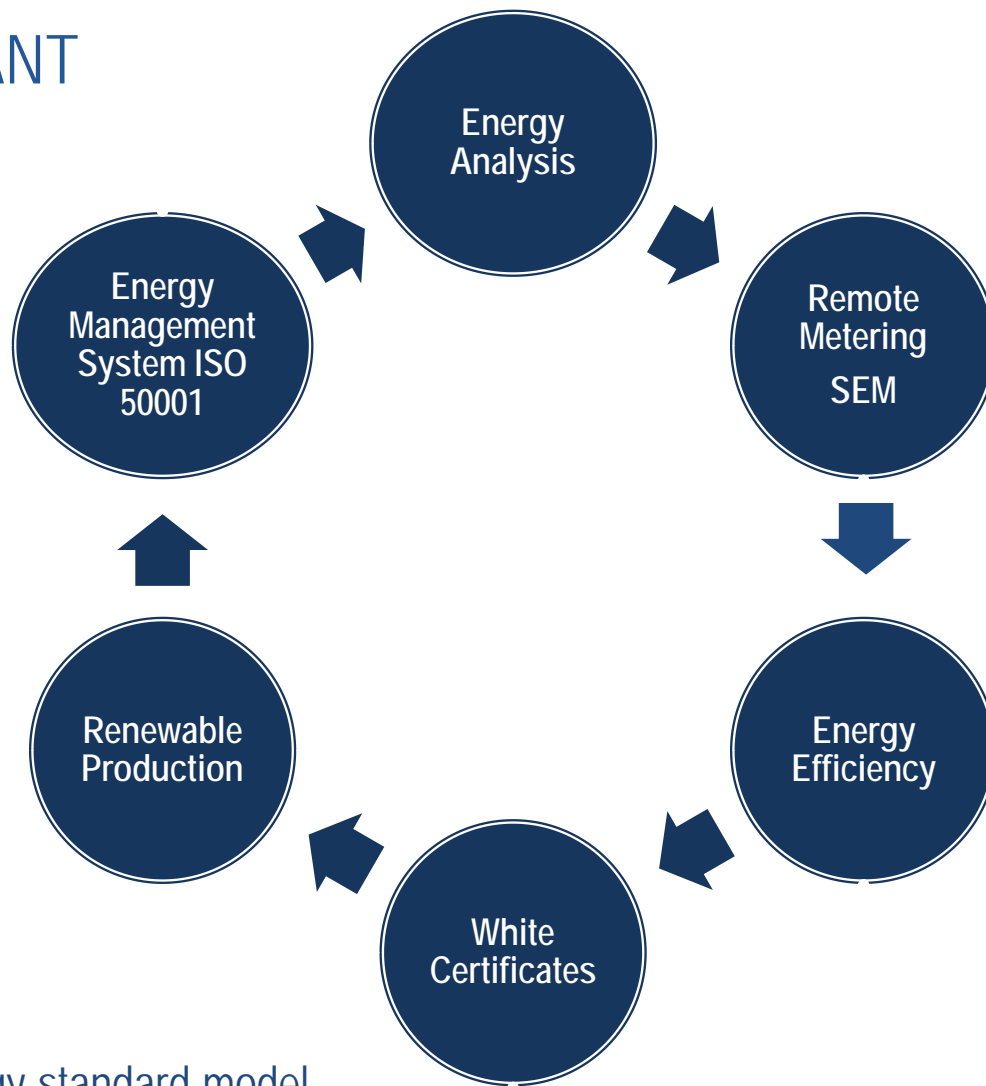
# THE ENERGY VECTORS



# GREEN PLANT– TRAVEL / SERVICE / TRAIN



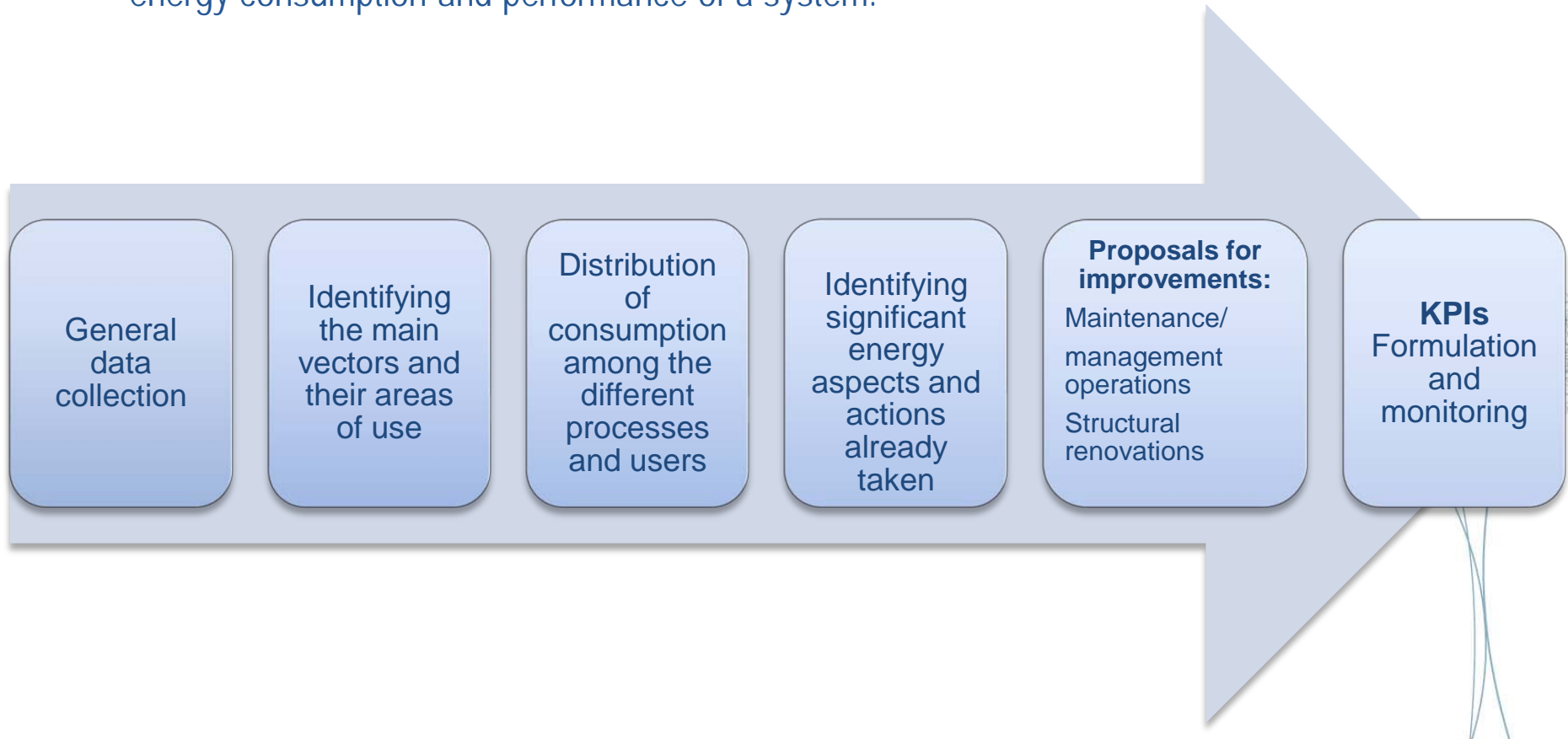
# GREEN PLANT



- Definition of an energy standard model
- Implementation of investments in energy efficiency and renewable energy production (led, radiant strips, photovoltaic, solar thermal, insulation, automatic doors in maintenance workshops, etc)

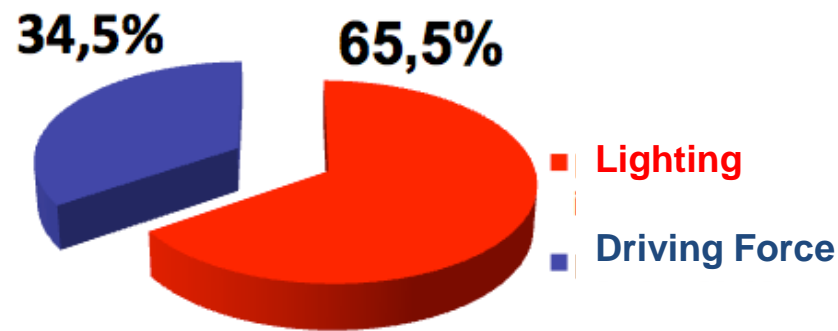
# ENERGY ANALISYS

- The Energy Audit is a systematic procedure to identify and quantify energy saving opportunities in terms of cost-effectiveness through an adequate knowledge of the profile of energy consumption and performance of a system.

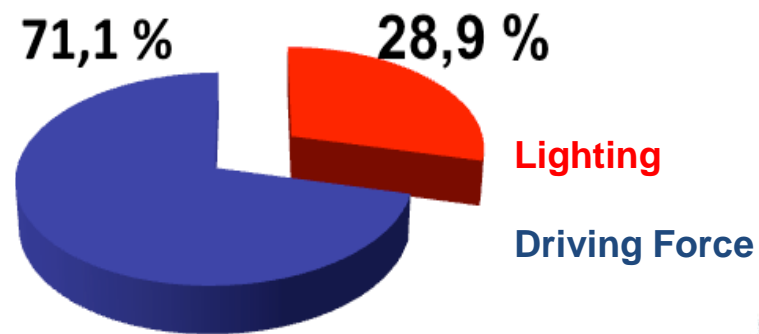


# ENERGY ANALISYS

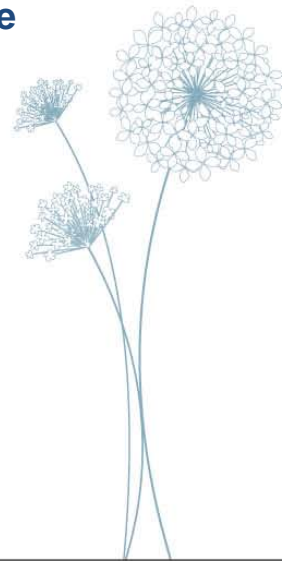
- Different distribution of electricity consumption among current and cyclical maintenance: the prevalence of consumption for lighting in current maintenance facilities and the corresponding prevalence of consumption for driving force in cyclical maintenance;



current maintenance workshops



cyclical maintenance workshops



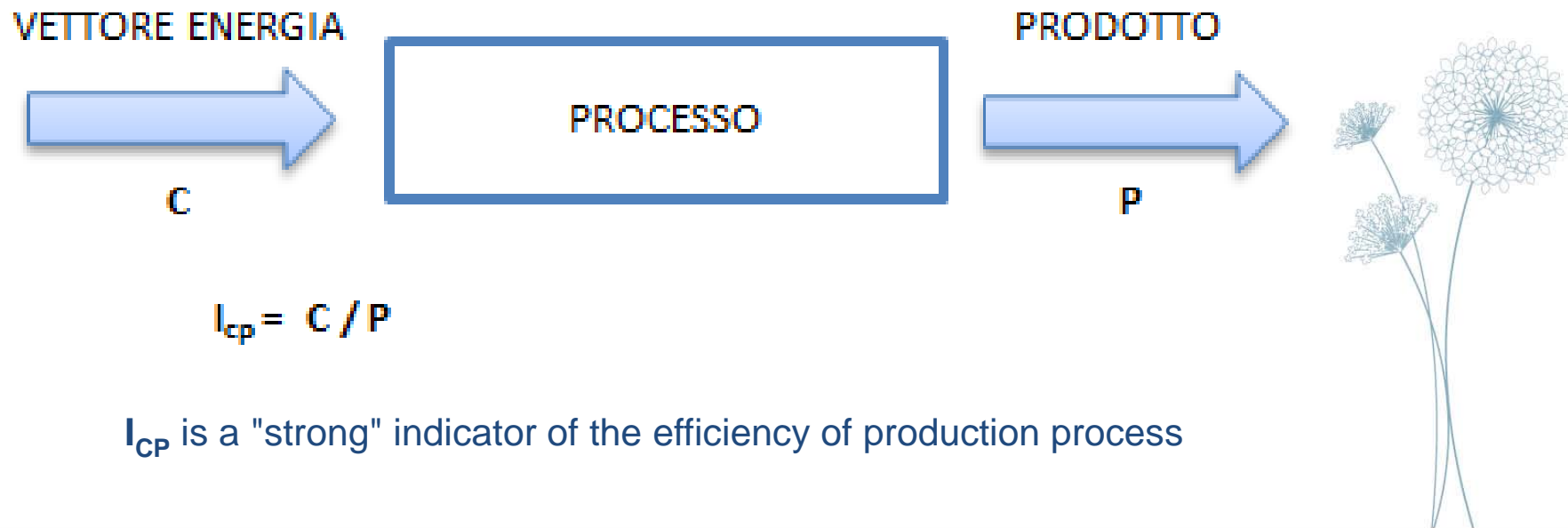
The energy audits are very important to raise the awareness of energy consumption



# PERFORMANCE INDEX

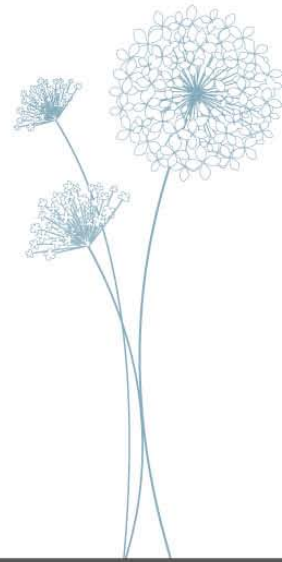
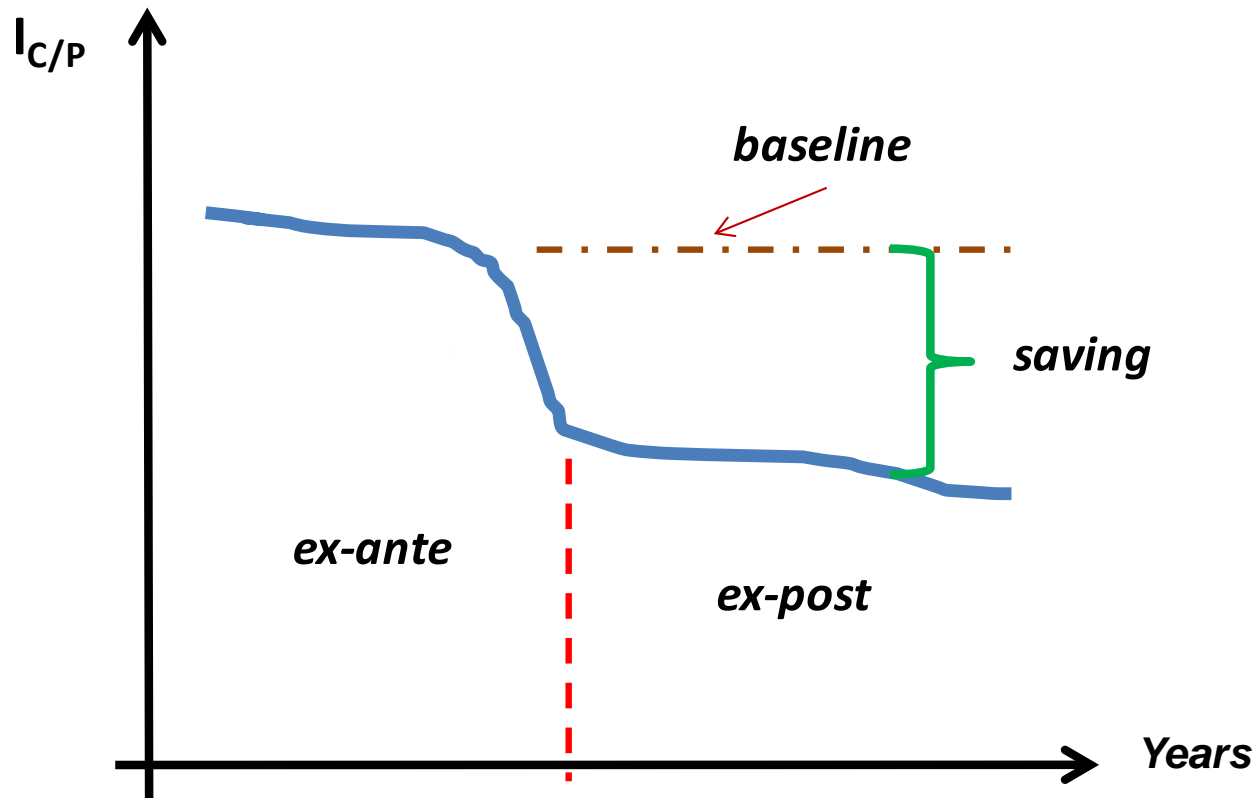
In the first energy analysis emerged a difficulty in comparing the performance indicators of the plants, even within the same maintenance category.

It's very important to measure and monitoring the correlation between the energy contributions that enter the production process and production through a performance index given by the ratio between the vector and the quantities produced by different production mix.

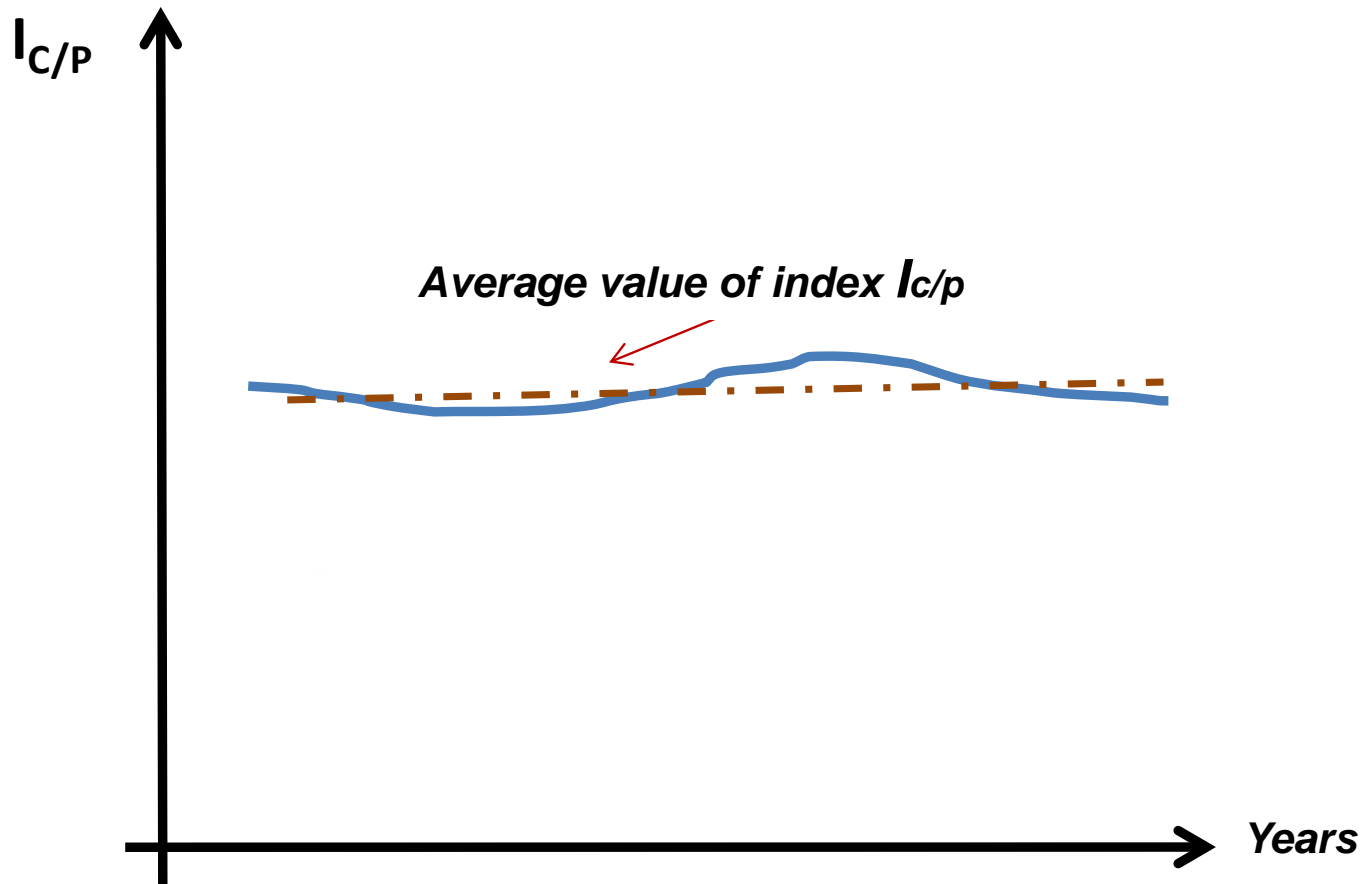


# HYPOTHESIS OF PATH 1/3

Identification of positive effects related to energy efficiency measures

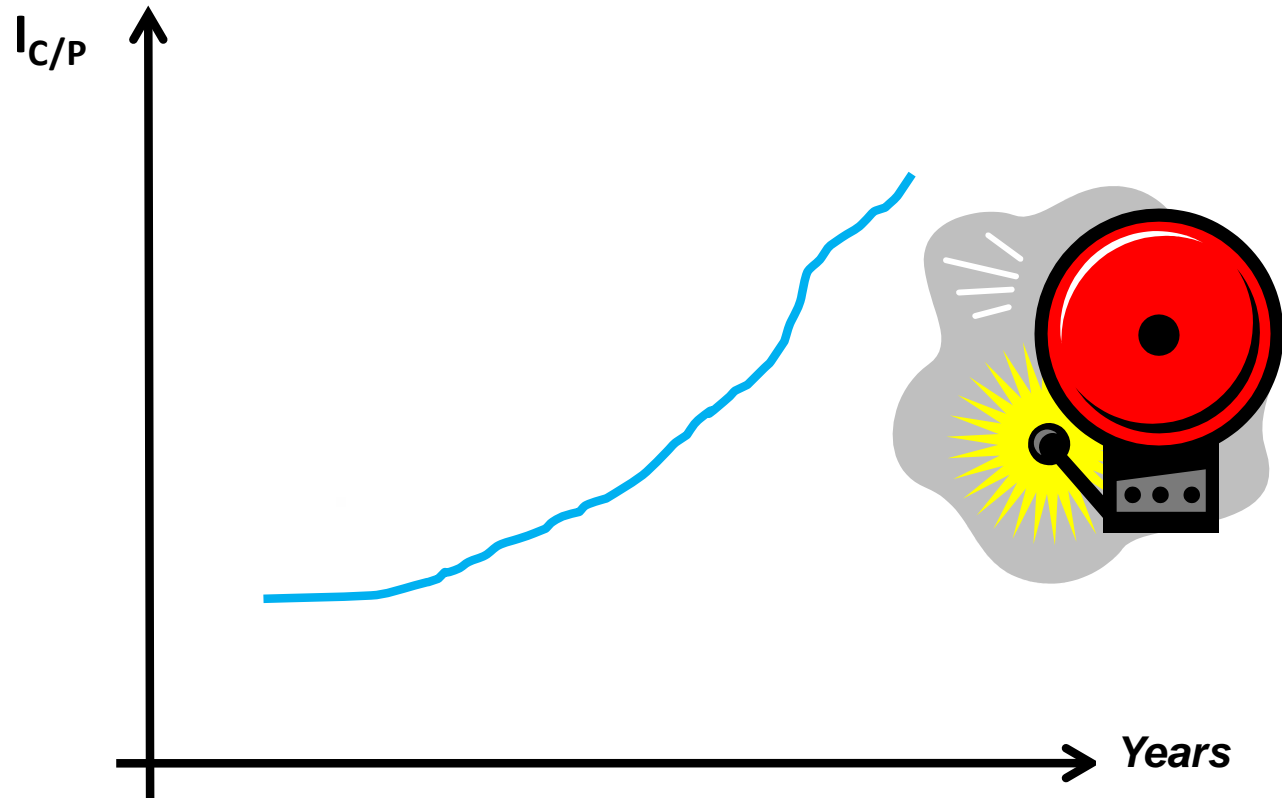


# HYPOTHESIS OF PATH 2/3



Positioning in terms of average value of the performance index  $I_{C/P}$  compared to the reference sector benchmark.

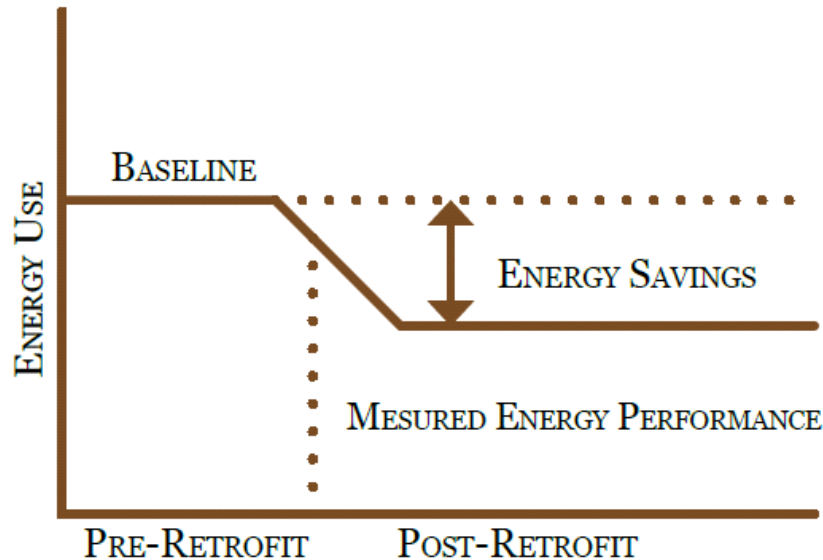
# HYPOTHESIS OF PATH 3/3



Highlighting any issues that may have led to abnormal performance index  $I_{CP}$ ;

# THE WHITE CERTIFICATES (WHC) MECHANISM

White certificates, also known as “Energy Efficiency Certificates” (EEC), are tradable instruments giving proof of the achievement of end-use energy savings versus a baseline, through energy efficiency improvement initiatives and projects.



Under the scheme, electricity and natural-gas distributors are required to achieve yearly quantitative primary-energy saving targets, expressed in Tons of Oil Equivalent (TOE) saved. Each certificate is worth one ton of oil equivalent (toe) saved.



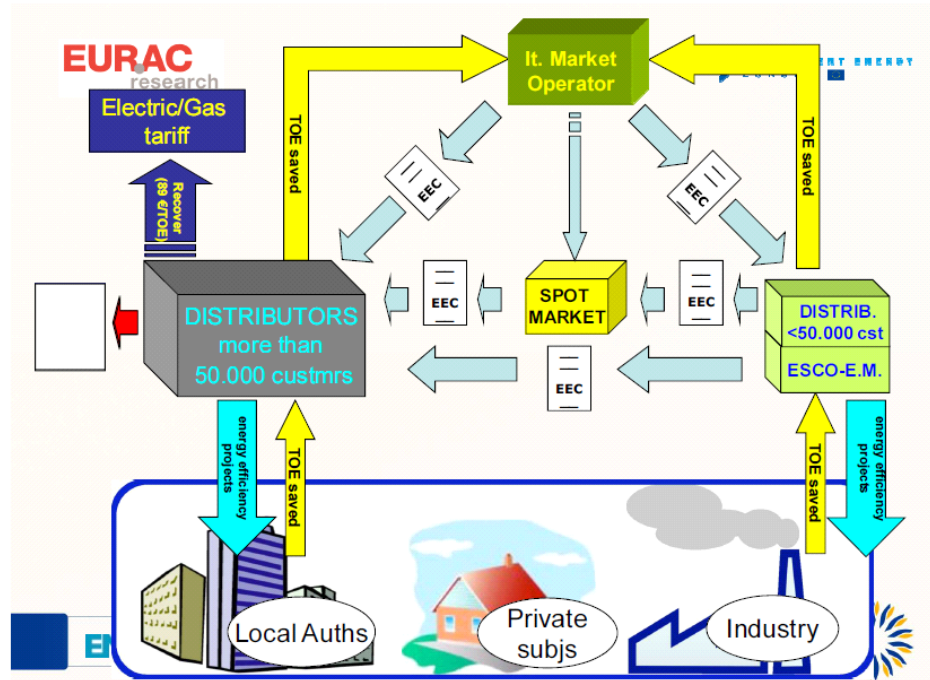
# THE WHITE CERTIFICATES (WHC) MECHANISM

1 WhC = 1 saved toe (ton of oil equivalent)

1 WhC = approx. 100€ (originally, they are tradeable) WhCs hold up 5 years

Parties eligible to submit projects for accruing white certificates are:

- i) electricity and gas distributors with more than 50,000 final customers ("obliged parties")
- ii) companies operating in the sector of energy services (ESCOs)
- iii) organisations having an energy manager or an ISO 50001-certified energy management system in place.



# CASE HISTORY

In the ex-ante situation the workshop in Verona was characterized by a single thermal power plant for the production of steam at 6 bar for both the needs of the process that spaces heating by means of air heaters

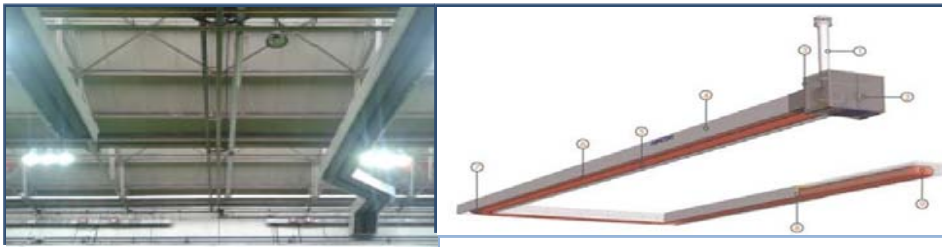


The optimization project consisted of the divestment of the existing thermal power plant through:

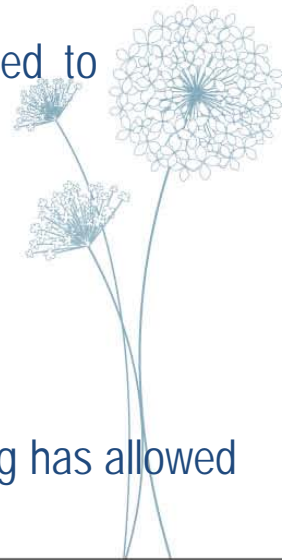
- the adoption of individual boilers with burners dedicated to each user process



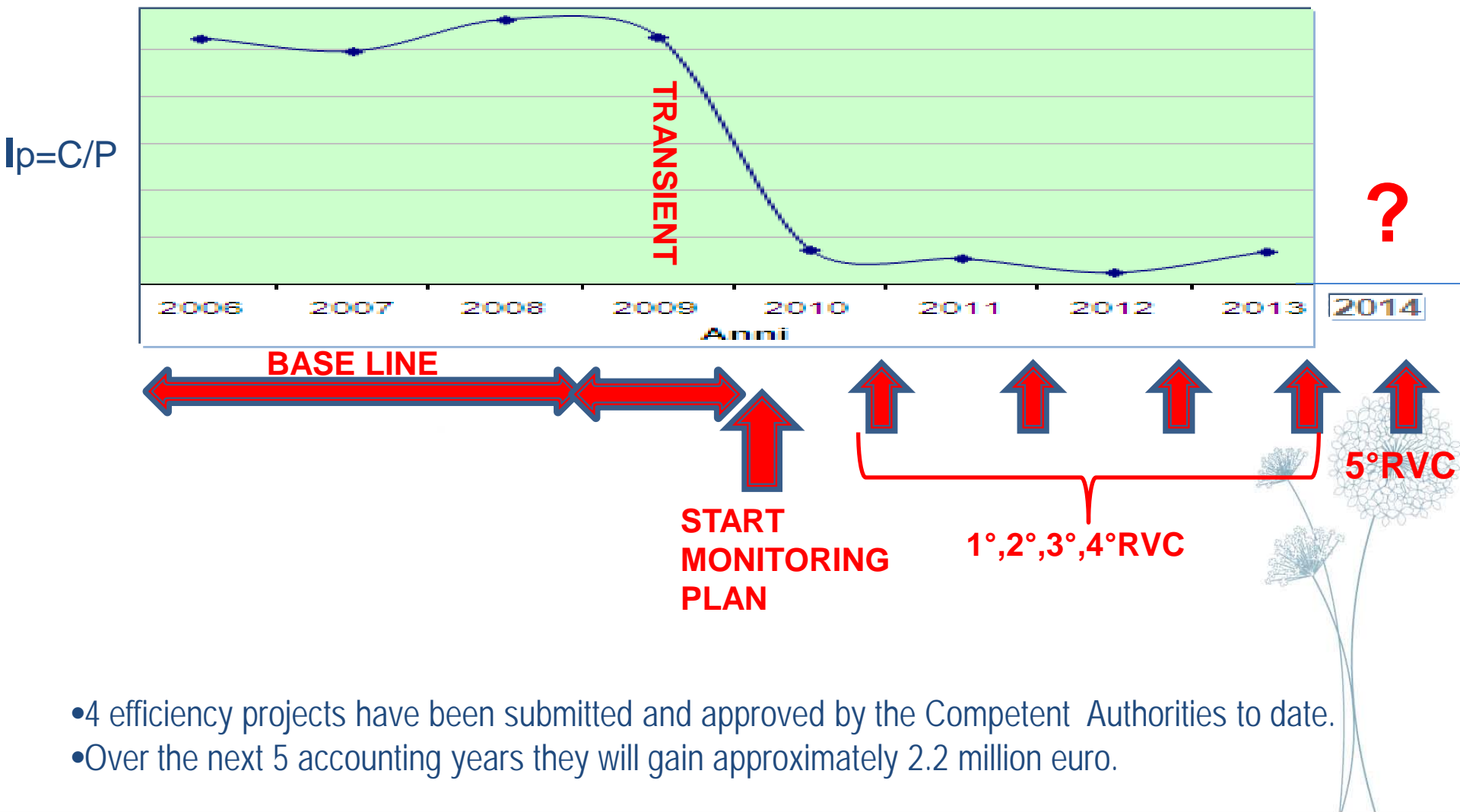
- the adoption of a series of generators, hot pressurized air, natural gas fueled coupled to innovative radiant strips



The elimination of the distribution of the steam / hot water and the optimization of the piping has allowed high savings in thermal equal heated spaces and number of pieces processed



# CASE HISTORY



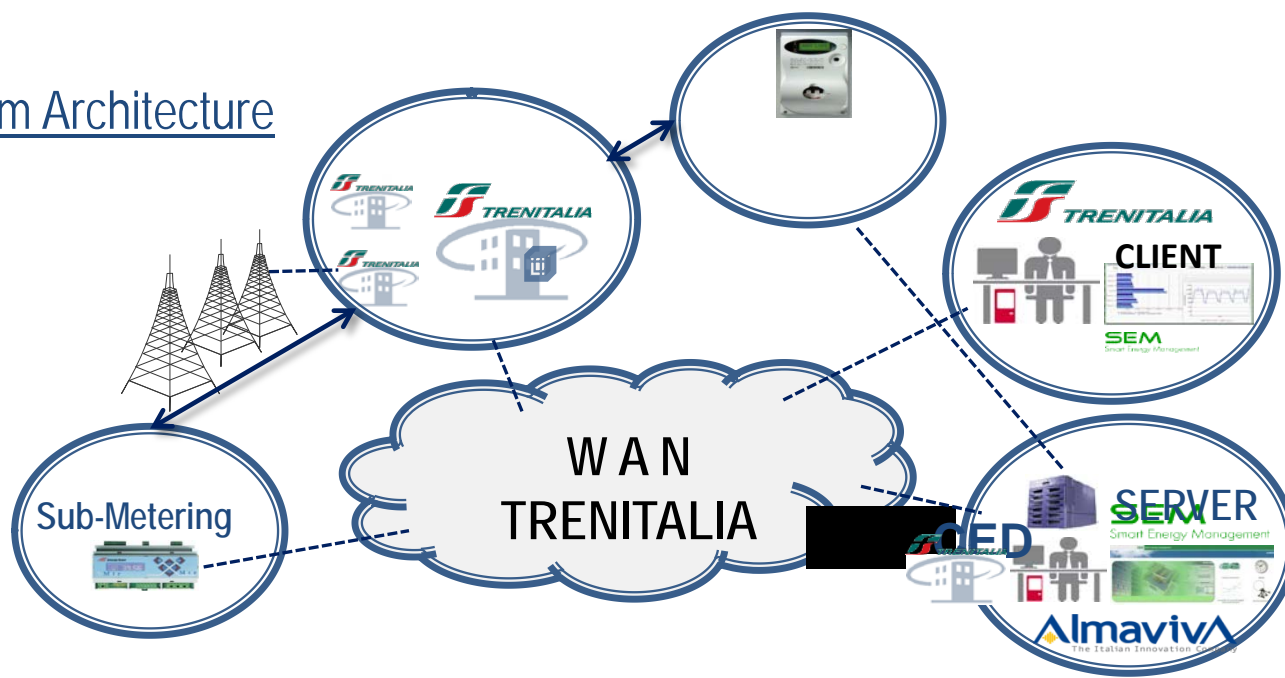
# REMOTE SMART ENERGY METERING

Modular elements that in a first phase only monitor the electrical consumption, extensible also to gas and water

The project will cover 44 maintenance facilities, classified in 3 different ranges indicating the complexity of the installation and monitoring

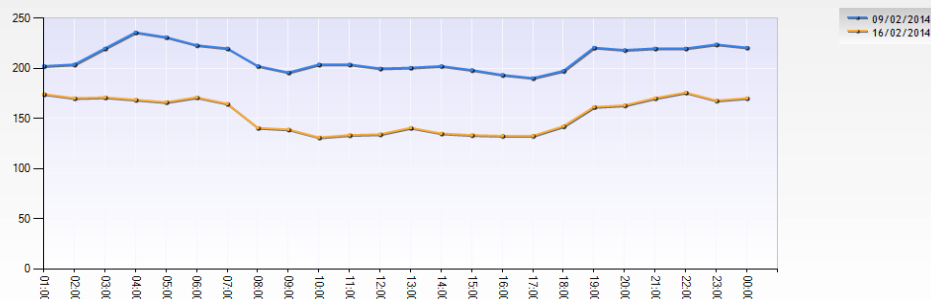
	Divisione				
Categoria	DPLH	DPR	DC	DT	Totale complessivo
A	2	3		7	12
B	8	2	6	1	17
C		15		0	15
	10	20	6	8	44

## System Architecture



# REMOTE SMART ENERGY METERING

Periodo di misura da 16/02/2014 a 16/02/2014 con campionamento di 1 ora



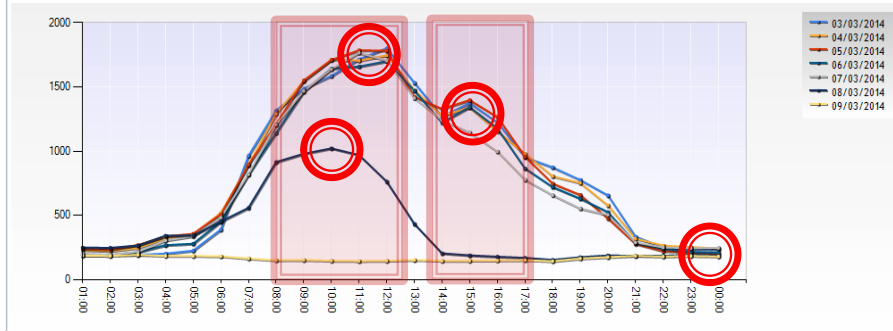
Difference between the consumption of 1,350 kWh for two Sundays in February

Day (and night) significant values

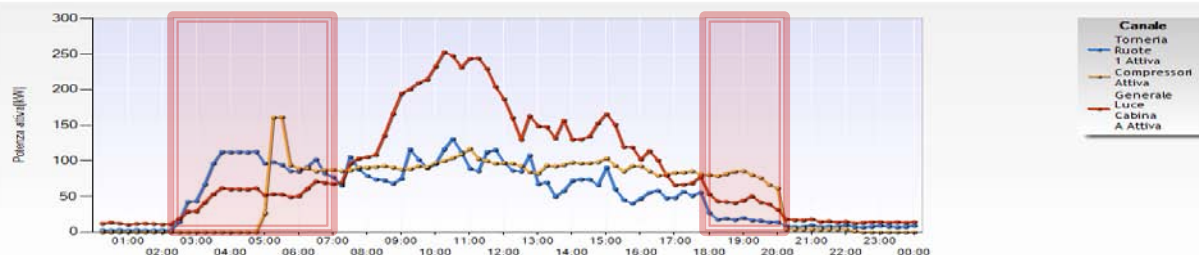
Consumption analysis of peaks

Correspondence between timetables of work shifts and consumption

Periodo di misura da 09/03/2014 a 09/03/2014 con campionamento di 1 ora



Periodo di misura da 07/03/2014 a 07/03/2014 con campionamento di 15 minuti



Planning times on / off of certain machinery savings could be achieved



# THE AUTHORIZED INVESTMENTS



	Energy Efficiency(€)	Photovoltaic and lighting (€)	Regulatory adaptation(€)	TOTAL (€)
IDP Napoli Smistamento	970.000	2.815.000	-	3.785.000
IDP Milano Martesana	1.600.000	3.840.000	-	5.440.000
OMAV Roma S.Lorenzo	2.085.000	3.160.000	1.975.00	7.170.000
OMC S.Maria La Bruna	505.000	3.175.000	-	3.680.000



Trenitalia has in house developed the final design  
The specifications are ready to carry out a public tender.

# EXPECTED SAVINGS

	Power (KWp) and Producibility(KWh/year)	Reduction Purchase Electricity for self-consumption and Energy Efficiency measures	% Reduction requirement for Electricity Energy Efficiency measures
IDP Napoli Smistamento	2.500 kWp 3.311.676 KWh/year	-49,4% da 7.7 a 3.9 GWh	-15%
IDP Milano Martesana	1.630 kWp 1.770.180 KWh/year	38 % da 7.0 a 4,3 GWh	-23%
OMAV Roma S.Lorenzo	1.116 kWp 1.554.400 KWh/year	-48% da 3.3 a 1.7 GWh	-21%
OMC S.Maria La Bruna	1.854 kWp 2.624.047 KWh/year	-73.5% da 3.4 a 0.9 GWh	-19%

(kwh x hh su base annua)

