Our experiences and activities of Smart Community, and Renewables

"Scaling-up renewables through decentralised energy solutions"

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Today's contents:

Major topics:

- What have been the drivers behind city and industry decentralised energy investments?
- How can these players help provide greater energy system integration?
- How essential are smart energy systems and data in facilitating these local energy solutions?

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1) Our experiences of Smart Community
   - Kashiwanoha project (in Japan)
2) New approach to design Smart Community
3) Forecasting model of PV output in broad region

AEMS Case Study: Kashiwanoha, Japan [1/2]

HITACHI
Inspire the Next

- An advanced, world-leading problem-solving model
  “Kashiwa-no-ha Smart City”

SMART CITY PROJECT

1 Environmental-Symbiotic City

2 City of Health and longevity

3 City of New industry Creation

Harmony with the environment × Technology × Community

AEMS: Area Energy Management System）
BCP: Business Continuity Plan)
LCP : Life Continuity Plan)

Hitachi’s “Area Energy-Management Solution”

AEMS	Electric interchange facilities
Area energy-management	Electric interchange
Provision of information to users	BCP and LCP measures

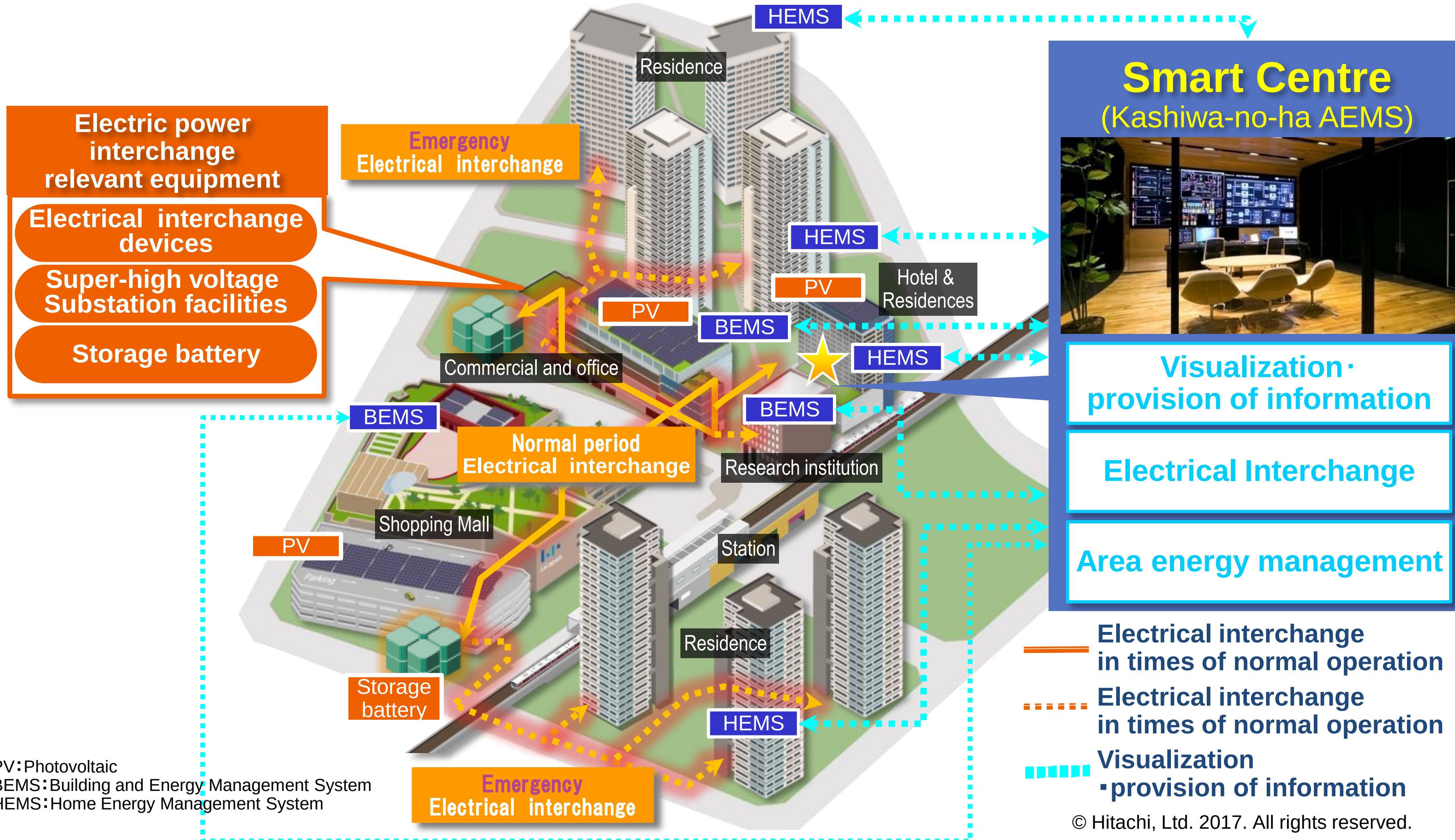
*Source: Mitsui Fudosan Co., Ltd.

AEMS can bring forth an integral management of creating, saving and storing energies in an entire community.

AEMS Case Study: Kashiwanoha, Japan [2/2]

HITACHI
Inspire the Next

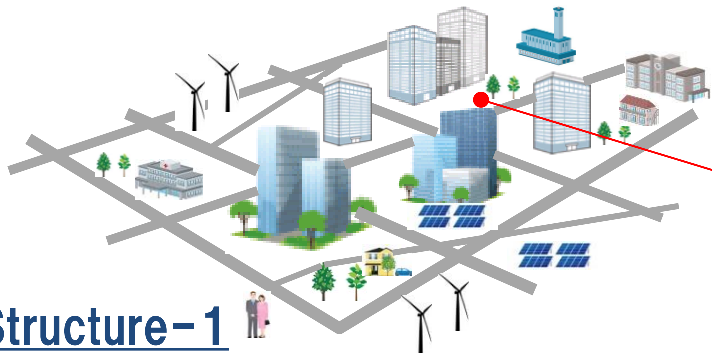
- Area Energy Management Systems that can efficiently operate, monitor, and control energy across the entire region.
  - AEMS optimizes energy usage by centrally managing the energy information for the entire region.
  - By creating, storing, and distributing renewable energy, such as solar power, among city districts, the entire city can share benefits such as reduced CO_2, and an emergency power supply.



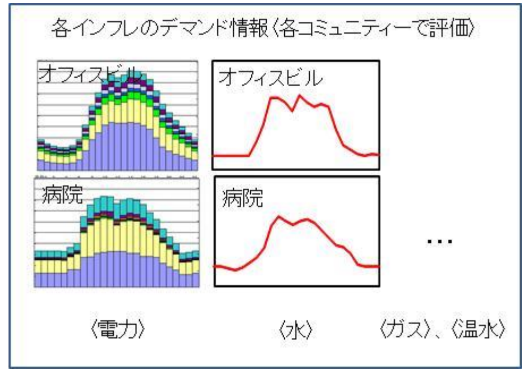
PV：Photovoltaic
BEMS：Building and Energy Management System
HEMS：Home Energy Management System

Approach how to design Smart Community [1/4]

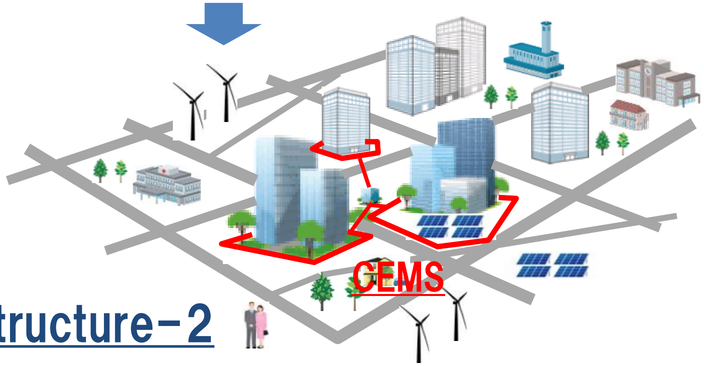
■Integrated Infrastructure simulator on Power/Water/Gas/Hot water



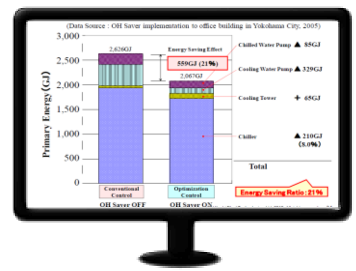
Structure-1



Estimation of primary energy comsumption



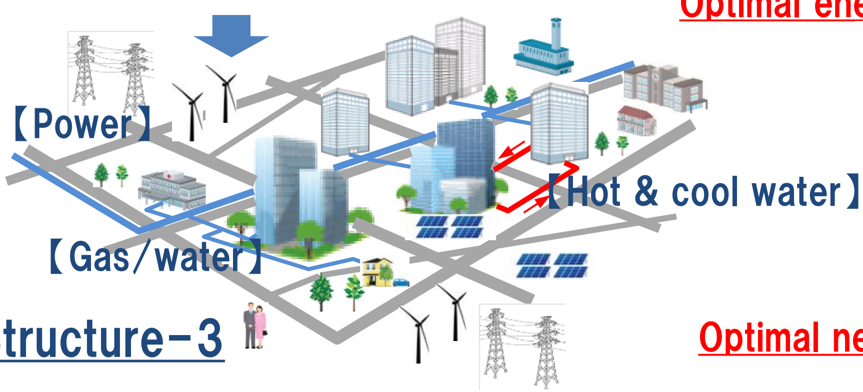
Structure-2



Optimal energy management with BEMS/CEMS

Phase-1

Phase-2



Structure-3

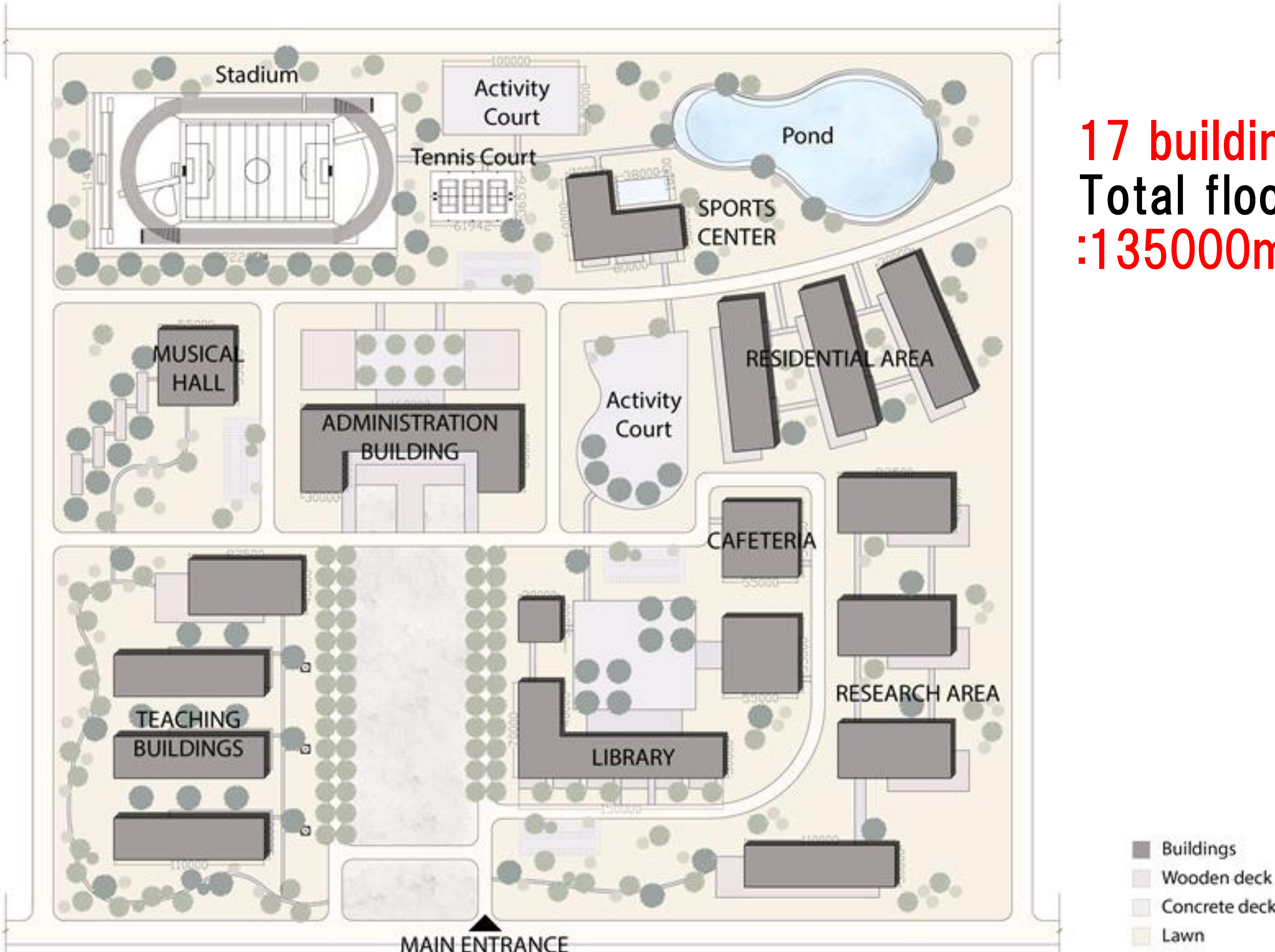
Optimal network system on infrastructure

Optimal management on buildings

Optimal infrastructure

Optimal energy management of community

Virtual Smart Community [2/4]



17 buildings
Total floor area
:135000m^3

Optimization of demand and supply [3/4]

TOKYO TECH

Considered assets

Demand side (Air conditioner)								Supply side (Distributed power)						
ABS		RH		AHP	WHP	TC		GE			PV		Wind	
USRT								kW			kW		MW	
1200	600	1200	600	500	500	2000	1000	200			1200		2.0	
2	4	2	4	5	5	1	2	5	7	10	×1*	×2	None	1

HP:Heat Pump, TC:Turbo Colling, GE:Gas Engine etc.

Results of Optimization

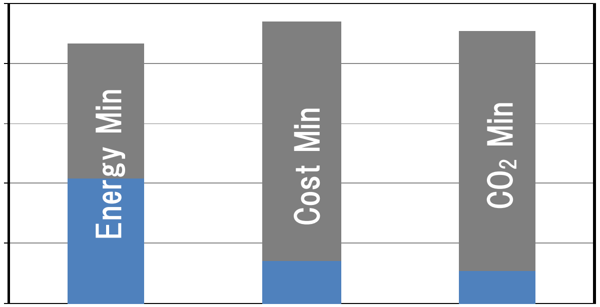
Object functions	Annual Primary Energy	Annual Cost	Annual CO_2	Air conditioner		Distributed power		
	[GJ]	[k$]	[t]	Heat/cool	Cooling	GE	PV	Wind
Primary Energy Min	215871	3089	12688	AHP:5 units	TC:1 units	7 units	2.4MW	1 unit
Cost Min	234375	2175	12206	ABS:2 units		10 units		None
Annual CO_2 Min	226851	2410	11685	ABS:2 units		10 units		1 units

■Conditions of primary energy (Tennessee, US):

1) Electric tariff :10￠/kWh

2) Gas tariff:15￠/Nm^3

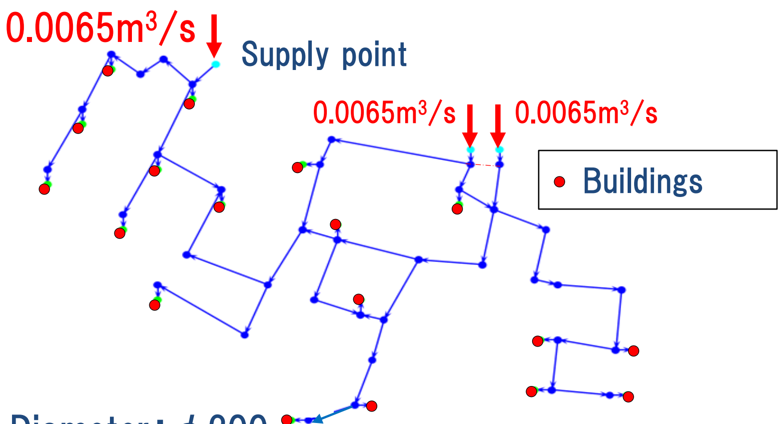
3) Daily Electric and heat demand for buildings



Optimization of infrastructure networks [4/4]

Water network

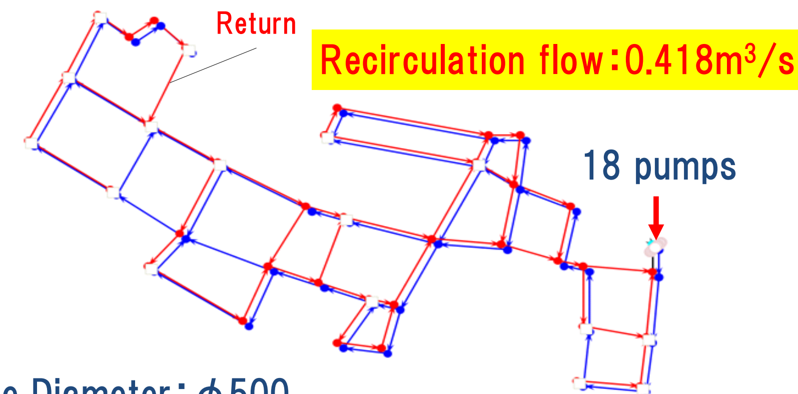
■Minimization of head loss & cost



Pipe Diameter : ϕ200

Hot water network

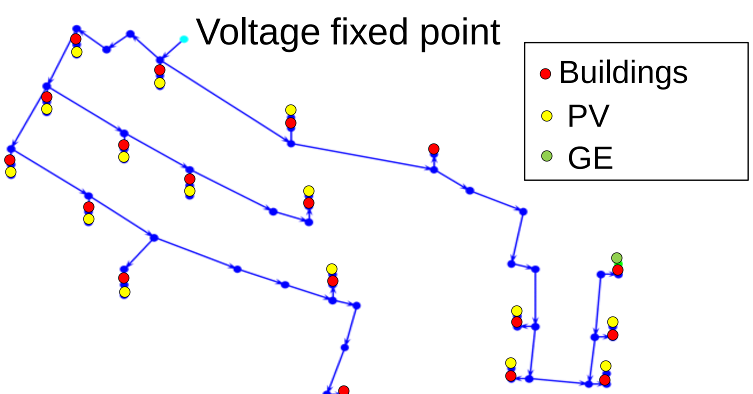
■Minimization of head loss & heat loss



Pipe Diameter : ϕ500

Electric grid network

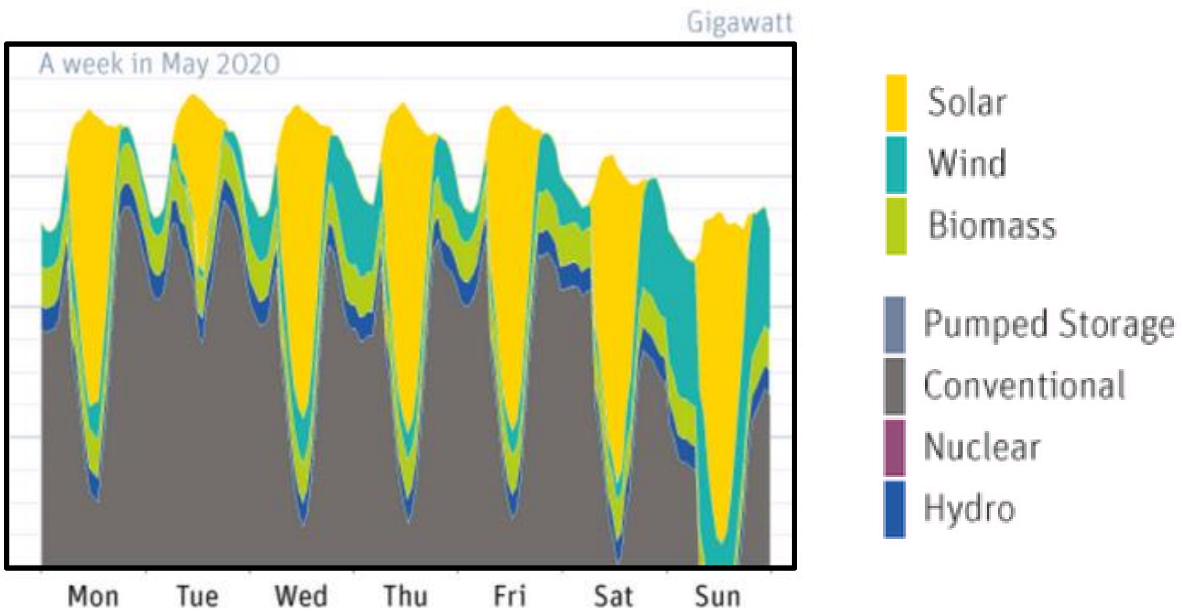
■Minimization of voltage fluctuation



Cross section : 400mm^2

Forecasting of PV output in broad area [1/4]

Needs:
Under high share renewables, reliable supply adjustability should be required. On the other hand, stand-by operation of thermal power should be reduced from point of view of operation cost and CO_2 emissions.→Prediction of irradiation

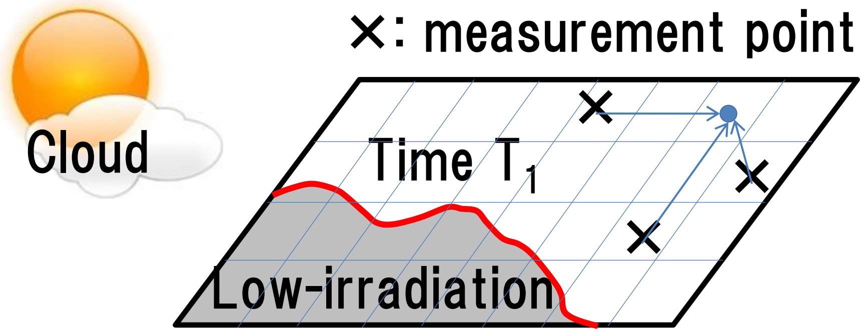


Predicted weekly balance of demand/supply

(Source : https://www.quora.com/Should-other-nations-follow-Germanys-lead-on-promoting-solar-power-1)

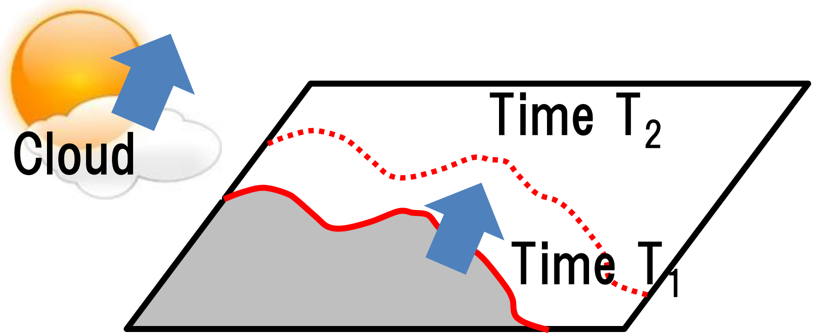
Fundamental concept of present model [2/4]

【STEP 1】



1) Division into fine mesh
2) Interpolation of irradiation at the center of a cell from measurements
3) Visualization of cloud

【STEP 2】



1) Estimation of cloud velocity using an advection model of cloud

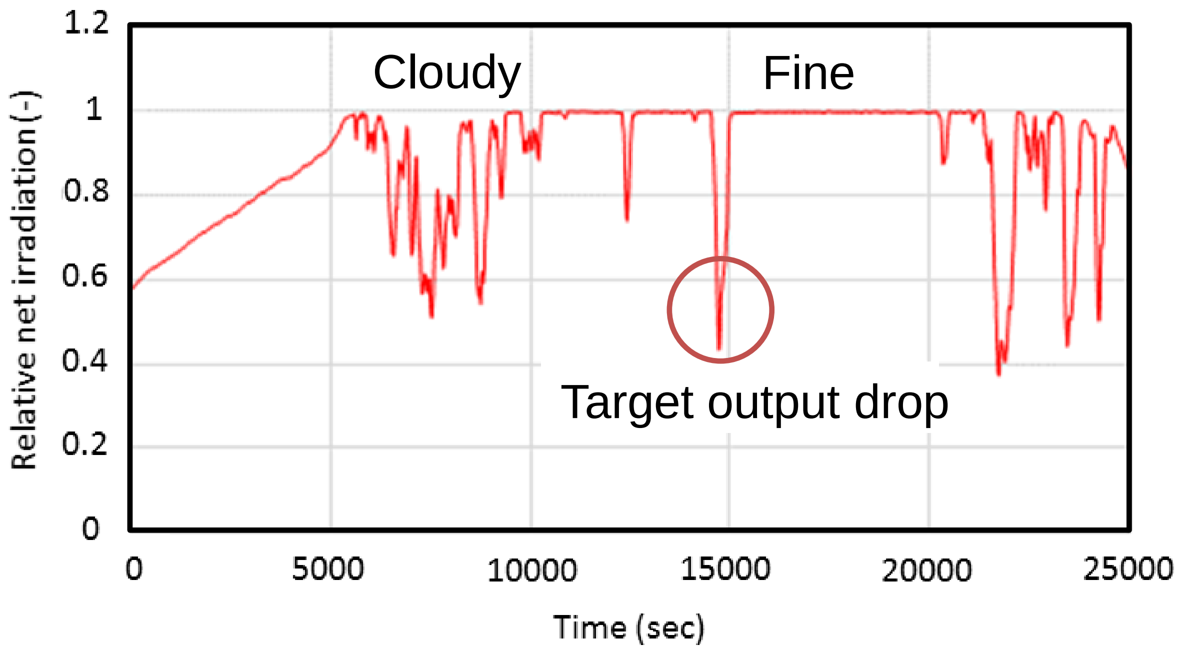
【STEP 3】

Prediction of future cloud dynamics using an advection model with cloud velocity from STEP 2 → Forecast of irradiation

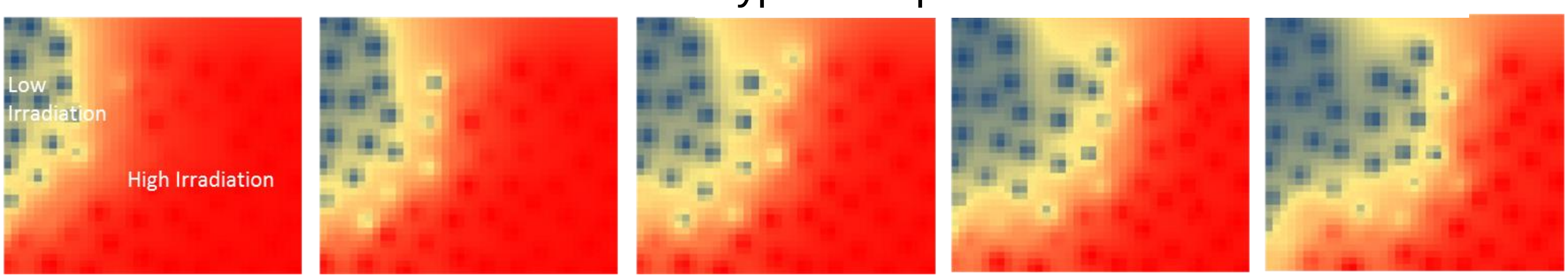
Example of Visualization of cloud dynamics [3/4]

62MW-PV system (Marubeni)

Including of 121 PCS units.
(Capacity:600kW)



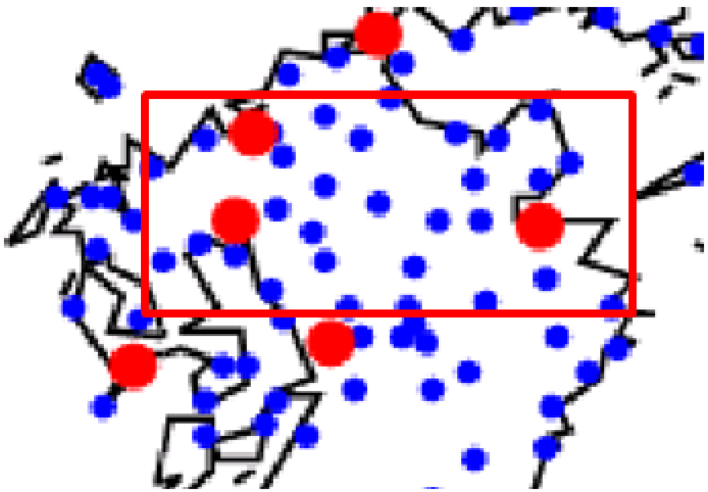
Typical output trend of 82MW-class PV

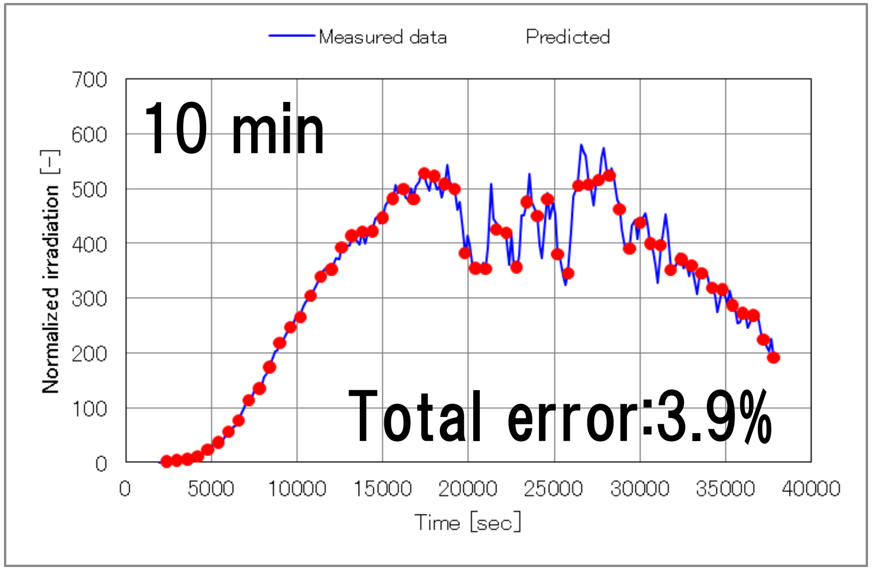


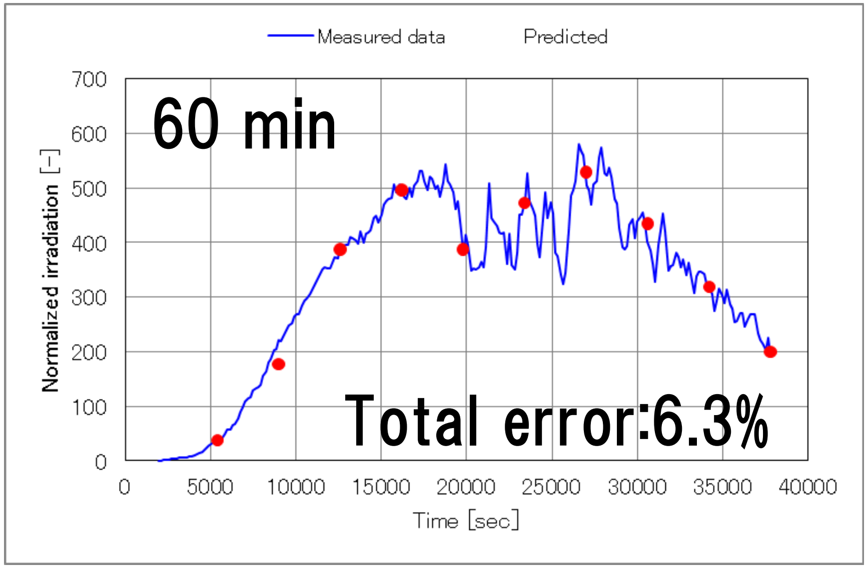
5 sec　15 sec　25 sec　35 sec　45 sec

Visualized cloud on PV

PV forecasting in Kyushu area [4/4]







- Target:170km×40km
- Measurement points:31
- Forecasting period
  :10 & 60 mins
- Date:14/Mar/2016

Key Findings:

1) Trough our experiences, to expand Smart Community, "Clear Incentive" for residents should be key.
2) Total optimization of Energy, which includes Supply, demand sides, and Infrastructure networks might provide more "Energy Saving".
3) Forecasting PV output in broad region should be key for more installation of PV.

Thank you for your attention!