

Nushima Project

An Experimental Study on a Self-Sustainable Decentralized Energy System for an Isolated Island

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Outline

The renewal of conventional energy systems is important countermeasures against global warming effects and natural disaster, and a self-sustainable decentralized energy system is one of the promising solutions for future sustainable and resilient societies.

This project, which is supported by the Technology Development Projects for Prevention from Global Warming by the Ministry of Environment, Japan, for 3 years (2012-2014), attempts to construct a prototype of a self-sustainable decentralized energy system, based on DC power feeding and effective utilization of renewable energy, as a demonstration experiment in Nushima Island.

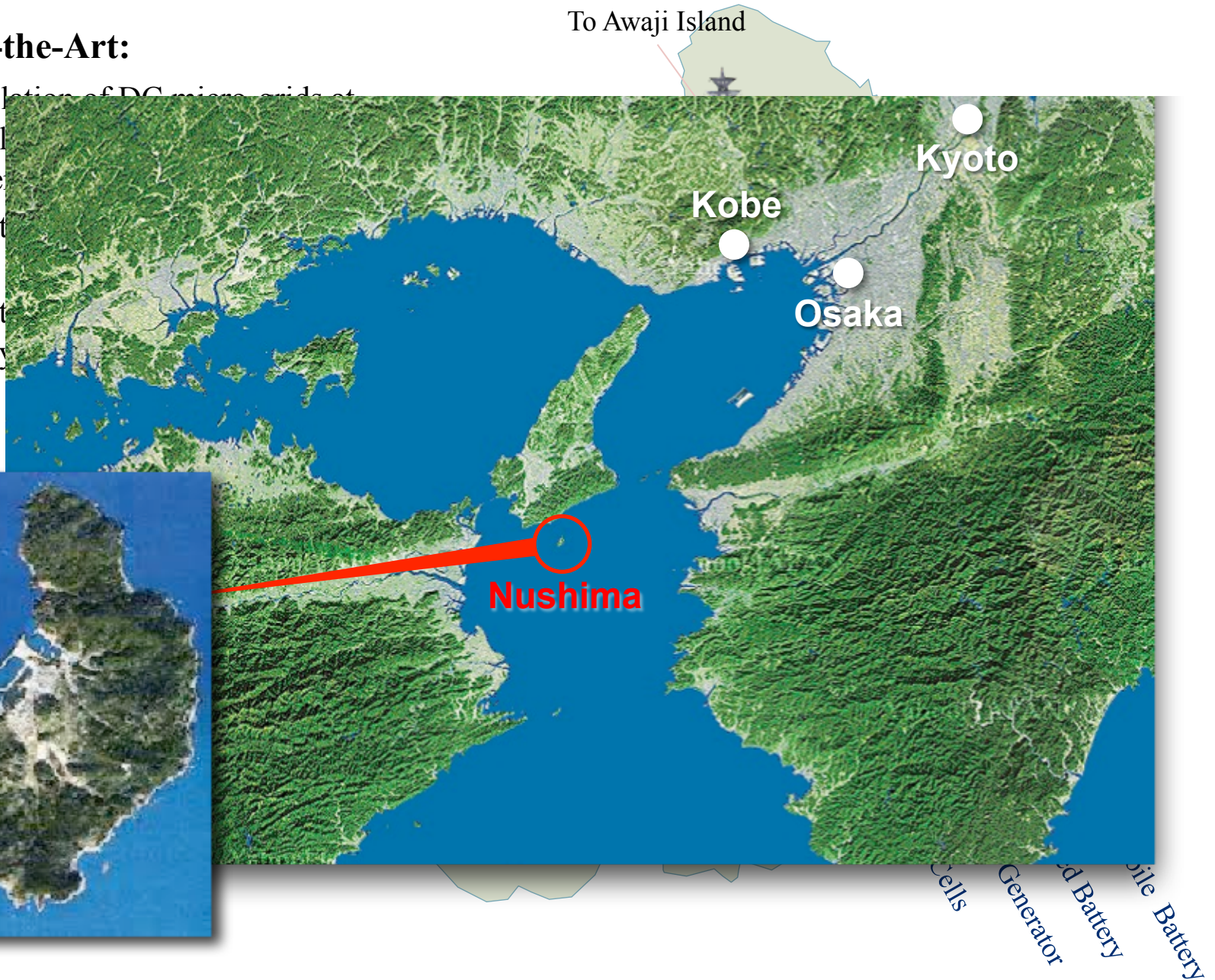
In the project, the following sub-topics are considered:

- 1) highly efficient DC micro-grid,
- 2) highly efficient stationary and mobile battery systems,
- 3) demand-side energy management by adopting dynamic pricing, and
- 4) optimization of the design and the utilization of the total system.

In this organized session, the state-of-the-art of the project is introduced.

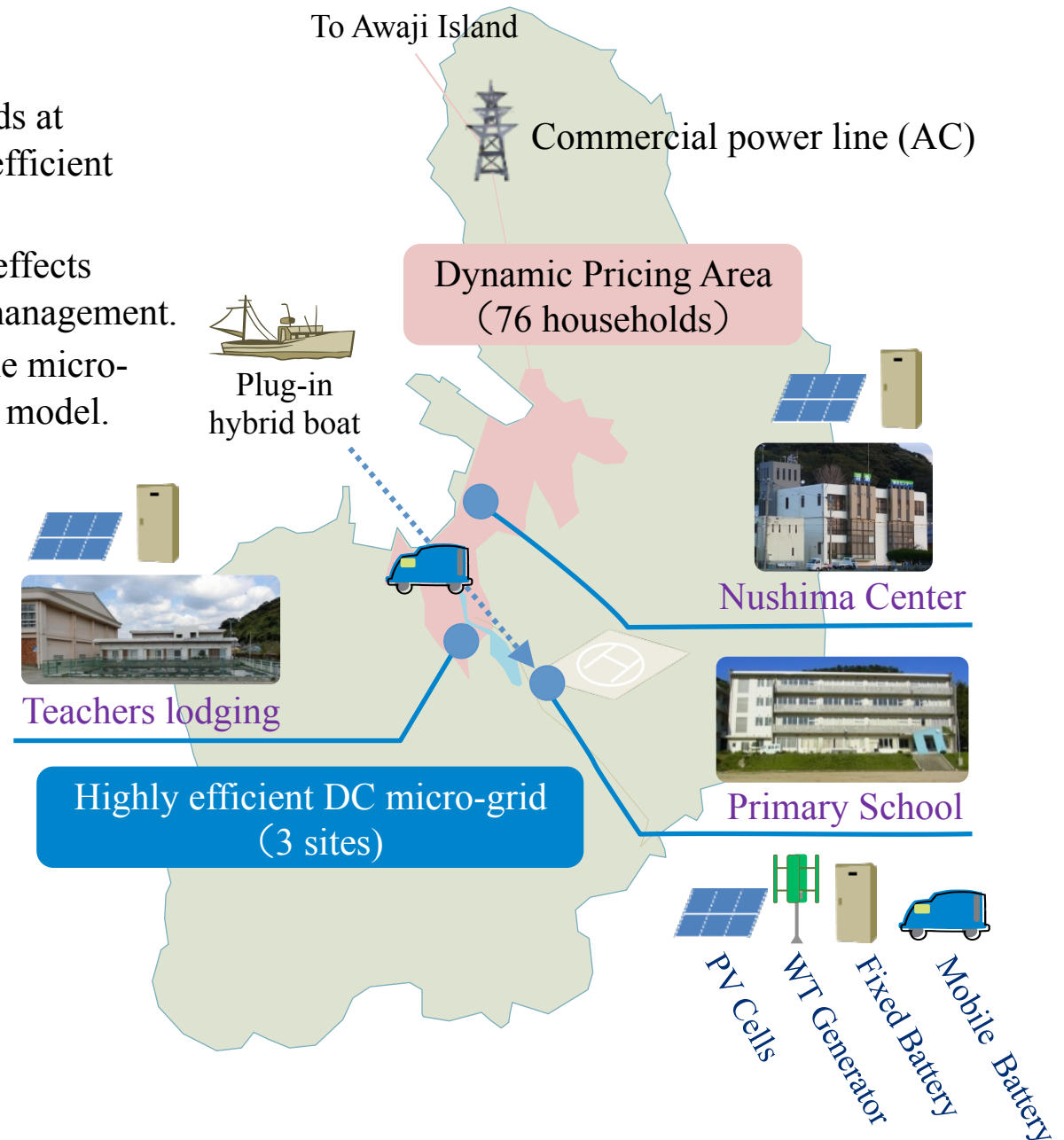
State-of-the-Art:

- 1) Installation of DC micro-grids at three locations
- 2) Quantification of the impact of the micro-grids on the main grid system
- 3) Quantification of the impact of the micro-grids on the main grid system

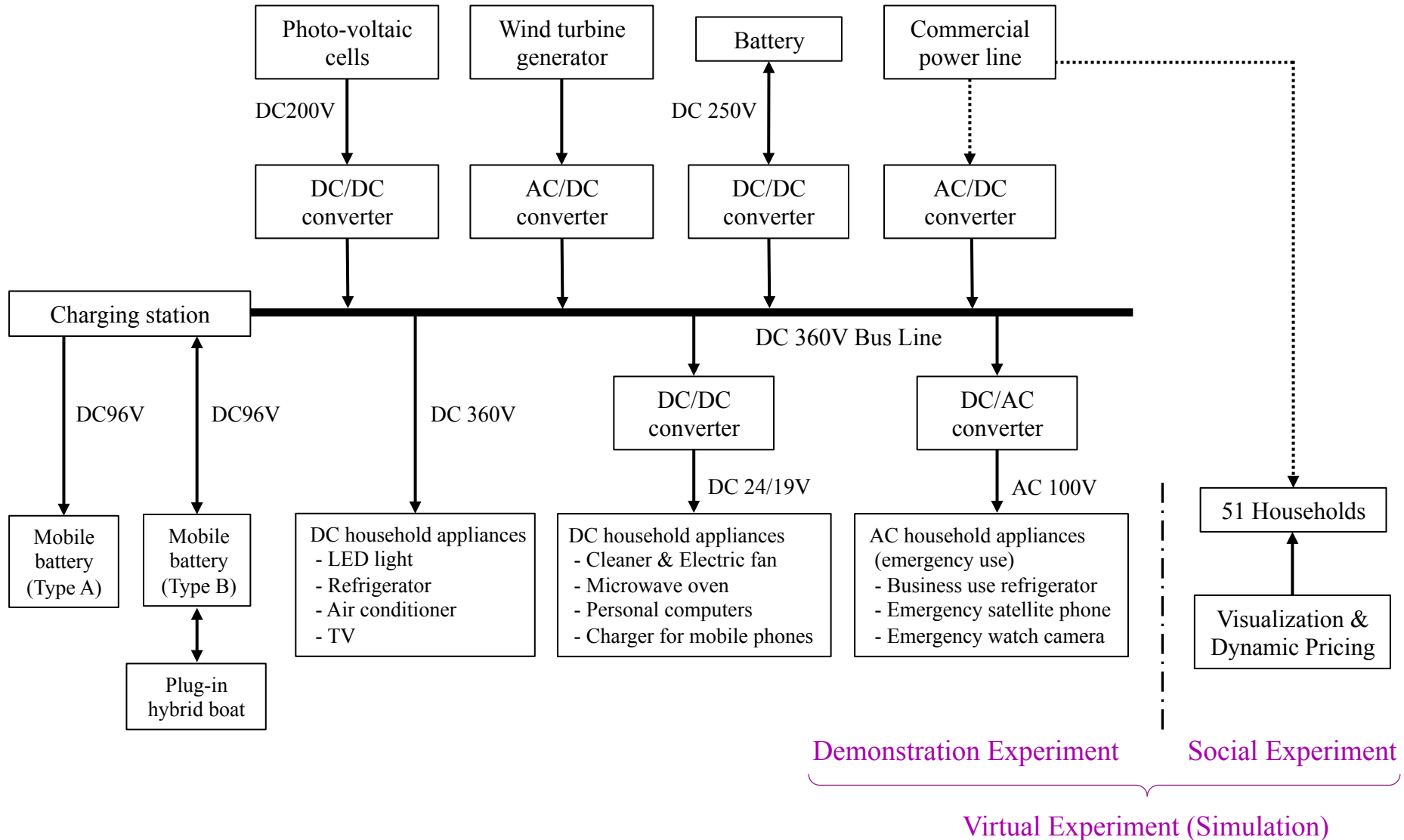


State-of-the-Art:

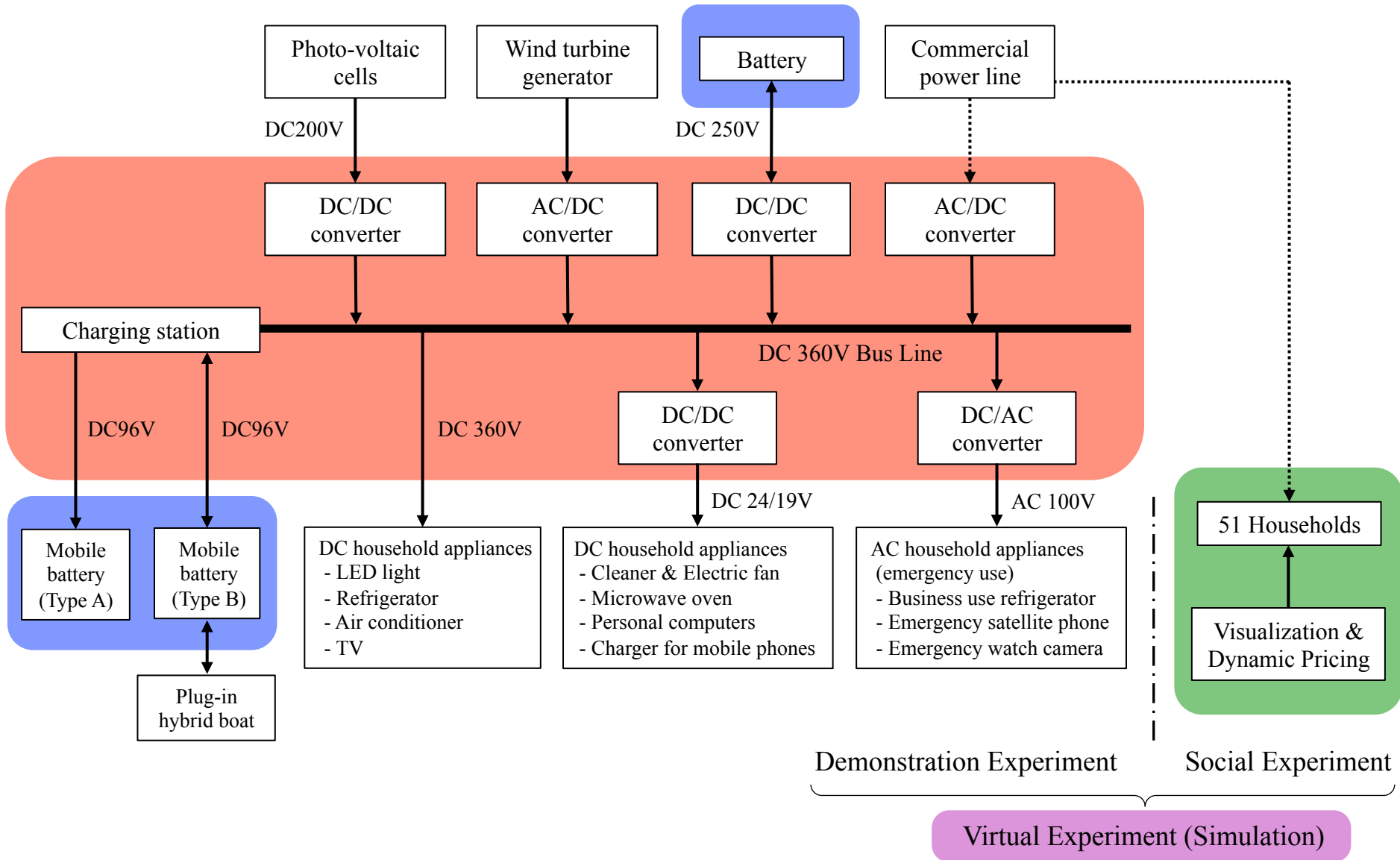
- 1) Installation of DC micro-grids at three locations, with highly efficient converters and batteries.
- 2) Quantitative analysis of the effects of the demand-side energy management.
- 3) Quantitative evaluation of the micro-grid system by using the MP model.



DC Micro-Grid System



DC Micro-Grid System



Appearance of DC Micro-grid System



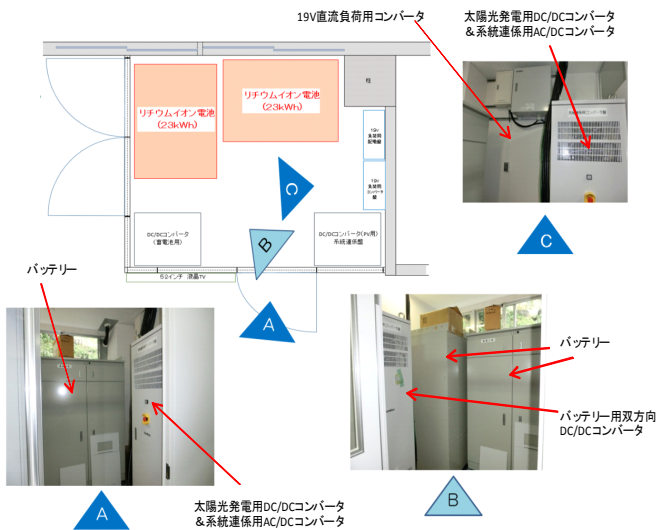
PV Array (Roof-top)



Nushima Elementary School



Wind Turbine



Li-ion Battery Units and DC-DC Converter



Control & Monitoring

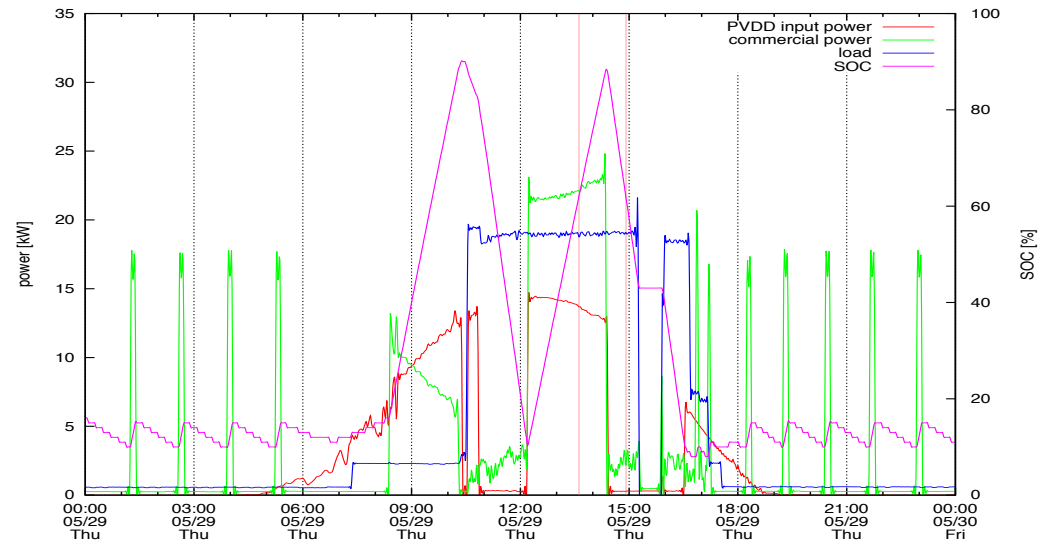
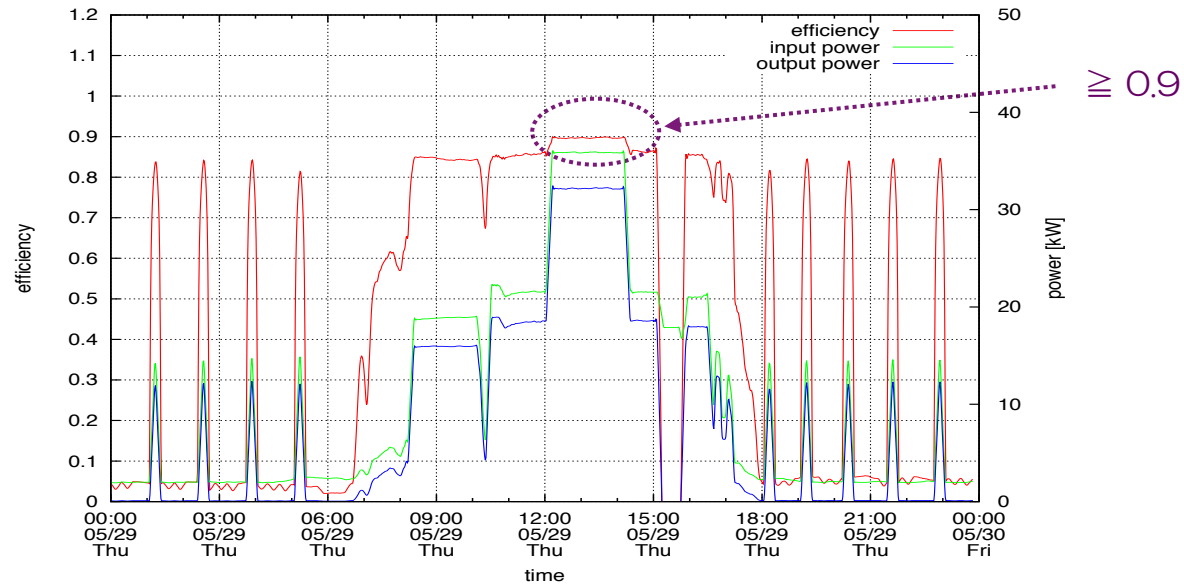


Mobile Battery Charger

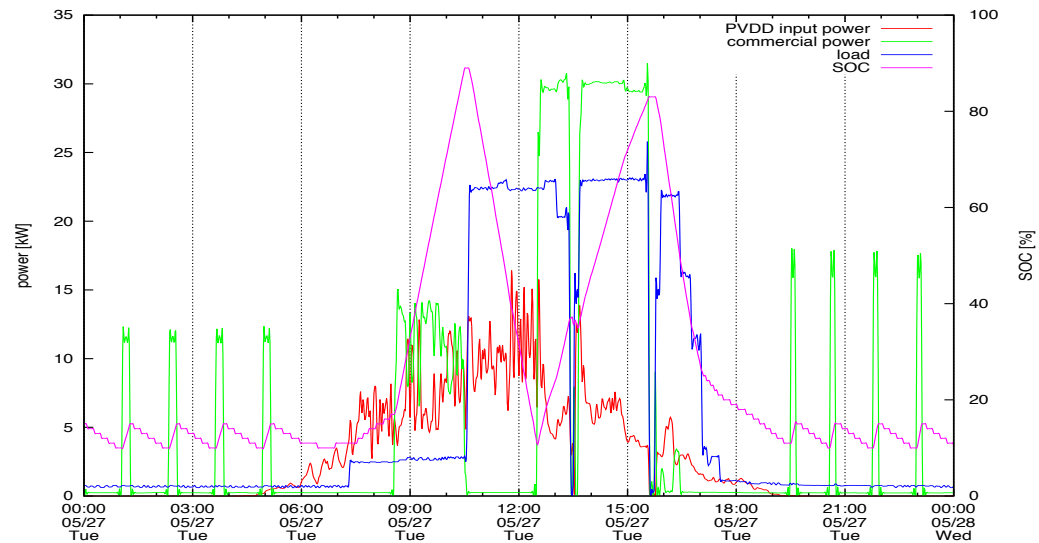
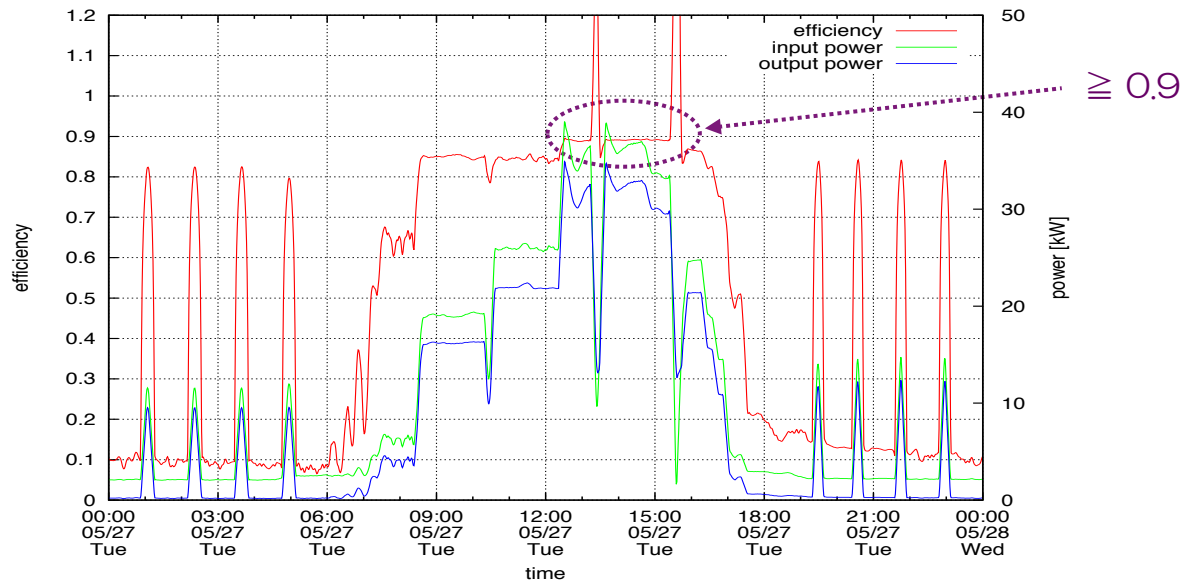


Step-down DC-DC Converter

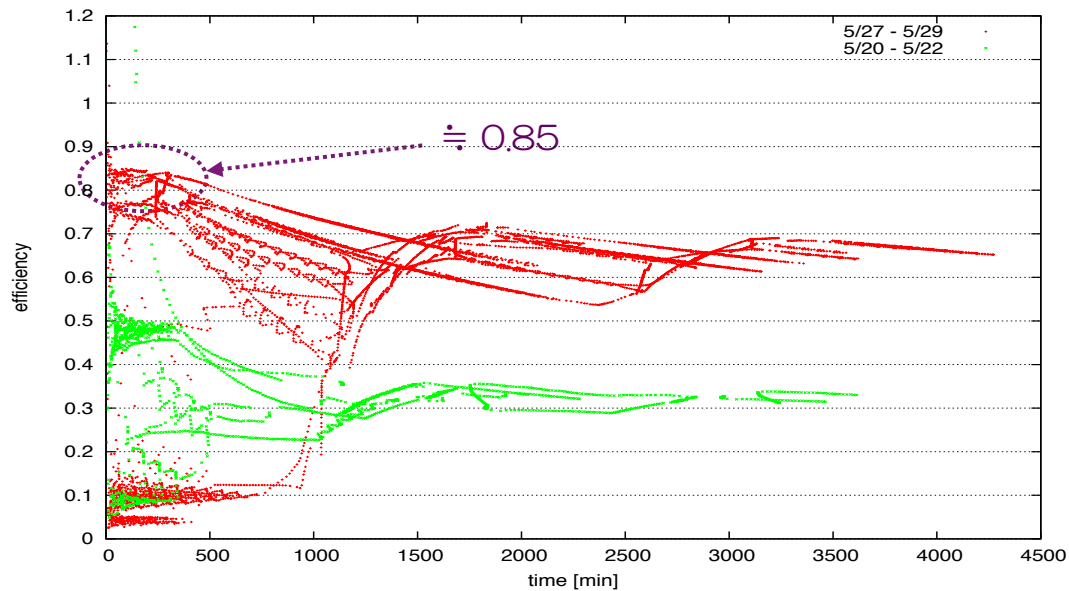
Demonstration Experiment — Efficiency of Power Conversion (May 29)



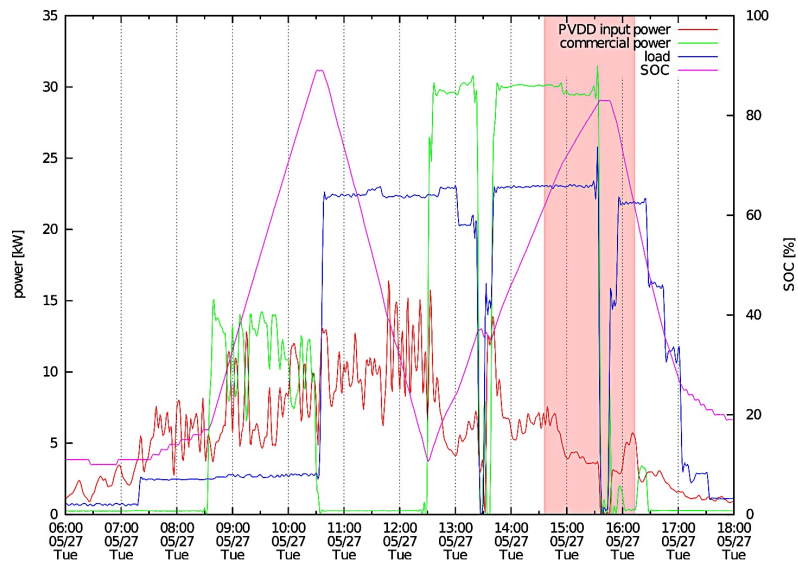
Demonstration Experiment — Efficiency of Power Conversion (May 27)



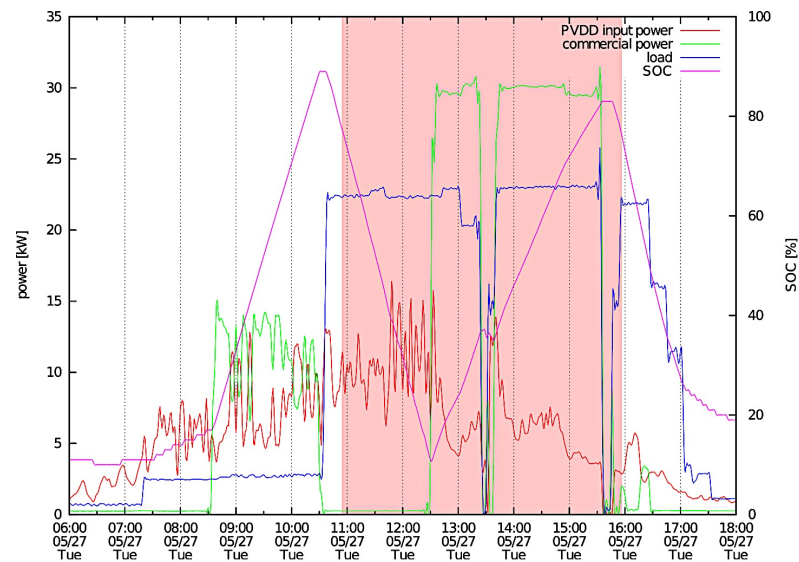
Demonstration Experiment — Efficiency of Energy Utilization



0.849



0.840



Social Experiment — Visualization of Electricity Consumption



Smart meter

Only in
Pattern 2 & 3

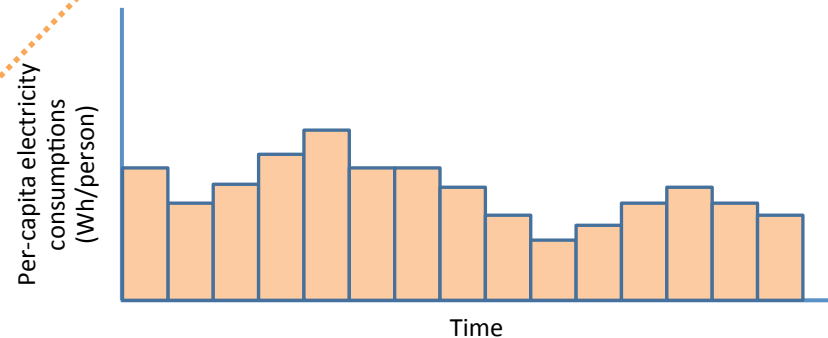
Only in
Pattern 3

Electricity consumptions in your house

Now (W/person)	Today (Wh/person)	Yesterday (Wh/person)	This month (Wh/person)
450	3,000	7,500	27,000

Per-capita electricity consumptions

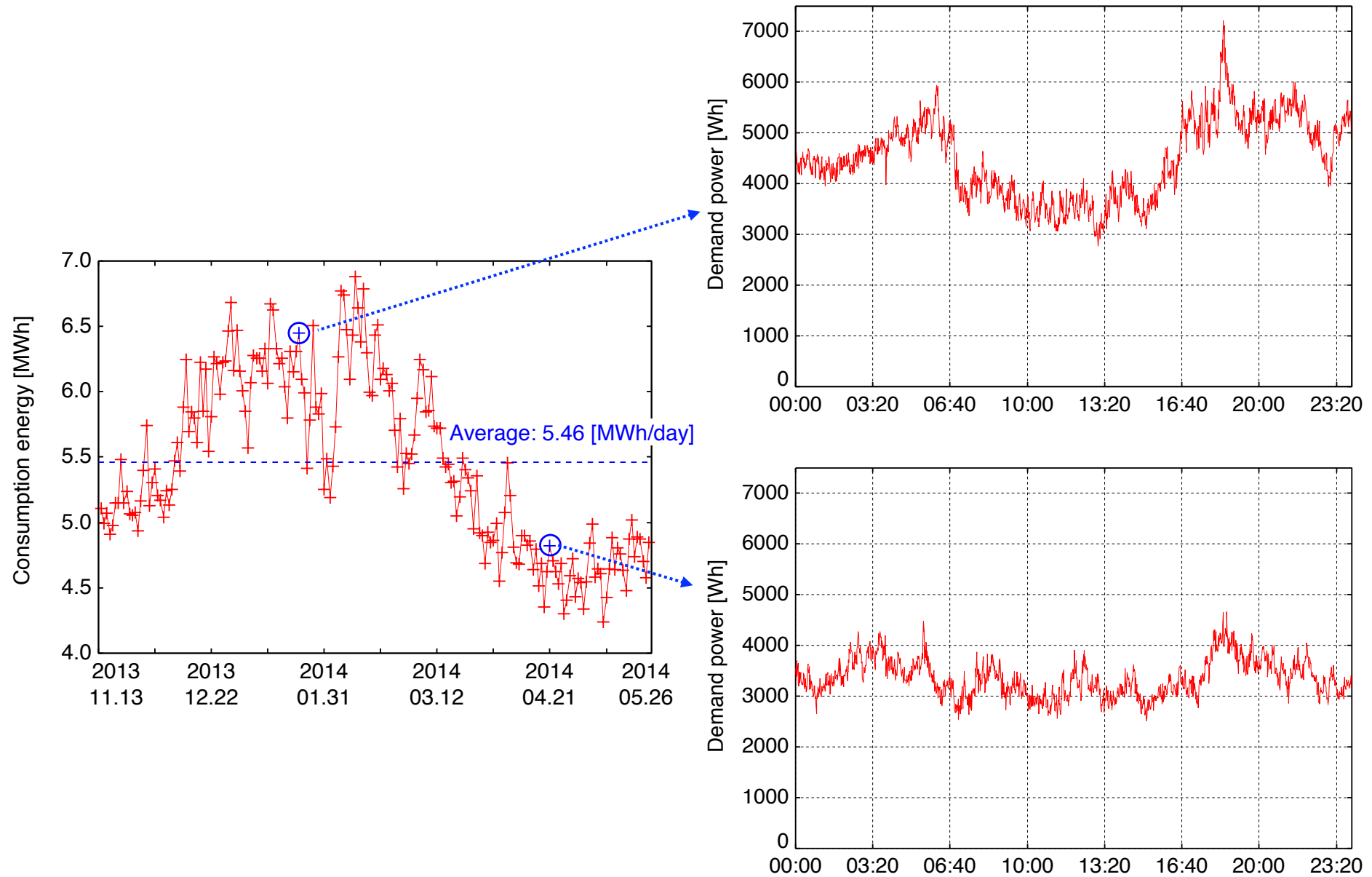
	Now (W/person)	Today (Wh/person)	Yesterday (Wh/person)	This month (Wh/person)
Your house	150	1,000	2,500	9,000
Average of all houses			3,625	10,756



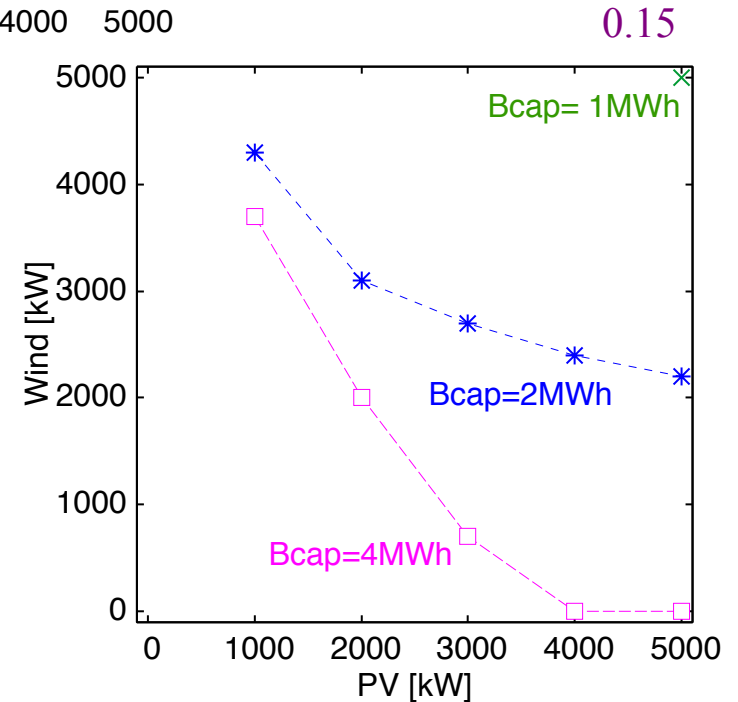
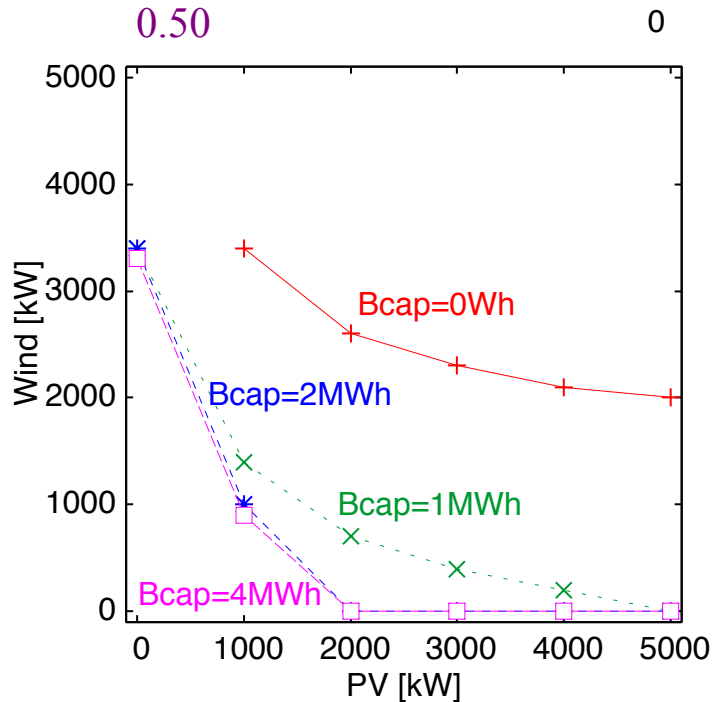
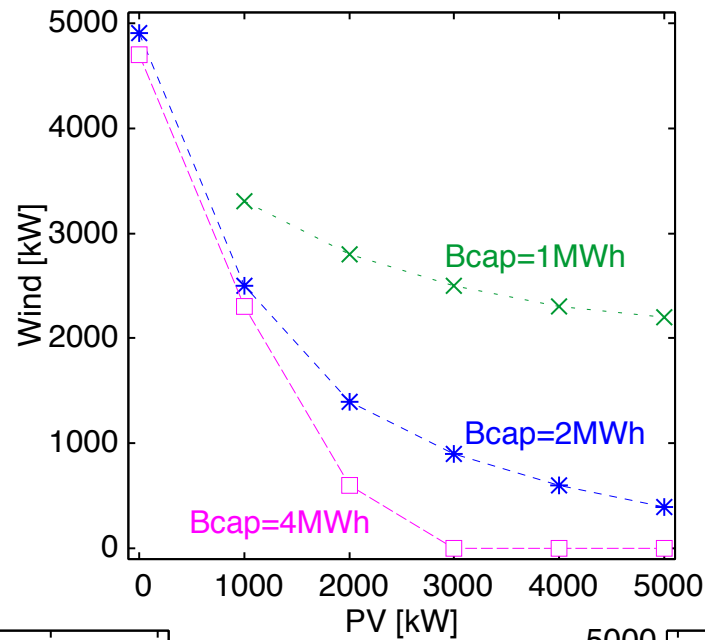
Least Electricity consumption ranking

Your rank: **14th** (yesterday)

Virtual Experiment — Electricity Consumption in Nushima (Data)

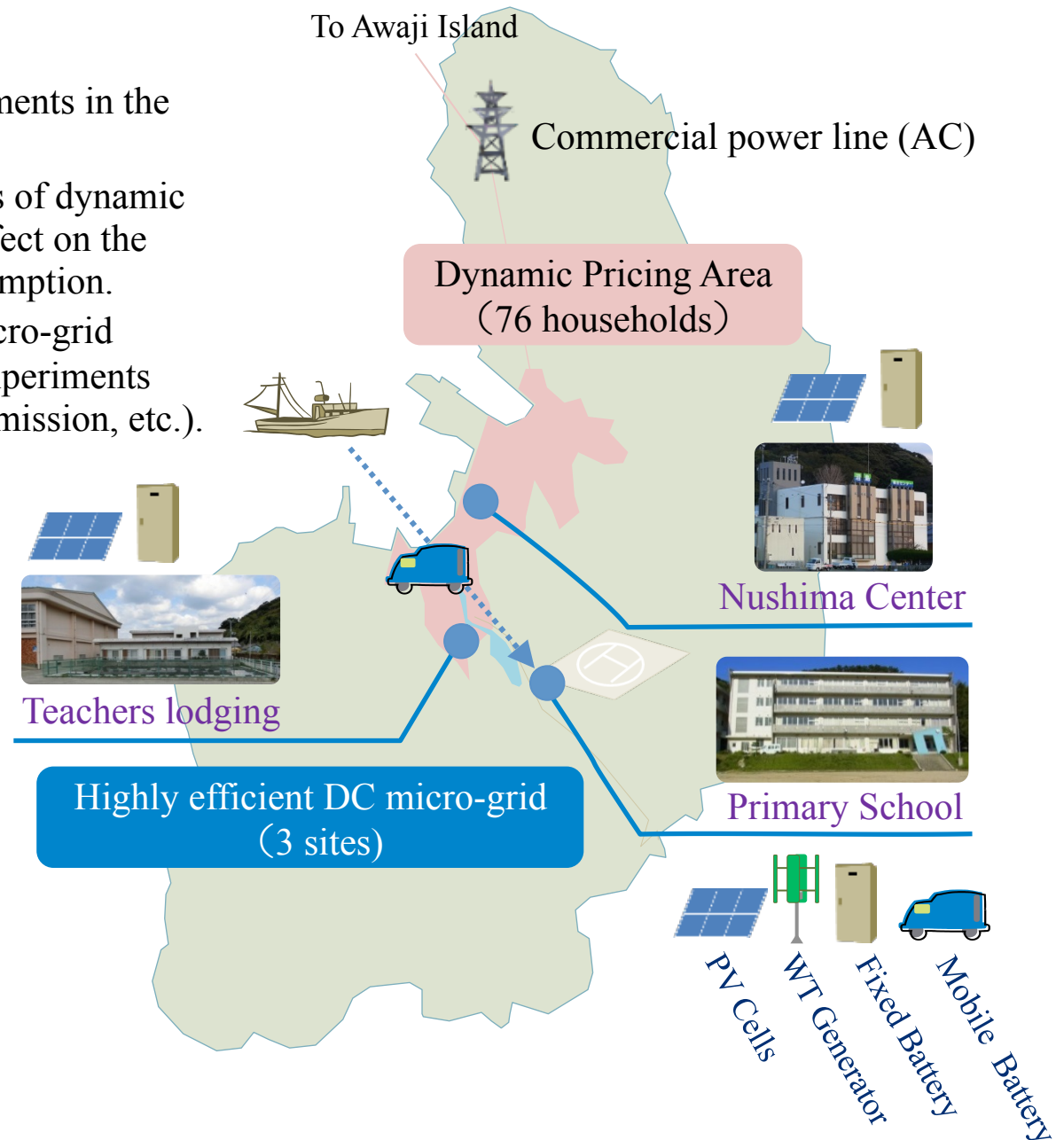


Virtual Experiment — Optimal Allocation of PV and Wind Turbine



Future Issues:

- 1) Performing full-scale experiments in the experimental fields, .
- 2) Setting up social experiments of dynamic pricing and evaluating the effect on the reduction of electricity consumption.
- 3) Evaluating the whole DC micro-grid system through simulation experiments (w.r.t. the reduction of CO₂ emission, etc.).



Future Directions

Environmental Future Initiative:

1) From demonstration to establishment.

Guarantee for safety & stability, Validation of economic efficiency, Design of a system, Contribution to regional vitalization, etc.

2) From Nushima to Awaji-Island, all over Japan, and the whole earth.

So many islands in the world!!

