Concluding Remark Session III Energy – Modelling and Simulation

Session 3, Workshop II on “Intelligent Infrastructure”, E-Asia joint Research Program

Chair: Hiroshi Takamori

Session 3: Energy – Modeling and Simulation

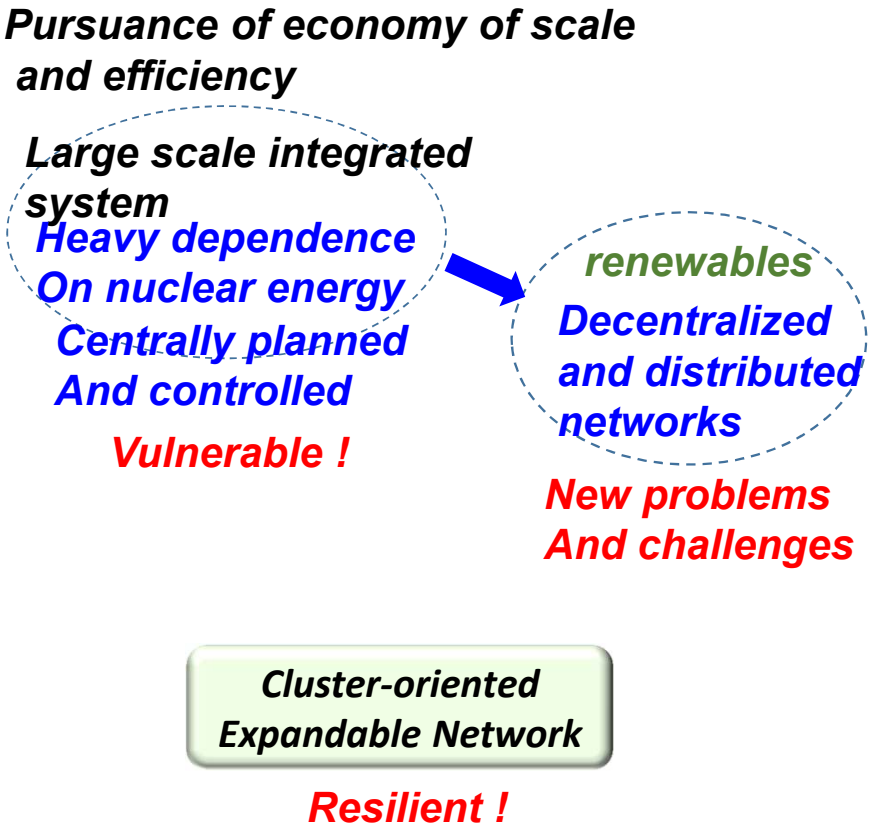
1. “Initiatives for Intelligent and Resilient Electric Energy Network for East Asian Prosperity”, Prof. Ryuichi Yokoyama, Waseda University
2. “Optimal Generation Scheduling of the Philippine Power System Grid,” Prof. Noel Regis Estoperez, Midanao State Univ., Philippine
3. “Modeling for Smart Community Design based on Domestic Characteristic and Existing Infrastructure,” Prof. Iba, Meijo Univ., Japan
4. “Simulation and Modelling on Renewable Energy: Research Experiences for Indonesia Case,” Dr. Meita Rumbayan, Sam Ratulungi Univ., Indonesia
5. “Royal Project: A Success Story of Sufficiency Economy Philosophy in Thailand,” Prof. Pichayalak Pichayakul

In this conclusion,

1. **A summary on each presentation**
2. **Some brief comments in reference to the framework of Energy related infrastructure and also from the perspective of modeling and simulation, the most fundamental principle for scientific inquiries and technology advancement.**

Initiatives for Intelligent and Resilient Electric Energy Network for East Asian Prosperity, Prof. R. Yokoyama

- Electric energy turbulences experienced by Japan and some lessons learned , leading to a paradigm shift related to the electric energy infrastructure
  - Renewables, decentralized, market oriented
- Smart grid and demonstration projects
  - Pilot projects in Japan
  - Oversea Smart Community Development
    - Smart Grid projects: New Mexico, Los Alamos, Maui island (Hawaii) . NEDO promoted.



Development of Smart Industrial Park of Smart Industrial Park Sryacipta in Indonesia

1. *NEDO and the Ministry of Energy and Mineral Resources (MEMR) of Indonesia reached agreement on jointly conducting NEDO's first smart community demonstration project in Asia in Indonesia's Suryacipta City of Industry (SCI) and NEDO and MEMR signed an MOU (memorandum of understanding) on July 15, 2013, in Jakarta.*
2. *Power Qualty Stabilization is implemented at an industrial park on Java island to cope with voltage variation and sudden blackout*
3. *35 million US$ is invested for this project (for 4 years, 2012～2016) to demonstrate Smart and Eco Industrial Park in Indonesia as a Japanese infrastructure export model.*

Japan/Indonesia Joint Forum October,2012

***NEDO: New Energy and Industrial Technology Development Organization**

A Japanese governmental agency for energy, environmental, and industrial technologies

Reference : New Energy and Industrial Technology Development Organization, Japan

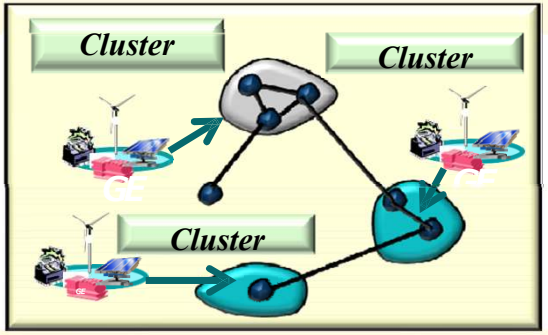
Conclusion of MOU, July,2013

Resilient and Expandable Distribution by Cluster-Oriented Network

Objectives and Features of Expandable Grids

Objectives and Features

- ***Structure of Cluster-based Expandable Smart Distribution Grids***
  - *Construction of an appropriate scale distribution grid (The first cluster)*
  - *Expansions of clusters according to increase of regional demands (The second cluster)*
  - *Interconnections of clusters by electrical routers (Tie lines and Inverter control)*

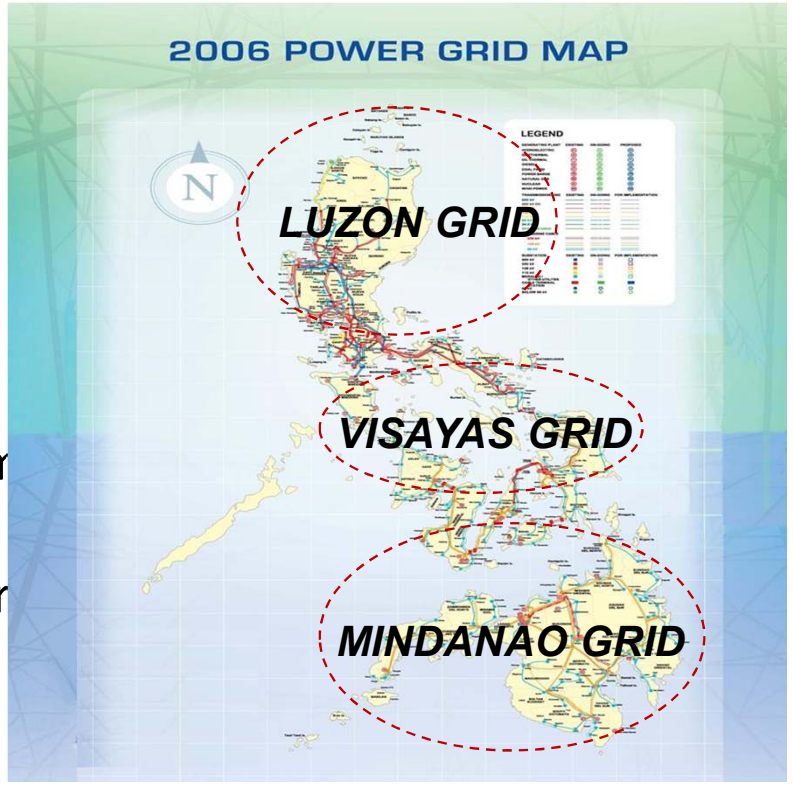


- ***The Role of the Proposed grid***

- *New Power Supply Social Infrastructure for Developing Areas and Regions*
- ~~*Medium Scale Power Supply for Islands and Remote areas*~~
- *Power Supply for Non-electrified Regions in Developing Countries and Emergency Supply*

“Optimal Generation Scheduling of the Philippine Power System Grid,” Prof. Noel Regis Estoperez

- The power systems of major islands, Luzon, Visayas and Mindanao are presently separated and individually operated
- This study inquires into “the **unified Philippine grid,**” a future world yet to be realized.
- Methodologies: 1. Modeling, 2. Simulation, 3. Optimization
  - basic ways to acquire new knowledge and wisdom in science and technologies.
  - Allow us experiments in the modelled world rather than in real life where experiments are impossible
- Data used so that it is not aloof from realities ⇒the Wholesale Electricity Spot Market (WESM)



K. RECOMMENDATIONS

- *Use the models to simulate other power system analysis.(Fault Studies, Stability, etc)*
- *Study specific equipment and devices like generators and transformers or transmission lines, and study their response thru MW and MVAR flow, p.u. voltages, losses, costs, and other electrical parameters at any given power system conditions.*
- *A forecasted load is available at WESM. OPF Simulation will give a forecasted Optimal generation scheduling.*
- *Others may test the accuracy of these models by utilizing other random set of WESM and IMEM data.*

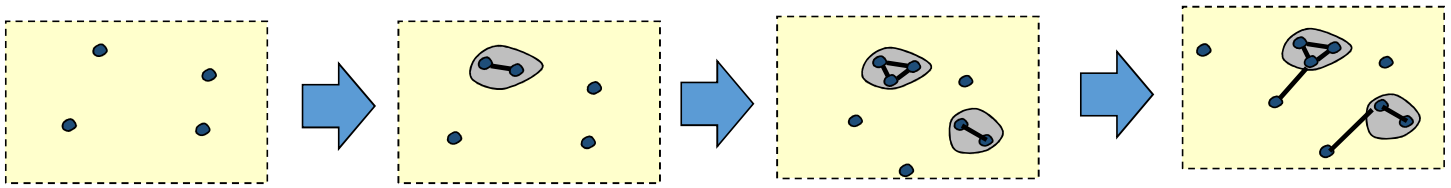
“Modeling for Smart Community Design based on Domestic Characteristic and Existing Infrastructure,” Prof. Iba

- Addresses how smart city should be promoted in e-Asia
  - Review changes, model transitions the power industry of Japan has undergone: some system reforms and even paradigm shift
  - Review traditional pattern of electric power system development

Resilient and Expandable Networks:"Cluster"

Proposed "Electricity Cluster-oriented Network"

- *Electric power is produced locally for local power consumption mainly by renewable energy*
- *Expansion of distribution networks is done by addition of cluster*
- *Grid-independent and autonomous network applied for remote area*



Global Design for Better Infrastructure

Do not repeat developed countries' mistakes.
Smarter solutions might be introduced in e-Asia countries.

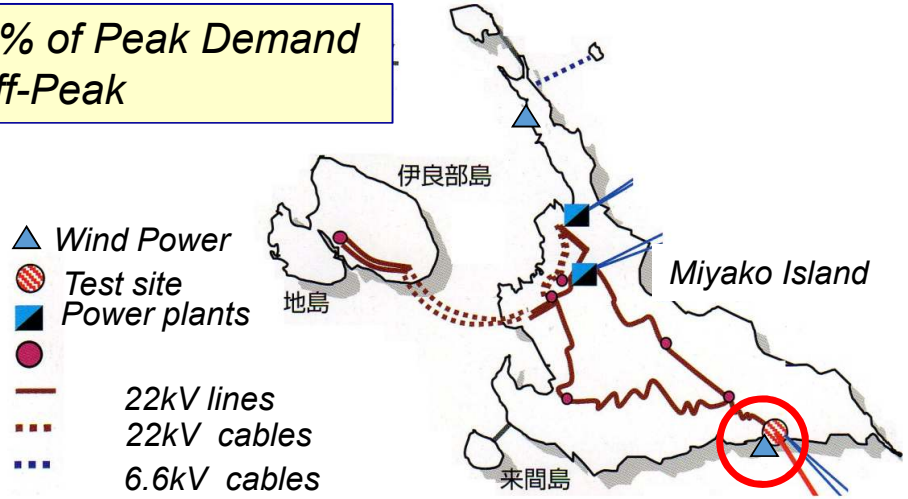
- *Historical and regional culture and custom should be considered.*



Renewable energy integration to *in Miyako island*

Brief Summary
Start Date of Operation: 15th October 2010
PV generation: 4 MW
WP generation: 4 MW
NAS Battery : 4MW / 32MWh
Li-Ion Battery: 100kW / 200 kWh
22kV/6.6kV distribution network
Total Demand : 50MW
Population : 55,000
Area :205km²

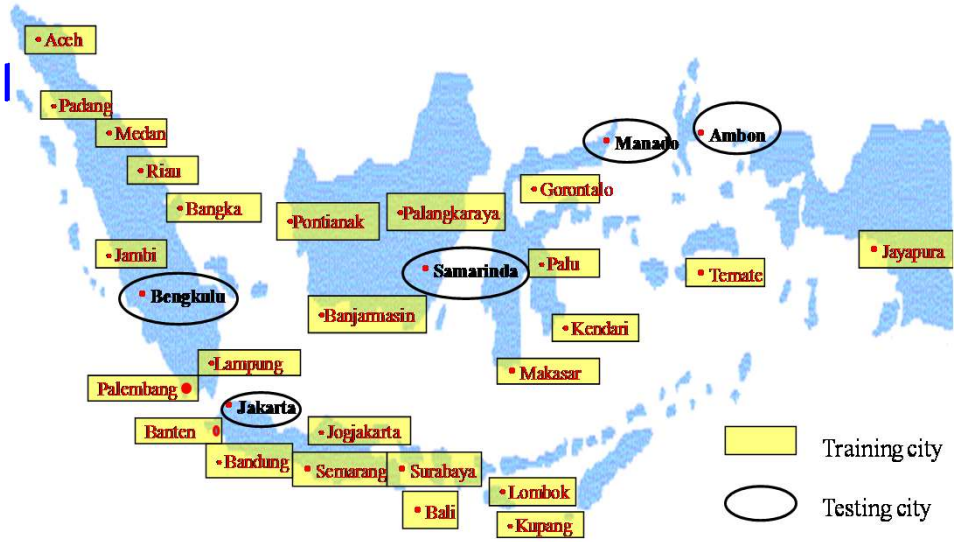
RE supply 16% of Peak Demand
30-50% in Off-Peak



Source: Web site of IRENA : Okinawa Electric Power May 26,2012

Simulation and Modelling on Renewable Energy: Research Experiences for Indonesia Case," Dr. Meita Rumbayan,

- Energy Related Challenges Indonesia faces
  - Power shortages, Low electrification ratio, Environmental emissions by fossil fuel utilization, Exploitation of renewable energy resources: Solar energy and geothermal energy
- Two Research Cases
  - Study on **solar energy potentials** based on "**Analytical Neural Network model**
  - Analysis on **Geothermal power plant** at "Lahendong" site with **RET Screen Simulator**
    - **Economic and financial evaluation**
    - **Effect of "Feed in Tariff " and "Carbon Credit" on green-house gas mitigation**



"Simulation and Modelling on Renewable Energy: Research Experiences for Indonesia Case," Dr. Meita Rumbayan

- Findings and Proposals
  - Exploit the diverse geographical conditions in Indonesia
  - Develop rural electrification
  - Joint research
    - for Electrification and energy management for islands
    - Inter-Island Energy management
    - Philippines looking to a Unified Philippines
    - Japan is also in the trend from regional monopoly system to Inter-regional management of electric energy

Unified Philippine Grid

Indonesia

Future Works Recommendation

- For further plan, it is needed to develop simulation and modeling on other renewable energy sources with energy system tool for Indonesia case.
- Propose joint research to develop simulation and modeling for Island Energy System (for island characteristics such as Japan, Indonesia, Philippines) become interesting opportunity as well as new challenge.
- Conduct research and development for energy supply and demand for Indonesia ->energy solution for Indonesia depend on the its geographical condition and natural resources.

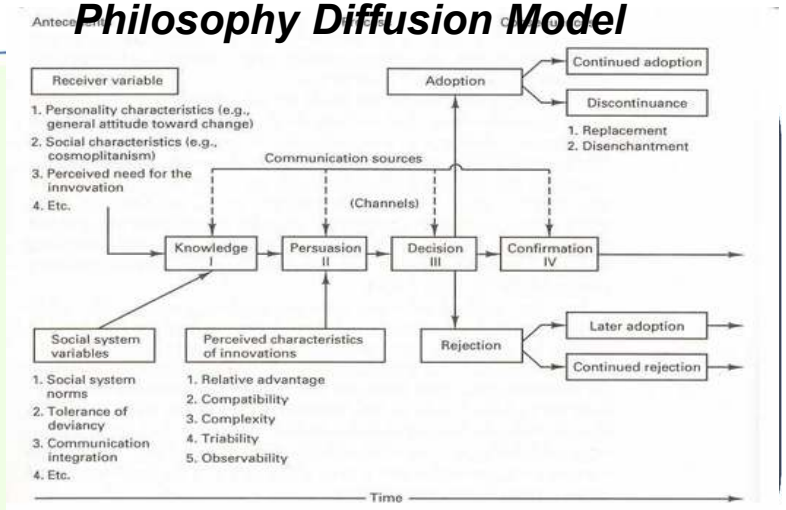
"Royal Project: A Success Story of Sufficiency Economy Concept in Thailand," by Dr. Pichayalak

- Dr. Pichayakul's presentation is unique in this session, with touch of Social Science approach.
- This reminds us of the importance of social and cultural aspects of infrastructure. The cultural part of Infrastructure is to serve the value of people in the society and it evolves as people's value changes.
- The new concept formation is an important part of "Modelling." **The society changes and advances as new concepts are diffused**.
- We should keep in mind of the importance of Consensus Formation even for physical infrastructure reformation. If this process is confused, infrastructure will be confused as well, and even can get chaotic.

- **Sufficiency Economy**: "To develop economy based on a principle of self-reliance"
- **Sufficiency**: "To lead a reasonably comfortable life, without excess, or overindulgence in luxury, but enough"

- Royal Project Foundation
- Vision: "Aim to research and develop proper technology to enhance highland communities' quality of life and to preserve environment sustainably."

Philosophy Diffusion Model



Completed supply chain

1.Research

2.Teach/Coach

3.Plant

4.Harvest

5. Collect

Electricity

Fund

Technology

Irrigation

Infrastructure

Quality control

Trust

Respect

Passion

Knowledge

Network

Teamwork

9. Sell

8. Transport

7. Pack

6.Transport

Outline of Takamori's: Modelling in Intelligent Inquiries

1. Importance of modelling: Role and uses of model

   The origin of modelling traces back to all the scientific inquiries. Man has always represented wisdom and knowledge acquired in the form of model,

2. Need for model is more acute for societal problems,

   because we can not do experiments in reality as in engineering or physical sciences. For societal problem, we can do experiments only with models virtually. There, no matter how a serious failure we can make. We learn from it and acquire new wisdom and knowledge.

3. Some examples of societal problems and the Societal system

   Management of environment and externalities, planning, design and management of smart cities, communities, and also special economic zones

4. Challenges to Modelling of Infrastructure Systems

   Infrastructure is a man-made environment, a platform on which a variety of agents and players act purposefully. Infrastructure provides vehicle on which people and firms transact, compete, conflict and even contradict.

In this workshop, various maps appeared in many presentations. All these impressed us for their richness in fresh findings as well as suggestions for action

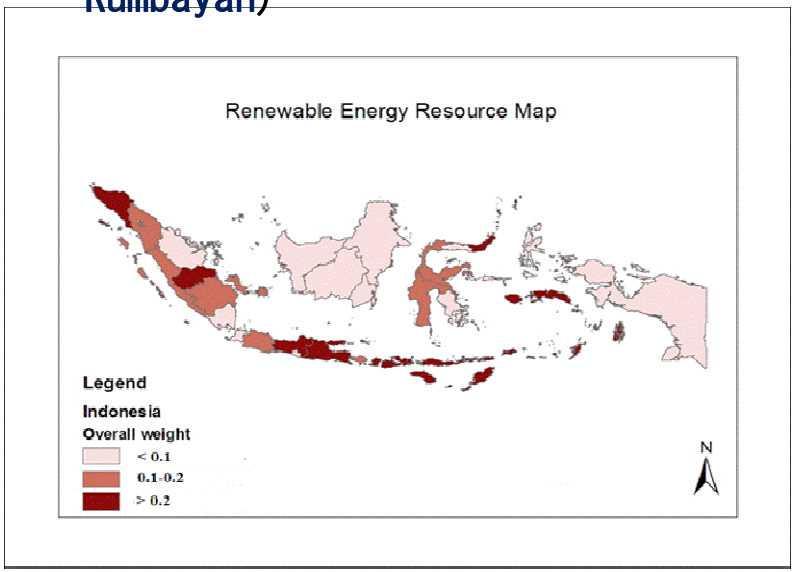
Example 1: a "Renewable Energy Resource Map for Indonesia such as shown by Dr. Rumbayan shown in the right hand side

Example 2: Maps for different purpose, drawn by Remote sensing technology.
See Prof. Tateishi's presentation
E.g.: untapped natural resources on earth

Example 3: Flood Hazard maps in Philippines in Dr. Paringit's presentation. How useful these would be for effective hazard precaution and management in the future

Example 4: Map of the Concept of Concentrated Decentralization Development Strategy in "Infrastructure and Urban System Development in Myanmar" by Ms Hlaing Maw Oo See the next slide.

The resource map by combining the AHP and GIS to show the priority site of renewable energy resources for the entire Indonesia (Dr. Meita Rumbayan)



*What we need is the **concept and purpose** formulation, for which these informative maps (models) can be used*

Prof. Noel R. Estoperez, "System Modeling and Technical Evaluation of the Philippines Power Grid"

Prof. Estoperez presented system modeling and evaluation of the Philippines Power Grid.

The power grid is the vital artery of energy infrastructure for any country. Most notable in Prof. Estoperez's presentation is that his study is intended for future economic planning and serving as a tool for the Wholesale Electricity Spot Market (WESM) for the country.

This tells us that infrastructure is something that is always in evolution. The Philippines Power Grid may sometimes provide a platform for a market where energy transactions will be taking place.

C. OBJECTIVES OF THE STUDY

- *To model the Luzon, Visayas and Mindanao Grid separately through a load flow software*
- *To evaluate the system of each islands' simplified model in terms of loading, voltages and system loss*
- *To evaluate the system of the interconnection for the new Philippine Grid Model in terms of loading, voltages and system's loss.*

D. SIGNIFICANCE OF THE STUDY

- *The Philippine grid model serves as a guide for technical evaluation in the power exchange between Luzon, Visayas and Mindanao*
- *can be utilized for planning, operation and economic scheduling*
- *Preparatory tool of implementation for the Wholesale Electricity Spot Market (WESM) for the whole country.*

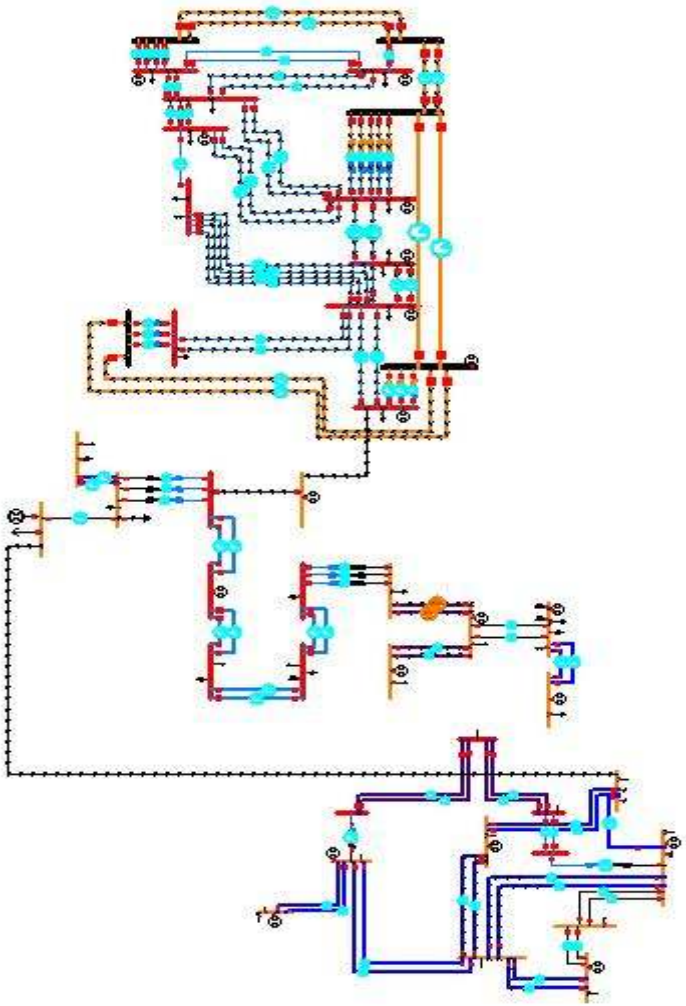
New Concept for energy transactions !
Build in market mechanism Introducing competition in this industry.
The market principle may work wonder to make industrial infrastructure work efficiently without a centralized management.

This is again an example of the map.

This map is a model serving the energy system planner To design, manage, and visualize the concept for innovation.

F.2 Philippine Grid Model
(41 Bus System)

Demand	8342.6 MW
Generation	8756.95 MW
Transformer Loading Capacity	70.2%
Lowest Voltage	0.84 p.u.
System's Loss	414.35 MW



Concepts, Aspiration are what drive us toward formulating an Intelligent Plan with Model

- **Some Examples**
  - **Trans-Asean Power Gird Concept**

Greater GMS

Power Interconnection Concepts

Source: http://www.uniten.edu.my/newhome/uploaded/coe/arsepe/2007/seminar/week%201/UNITEN%20ARSEPE%2007%20SA6A%20Dr%20Hassan.pdf

Electronic Commerce Diffusion for Customs Clearance and Trade Facilitation: Case of Port Klang Community System Presented by Dr. Hadijah Iberahim, Arshad Ayub

Graduate Business School, Faculty of Business Management, Universiti Teknologi MARA, MALAYSIA

Dr. Iberahim presented The Port Klang Community System (PKCS) , the first EDI-based port community system in Malaysia.

Electronic Data Interchange (EDI) is a form of electronic commerce, allowing business transactions conducted over computer networks for both public and private organizations. It is indeed a modern **electronic infrastructure** providing a platform on which interactions among businesses, governments and consumers take place.

This presentation is instructive giving us lesson that

1. Infrastructure is not itself an objective but a facilitator to make our life more convenient, efficient, safer and happier, but
2. even an innovative infrastructure can create new unexpected issues.

Issues and Challenges

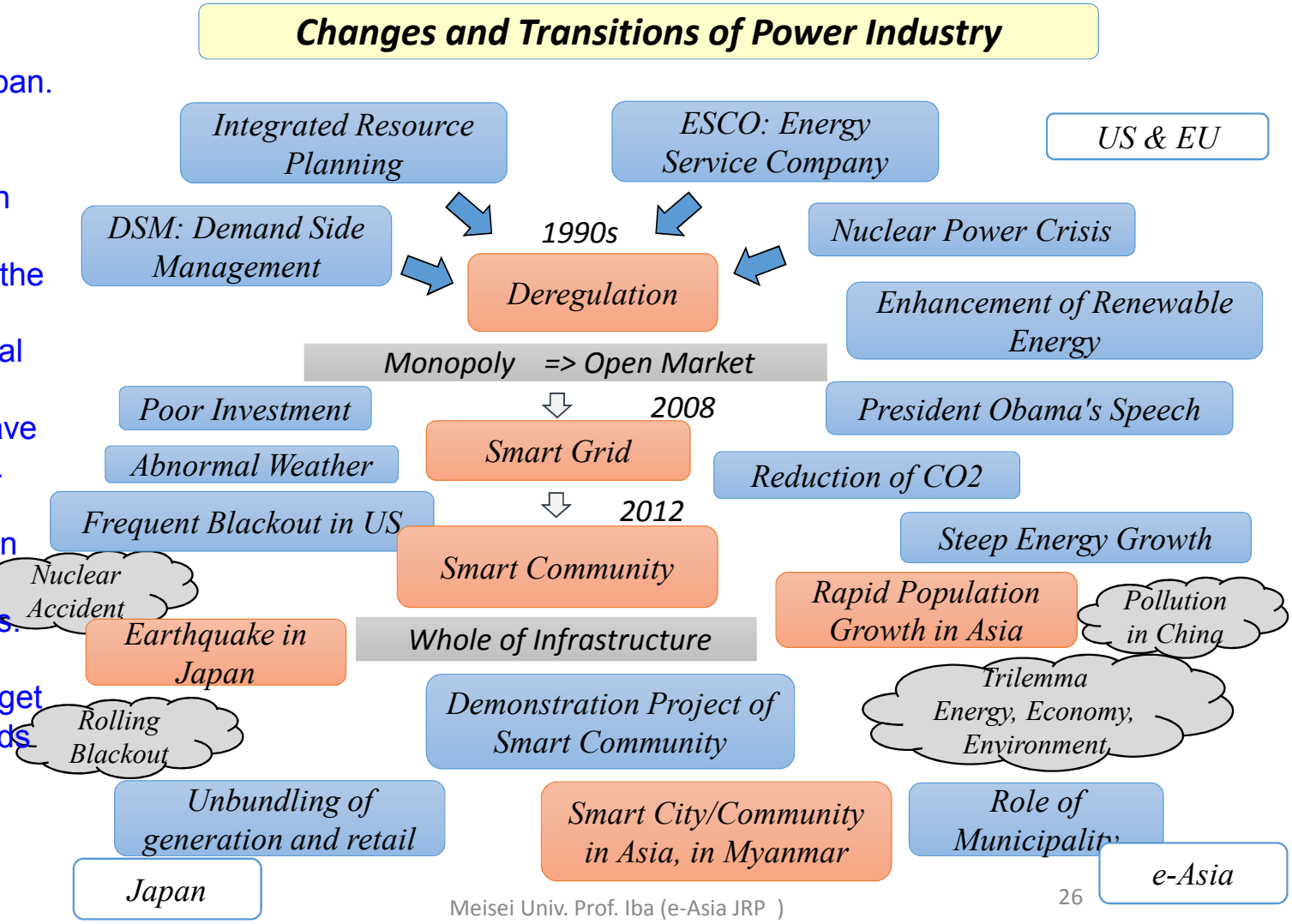
Port Community System: Port and Harbor Electronic Data Interchange (EDI)

Case of Port Klang Community System

- ❑ *Capacity Building in Regional Development*
- ❑ *Sustainability and Green Growth*
- ❑ *Management Perspective on EDI Integration*

"Modeling for Smart Community Design," by Dr. Kenji Iba, Meisei University, Tokyo

Dr. Iba's presentation started with an overview of the evolution of the infrastructure of power industry in Japan. The chart at the right-hand demonstrates how an industrial infrastructure is intimately related with societal consensus and the accompanying set of laws regulating the ways of business transactions.
Aside from the huge physical industrial complex, the organizational and conceptual aspects of the industry have seen a series of epoch-making shifts. The consensus of the society shifted from the regional monopoly concept in early days toward deregulation and market-based reorganization in 1990s. Until Fukushima's nuclear disaster in March of 2011, it was the national target that almost 50 percent of energy needs depends upon the nuclear energy.



Comments on Dr. Kenji Iba's presentation continued

In the aftermath of Fukushima nuclear disaster, the society has been undergoing a serious soul-searching as to the optimal energy-mix in the future. A substantial portion of people demand a complete abolishment of the nuclear power. Almost all of the fifty three nuclear plants are standstill as of now. This is a case of concept confusion in the society. The soul-searching is even extending to restructuring the industry, namely, "unbundling the generating sector and the retail sector", that, traditionally, have been vertically integrated. Please see the Dr. Iba's slide: *Changes and Transitions of Power Industry*

The major theme of Dr. Iba's presentation is "modelling for the smart community design." He discussed 1) Who and what stakeholders are to participate in the design, 2) Steps and processes to be taken, 3) What factors and who's benefits are to be taken into consideration, etc.

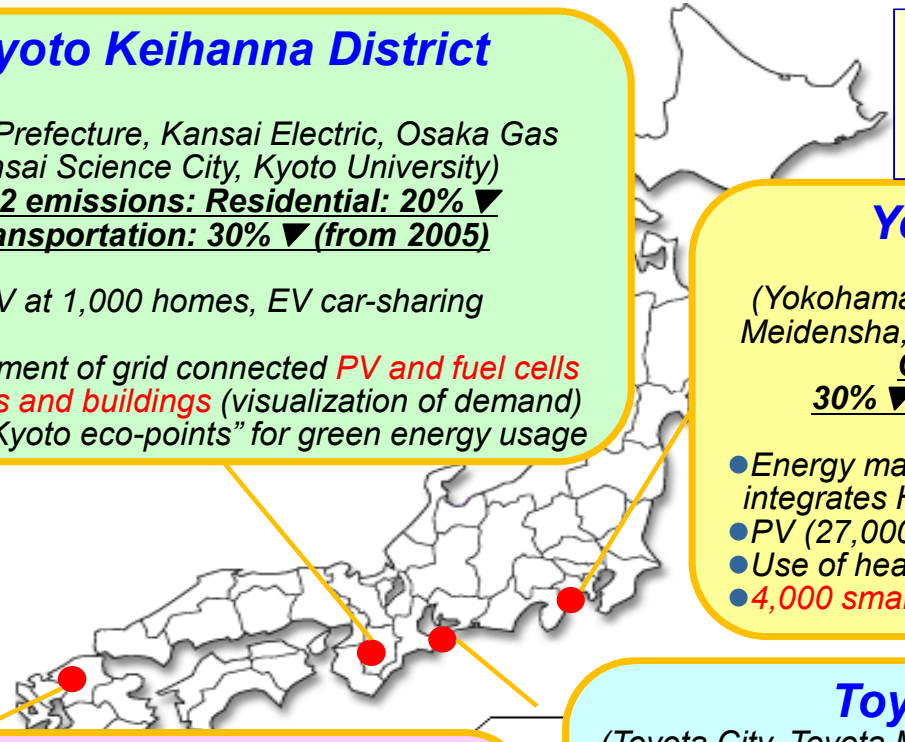
As a new development in modelling approach, Dr. Iba pointed out some venturous smart community projects that are taking place in many parts of the real world. In science and engineering fields, models have usually been represented in symbols such as mathematical formulae on paper, computer or internet, namely in the virtual space. The simulation, that is implementation as well as experimentation with the model, has also been performed in the virtual space. In the frontier of societal disciplines, however, modelling is now taking on experimental simulation in real world settings.

Demonstration Projects in Japan (2010-2014) (From Dr. Iba's presentation)

From modelling in virtual space to model simulation in real world settings.

Demonstrative smart community projects in this slide and the next exemplify the experimental implementation of the "smart community concept."

Hand in hand with the advancement of technology, new concepts emerge for infrastructure renewal.



Kyoto Keihanna District

(Kyoto Prefecture, Kansai Electric, Osaka Gas Kansai Science City, Kyoto University)

CO2 emissions: Residential: 20% ▼
Transportation: 30% ▼ (from 2005)

- *Install PV at 1,000 homes, EV car-sharing system*
- *Management of grid connected PV and fuel cells in houses and buildings (visualization of demand)*
- *Grant "Kyoto eco-points" for green energy usage*

Total Budget
2011 : 67 million $
2012 : 186 million $

Yokohama City

(Yokohama City, Toshiba, Panasonic, Meidensha, Nissan, Accenture, others)

CO2 emissions:
30% ▼ by 2025 (from 2004)

- *Energy management system that integrates HEMS, BEMS and EVs*
- *PV (27,000 kW)*
- *Use of heat and unused energy*
- *4,000 smart houses, 2,000 EVs*

Kitakyushu City

(Kitakyushu City, Fuji Electric, GE, IBM, Nippon Steel)

CO2 emissions: 50% ▼ (from 2005)

- *Real-time management at 70 companies and 200 houses*
- *Energy management using HEMS and BEMS*
- *Energy system that coordinates demand side management with overall power system*

Toyota City

(Toyota City. Toyota Motor, Chubu Electric Power, Toho Gas, Toshiba, Mitsubishi Heavy Industries, Denso, Sharp, Fujitsu, Dream Incubator, etc.)

CO2 emissions: Residential 20% ▼
Transportation: 40% ▼

- *Use of heat and unused energy in addition to electricity*
- *Demand response at more than 70 homes 3,100 EV, V to H and V to G*

NEDO's Global Smart Community Projects (From Dr. Iba's presentation)

Venture projects of "the model smart community" taking place in various cities in the world.
The participants in these experimental projects include numerous inhabitants, energy producers, distributors, electric vehicles, and all the related firms.

Hundreds of industrial firms are involved in organized manner to create the infrastructure that would best serve the smart community concept.

Lyon, France

A new type of urban lifestyle will be demonstrated through smart redevelopment of an existing city by combining energy saving and an EV transportation system.

, in this workshop.

New Mexico, USA

Large-scale PV has been introduced, smart grid systems that combine demand response using real-time pricing and storage batteries will be constructed.

Malaga, Spain

EV operating systems where EVs have been already disseminated. New business models.

Gongquingcheng City, Jiangxi Province, China

A leading model that can achieve both economic growth and a low-carbon society by low-carbon traffic systems.

Maui Island, State of Hawaii, USA

Large-scale renewable energy, including wind and solar power for remote islands using EV charging control system.

**NEDO: New Energy and Industrial Technology Development Organization*

A Japanese governmental agency for energy, environmental, and industrial technologies