University as a Platform for Social Experimentation towards Sustainability Innovation

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Diversity and Complexity of Knowledge on Sustainability

- Sustainability concerning knowledge on diverse aspects
  - Ranging from natural environment to artifacts
- Sustainability science cutting across different academic disciplines
  - Integration of natural sciences, engineering, social sciences, and humanities
  - Aimed at understanding the fundamental characteristics of complex and dynamic interactions between natural, human, and social systems

How Sustainability Science is Different from Others

- Systemic aspects
  - Many issues are connected and interdependent, e.g. climate change and biodiversity
  - Requiring systemic understanding and interventions
- Long-term time framework
  - Impacts and influences in the future
  - Dynamic process of change
  - Equity of different generations
- Action-oriented
  - Implementing knowledge for actions to address the pressing sustainability challenges our societies face

Critical Role of Innovation towards Sustainability

- *Stern Review on the Economics of Climate Change* (2007)
- Accelerating technological innovation as a key component of policies to deliver timely, effective and economically efficient climate change mitigation

Understanding Innovation: From Individual Attributes to Systemic Initiatives

- Importance of Innovation in Economic Development
  - Schumpeter Mark I in the 1930s and Schumpeter Mark II in the 40s
- Market Concentration, Firm Size
  - Industrial Economics in the 1950s and 60s
- R&D Organization and Strategy
  - Rosenberg, 1976; Mowery, 1981; Freeman, 1982; Rosenberg, 1982; Dosi, 1984; 1988; Kodama, 1991; Rosenberg, 1994; Kodama, 1995
- National and Sectoral Innovation Systems
  - Freeman, 1987; Lundvall, 1992; Nelson, 1993; Carlsson, 1995; Edquist, 1997; Goto and Odagiri, 1997
- Network of Universities, Firms, and Public Organizations
  - Owen-Smith, Riccaboni, Pammolli, and Powell, 2002; Owen-Smith and Powell, 2004

Rapid Progress and Diversification in Knowledge for Innovation

- Scientific progress developing rapidly and the sources of knowledge widely distributed
- No single organization having all the necessary skills to stay on top of all areas of progress and bring forth significant innovation (Powell and Grodal, 2005)
- Crucial role of inter-organizational networks in influencing the change and direction of technological development
- Vital importance of external knowledge networks and of collaboration during the development of new products and processes (Freeman, 1991)

Collaborating Opportunities and Mutual and Interactive Learning through Networks

- Dense ties between partners in technology collaboration networks fostering information diffusion and knowledge exchange
- Enhancement of the technological performance and collaborating opportunities of the partners (Ahuja, 2000; Stuart, 1998; Uzzi, 1997)
- Benefits of inter-organizational relationships in terms of mutual and interactive learning through networks (Gulati, 1999; Powell, Koput, and Smith-Doerr, 1996)

Expansion of the Missions of Academia

Teaching University	Research University	Entrepreneurial University
Preservation and dissemination of knowledge	First academic revolution	Second academic revolution
New mission of teaching, generating conflict of interest controversies	Two missions: teaching and research	Third mission: economic and social development; traditional missions continued

Etzkowitz (2003)

Functions of Industry-Academy Collaboration

- Scientific and technological knowledge
  - Can increase the efficiency of applied R&D in industry by guiding research towards more fruitful departures
- Prototypes for new products and processes
- Equipment and instrumentation
  - Used by firms in their production processes or their research
- Skills/Human capital
  - Embodied in students and faculty members
- Capacity for scientific and technological problem-solving
- Networks of scientists and engineers and users

Types of Industry-Academia Collaboration

- Academic Society
  - Exchange and dissemination of the findings of basic research
- Bilateral Research Collaboration
  - Technological development
- Platform for Stakeholder Collaboration
  - Societal experimentation for innovation towards sustainability

Functions of Innovation Systems

- Knowledge development and diffusion
  - R&D
- Influence on search direction
  - Understanding of social needs
- Niche experimentation
  - Promotion of Entrepreneurship
- Market formation
  - Establishment of Robust Business Models
- Legitimization
  - Social acceptance
- Resource mobilization
  - Human resources
  - Financial channels

(cf. Bergek, Jacobsson, Carlsson, Lindmark, and Rickne, 2008)

Phases of Knowledge Dynamics in Sustainability Innovation

- Emergence of a problem
  - Scientific mechanisms, natural science
- Recognition of the problem
  - Reporting in the media, discourse analysis
- Scientific research conducted at universities and research institutes
  - Behavior of scientists with incentives, sociology and economics of science
- Technological development
  - Behavior of private firms with incentives, economics of technological change and innovation studies
- Impacts in society
  - Assessment of environmental protection and safety, energy/materials flow analysis and life cycle assessment (LCA)
- Feedbacks from society
  - Reactions of various actors, science and technology studies (STS)

<u>Nonlinear processes of multiple channels of feedbacks</u>

Case of the Development and Diffusion of Mosquito Nets for Preventing Malaria

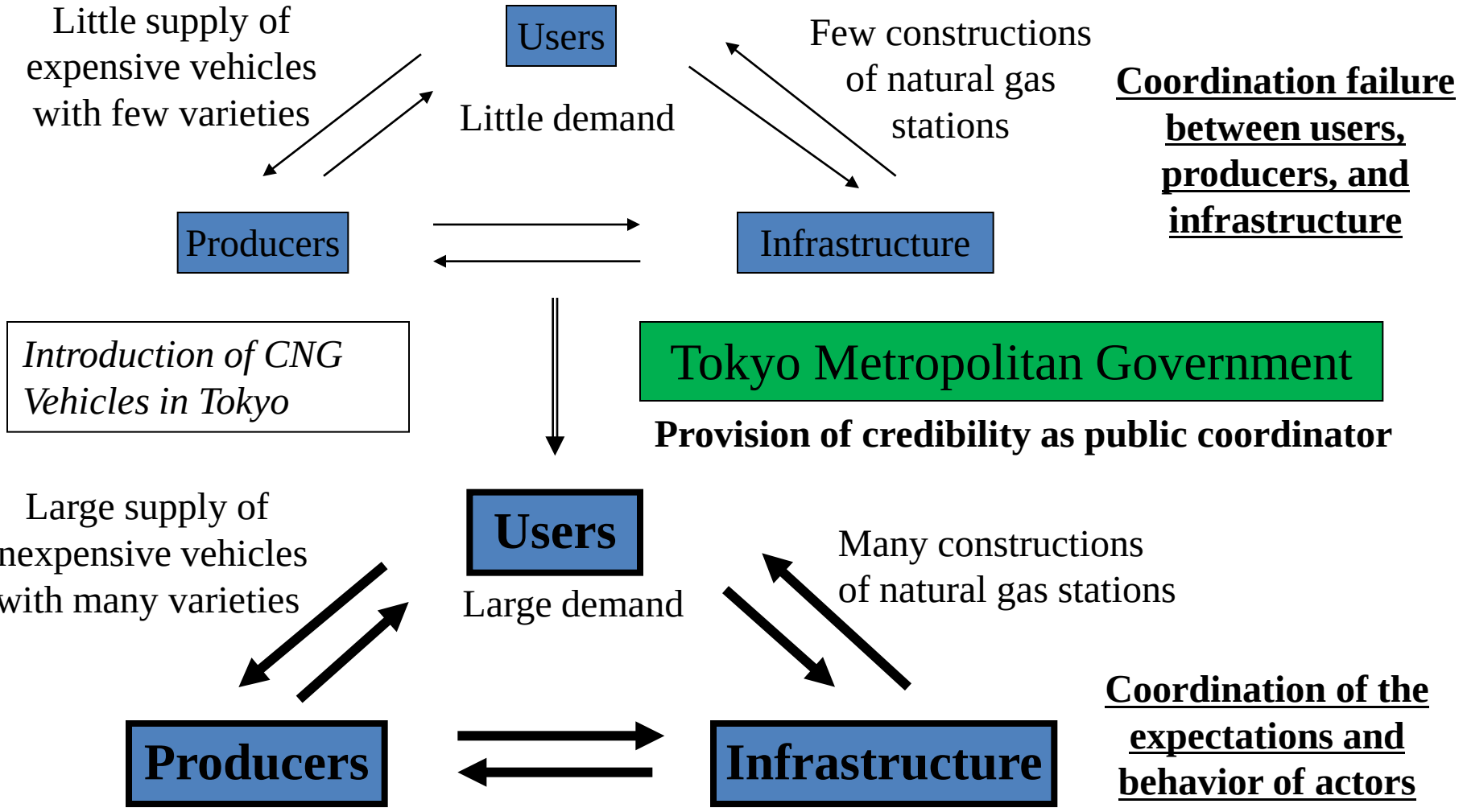
Olyset Net of Sumitomo Chemical

Ito (2009)

Innovation through Collaboration with Stakeholders

- University and research institutes
  - Collection of data and information on the location of diseases such as malaria
  - Evaluation of the effectiveness of anti-malaria nets actually used in local conditions
- Public sectors, including governments and international organizations (WHO, UNICEF)
  - Ensuring long-term, sustained demands for products
  - Reliable and credible information on technologies
  - Providing legitimacy and neutrality
- Non-governmental organizations
  - Delivery and recycling of mosquito nets
  - Sharing and disseminating information
  - Establishment of networks of relevant actors at local communities

Coordination of the Expectations and Behavior of Relevant Actors for Introducing Clean Vehicles



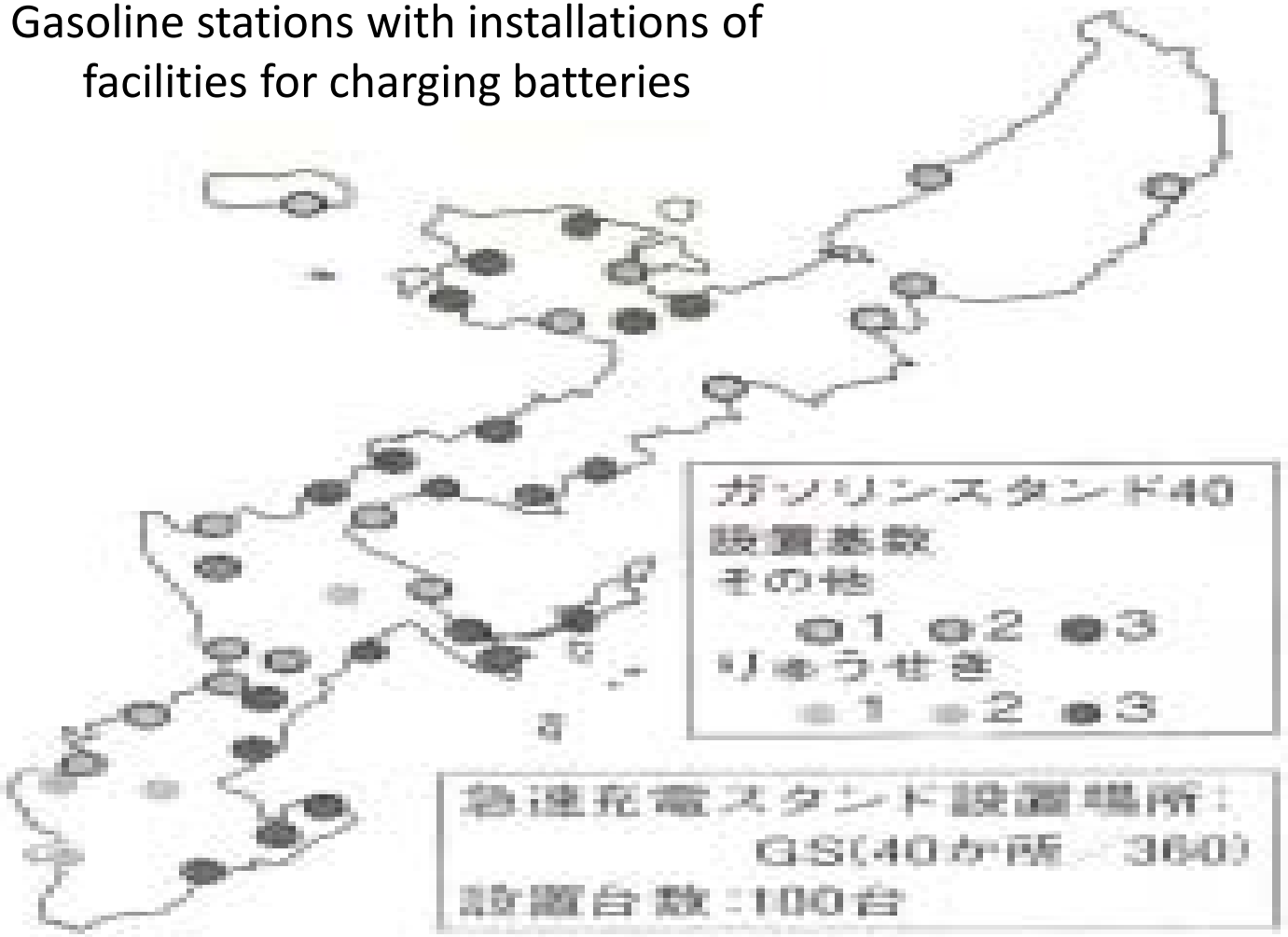
Yarime (2009)

Recent University Initiatives for Creating a Platform for Stakeholder Collaboration

- Social System Innovation through Secondary Batteries
- Introduction of electric vehicles to the island of Okinawa
- Creation of platform initiated by university researchers
  - University
  - Automotive company
  - Car rental company
  - Infrastructure provider
  - Local business communities

Installation of Facilities for Charging Batteries in the Island of Okinawa

Gasoline stations with installations of facilities for charging batteries



Miyata (2009)

Social Experimentation for Innovation through Stakeholder Collaboration in Kashiwa City, Japan

Low-Carbon Society

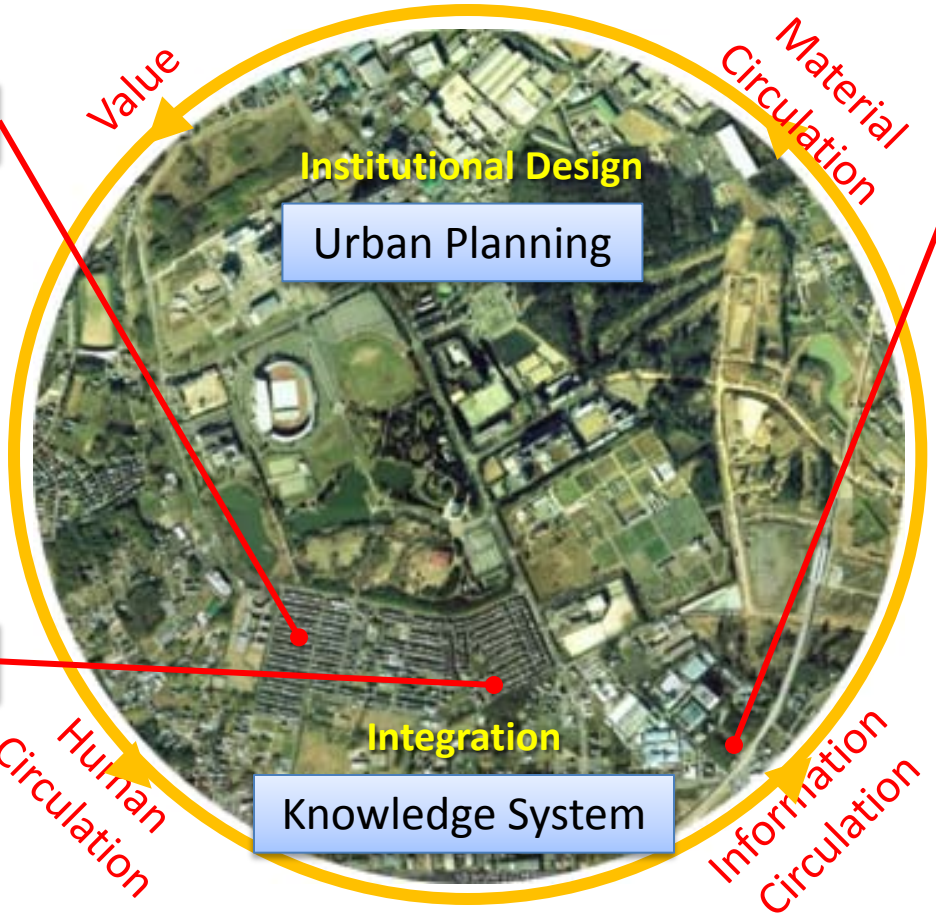
Aging Society

Photovoltaics, Heat Pump, Smart Grid

Housing

Electric Vehicles, On-Demand Bus

Mobility



Low Carbonization with Elderly People

Agriculture

Co-Evolution of Technology and Institutions for

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Emergence of Smart Grids/Smart Cities for Sustainability

- Systemic approaches to achieving sustainability of cities around the world
  - Tianjin Eco Cities, Green Grid Initiative in New Mexico,
- Integration of electricity, water, housing, transport, and information
- Various types of stakeholders in society, including component suppliers, infrastructure providers, users, etc.
- Cannot be implemented by a single company specializing in providing specific products
- Requires collaboration with companies in different industries, governments, international organizations
- Transition in business models at corporate levels to societal level

Integration of Various Knowledge and Packaging for Transfer of Social Business Models for Innovation

- Understanding the mechanisms of producing innovation
- Linking and Integrating Innovations in Different Fields
- Establishing business model at societal levels
- Packaging of knowledge, experience, and know-how
- International Transfer of Systems Innovation and Institutional Design

Some Issues to be Explored

- Functions expected for industry-academia collaboration
  - Vision creation, data collection and analysis, social legitimization
- Challenges and obstacles in industry-academia collaboration
  - Procedures, mindsets, costs, outcomes, evaluation
- Choice of targets for industry-academia collaboration
  - Industrial sector, geographical region, technological field, societal issue
- Methodology of industry-academia collaboration
  - Basic research, technological development, social demonstration, wider diffusion