

LOCARNET Session 6 Land Use
Innovative Modelling and Monitoring Research
for Land Use Scenarios of Eco-Cities
Oct. 8th, 2015

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Director of Social Environmental Systems Research Center,
NIES, Japan
with Dr. Minoru Fujii, NIES

- (1) Integrative modelling research for low carbon society
- (2) Multi scale technology and policy simulation system
- (3) Interactive monitoring and regional evaluation system research

PREPARED by
Dr. Shuichi Ashina, Dr. Kei Gomi, Kei, Dr. Takuya Togawa

New Challenges for Modelling and Monitoring Research

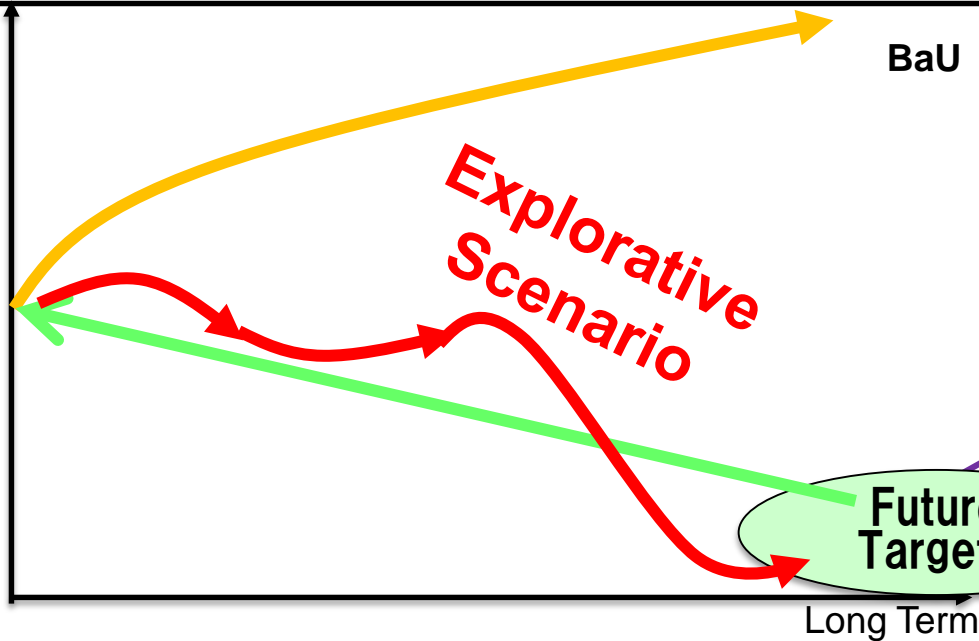
Research challenge to compile innovative modelling and monitoring approach

Low Carbon Solutions on Local Contents

Technology and policy Solution Design Adapting to Local Characteristics

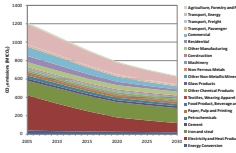


Environmental Emission



Integrated Model for Future Vision

Normative Targets by General Equilibrium Model



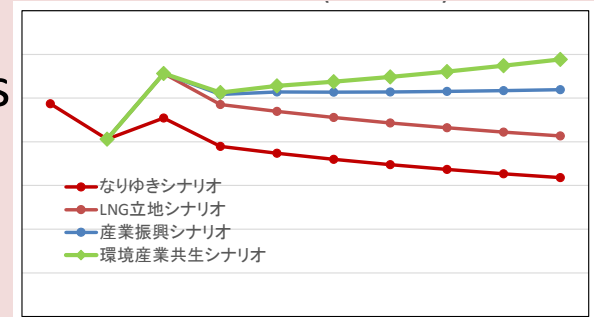
Environmental Monitoring Information System

2. Future technology and policy system analysis for eco-cities

① Macro-scope

Alternative
future vision

- population, industries
- core developments
- energy locality



Future frame

② Spatial-scope

Land use zoning
/network design

- land use distribution patterns
- local energy network
- location of core developments

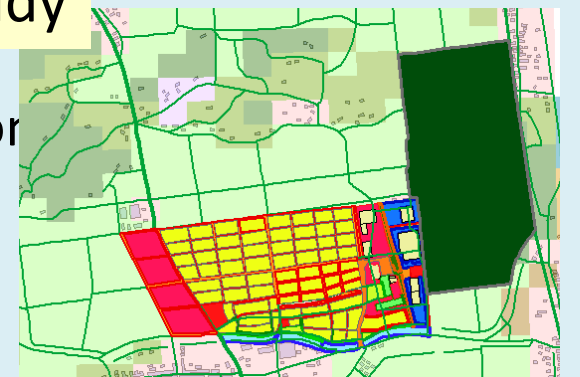


Feasibility Study

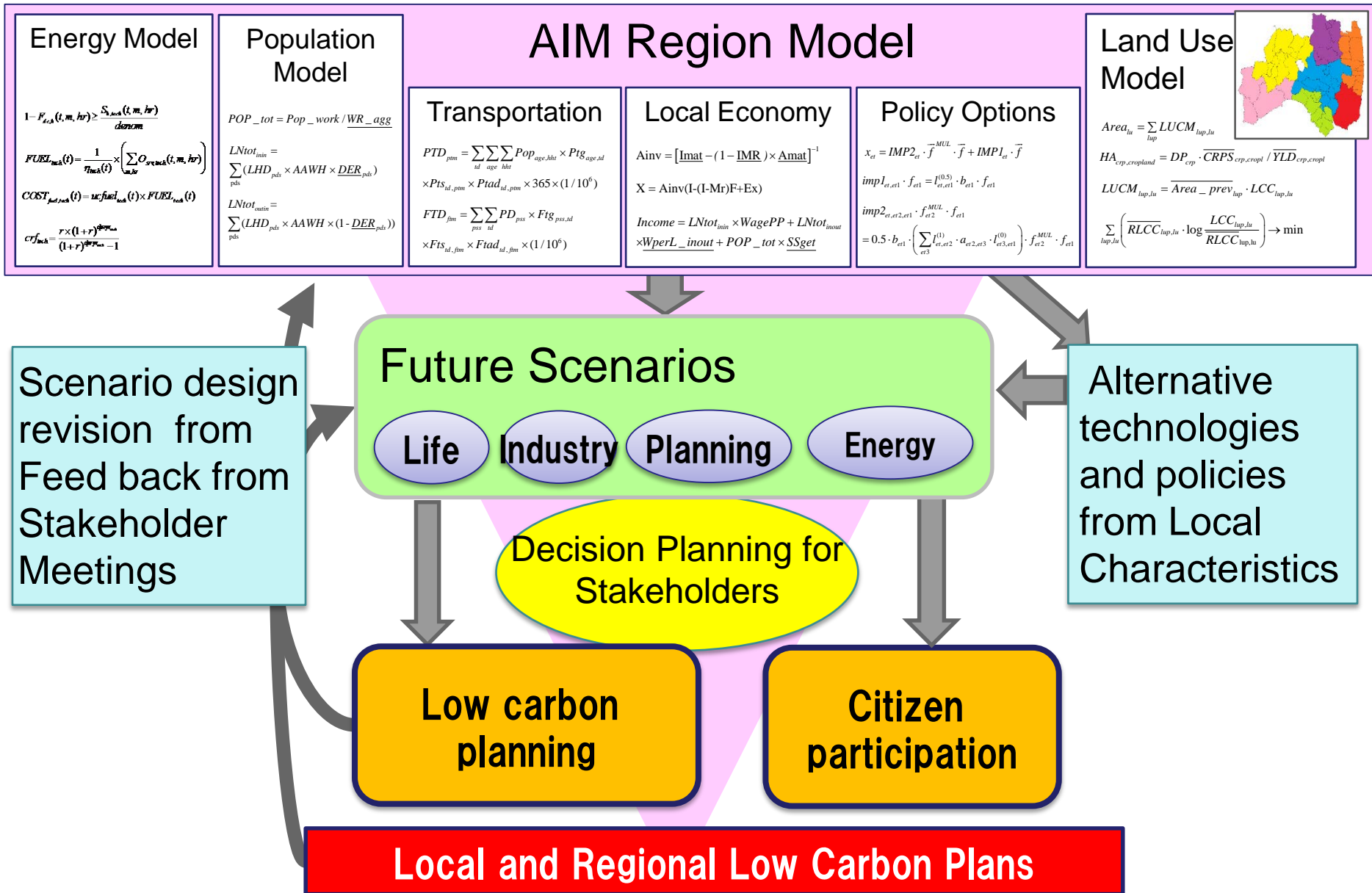
③ Project Design

Core projects for
revitalization

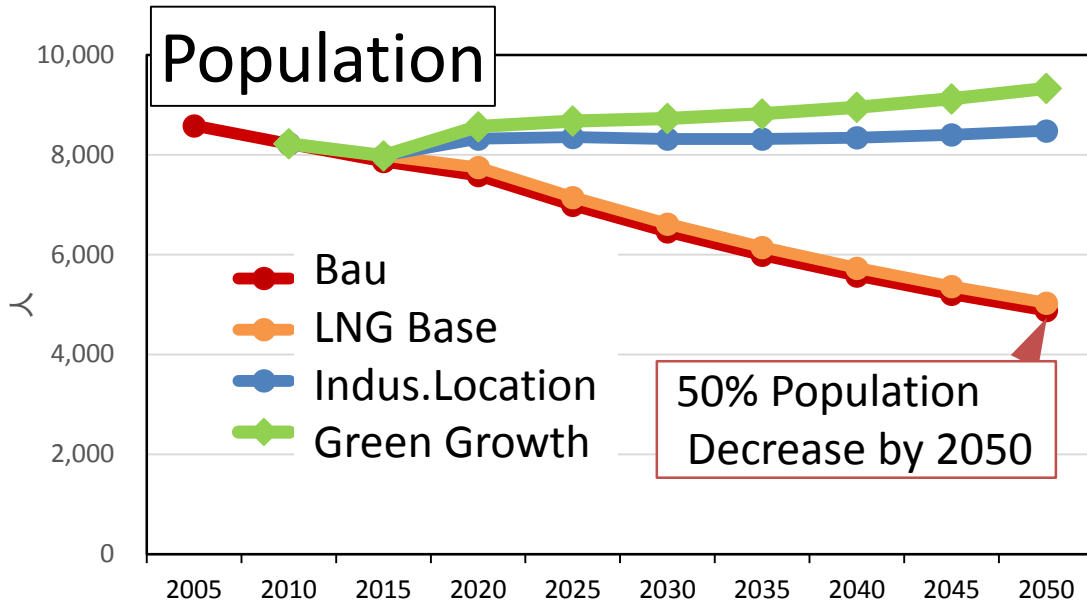
- zoning and regulation
- district planning
- key industries



Integrative Model Application toward Low Carbon Cities and Regions



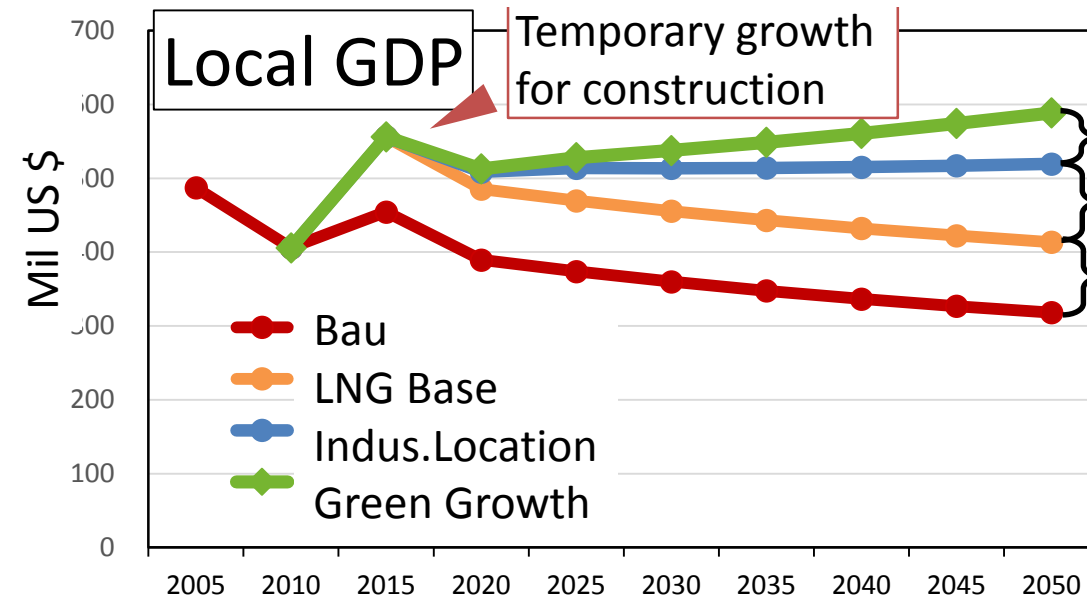
Macro-scope Simulation for the Future Scenario of Population and Production



Population recovery by green growth

Population keeping with industrial locations

Limited population effects by LNG base



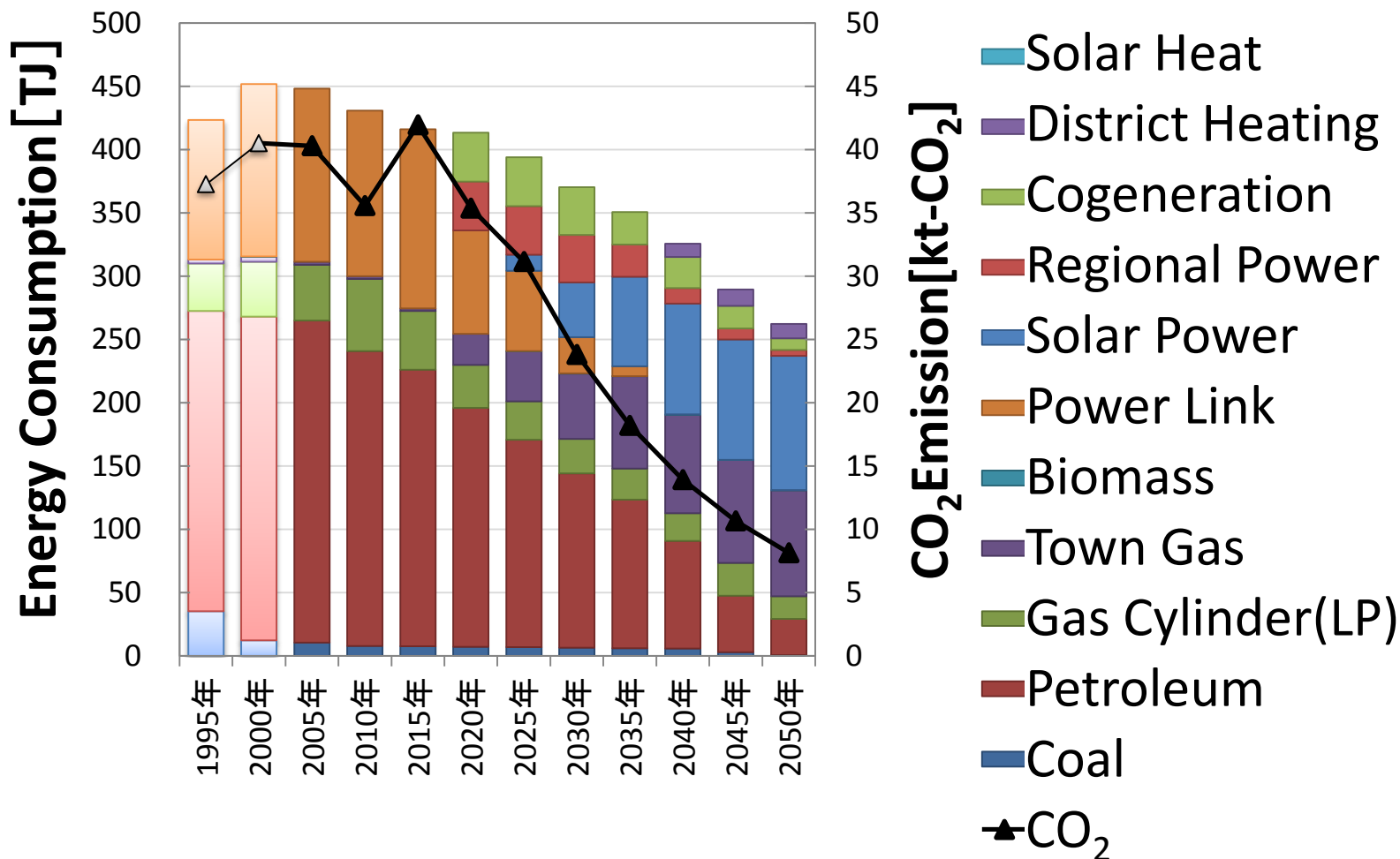
Additional 70 mil US\$ effects by green growth

Additional 110 mil US\$ by industrial locations

100 mil US\$ by LNG base construction and operation

Macro Scope Technology Assessment for Local Government

Assessment for Suitable Technology Assessment for the Low Carbon Future (80% Reduction in 2050 from 1990) in Shinchi Town of Fukushima



Development of Regional Integrated Models (Regional AIM) and Spatial Planning Model to design sustainable regions and cities

Integrated Model (AIM)

Design of Vision and Road Map for *National Scale*

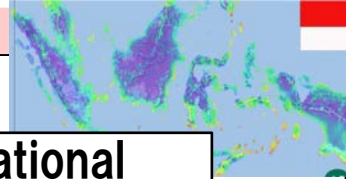
National
End Use Model

*CGE model

*Computational General Equilibrium

National
Targets

National
Road Maps



Analysis for Province Scale

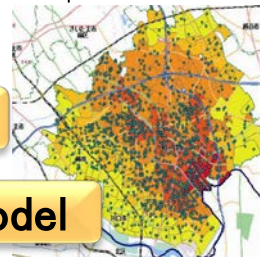
*Regional
Parameters*

End
Use
Model

Fukushima
CGE
Model

Fukushima
Targets

Fukushima
R. Maps



Planning for Local Scale Kabupaten Kota

Snap
Shot
Models

Policy
Support
Tools

Local
Targets

Low Carbon Urban Design Model

Strategic Spatial Zoning System

Forestry Eco System Service Model

Low Carbon District Design Models

Local Heat/Energy Management

Low Carbon Industrial System



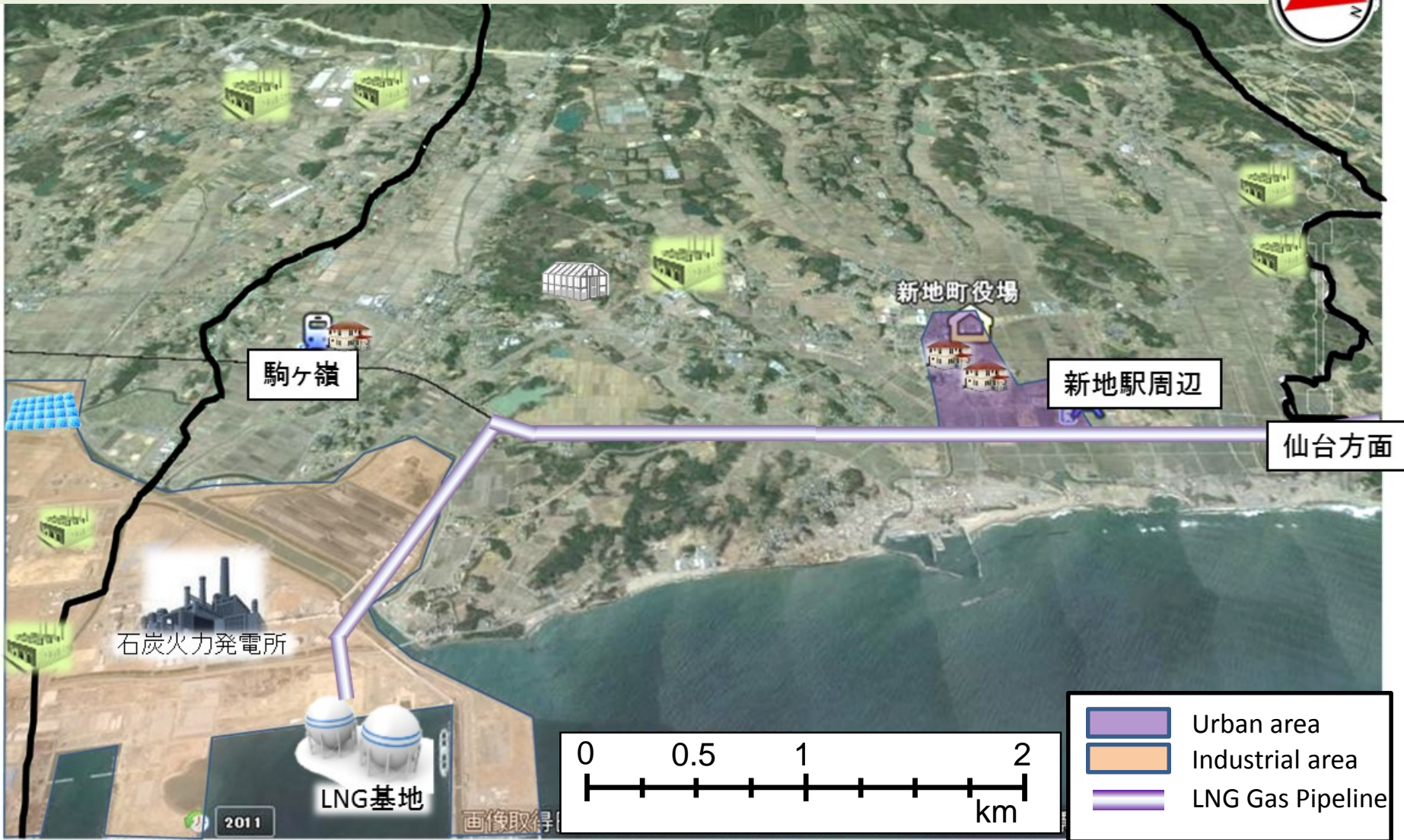
Social Monitoring System & Project Data

Buildings

Industries

Life Style

Future Scenario Simulation for Fukushima Shinchi Township ; BAU Recovery Scenario





メガソーラー

駒ヶ嶺

新地駅周

野菜工場

石炭火力発電所

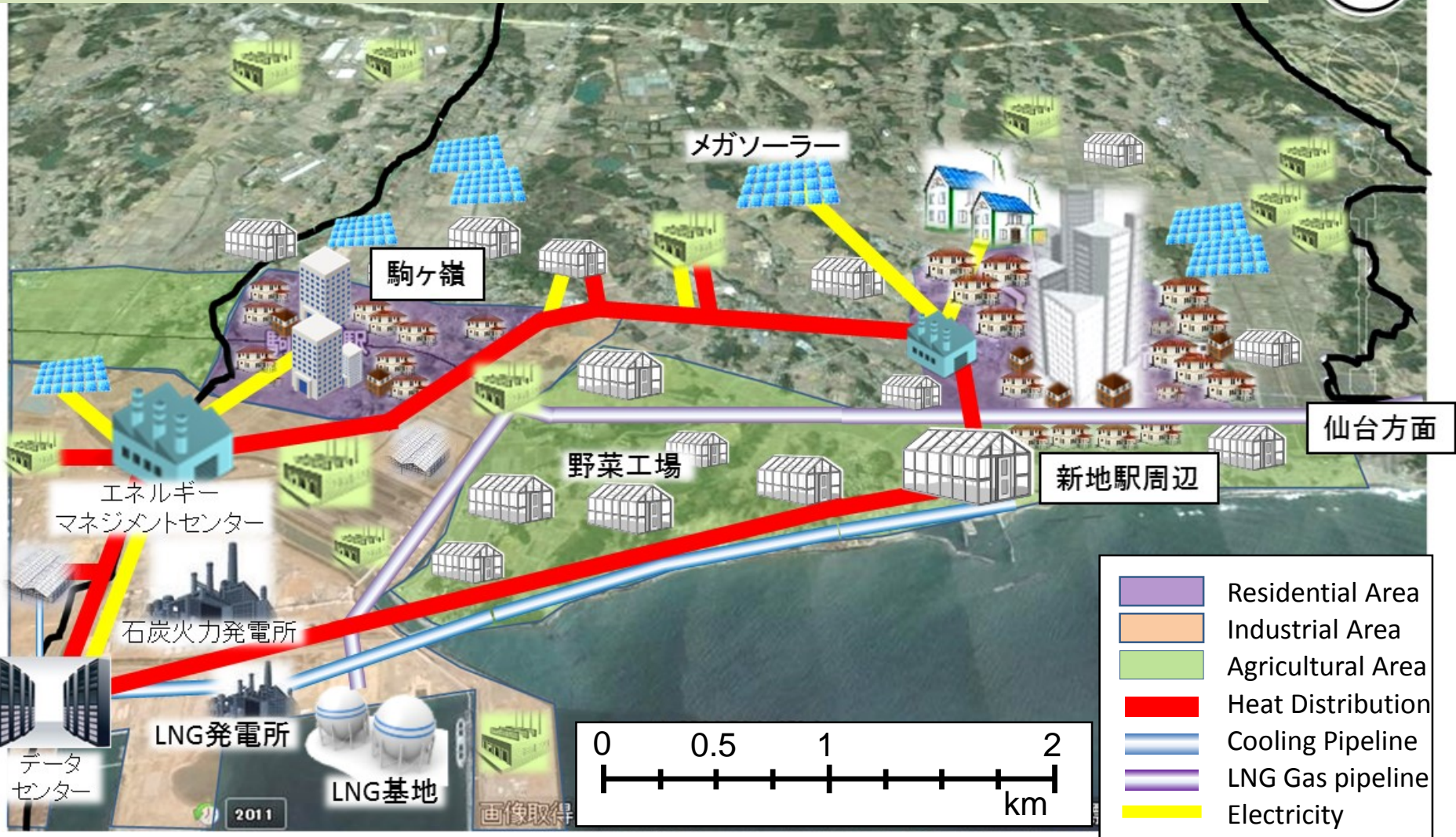
LNG基地

Image © 2014 DigitalGlobe
© 2014 ZENRIN
Image © 2014 TerraMetrics

2011

画像取得日: 2014/4/1 37° 51'44.96" N 140° 55'27.22" E 標高

Future Scenario Simulation for Fukushima Shinchichi Township ; Green Growth Scenario



Estimation of Alternative Future Recovery Scenarios

Alternative Spatial Scenario

Quantification of Impacts and Costs

BAU



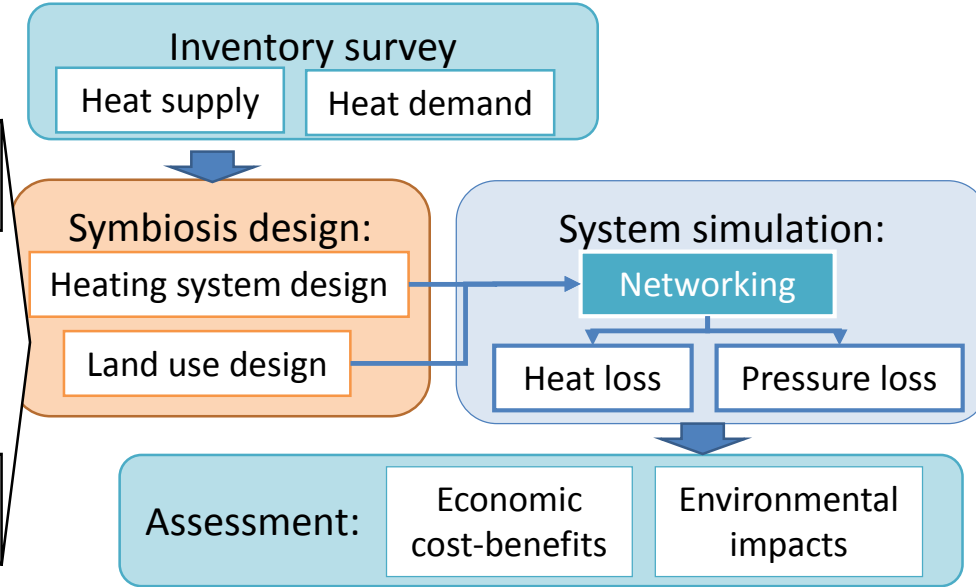
+Compact City



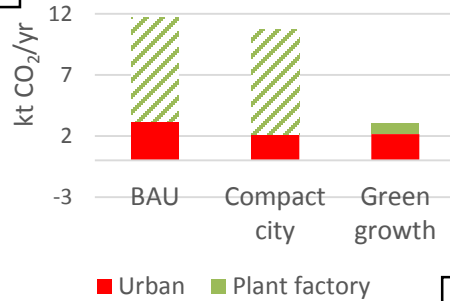
+Green Growth



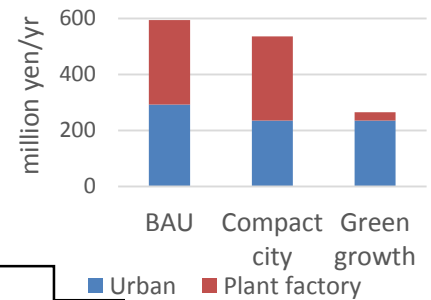
Effects of Local Energy Management



CO₂ emission comparison:



Fuel cost comparison:



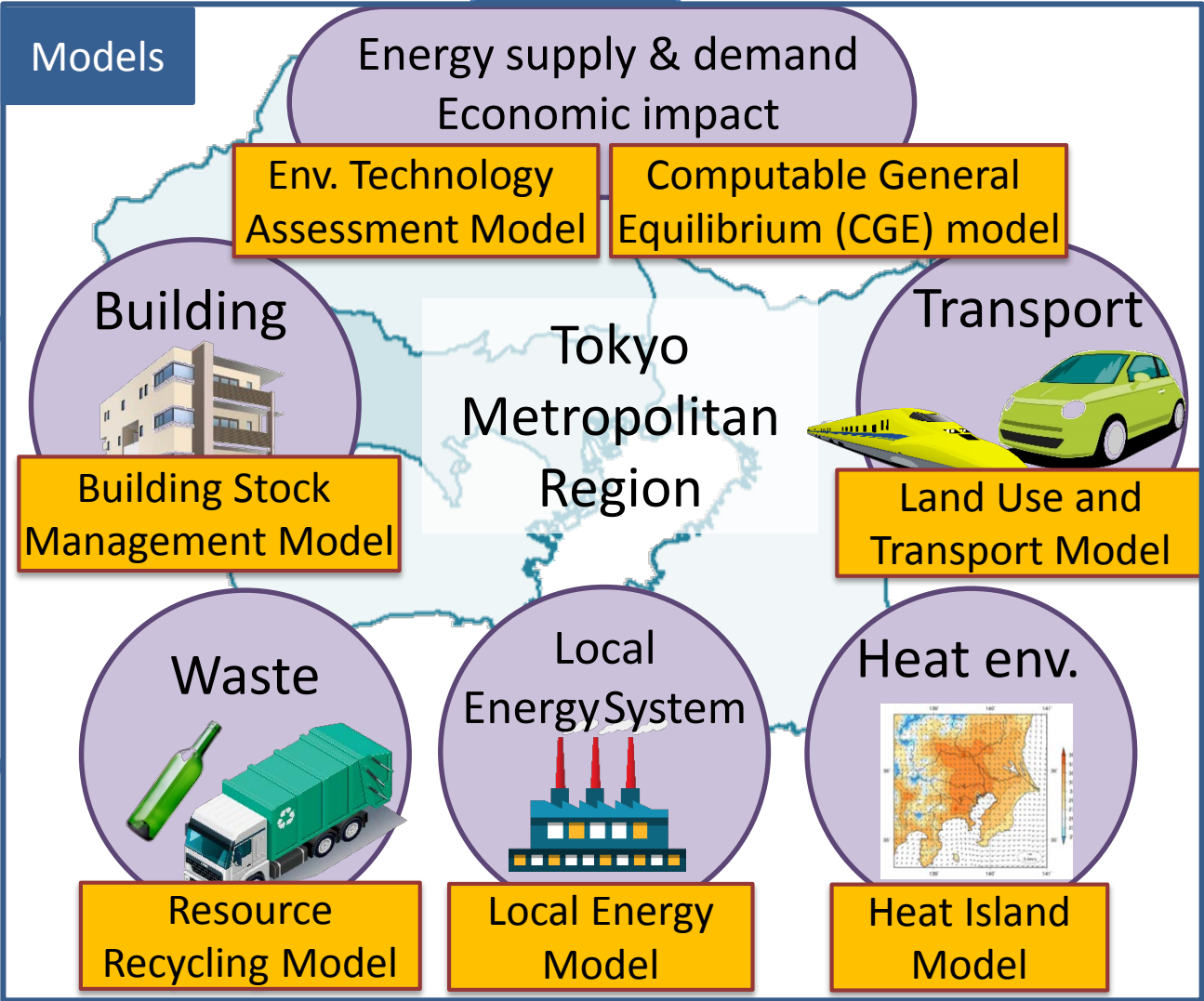
Green growth can bring significant co-benefit of CO₂ emission reduction and fuel saving.

Environmental Measures Analysis in Tokyo Metropolitan Region

- Locally suitable env. measures
- Compact land-use

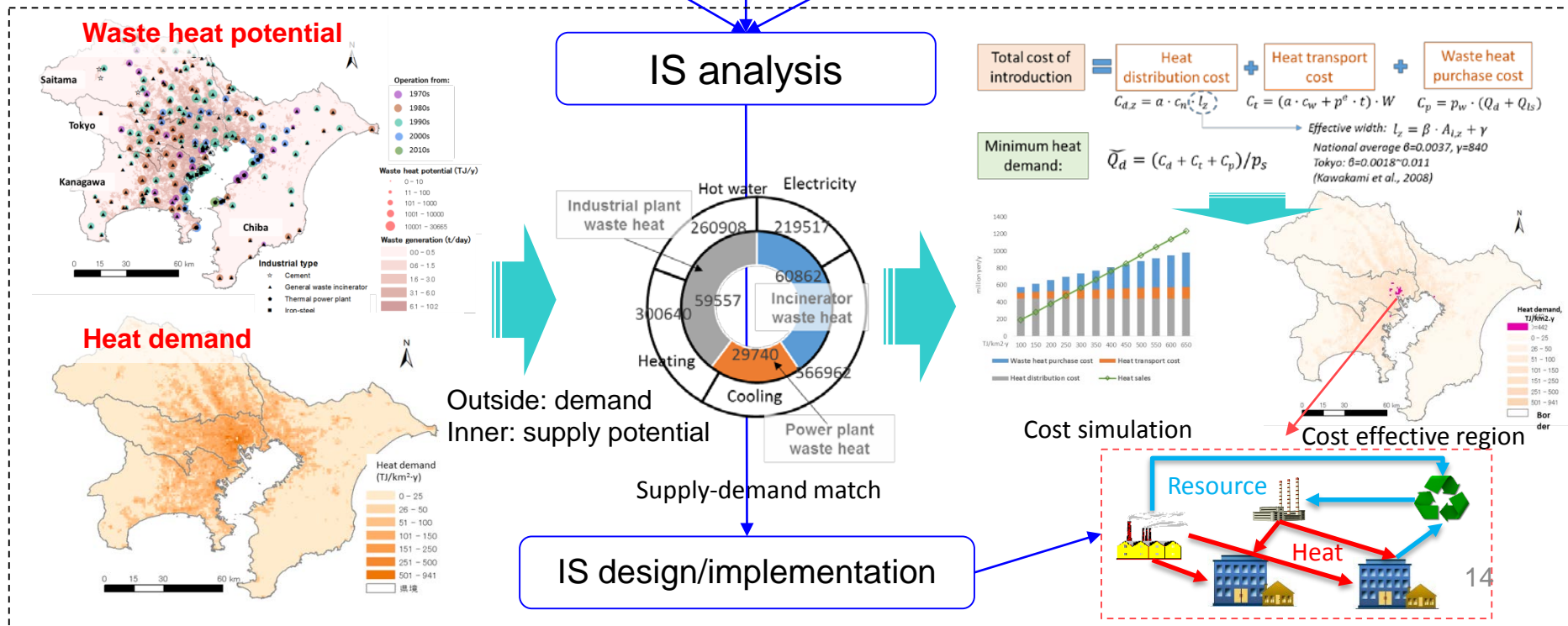
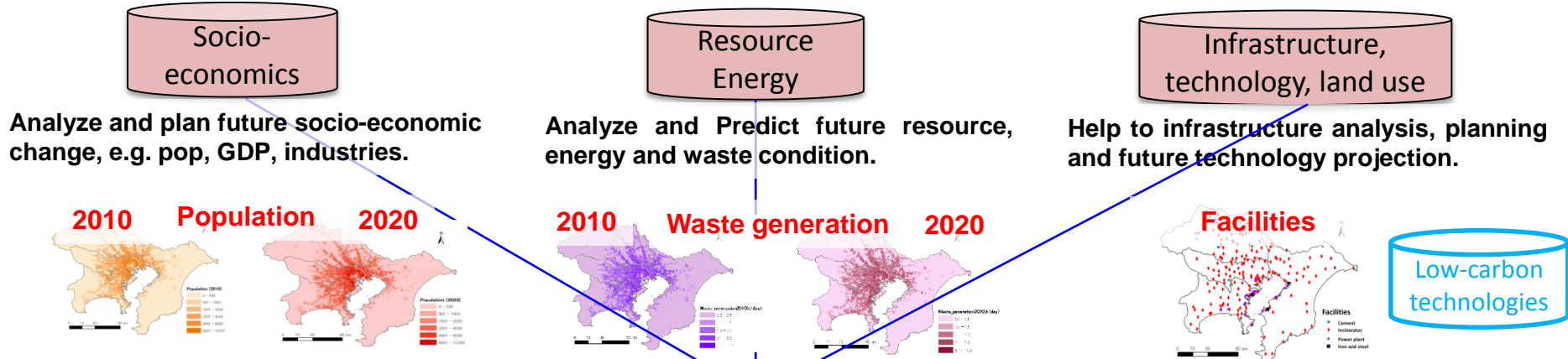
Scenarios
(2020, 2030, 2050)

- Effect of env. measures
- Energy saving & LCS
 - 3R
 - Heat island mitigation
 - Convenient transport
 - Economic impact



Primary application case in Tokyo region, Japan

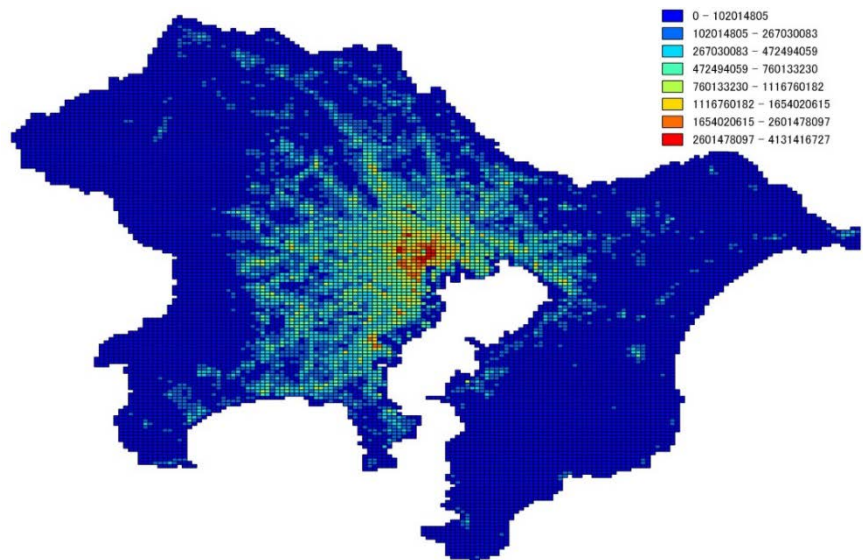
An application case in Tokyo region (macro to spatial scale). Regional condition, resource and energy circulation, and future industrial and urban symbiosis are analyzed.



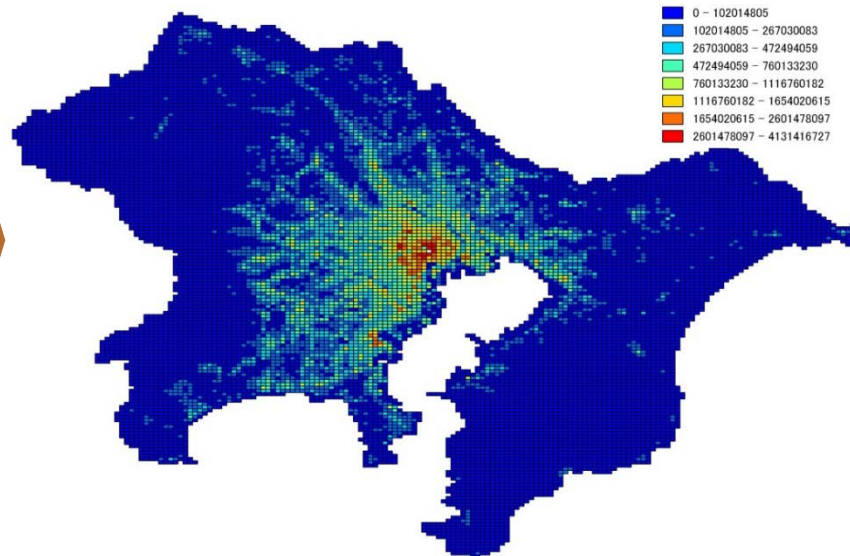
Output of Local Energy Model

Projected energy demand by sector and by service

2014, Total energy demand



2050, total energy demand



Total energy demand in Tokyo Metropolitan Region (PJ/year)

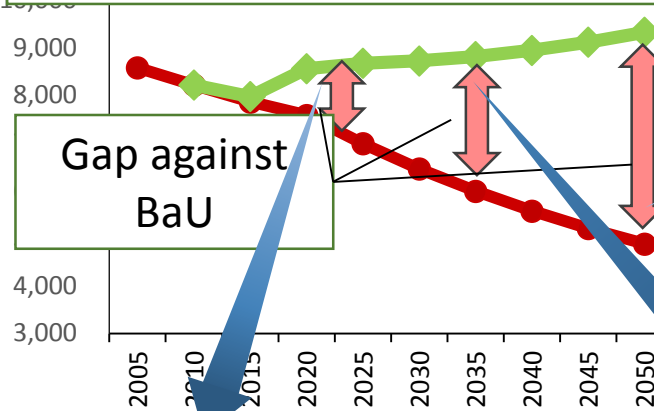
	2014		2050	
	Residential	Commercial	Residential	Commercial
Power	58.4	238.7	47.9	248.2
Cooling	95.2	698.3	78.2	726.2
Heating	90.2	311.9	74.0	324.4
Hot-water	255.2	10.1	209.5	10.5
Sub-total	499.0	1258.9	409.6	1309.3
Total	1758.0		1718.9	

Kei GOMI, Shuichi ASHINA, Tsuyoshi FUJITA, Toshihiko MASUI (2015):
 Development Of A Methodology For Regional Future Scenarios Considering Interaction Of Industry And Population And Application In So-ma Region In Fukushima Prefecture Journal of JSCE (Accepted) (In Japanese)

Considering time-frame in the technology assessment models

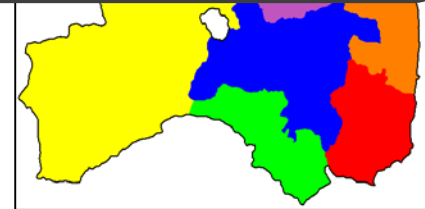
With future targets of demography, economy, and environment in the region, the most suitable technology is chosen in short, mid, and long term. Structure of land use and related industries are describe as well.

Long-term target of the region
[Demography, employment, town-making, low-carbon, etc]



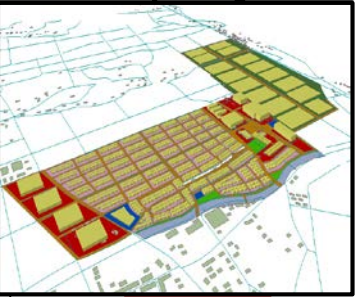
Long-term: Urban-Industry-Agriculture Complex

- Industrial ecology by strategic locations
- Intensive local energy use with IT facilities
- Industrial development centered by local energy business creates employment (~ 3000)



Short term: Pioneering point development project

- Town-planning with local energy
- A show-case of low-carbon system
- Economic impact in several years



Short term: Cluster development

- Compact clusters of residents, commerce and industries
- Convenient transport
- Creating employment (~1000) and enhance settlement



– Integrative Assessment

to identify technology effects with policy system implementation focusing CO2 and other socio–environmental effects

– Inter–temporal Assessment

to identify the suitability of technology and policy packages based on the future targets and present situations

– Inter–Scale Assessment

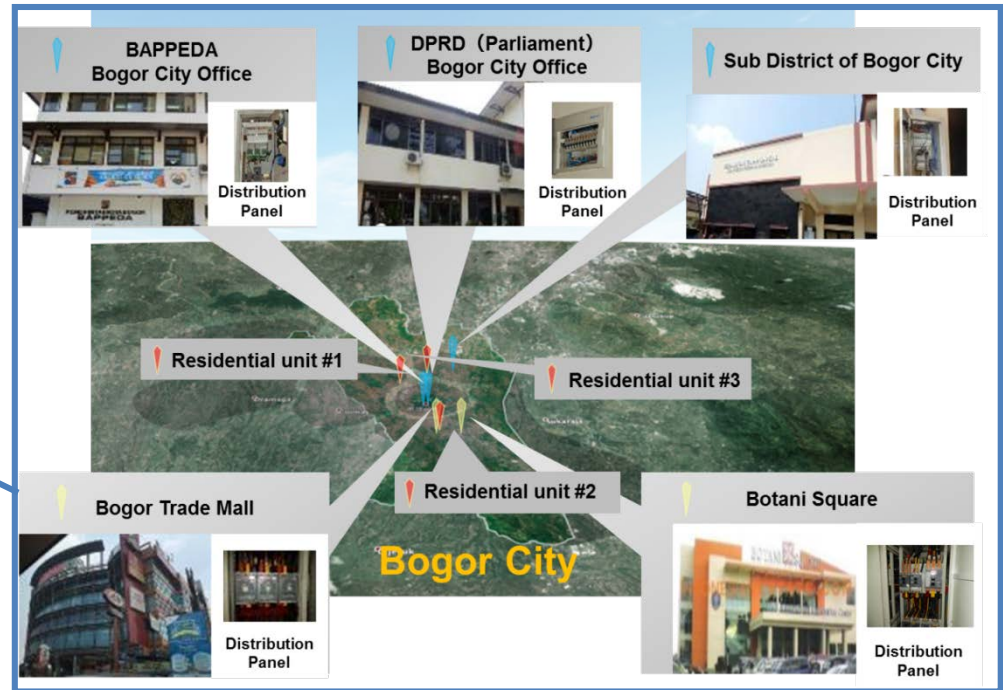
to identify the suitability of technology and policy packages based on the future targets and present situations

– Interactive Assessment

to apply methodology and tools into local planning and decision making process for Fukushima Restoration plans after radio–active pollution removal

Monitoring sites of Bogor City in 2014-2015

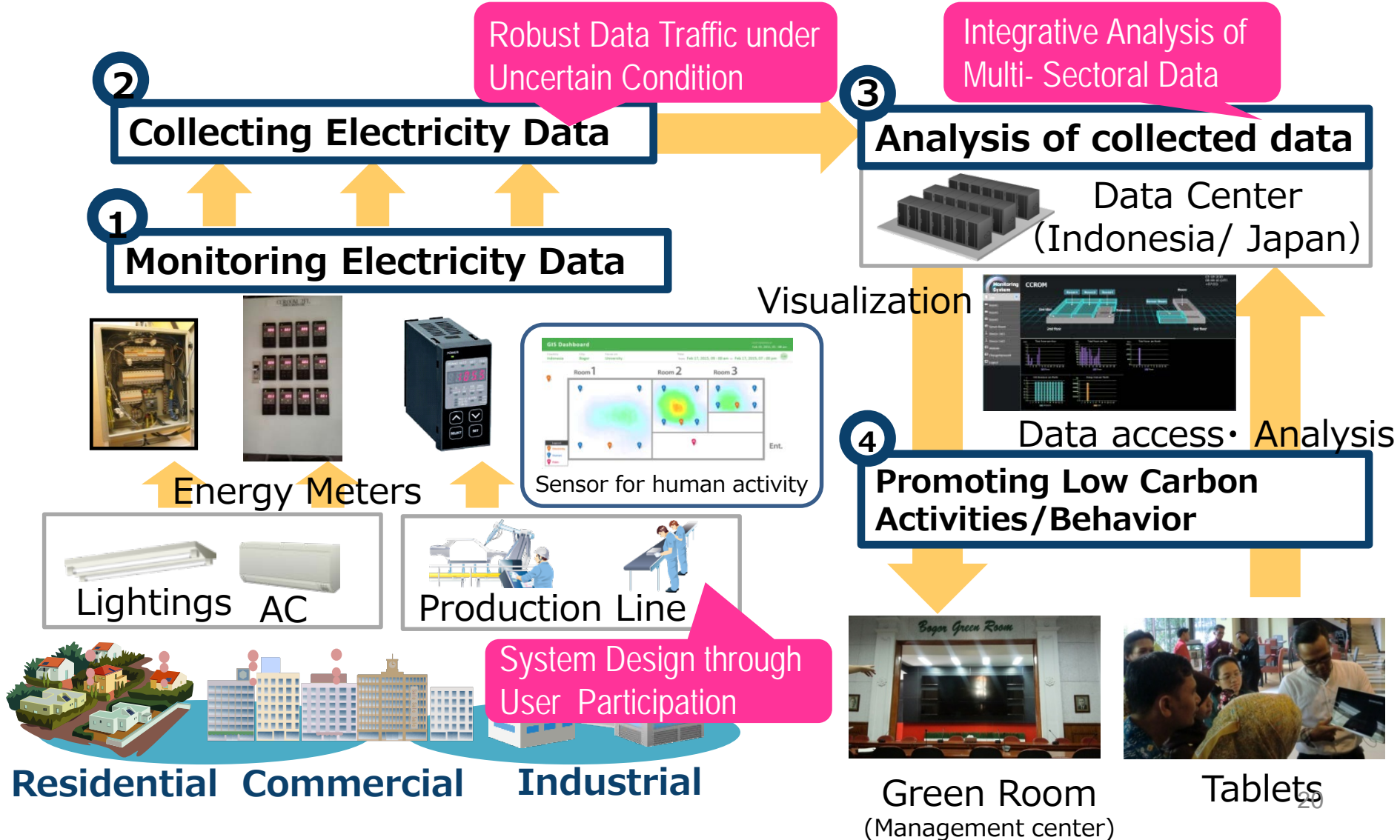
Shopping mall is targeted in 2015FY
50 monitoring points in Bogor city



Sector	Number of facilities	Number of point
Government building	3	30
Residential house	3	12
Commercial facilities	2	8

Action framework of urban monitoring system in Asia

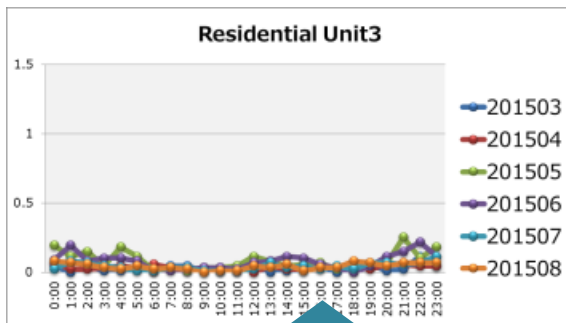
- Advanced internet security technologies effectively manage and protect the data
- Excellent recovery data collection capability
- Relationship analysis between human behavior and energy use



Analysis example in Residential Unit

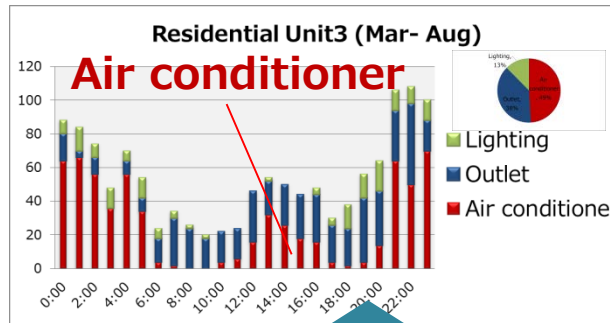
Potential of energy-saving is 15% in Residential Unit
Air conditioner has 50% of Electricity Consumption

1 Electricity demand of each month [kwh/h/m²]



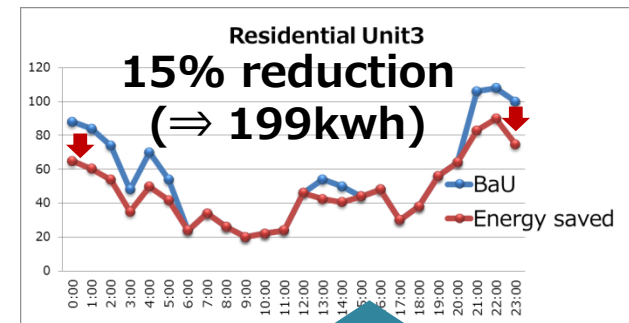
Variation of each month is small

2 Electricity demand characteristics [kwh/h]



Air conditioner has high percentage (50%)

3 Simulation of energy-saving [kwh/h]



Potential of Energy-saving is 15%

1. Raising the set temperature 2 degrees (4%)
2. Maintenance of equipment (3%)
3. Replacing to latest air conditioner (8%)

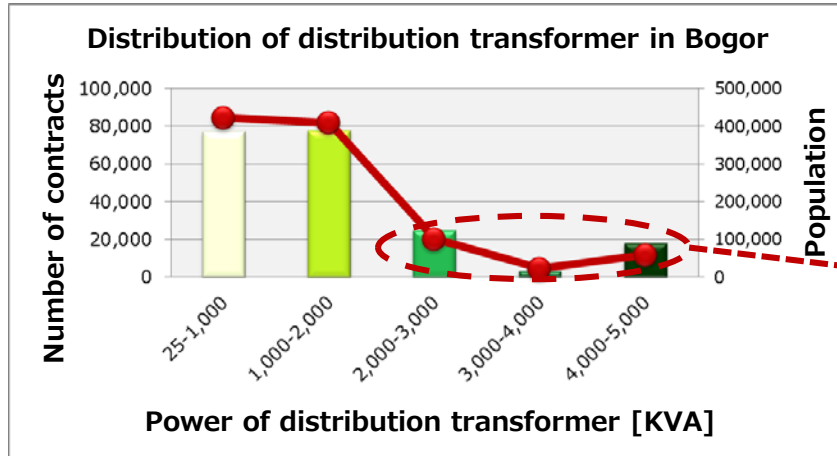


Potential of CO₂ reduction in Residential Unit:
 $199[\text{kwh/year}] \times 0.814[\text{kg/kwh}] \doteq 0.162[\text{tCO}_2/\text{year}]$
 (Indonesia <Java> FY2012)

Potential of CO2 reduction in Bogor city

Potential of residential and small facility in Bogor city is about **19,342 [tCO₂/year]** based on hypothesis

(1) Distribution of distribution transformer in Bogor



Possibility Range of low carbon development

(2) Potential of CO2 reduction in Bogor

※ ③ = ① × ②

Category	① Monitoring Result [tCO ₂ / year / facility] 【2000-3000KVA】	② Possibility Range [number of contracts] 【2000-5000KVA】	③ Reduction potential [tCO ₂ / year] 【2000-5000KVA】
Residential	0.162	49527	8040
Small Office	2.564	2949	7561
Small Commercial	4.365	857	3740
Total		53333	19342

Potential of residential, small office and small commercial is 19,000 [tCO₂ / year]

Future vision of Eco-city monitoring in Indonesia

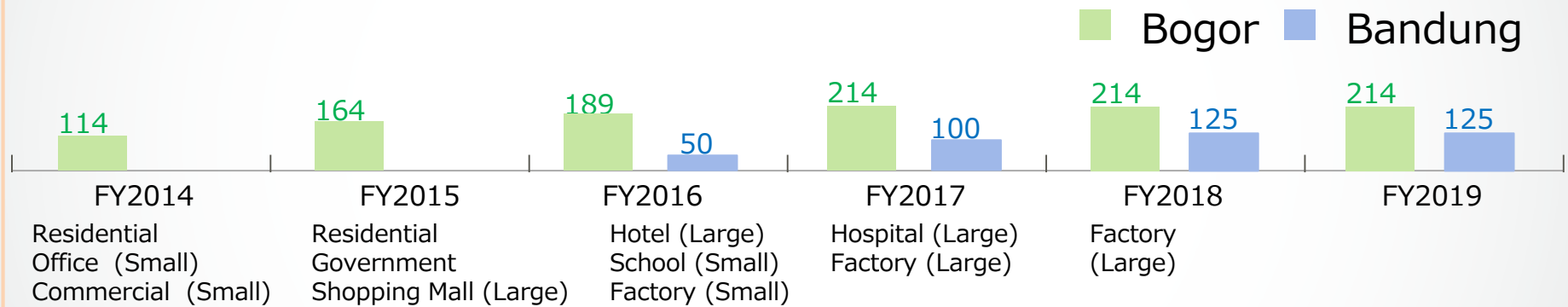
Monitoring Data
Oriented Innovation

Step1
6-year Plan

Step2 Evaluation of statistical sample value (890) by monitoring

Step 3
Compare with GOSAT data

Future Plan of Eco-city monitoring



City	Category	tCO ₂ /year/facility
Bogor	Residential	0.162
	Office (Small)	2.564
	Office (Large)	FY2017
	Commercial (Small)	4.365
	Office (Large)	FY2016

City	Category	tCO ₂ /year/facility
Bandung	Factory (Small)	FY2016
	Factory (Large)	FY2018

Interactive Eco-policy Planning System in Asia

Fukushima Shinchi Township

Community Assist Tablet Network



Local Needs

Regional Environment Information

National Institute for Env. Studies

Urban Spatial Analysis

Local environment diagnosis

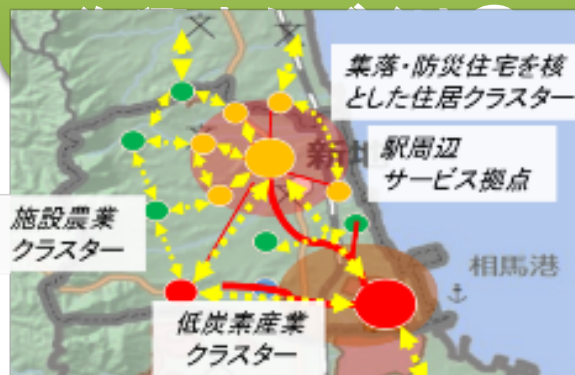
Integrated Modelling

Future scenario assessment

Tech. and policy inventory

- low carbon tech
- circulation tech
- industrial symbiosis
- policy / regulation
- land use control

Simulation for recovery roadmap



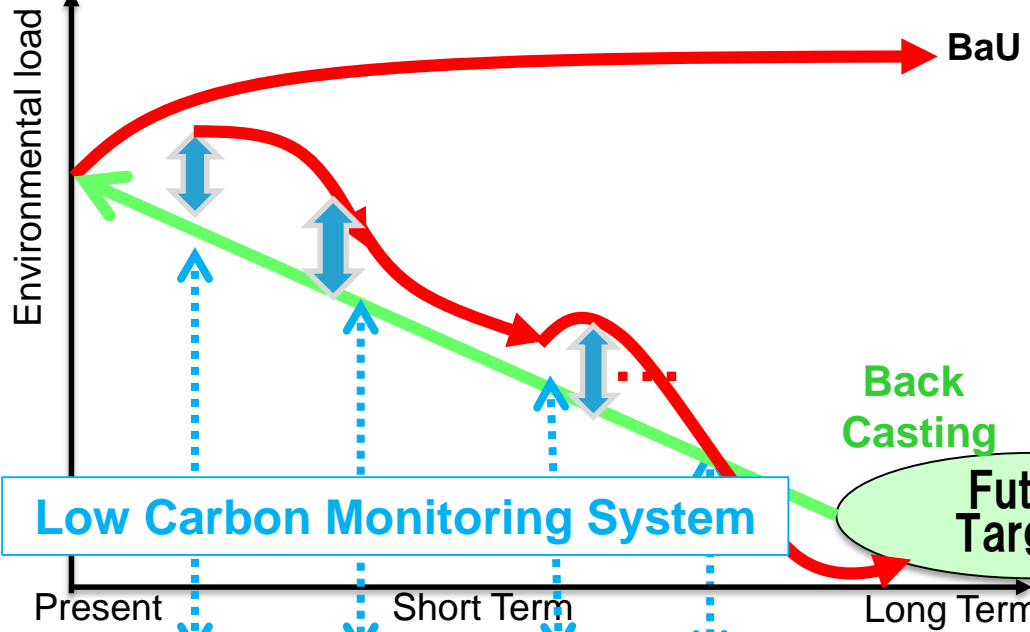
Planning for Sustainable Future



Innovative Modelling and Monitoring Research Project

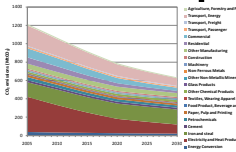
Low Carbon Solutions on Local Contents

Technology and policy Solution Design Adapting to Local Characteristics

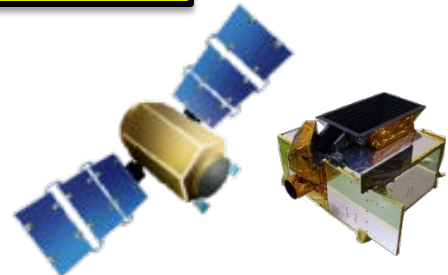
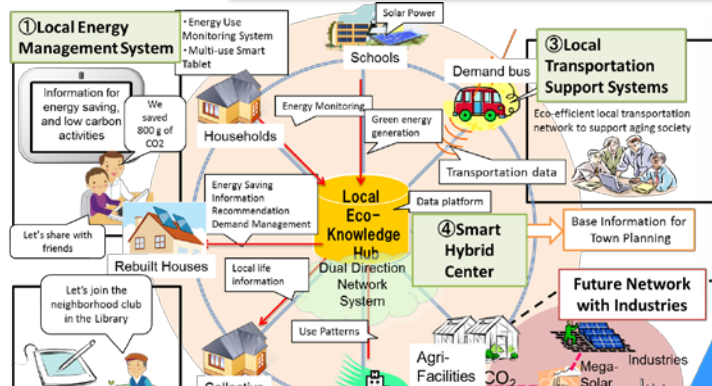


Integrated Model for Future Vision

Normative Targets by General Equilibrium Model



Dual Direction Low Carbon Monitoring Information System



List or related publications

- Yong Geng, Fujita Tsuyoshi, Xudong Chen; Evaluation of Innovative Municipal Solid Waste Management through Urban Symbiosis: A Case Study of Kawasaki, Environmental Sci and Tech., 2009 (revised)
- Rene Van Berkel, Tsuyoshi Fujita, Shizuka Hashimoto, Minoru Fujii ; Quantitative Assessment of Urban and Industrial Symbiosis in Kawasaki, Japan, Environmental Science & Technology , Vol.43, No.5, 2009 ,pp.1271-1281,0129.2009
- Rene van Berkel, Tsuyoshi Fujita, Shizuka Hashimoto, Yong Geng ; Industrial and Urban Symbiosis in Japan : Analysis of the Eco-Town Program 1997-2006 ; Journal of Environmental Management, vol.90,pp.1544-1556,2009
- Shizuka Hashimoto, Tsuyoshi Fujita, Yong Geng, Emiri Nagasawa ; Achieving CO2 Emission Reduction through Industrial Symbiosis: A Case of Kawasaki , Journal of Environmental Management, 2008 (submitted)
- Yong Geng, Qinghua Zhu, Brent Doberstein, Tsuyoshi Fujita ; Implementing China's Circular Economy Concept at the Regional Level: a review of progress in Dalian, China, Journal of Waste Management, vol.29,pp996-1002,2009
- Yong Geng, Rene Van Berkel , Tsuyoshi Fujita ; Regional Initiatives on Promoting Cleaner Production in China: A Case of Liaoning, Journal of Cleaner Production, 2008 (submitted)
- Zhu Qinghua, Yong Geng, Tsuyoshi Fujita , Shizuka Hashimoto ; Green supply chain management in leading manufacturers: Case studies in Japanese large companies, International Journal of Sustainable Development and World Ecology, 2008 (submitted)
- Yong Geng, Pang Zhang, Raymond P. Cote, Tsuyoshi Fujita ; Assessment of the National Eco-industrial Park Standards for Promoting Industrial Symbiosis in China, J. of Industrial Ecology, Vol.13, No.1, pp.15-26, 2008
- Looi-Fang Wong, Tsuyoshi Fujita, Kaiquin Xu ; Evaluation of regional bio-energy recovery by local methane fermentation thermal recycling systems, Journal of Waste Management,vol.28, pp.2259-2270, 2008

Thank you for your Attention