Summary of LCD studies in Asia

Session 7: Modeling session (2)

The 19th AIM International Workshop

December 13-14, 2013

Ohyama Memorial Hall, NIES

Tsukuba, Japan

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CONTENTS

- ✓ **Now, we have conducted 20 national and regional studies in Asia region.**
- ✓ **Explain what we imaged, in these studies, as the vision of Asian Low Carbon Societies**
- ✓ **Basic research procedure of our LC development scenario approach**
- ✓ **Tools prepared for developing Asian Low Carbon development Scenarios**
- ✓ **Applications to the Asian region and some lessons from them**

Outline of the Research on Asian Low Carbon Development Scenarios

1. **Considering domestic and international factors which will change dramatically in future, the studies tried to creating visions of Low Carbon Societies, prescribe the transitions, accumulations, and deepening of factors which control the realization of the Societies.**
2. **We took account of regional distinctive diversified characteristics of regions, with the qualitative and quantitative methodologies which were prepared in the studies.**
3. **We expected the studies to propose positive Asian Low Carbon Development Actions and roadmaps which realize the Low Carbon Societies.**

Low Carbon Society Visions and Development Actions, which the studies imaged were;

By the middle of this century (2030-2050), the societies will realized the followings;

1. **Harmonized with drastically evolving Asian societies and economies,**
2. **Complying with each region's reduction target that consists with the global low carbon target, under the global, national and regional constraints on fossil and renewal energy resources, land resource, and human capacity,**
3. **Utilizing the most of co-benefits of LC policies and neighboring policies.**

Up to now, we have applied our LCD research approach to 8 nations and 12 regions in Asia regions

Overall research procedure of the LC Development Scenario approach

- Area
- Base year
- Target year
- Covered sectors
- Actors/Players
- LCD target

Setting framework

Qualification of Socio-economic Vision

Quantification of Socio-economic Visions and GHG emission

Try and error to keep consistency and unity among Socio-Economic policies and LCD targets

Analysis of alternative LCD scenarios and measures

Design LCD Actions and Roadmaps from the analysis

- Demography
- Lifestyle
- Economy
- Transport
- Building
- Resource efficiency
- Energy strategy
- Power supply

Quantifications of parameters:

- Population
- Final demand
- Transport volumes and characteristics
- Energy service demand generation
- Share of energy kinds, devices
- Power supply volumes, characteristics, and future plans

Evaluation of Scenarios / measures:

- Transportation system
- Energy service demand generation
- Deployment of new energy devices
- Options of Power supply
- Renewable energy
- Carbon sink
- etc.

Some checking points of Low Carbon Development Scenario development

1. LC Society Visions and Development Actions should be;
   1-1) Technologically,
   1-2) Economically/Financially, and
   1-3) Institutionally
   feasible and efficient.
   →Multi-criteria problem

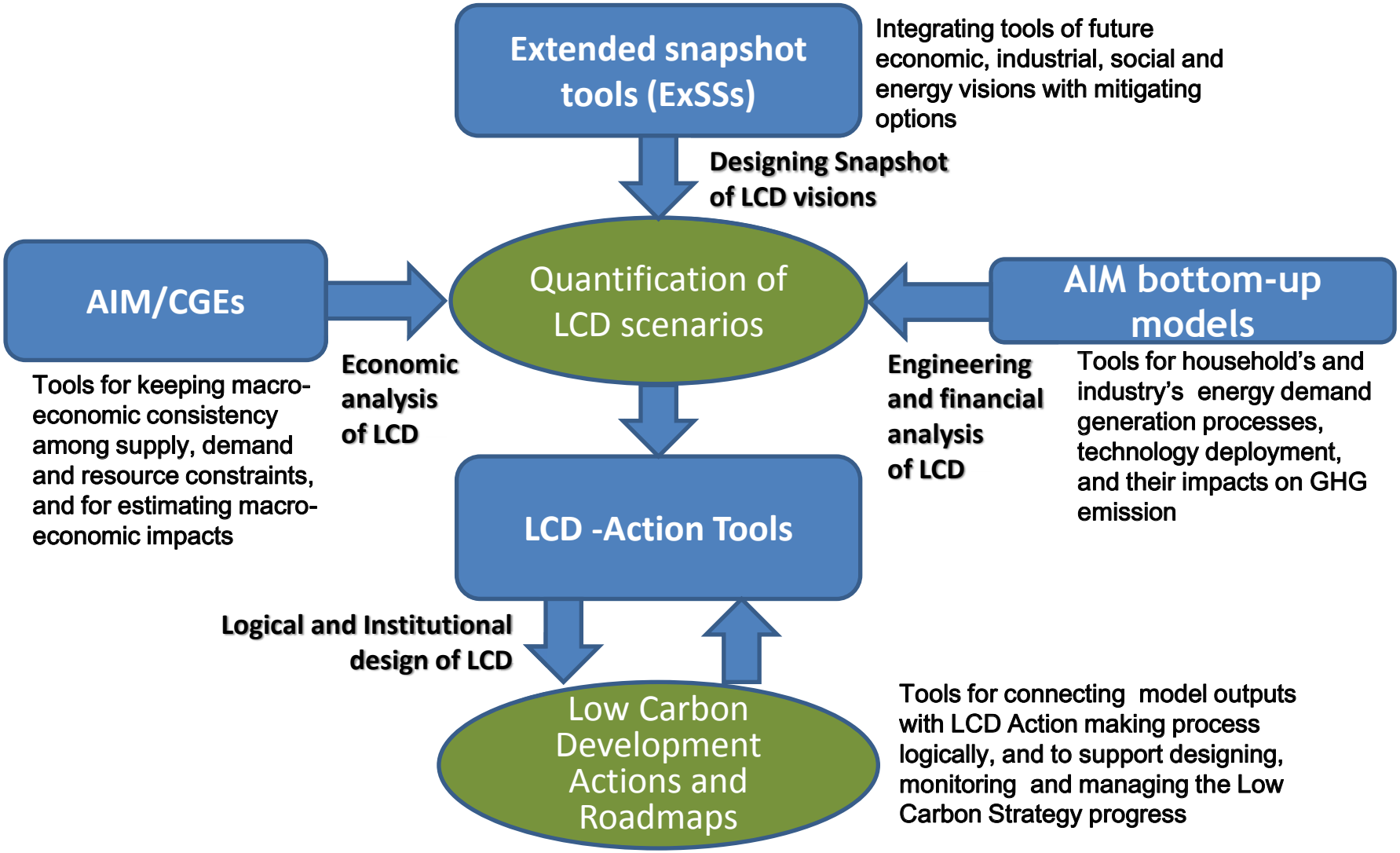
2. Also, they should be well harmonized, collaborating with related policies on:
   2-1) Vitalization of national/regional economy
   (Job creation, income increase, attraction to foreign direct investment, and so on),
   2-2) Enforcement of Environmentarity, Comfortability, and Security →Multi-objective problem

3. Importance of quantitativity, logicality, rationality and transparency of the scenarios and their development procedure

Tools to support constructing LCD scenarios

Question		Tool developed	Explanation
What kind of LCD measures are available?	→	LCM-DB	Low-carbon measures database
How to adjust diverse objectives and preferences among LCD Actions ?	→	AHP tool	Analytic hierarchy process tool
How to manage LCD Actions systematically ?	→	LCD-Action Tools	A group of Tools on Logical structure of LCD actions
How to develop quantitative visions, and check the feasibility with GHG reduction targets, industrial structure and so on?	→	ExSS,WASTE AFOLU-A	Extended snapshot tools.
What is the optimal technologies invested and how much are their costs?	→	AIM/Enduse AFOLU-B	AIM bottom-up models
How much is the impact to the regional macro-economy of LCD actions ?	→	AIM/CGEs	AIM Computable general equilibrium models
How to construct the schedule of LCD actions?	→	BCT	Backcasting tool

How to combine the tools in order to keep consistency and unity among Socio-Economic policies and LCD actions



An examples of socio-macroeconomic Impact Evaluation of Alternative LCD Scenarios

Combined outputs of ExSS , CGE, Enduse model, Shiga study

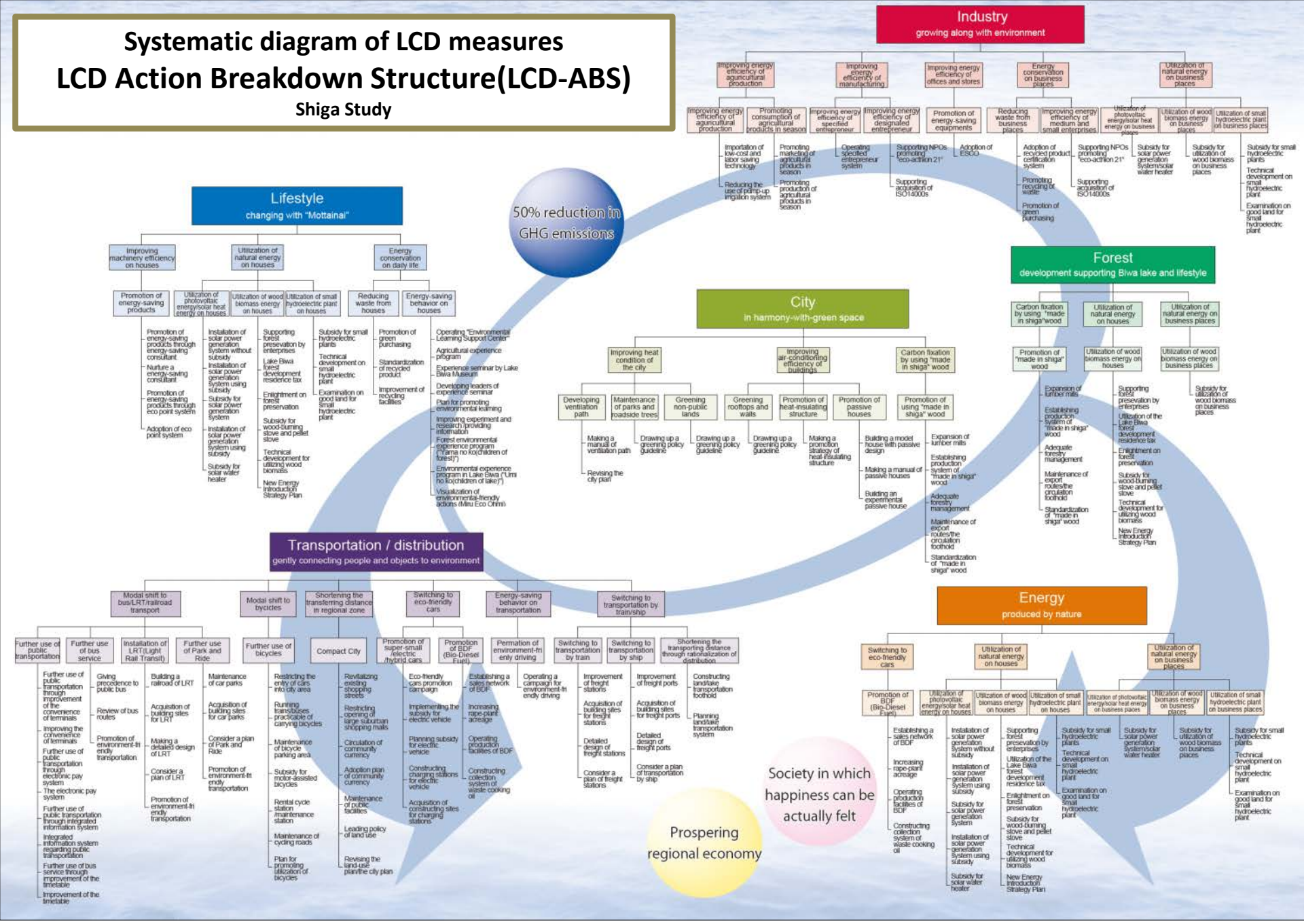
- Comparison among one BaU scenario and three alternative LCD scenarios
- Technocentric scenario: focused on the vitalization of eco-industry in the region
- Agrocentric scenario: focused on the regional renewable energy production
- Balanced scenario: balanced mix of Technocentric and Agrocentric scenarios

	Scenario	Unit	Base year	BaU		Balanced		Technocentric		Agrocentric	
	year		2000	2030	2030/2000 (%)	2030	2030/2000 (%)	2030	2030/2000 (%)	2030	2030/2000 (%)
Quantified Targets	GHG emission	ktCO2eq	12876.7	14369.5	11.6	6275.8	-51.3	6515.6	-49.4	6425.5	-50.1
	TN load to lake Biwa	kt	6.7	6.6	-1.5	3.3	-50.7	3.3	-50.1	3.3	-50.3
	TP load to lake Biwa	kt	0.38	0.39	2.6	0.09	-76.3	0.10	-74.9	0.10	-75.0
	COD load to lake Biwa	kt	16.2	15.1	-6.8	7.7	-52.5	7.9	-51.4	8.3	-48.8
	Waste final disposal	kt	377.8	400.1	5.9	168.7	-55.4	173.8	-54.0	182.5	-51.7
Social Macro-economic Impacts	Total energy consumption	ktoe	12145.9	13783.2	13.5	6214.4	-48.8	4506.1	-62.9	8477.8	-30.2
	Population	1000	1396.9	1380.8	-1.2	1401.6	0.3	1378.8	-1.3	1405.3	0.6
	Gross Regional Production (GRP)	Bill. JPY/y	5884.0	7677.0	30.5	7737.5	31.5	7708.0	31.0	7655.1	30.1
	Implementation cost (direct financial cost)	Bill. JPY/y		0.0		343.0		370.7		210.5	
	Macro-economic impact (GRP change from BaU)	Bill. JPY/y		0.0		60.5		31.0		-21.9	
	Created Job	1000		0.0		20.1		25.7		15.6	

: Targeted for 75%(-0.75) reduction

: Targeted for 50%(-0.50) reduction

Systematic diagram of LCD measures
LCD Action Breakdown Structure(LCD-ABS)
Shiga Study

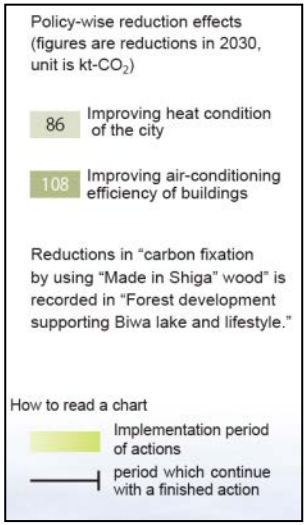


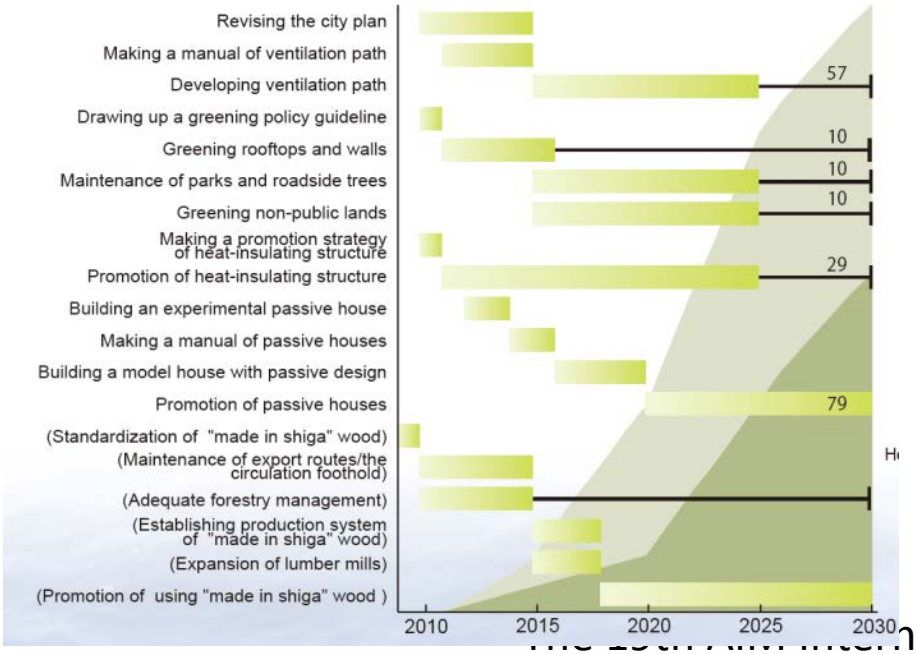
AIM
ASIA-PACIFIC INTEGRATED MODEL

Necessary timing of actions backcasted and their effects (1)

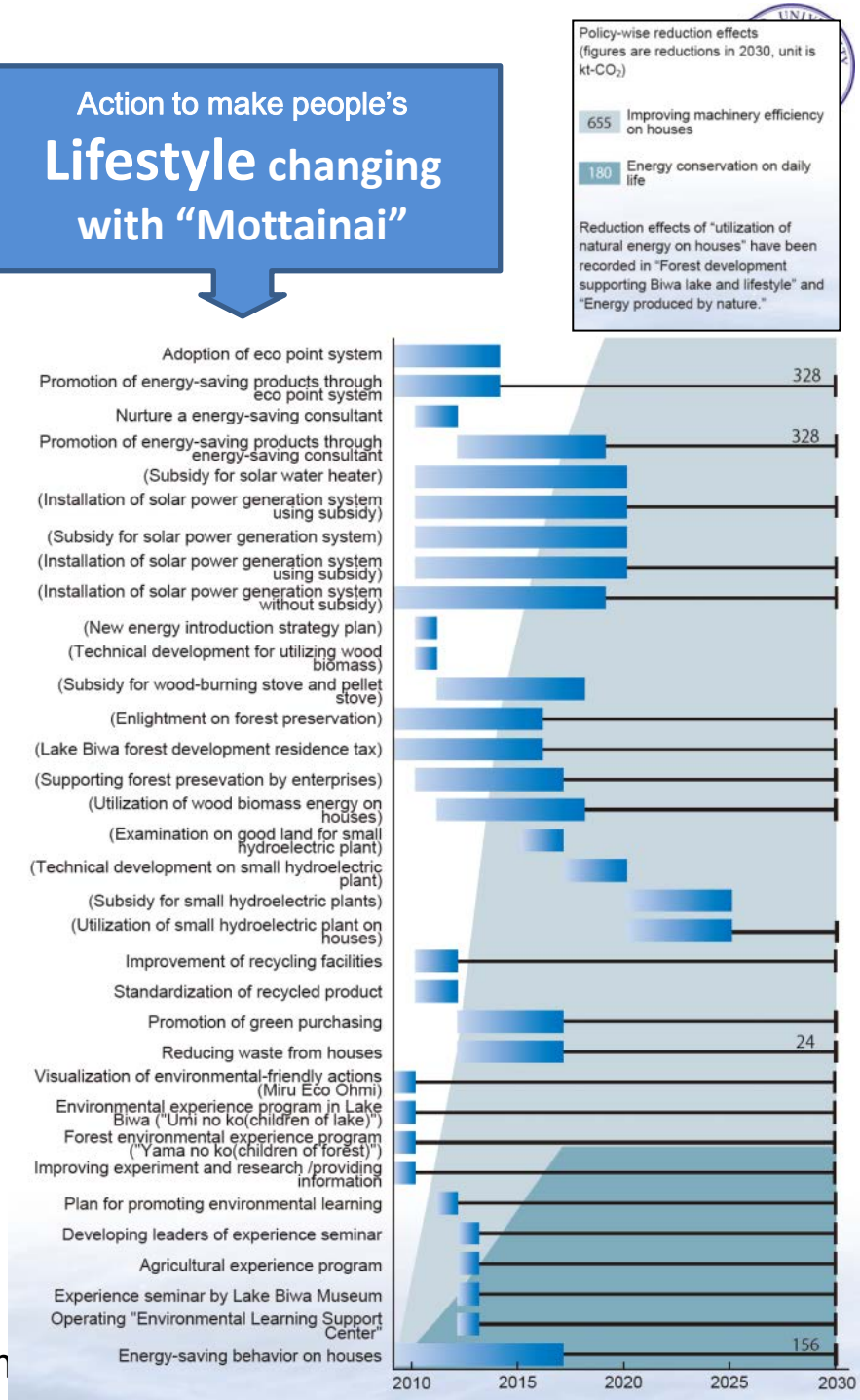
Outputs of BCT, Shiga study

Action to make the City as harmony-with-green space



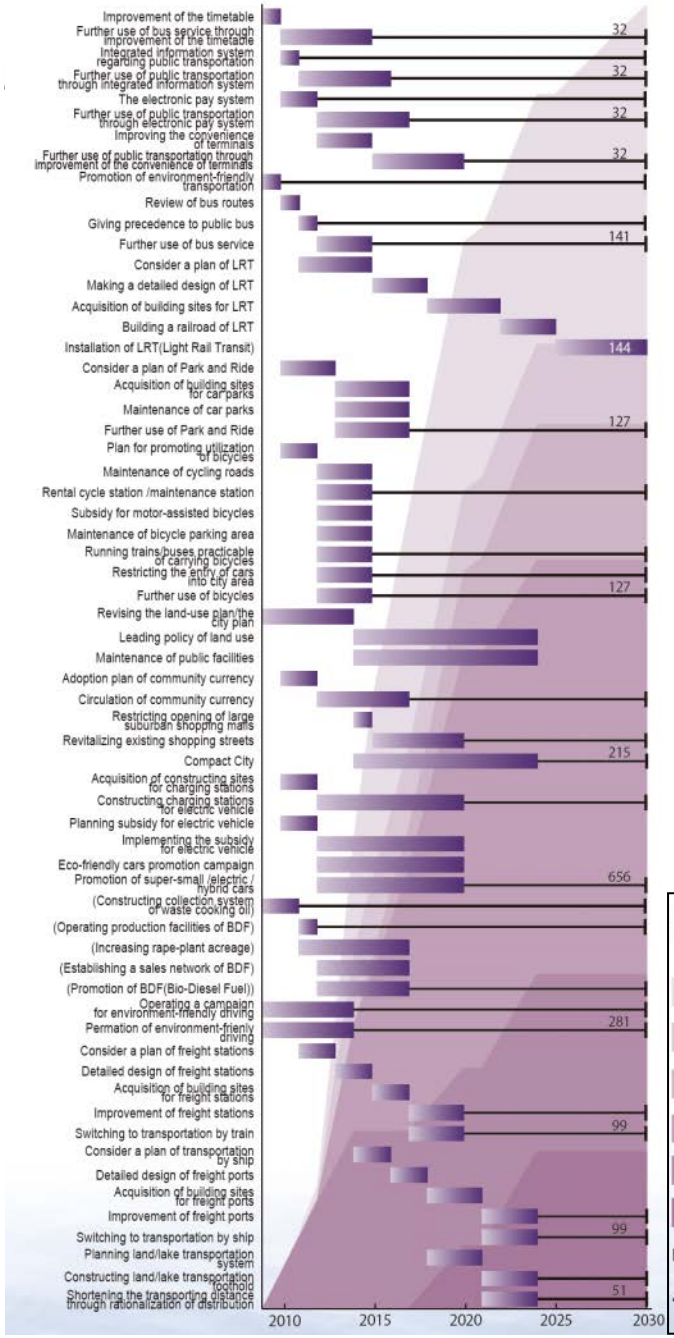


Action to make people's Lifestyle changing with "Mottainai"



Necessary timing of actions backcasted and their effects (2)

Outputs of BCT, Shiga study



Action to make the **Transportation/ distribution** gently connecting people and objects to environment

Policy-wise reduction effects
(figures are reductions in 2030, unit is kt-CO_2)

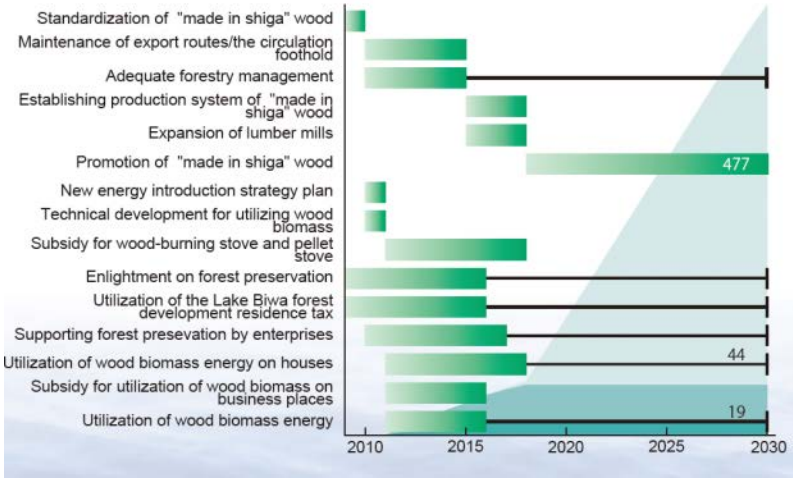
538	Modal shift to bus/LRT/railroad transport
127	Modal shift to bycicles
215	Shortening the transferring distance in regional zone
656	Switching to eco-friendly cars(except as BDF)
281	Energy-saving behavior on transportation
249	Switching to transportation by train/ship

Bio-diesel fuel (BDF) related reductions included in "switching to eco-friendly cars" are recorded in "Energy produced by nature."

Action to make **Forest development** supporting Biwa lake and lifestyle

Policy-wise reduction effects
(figures are reductions in 2030, unit is kt-CO_2)

477	Carbon fixation by using "made in shiga"wood
44	Utilization of natural energy on houses (wood biomass)
19	Utilization of natural energy on business places and agriculture (wood biomass)



Necessary timing of actions backcasted and their effects (3)

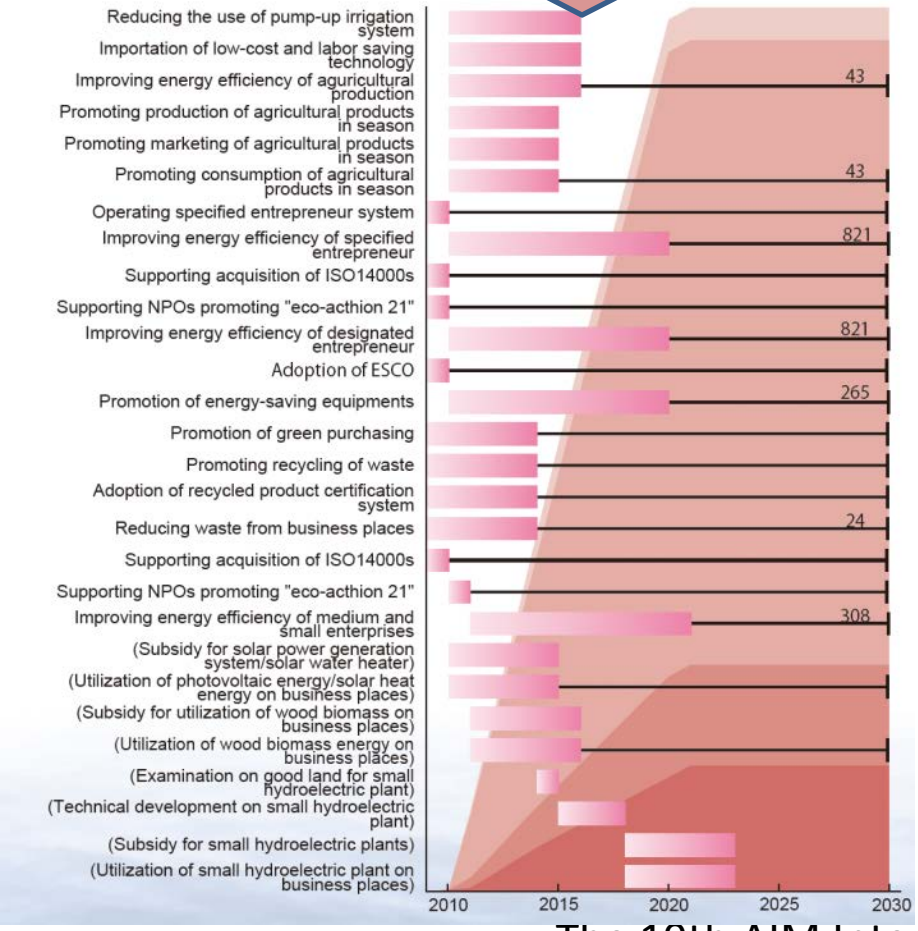
Outputs of BCT, Shiga study

Policy-wise reduction effects
(figures are reductions in 2030, unit is kt-CO_2)

- 86 Improving energy efficiency of aguricultural production
- 1643 Improving energy efficiency of manufacturing
- 265 Improving energy efficiency of offices and stores
- 332 Energy-saving behavior on business places

Reductions achieved due to "Utilization of natural energy in agriculture and at business places" are recorded in "Energy produced by nature" and "Forest development supporting Lake Biwa and lifestyle."

Action to make Industry growing along with environment

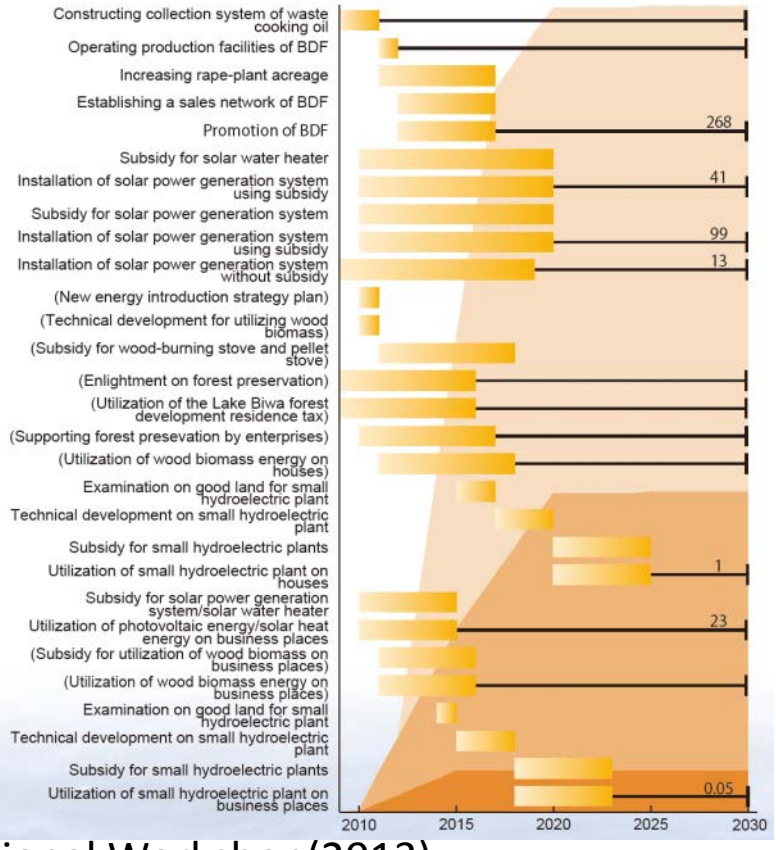


Action to make Energy produced by nature

Policy-wise reduction effects
(figures are reductions in 2030, unit is kt-CO_2)

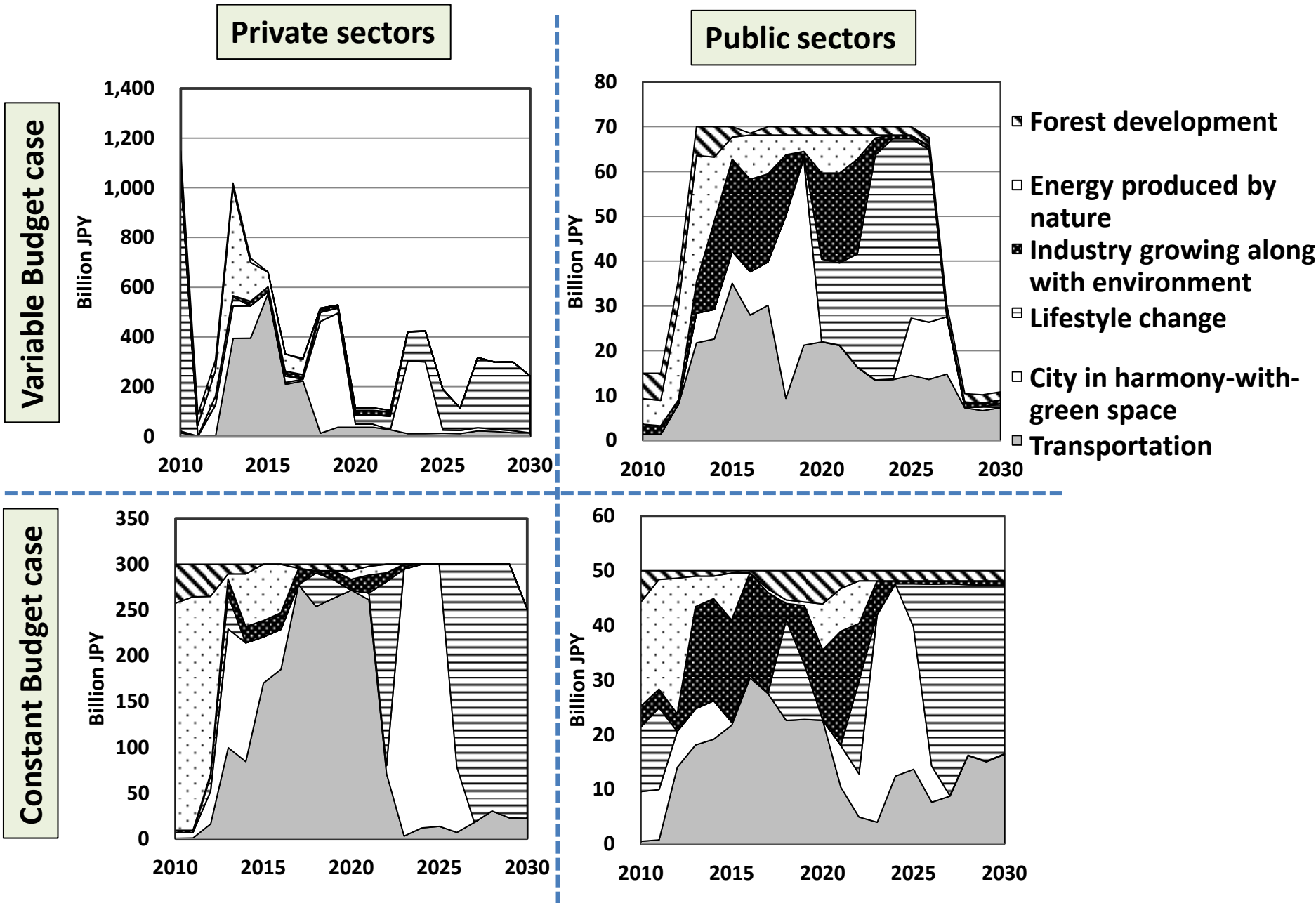
- 268 Switching to eco-friendly cars (promotion of BDF)
- 154 Utilization of natural energy on houses (except wood biomass)
- 23 Utilization of natural energy on business places and agriculture (except wood biomass)

Reductions achieved from wood biomass in "utilization of natural energy in houses" and "Utilization of natural energy in agriculture and at business places" is recorded in "Forest development supporting Lake Biwa and lifestyle."



Annual cost flows for implementation

Outputs of BCT, Shiga study



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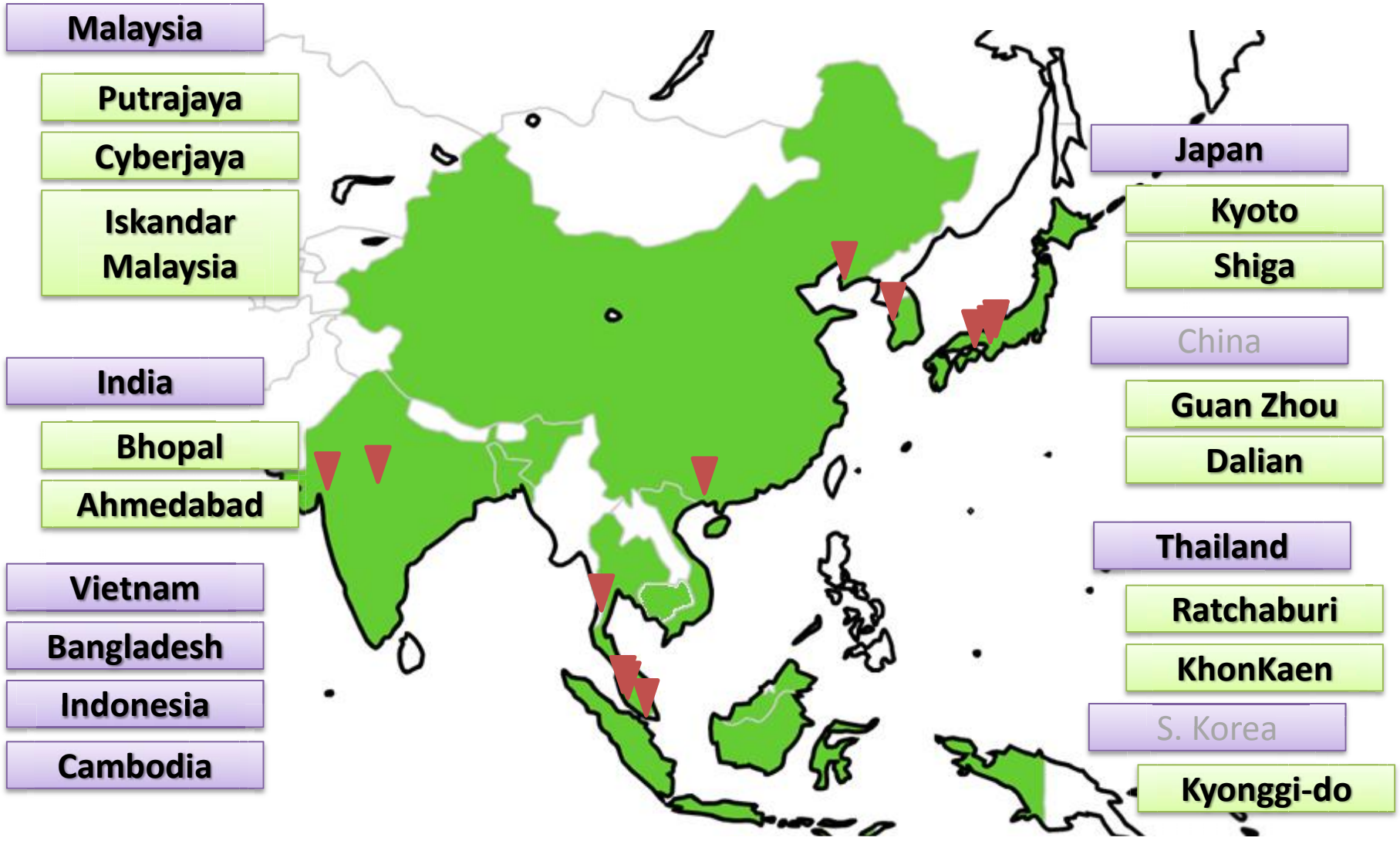
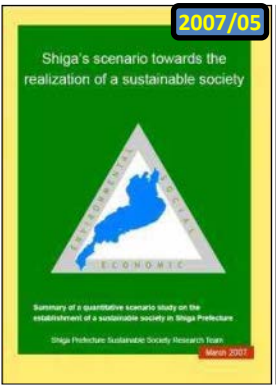
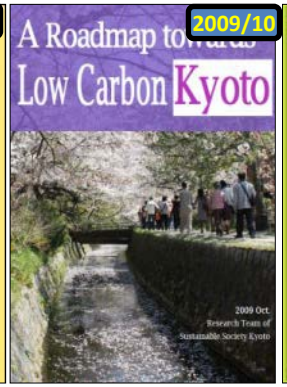
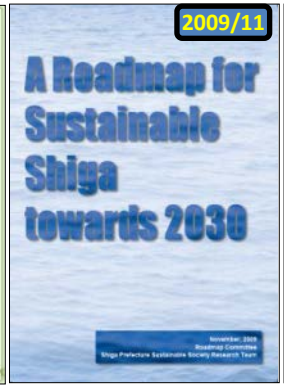


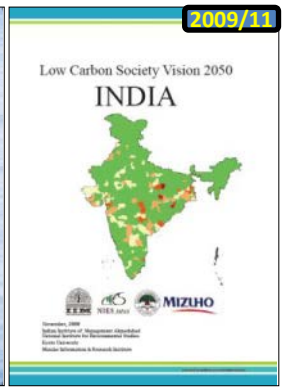
Examples of Brochures introducing Asian Low Carbon Scenarios

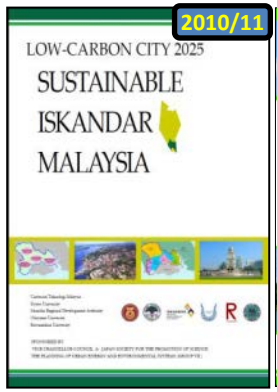
Communication and feedbacks of LCD study to real world

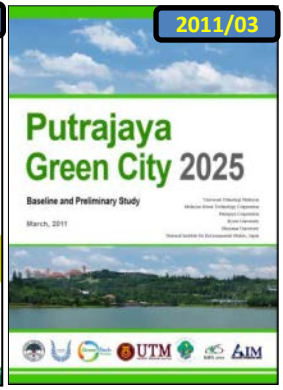


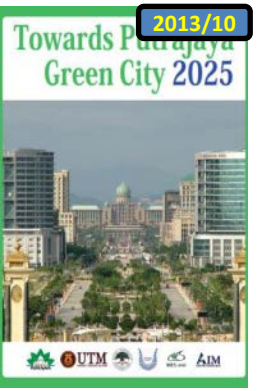


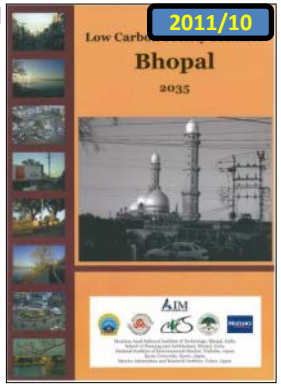


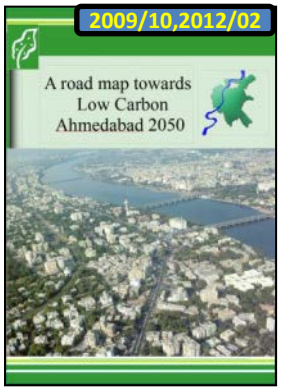


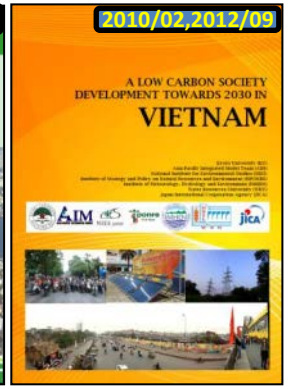


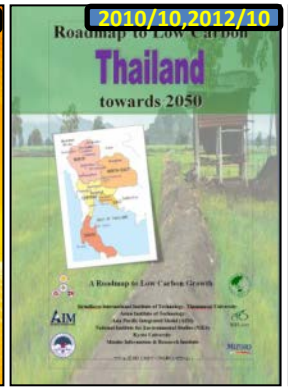


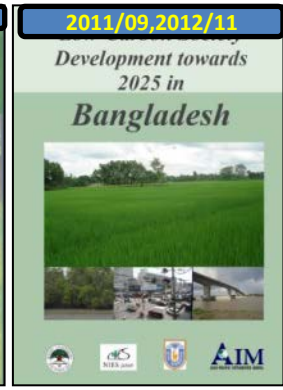


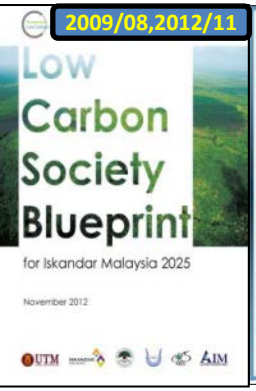


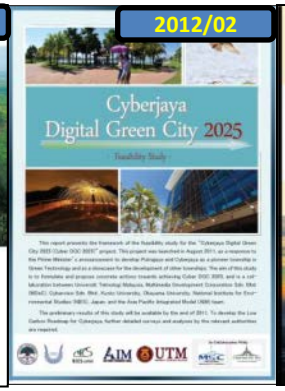


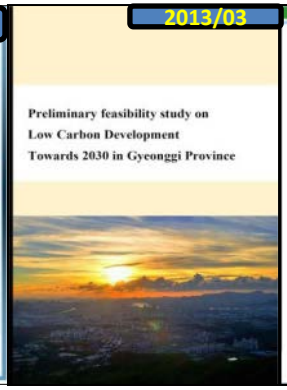


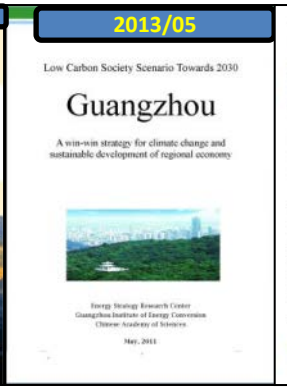


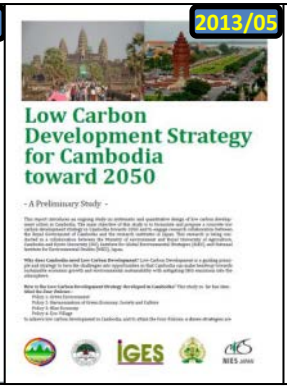


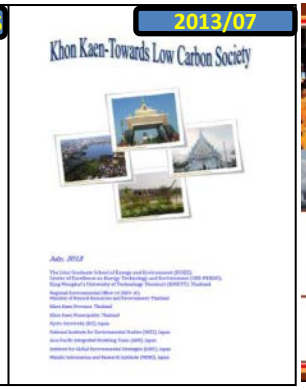


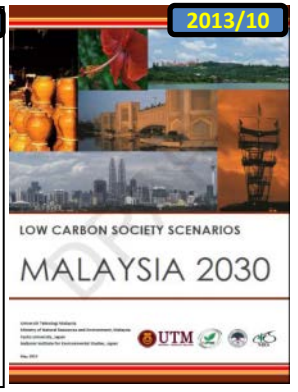




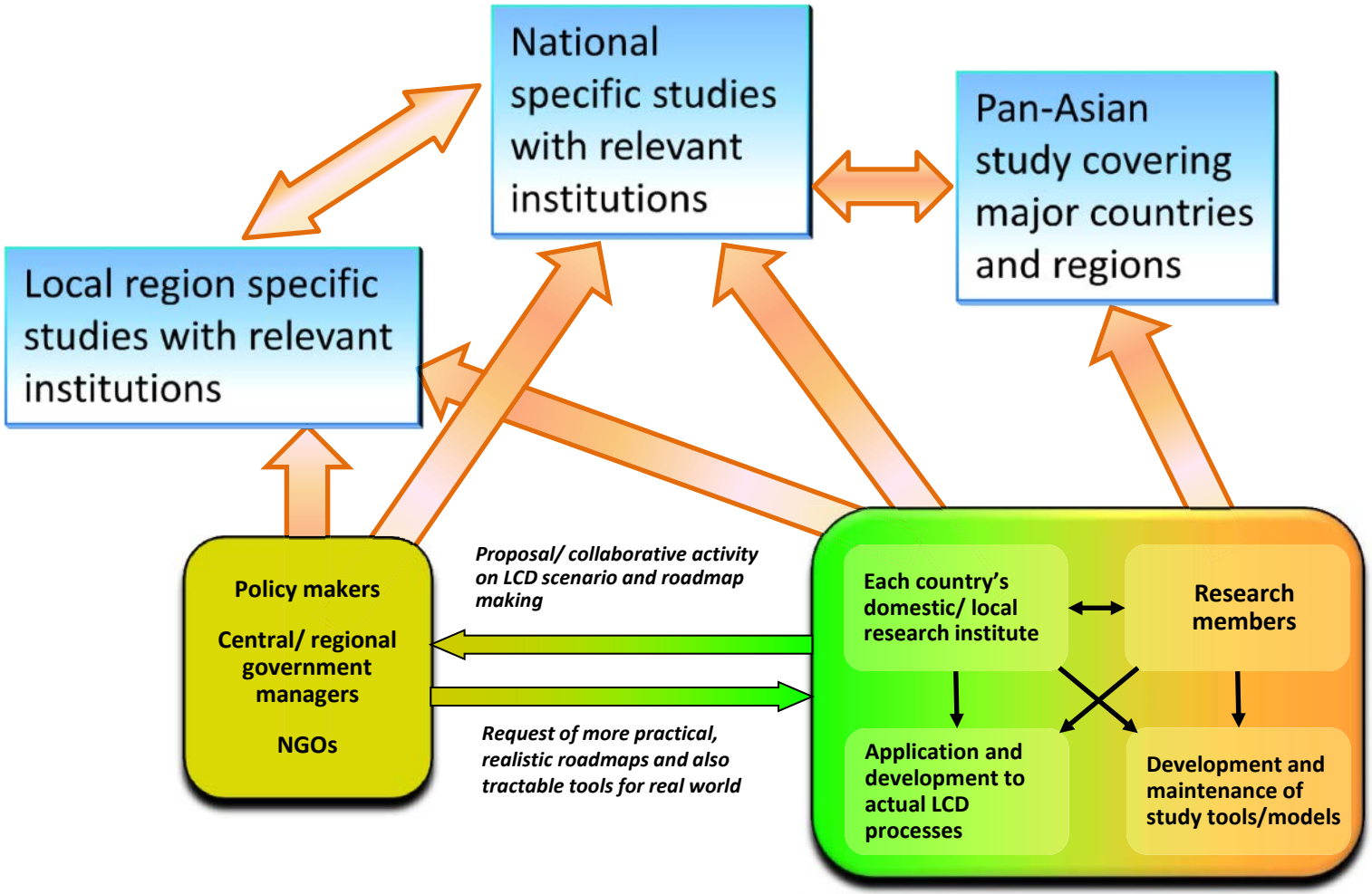








In order to make these actions happen, collaboration with central/regional governments and researchers in Asian region is necessary. Through this activities, their capacity developments are strongly expected



Some extracts of outputs from the Asian LCD studies

Per capita emission: 0.6 to 13.4 tCO_2, Percent reduction from BaU: 22% to 85%, and population weighted average emission in the most stringent policy cases is 10% increase in 2030 from 2005 .

Coutry /Region	Region code	Scenario code	Covered sectors	Base year information						Target year information						Year of study
				Year	Population (1000)	GDP (GRP) total	GDP (GRP) per cap (USD)	GHG emission total	GHG emission per cap (tCO2)	Year	GHG emission in BaU	GHG emission with Actions (% change from base year)		(% change from BaU)	Number of Actions	
Shiga prefecture	JPN-SIG	JPN-SIG2030	Energy, Waste, Forestry, Water pollution, Industrial process	2000	1397	5884 Bill. JPY	40811	12877 ktCO2eq	9.2	2030	14369 (11.6)	6276 (-51.3)		(-56.3)	6 Actions	2007
Kyoto city	JPN-KYT	JPN-KYT2030	Energy, Waste, Forestry	2005	1470	6124 Bill. JPY	40365	8015 ktCO2eq	5.5	2030	8897 (11.0)	4586 (-42.8)		(-48.5)	6 Actions	2009
Dalian province	CHN-DLN	CHN-DLN2020	Energy	2007	5721	294 Bill. CNY	6201	46010 ktCO2eq	8.0	2020	177760 (286.4)	123490 (168.4)		(-30.5)	-	2010
Dalian province	CHN-DLN	CHN-DLN2050	Energy	2007	5721	294 Bill. CNY	6201	46010 ktCO2eq	8.0	2050	651460 (1315.9)	256250 (456.9)		(-60.7)	-	2010
Guang Zhou city	CHN-GZ	CHN-GZ2030	Energy	2005	9600	506 Bill. CNY	6368	98 MtCO2eq	10.2	2030	336 (242.9)	165 (68.4)		(-50.9)	5 Actions	2013
Khon Kaen province	THA-KK	THA-KK2050	Energy, Waste, AFOLU	2005	1750	2933 Mill. USD	1676	2372 ktCO2eq	1.4	2050	7525 (217.2)	5173 (118.1)		(-31.3)	3 Strategies	2013
Khon Kaen province	THA-KK	THA-KK2030	Energy, Waste, AFOLU	2005	1750	2933 Mill. USD	1676	2372 ktCO2eq	1.4	2030	5256 (121.6)	3585 (51.1)		(-31.8)	3 Strategies	2013
Gyeonggi province	KOR-GYG	KOR-GYG2030	Energy, Land use	2005	10600	169 Tril. KRW	15348	76 MtCO2eq	7.1	2030	162 (114.7)	126 (67.2)		(-22.1)	-	2012
Putrajaya district	MYS-PTJ	MYS-PTJ2030	Energy, Waste, Forestry	2007	49	1062 Mill. MYR	5653	664 ktCO2eq	13.4	2030	4186 (530.4)	1780 (168.1)		(-57.5)	12 Actions	2012
Iskandar Malaysia	MYS-ISK	MYS-ISK2025	Energy, Waste, Forestry	2005	1353	36 Bill. MYR	6944	11 MtCO2eq	8.4	2025	31 (174.6)	19 (65.8)		(-39.6)	12 Actions	2013
India	IND	IND2050	Energy	2005	1103000	33 Tril. INR	680	1292 MtCO2eq	1.2	2050	7241 (460.4)	3114 (141.0)		(-57.0)	10 Actions	2009
Bhopal city	IND-BPL	IND-BPL2035	Energy	2005	1844	70 Bill. INR	868	3 MtCO2eq	1.4	2035	12 (380.0)	7 (180.0)		(-41.7)	7 Actions	2011
Ahamedabad city	IND-AMD	IND-AMD2035	Energy	2005	4700	305 Bill. INR	1483	10 MtCO2eq	2.2	2035	44 (332.4)	25 (140.4)		(-44.4)	8 Actions	2010
Ahamedabad city	IND-AMD	IND-AMD2050	Energy	2005	4700	305 Bill. INR	1483	10 MtCO2eq	2.2	2050	86 (746.1)	25 (140.8)		(-71.5)	8 Actions	2010
Vietnam	VNM	VNM2030	Energy, AFOLU	2005	83100	818 Tril. VND	615	151 MtCO2eq	1.8	2030	601 (298.0)	379 (151.0)		(-36.9)	11 Actions	2012
Bangladesh	BGD	BGD2035	Energy, AFOLU	2005	140000	4 Tril. BDT	446	88 MtCO2eq	0.6	2035	310 (252.4)	179 (104.1)		(-42.1)	-	2010
Indonesia	IDN	IDN2050CM1	Energy	2005	219000	1787 Tril. IDR	887	299 MtCO2eq	1.4	2050	4341 (1351.8)	2263 (656.9)		(-47.9)	-	2010
Indonesia	IDN	IDN2050CM2	Energy	2005	219000	1787 Tril. IDR	887	299 MtCO2eq	1.4	2050	4341 (1351.8)	670 (124.1)		(-84.6)	-	2010
Thailand	THA	THA2030	Energy	2005	60991	8017 Mill. THB	3391	185983 ktCO2eq	3.0	2030	563730 (203.1)	324170 (74.3)		(-42.5)	9Actions	2010
Malaysia	MYS	MYS2020EXT	Energy, Waste, AFOLU	2005	26128	509 Bill. MYR	5129	270710 ktCO2eq	10.4	2020	533575 (97.1)	418709 (54.7)		(-21.5)	-	2013
Malaysia	MYS	MYS2020APS	Energy, Waste, AFOLU	2005	26128	509 Bill. MYR	5129	270710 ktCO2eq	10.4	2020	533575 (97.1)	318567 (17.7)		(-40.3)	-	2013
Malaysia	MYS	MYS2030EXT	Energy, Waste, AFOLU	2005	26128	509 Bill. MYR	5129	270710 ktCO2eq	10.4	2030	741247 (173.8)	429007 (58.5)		(-42.1)	-	2013
Malaysia	MYS	MYS2030APS	Energy, Waste, AFOLU	2005	26128	509 Bill. MYR	5129	270710 ktCO2eq	10.4	2030	741247 (173.8)	359837 (32.9)		(-51.5)	-	2013
Japan	JPN	JPN2050A	Energy, Waste, Forestry, Water pollution, Industrial process	2000	126926	520 Trill. JPY	39690	1144 MtCO2eq	9.0	2050	—	(—)	312 (-72.8)	(—)	12 Actions	2008
Japan	JPN	JPN2050B	Energy, Waste, Forestry, Water pollution, Industrial process	2000	126926	520 Trill. JPY	39690	1144 MtCO2eq	9.0	2050	—	(—)	312 (-72.8)	(—)	12 Actions	2008

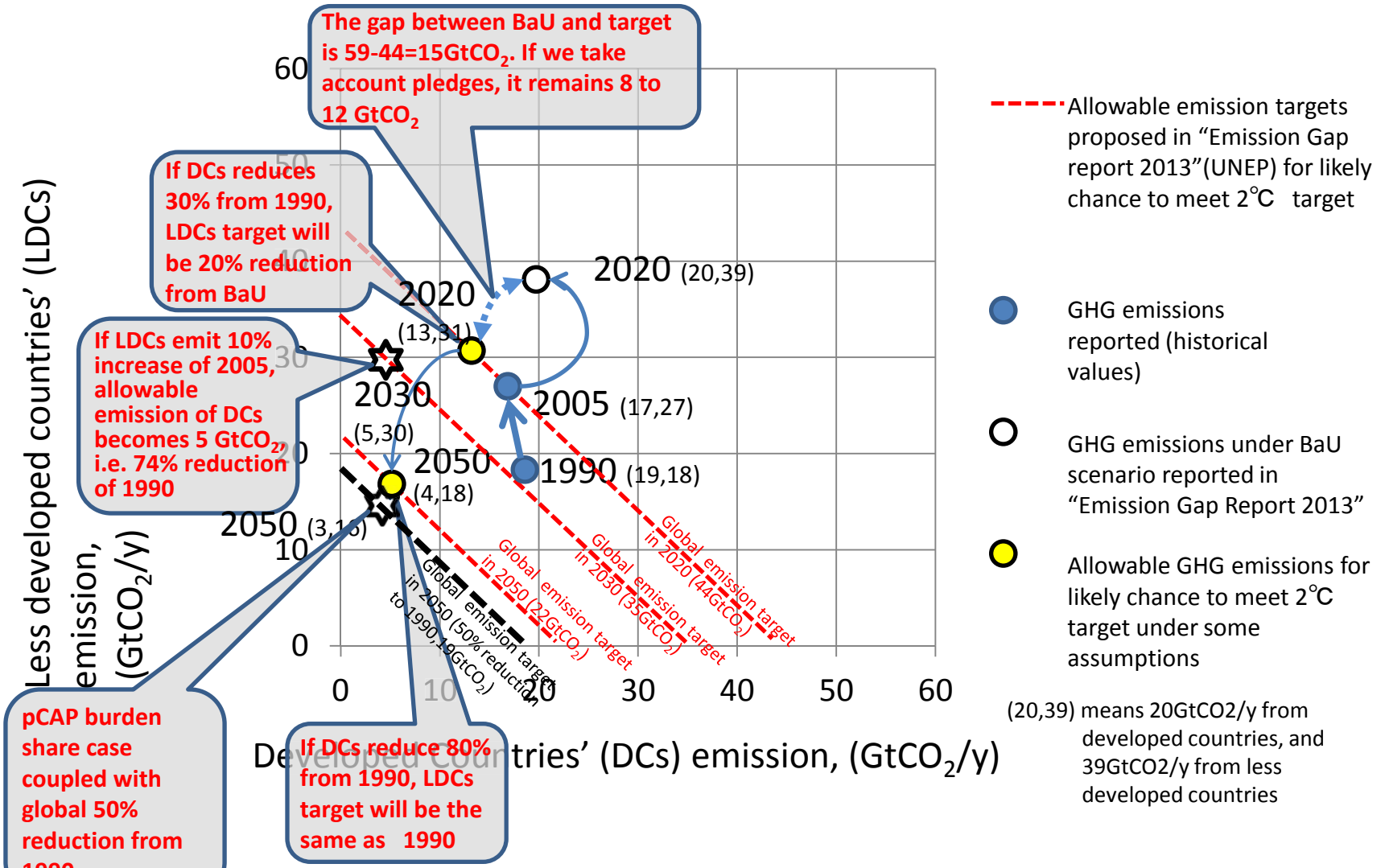
Required GHG reduction ratios in 2050 compared with year 2005, to meet the global 50% reduction are:

Burden share sheme	Required GHG reduction ratios (%) compared with year 2005											
	World	Annex-I	Non-Annex I	Asia except Japan	China	India	Indonesia	Japan	Korea	Malaysia	Thailand	Vietnam
pCAP	58	83	42	42	68	-51	15	83	85	67	61	12
pGDP	58	46-58	57-65	58-63	59-61	41-53	67	18-43	49-57	57-60	54-65	60-74
pCUM	58	95	34	43	97	-100	49	94	99	93	85	32

Minus is an increase of allowable emission compared with year 2005
Values of Indnesia and Malaysia are excluding emission/sink of LULC sectors
Ranges of pGDP are corresponding with ranges of GDP projections in references
pCAP: Equal per capita emission
pGDP: Equal per GDP emission
pCUM: Converge to equal cumulative emission per capita, after 2075

Matsuoka, et al., 2013, How to approach Asian Low-Carbon Societies?
Global Environmental Research, 17(1), 3-10

Allowable emissions in Developed Countries (DCs) and Less Developed Countries (LDCs)



Final Remarks

—Lessons from the experience of applying the approach—

1. Importance of 1) showing explicitly and quantitatively the alternative scenarios, 2) proposing several combinations of necessary actions/policies which keep the prescribed targets, 3) indicating and comparing illustratively their social, economical and financial effects of the proposed actions.

2. Importance of describing explicitly and quantitatively the role of constraints, such as;
   1) Financial constraint, 2) Experts capacity constraint, and 3) Management capacity constraint
   And also
   4) Complimentarily and competitivity of these constraints with related policies

3. Strong leadership and ownership of Scenarios/Actions by the domestic regional partners, who can modify, improve and maintain the Scenarios/Actions by themselves, and facilitate the discussion among regional leaders, citizens and researchers towards Low Carbon Developments.