Transition to Sustainable Energy & Low Carbon Systems in Developing Countries

2011 International Modeling Conference

2011 개도국 온실가스 감축분석모형 국제포럼

2011 7.8 (금) 09:00~18:00
코엑스 그랜드볼룸

주최: 환경부 GIR 온실가스종합정보센터

후원: 녹색성장 GREEN GROWTH KOREA 대통령직속 녹색성장위원회

2011 개도국 온실가스 감축분석모형 국제포럼 • 2011 International Modeling Conference •

Transition to Sustainable Energy & Low Carbon Systems in Developing Countries

개도국의 지속 가능한 에너지 및 저탄소 시스템으로의 전환

Welcoming Address

From President of Greenhouse Gas Inventory & Research Center of Korea

Immediately following its inauguration last June, the Greenhouse Gas Inventory & Research Center of Korea (GIR) launched its international GHG mitigation analysis conference series, gathering experts from around the world to discuss the modeling efforts of both, developed and developing countries, including bottom-up and top-down models, at the first annual "International Conference on Post-Kyoto Climate Change Mitigation Modeling". At that event, GIR had proposed to build cooperative efforts for developing countries to advance their capacity for modeling analysis. Thus, the Cooperative Green Growth Modeling Forum (C2GMF) Steering Committee was initiated this past March in Incheon (Songdo), Republic of Korea.

At this year's conference, themed on the "Transition to Sustainable Energy and Low Carbon Systems in Developing Countries", we will discuss options for sustainable energy for developing countries which have traditionally utilized biomass as a primary fuel source. We look forward to current and relevant presentations on how to advance the economic status of developing countries, integrating concepts of low carbon green growth with sessions discussing the economic impacts of policies (i.e. "Will Biofuel Mandates Raise Food Prices?"), as well as the implications of recent climate disasters on regional energy planning (i.e. "Low Carbon Society Roadmap for Developing Countries in Asia: Lessons Learned from Fukushima").

The morning keynote session, chaired by IPCC Vice Chair Dr. Hoesung Lee, will be focused on the IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation (SRREN). IPCC WG III Co-Chairs Dr. Ramon Pichs and Dr. Ottmar Edenhofer will be presenting key findings of the report, including an evaluation of the current global status and issues related to the supply of renewable energy, concentrating on policy measures as applicable to developing countries.

The afternoon session will encompass current topics affecting developing countries. The topics include 1) the complex relationship between "Bioenergy and Economic Development", 2) emerging findings on "Sustainable Energy Supply Systems" as countries choose critical paths to develop their energy infrastructure, and 3) analyses on the contributions of "GHG Mitigation Potential in the Agriculture/Forestry Sector".

We cordially invite you to attend this year's program as a joint endeavor for global cooperation in response to climate change issues. We look forward to a productive time of mutual exchange, and encourage your active participation through the Q&A and networking opportunities with internationally-recognized experts in the field.

President of Greenhouse Gas Inventory & Research Center of Korea
Dr. Seung Jick Yoo

인 사 말

국제 수준의 국가 온실가스 인벤토리 작성과 국가 온실가스 감축목표 분석을 위하여 설립된 온실가스종합정보센터가 출범한지 어느덧 1년이 지났습니다.

온실가스종합정보센터는 '10년 6월 제1차『온실가스 감축분석모형 국제포럼』을 개최하여 전 세계 모형전문가들과 함께 '선진국–개도국의 온실가스 감축모형'과 '상 · 하향식 감축모형'에 대하여 논의하였고, 포럼을 통해 개발도상국 모형 분석 역량강화를 위한 협력 체제 구축의 필요성에 공감하였습니다.

제1차 포럼에서 센터가 발표한 바와 같이 지난 3월에는 개도국 녹색성장 온실가스 감축모형 협력포럼 (Cooperate Green Growth Modeling Forum) 운영위원회를 구성하였습니다.

이번 제2차『온실가스 감축분석모형 국제포럼』에서는 '바이오에너지를 중심으로 한 개발도상국의 지속가능한 에너지 시스템'이란 주제를 가지고 국내 · 외 전문가들이 모여 개도국 저탄소 녹색 경제발전 전략의 쟁점과 실천 방향에 대하여 논의하고자 합니다.

특히 이번 포럼에서는 IPCC WGIII 공동의장이 '재생에너지원과 기후변화 완화에 관한 IPCC 특별보고서'를 직접 발표하는 자리를 마련하여 신재생에너지 보급에 대한 세계적 현황과 쟁점을 파악하고 나아가 개도국에 적용할 수 있는 현실적인 방안을 살펴볼 수 있을 것입니다.

또한 '바이오 에너지와 개도국의 경제발전', '지속가능한 에너지 공급시스템', '농업/삼림 부문의 온실가스 감축잠재량' 에 관한 심도 있는 발표와 토론의 장도 마련하였습니다.

센터는 개도국과의 국제협력을 지속적으로 강화해 나갈 것입니다.
『온실가스 감축분석모형 국제포럼』은 국제협력 현안을 발굴하고 협력사업 결과를 논의하는 장이 될 것입니다.

온실가스 감축모형 및 기후변화 정책에 대한 국내 · 외 전문가와의 경험과 지식을 공유하는데 관심 있는 모든 분들의 적극적인 참여를 바랍니다.

온실가스종합정보센터장
유 승 직

PROGRAM : 2011.7.8 (Friday)

08:00~9:00	**Registration**
09:00~9:30	**Opening Ceremony** * Opening Speech: ***Young Sook Yoo***, Minister of Environment, Republic of Korea * Welcome Speech: ***Soogil Young***, Chairman of Presidential Committee on Green Growth * Congratulatory Remarks: ***Hoesung Lee***, IPCC Vice Chair
09:30~11:30	**Keynote Session: IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation (SRREN)** 재생에너지원과 기후변화 완화에 관한 IPCC 특별보고서 Chair: ***Hoesung Lee***, IPCC Vice Chair
09:30 ~09:50	Key Trends of the IPCC SRREN ***Ottmar Edenhofer***, IPCC WGⅢ Co-Chair
09:50~10:10	Main Findings of the IPCC SRREN on Sustainable Development and Policies ***Ramon Pichs-Madruga***, IPCC WGⅢ Co-Chair Centro de Investigaciones de la Economia Mundial, CIEM (Cuba)
10:10~11:00	**Panel Discussion** Panelist: * ***Rimtaig Lee,*** Korea Wind Energy Industry Association * ***Won-Cheol Lee,*** Korea Petroleum Association * ***Ho-yeon Han,*** Korea Water Resources Corporation, Green Energy & Resources Department * ***Kyung-Jin Boo***, Korea Energy Economics Institute, Renewable Energy Research Department * ***Woo-Kyun Lee***, Korea University, Division of Environmental Science and Ecological Engineering * ***Eunnyeong Heo***, Seoul Natonal University, Department of Energy Systems Engineering
11:00~11:30	**Q&A**
11:30~13:00	Luncheon
13:00~14:30	**Session 1**: Bioenergy and Economic Development 바이오에너지와 경제발전 모형 ***Augusto Arzubiaga***, Director of Environment, Ministry of Foreign Affairs (Peru)
13:00~13:20	Economic Impacts of Bioenergy Production on African Countries ***Ruth Delzeit***, Kiel Institute (Germany)
13:20~13:40	Economic and Environmental Consequences of Eco-Friendly Tax Policy for Fostering Solid Biomass and Biogas Sectors in South Korea ***Jeong-Hwan Bae***, Chonnam National University
13:40~14:00	Will Biofuel Mandates Raise Food Prices? ***Marie-Helene Hubert,*** University of Rennes (France)

14:00~14:30	**Panel Discussion** Panelist: * ***Abul Quasem Al-Amin***, University of Malaya (Malaysia) * ***Genito Amos Maure***, Eduardo Mondlane University (Mozambique) * ***Doo Hwan Won***, Sung Shin Women's University
14:30~16:00	**Session 2: Sustainable Energy Supply Systems** 지속가능한 에너지 공급시스템 모형 Chair: Sang Yul Shim, Senior Research Fellow, Korea Energy Economics Institute, KEEI
14:30~14:50	Low Carbon Society Roadmap for Developing Countries in Asia : Lessons Learned from Fukushima ***Junichi Fujino***, National Institute of Environmental Studies, NIES (Japan)
14:50~15:10	Sustainable Energy Scenario for Power Sector of Korea ***Nyun-Bae Park***, Sejong University
15:10~15:30	Landfill Gas Electricity Generation (50MW) CDM Project in Sudokwon Landfill Site ***Lae Bong Han***, Sudokwon Landfill Site Management Corporation
15:30~16:00	**Panel Discussion** Panelist: * ***Thi Thu Huyen Nguyen***, Institute of Energy (Vietnam) * ***Nicolas Di Sbroiavacca***, Institute of Energy Economics at Foundation Bariloche (Argentina) * ***Cheolhung Cho***, Greenhouse Gas Inventory & Research Center of Korea, GIR
16:00~16:15	Coffee Break
16:15~17:45	**Session 3 : GHG Mitigation Potential in the Agriculture/Forestry Sector** 농업/산림 부문의 온실가스 감축잠재량 분석모형 Chair: ***Thevarack Phonekeo***, Director of Socio-Environment Division, Water Resources and Environment Administration, WREA (Lao PDR)
16:15~16:35	Mitigating Climate Change in Argentina: Some Options with Tree-formations and Agricultural Practices ***Hector Ginzo***, Argentinian Academy of Environmental Science (Argentina)
16:35~16:55	GHG Mitigation from the Agricultural Sector in Korea ***Beomseok Yoon***, Greenhouse Gas Inventory & Research Center of Korea, GIR
16:55~17:15	Transition from Conventional Biomass Use to Biofuels: Health, Economics and Sustainability Implications ***Eduardo Calvo***, National University of San Marcos (Peru)
17:15~17:45	**Panel Discussion** Panelist: * ***Anthony Maina***, Mau Forest Complex Interim Coordinating Secretariat (Kenya) * ***Chan Thou Chea***, Ministry of Environment (Cambodia) * ***Duk-Bae Lee***, National Academy of Agricultural Science
17:45~18:00	**Closing** ***Seung Jick Yoo***, President of Greenhouse Gas Inventory & Research Center of Korea, GIR

Contents

Opening Ceremony

Opening Speech: Young Sook Yoo
Welcome Speech: Soogil Young
Congratulatory Remarks: Hoesung Lee

Opening Ceremony

Opening Speech

Young Sook Yoo

Minister of Environment, Republic of Korea

Education

Ph.D. in Biochemistry, Oregon State University
M.S. in Chemistry, Ewha Womans University

Highlighted Experience

2010 ~ 2011	Health Care Technology Policy Review Committee Member, Department of Health and Human Resources
2009 ~ 2010	Advisory Board Member, Presidential Advisory Committee on Science & Technology
2009 ~ 2010	Research Director, Korea Advanced Institute of Science and Technology,
2005 ~ Present	Editorial Board Member, Germany Willy-VCH Publication, 'Electrophoresis' Journal
2004 ~ 2006	President, Korea Advanced Institute of Science and Technology, Bioanalysis and Biotransformation Research Center
1994	Visiting Researcher, National Institutes of Health (NIH)
1987 ~ 1989	Postdoc Researcher, Stanford University Medical School

Welcome Speech

Soogil Young

Chairman of Presidential Committee on Green Growth (PCGG)

Current Position/Affiliation

Co-Chair of the PCGG
Chairman of Green Investment Forum Korea
Vice-President of Seoul Financial Forum

Education

B.S. in Chemical Engineering, Seoul National University (Seoul, Korea)
Ph.D. in Economics, Johns Hopkins University (Maryland, USA)

Highlighted Experience

Director of National Strategy Institute
Chairman of Korea National Committee for Pacific Economic Cooperation (KOPEC)
Presidential Committee on Northeast Cooperation Initiative Member
MOFAT Ambassador to OECD
Chairman of OECD Development Centre Advisor Board
President of Korea Institute International Economic Policy (KIEP)
Economic Advisor to Ministry of Finance
President of Korea Transport Institute (KOTI)
Presidential Advisory 21st Century Committee member
Senior Research Fellow of Korea Development Institute (KDI)

Keynote Session

IPCC Special Report on Renewable Energy Sources (SRREN)

Chair: Hoesung Lee, IPCC

Ottmar Edenhofer, IPCC WGⅢ Co-Chair
Ramon Pichs-Madruga, IPCC WGⅢ Co-Chair

Keynote Session

Chair

Hoesung Lee
IPCC

Current Position/Affiliation

IPCC Vice-Chair

Professor, College of Environment, Keimyung University

Education

Ph.D. in Economics, University of New Jersey

Highlighted Experience

1992 ~ 1997 IPCC WG III Co-Chair

Panelist

Rimtaig Lee
Korea Wind Energy Industry Association

Won-Cheol Lee
Korea Petroleum Association

Panelist

Ho-yeon Han
Water Resources Corporation, Green Energy & Resources Department

Kyung-Jin Boo
Korea Energy Economics, Institute Renewable Energy Research Department

Woo-Kyun Lee
Korea University, Division of Environmental Science and Ecological Engineering

Eunnyeong Heo
Seoul National University, Department of Energy Systems Engineering

Presenter

Ottmar Edenhofer

IPCC WGIII Co-Chair

Current Position/Affiliation

Deputy Director and Chief Economist at the Potsdam Institute of Climate Impact Research Chair for "Economics of Climate Change" at the Technical University Berlin
International Association for Energy Economics

Education

Ph.D. in Economics (summa cum laude), Social Conflict and Technological Change
Evolutionary Models of Energy Use
Masters in Economics, University of Munich (with distinction)

Highlighted Experience

2007 ~ Present	Key Climate Change Advisor to the Federal Foreign Office
Jun 2008	Appointments to a professorship at the Technical University of Berlin for the Chair of Economics of Climate Change
2004 ~ 2008	Lead author in IPCC Working Group III, Chapter 1 and 11
Aug 2005	Fellow of the Hanse Institute for Advanced Study

Ramon Pichs-Madruga

IPCC WGIII Co-Chair

Current Position/Affiliation

Deputy-Director of Centro de Investigaciones de la Economia Mundial (CIEM), Havana, Cuba
Senior Professor at the Faculty of Economics, Havana University

Education

Ph.D. in Economics, Faculty of Economics, National Autonomous University in Mexico
Masters in Social Sciences, Lund University, Sweden
Highlighted Experience

2007 ~ Present	Member of the Scientific Advisory Committee of the Inter-American Institute for Global Change Research (IAI)
1997 ~ 2008	Vice-President of Working Group III

Keynote Session

Key Trends of the IPCC SRREN

Ottmar Edenhofer
IPCC WGⅢ Co-Chair

Key Trends of the IPCC SRREN

Friday 8th July 2011, COEX, Seoul, Republic of Korea

Prof. Dr. Ottmar Edenhofer

Co-Chair of the IPCC Working Group III "Mitigation of Climate Change"

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Special Report on Renewable Energy Sources and Climate Change Mitigation

1. Renewable Energy and Climate Change	Introductory Chapter
2. Bioenergy	Technology Chapters
3. Direct Solar Energy	
4. Geothermal Energy	
5. Hydropower	
6. Ocean Energy	
7. Wind Energy	
8. Integration of Renewable Energy into Present and Future Energy Systems	Integrative Chapters
9. Renewable Energy in the Context of Sustainable Development	
10. Mitigation Potential and Costs	
11. Policy, Financing and Implementation	

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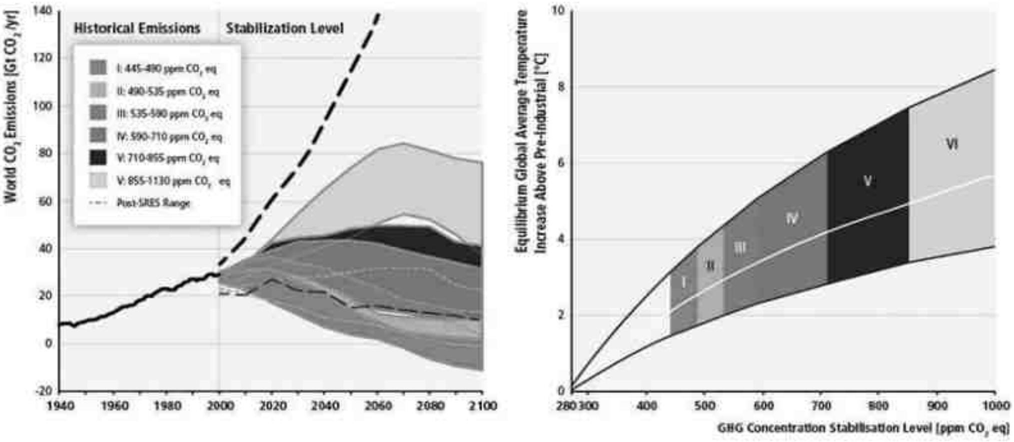
Demand for energy services is increasing.



GHG emissions resulting from the provision of energy services contribute significantly to the increase in atmospheric GHG concentrations.

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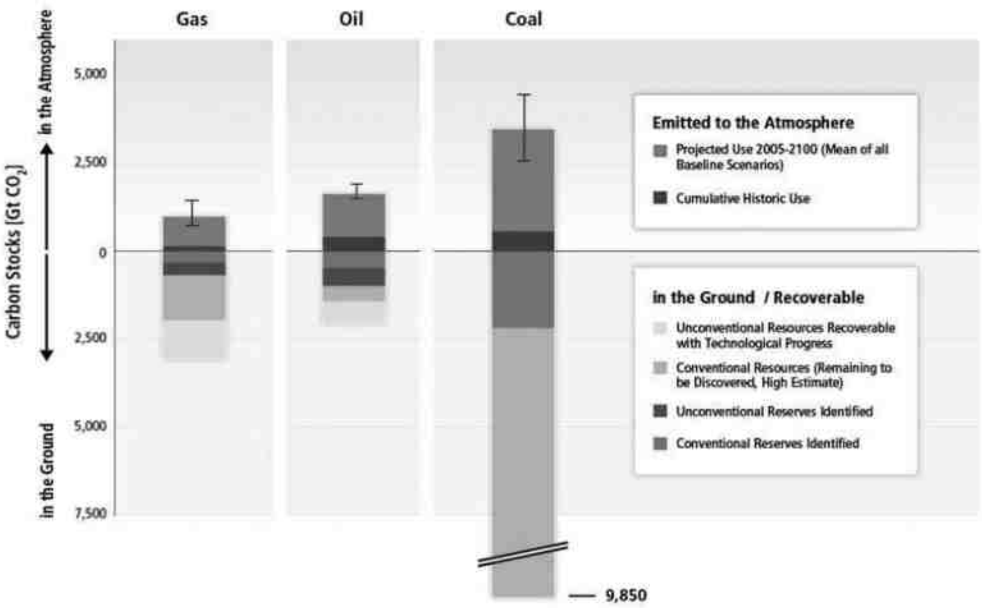
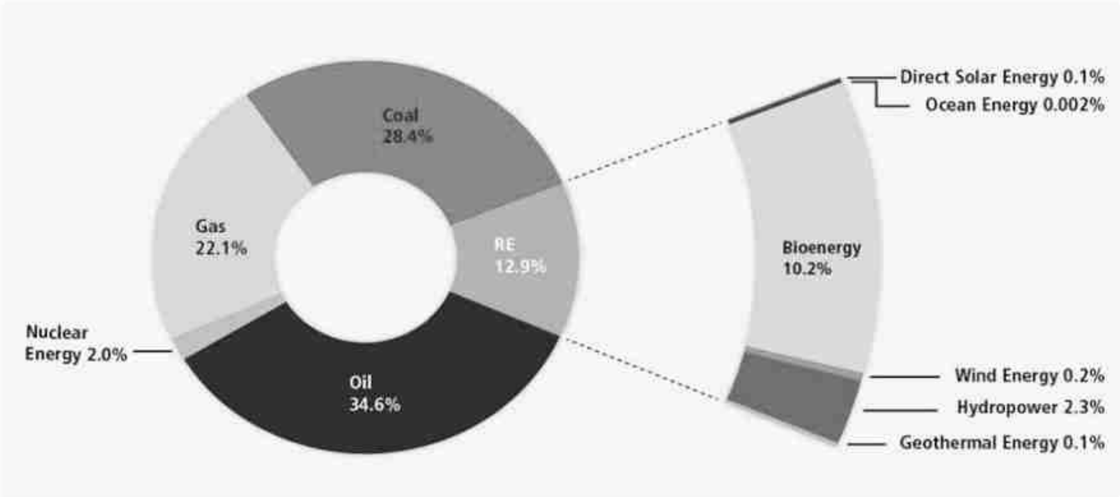
Potential emissions from remaining fossil resources could result in GHG concentration levels far above 600ppm.



The current global energy system is dominated by fossil fuels.



Shares of energy sources in total global primary energy supply in 2008

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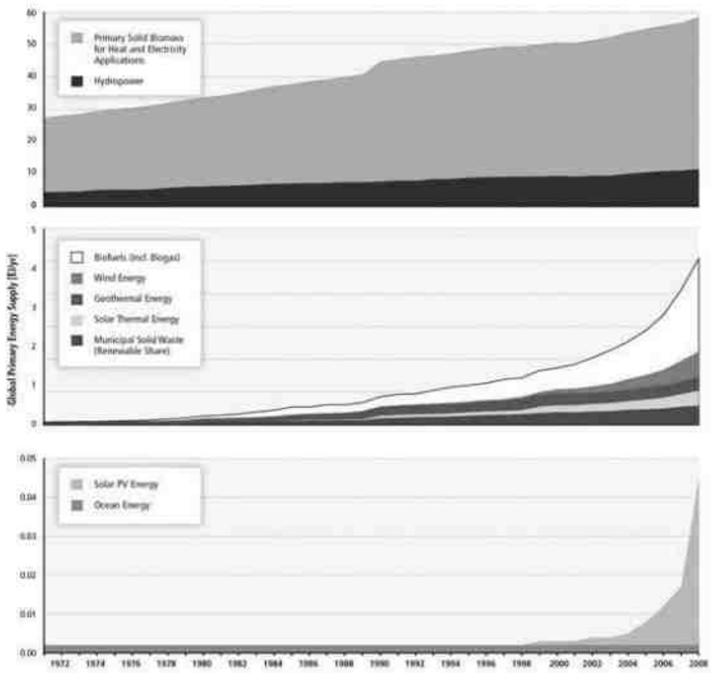
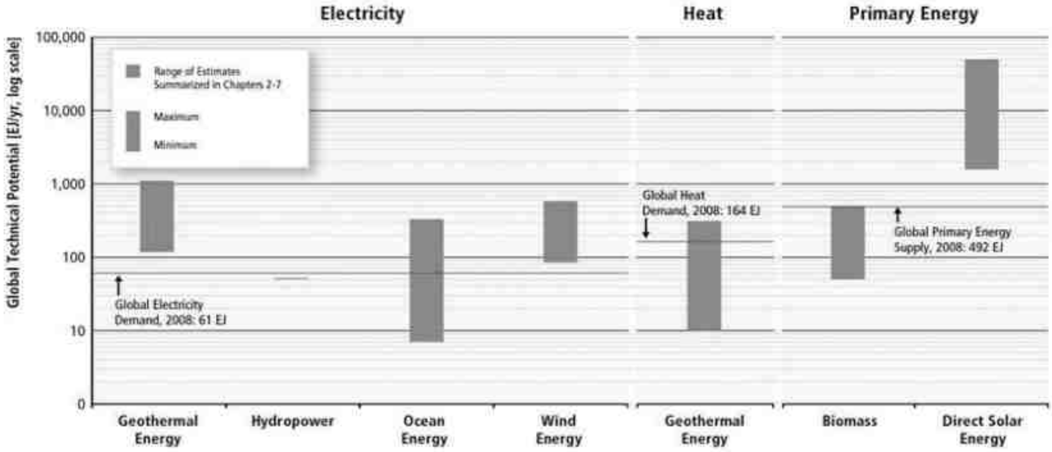
RE growth has been increasing rapidly in recent years.



140 GW of new RE power plant capacity was built in 2008-2009.

This equals 47% of all power plants built during that period.

The technical potential of renewable energy technologies to supply energy services exceeds current demands.



Range of Estimates of Global Technical Potentials

	Geothermal Energy	Hydropower	Ocean Energy	Wind Energy	Geothermal Energy	Biomass	Direct Solar Energy
Max (in EJ/yr)	1109	52	331	580	312	500	49837
Min (in EJ/yr)	118	50	7	85	10	50	1575

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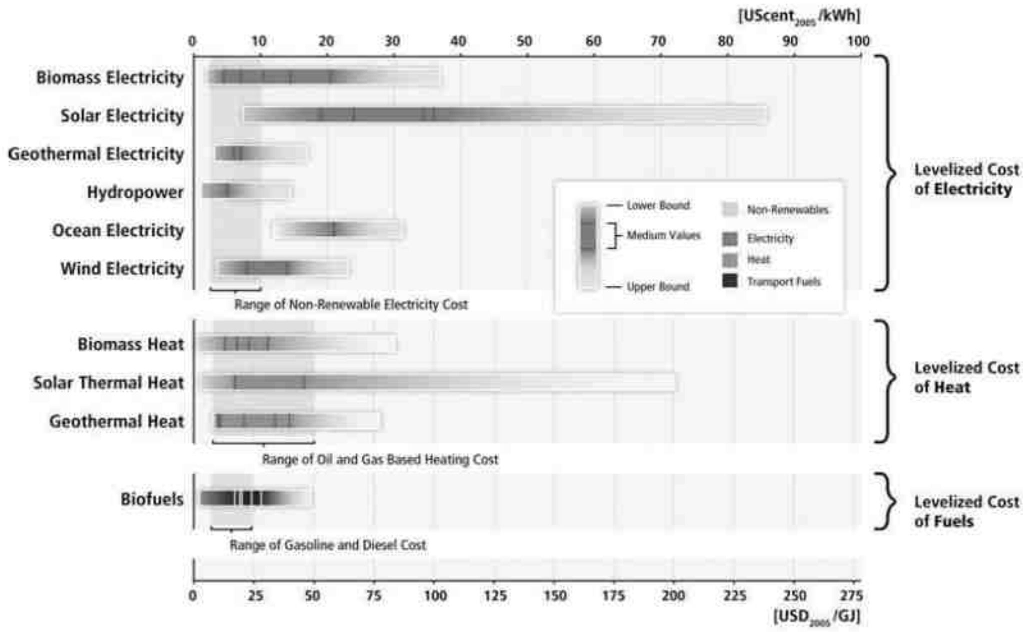
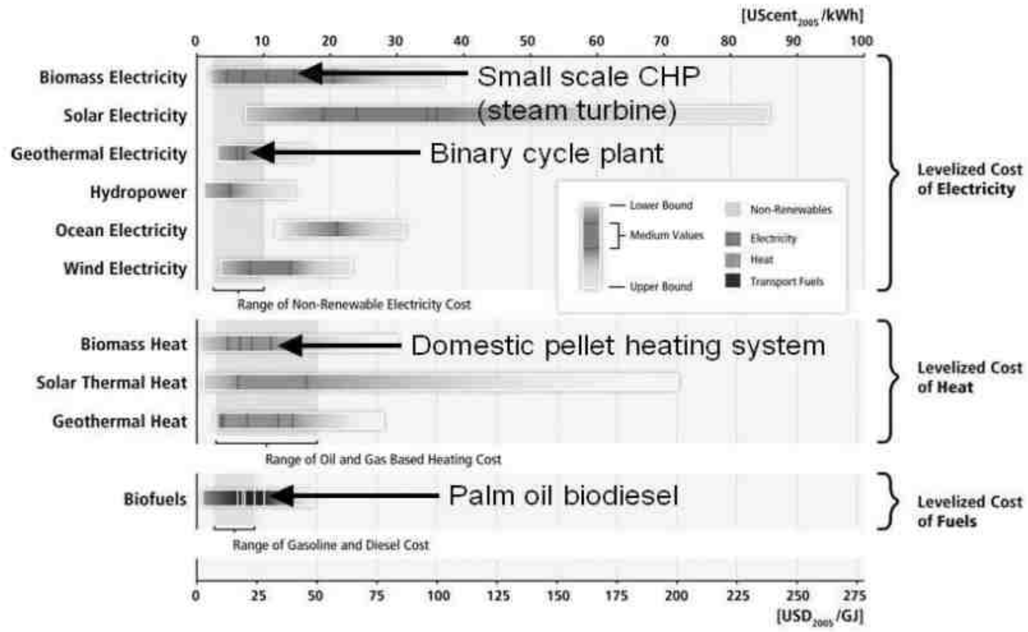
RE costs are still higher than existing energy prices, but in various settings RE is already competitive.



RE costs are still higher than existing energy prices, but in various settings RE is already competitive.



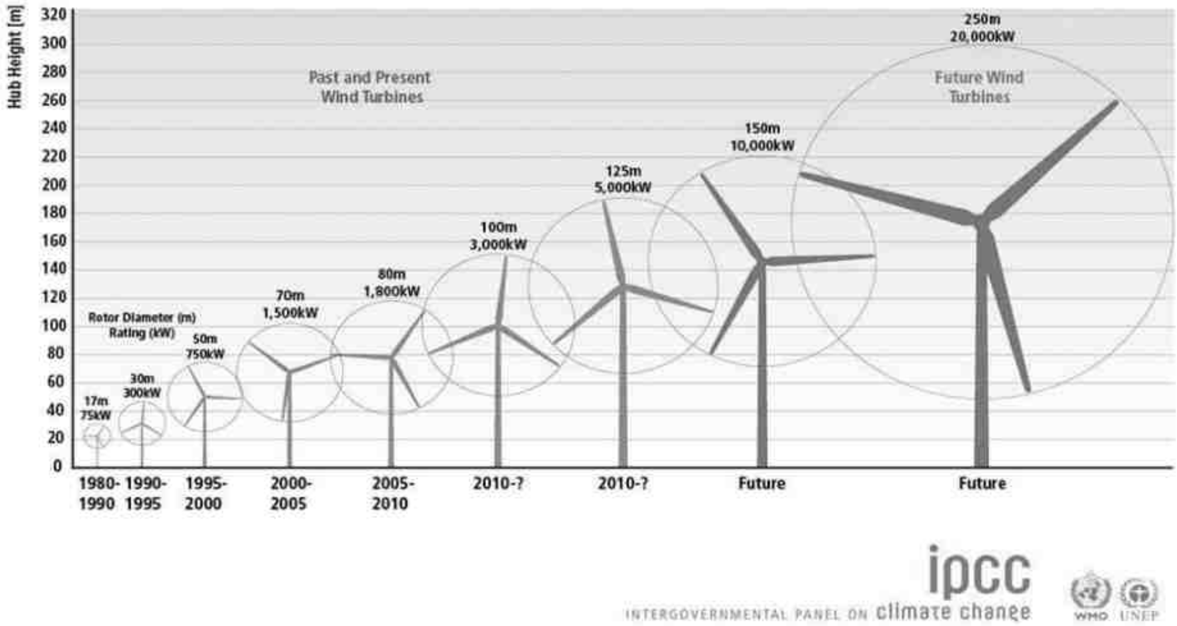
RE costs are still higher than existing energy prices, but in various settings RE is already competitive.

Notes: Medium values are shown for the following subcategories, sorted in the order as they appear in the respective ranges (from left to right):

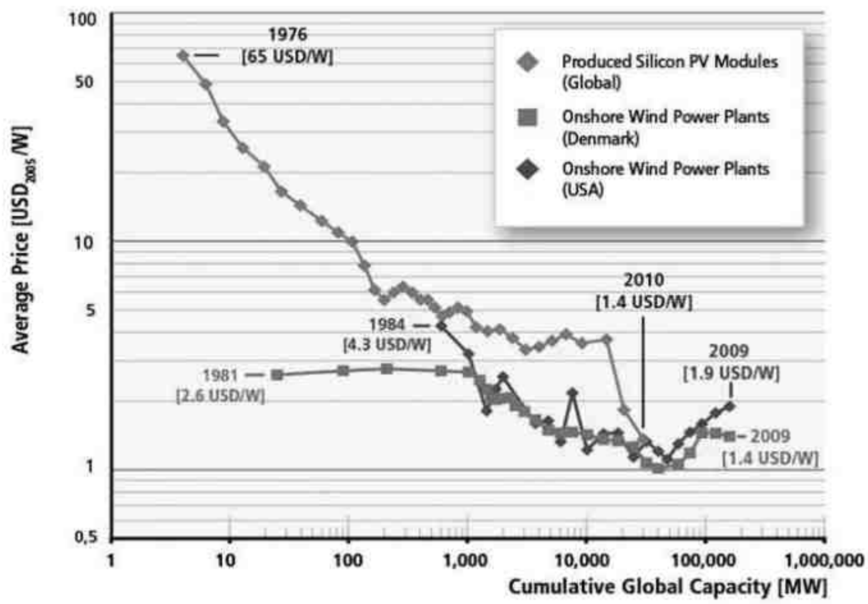
Electricity	Heat	Transport Fuels
Biomass: 1. Cofiring 2. Small scale combined heat and power, CHP (Gasification internal combustion engine) 3. Direct dedicated stoker & CHP 4. Small scale CHP (steam turbine) 5. Small scale CHP (organic Rankine cycle) **Solar Electricity:** 1. Concentrating solar power 2. Utility-scale PV (1-axis and fixed tilt) 3. Commercial rooftop PV 4. Residential rooftop PV **Geothermal Electricity:** 1. Condensing flash plant 2. Binary cycle plant **Hydropower:** 1. All types **Ocean Electricity:** 1. Tidal barrage **Wind Electricity:** 1. Onshore 2. Offshore	**Biomass Heat:** 1. Municipal solid waste based CHP 2. Anaerobic digestion based CHP 3. Steam turbine CHP 4. Domestic pellet heating system **Solar Thermal Heat:** 1. Domestic hot water systems in China 2. Water and space heating **Geothermal Heat:** 1. Greenhouses 2. Uncovered aquaculture ponds 3. District heating 4. Geothermal heat pumps 5. Geothermal building heating	**Biofuels:** 1. Corn ethanol 2. Soy biodiesel 3. Wheat ethanol 4. Sugarcane ethanol 5. Palm oil biodiesel

The lower range of the levelized cost of energy for each RE technology is based on a combination of the most favourable input-values, whereas the upper range is based on a combination of the least favourable input values. Reference ranges in the figure background for non-renewable electricity options are indicative of the levelized cost of centralized non-renewable electricity generation. Reference ranges for heat are indicative of recent costs for oil and gas based heat supply options. Reference ranges for transport fuels are based on recent crude oil spot prices of USD 40 to 130/barrel and corresponding diesel and gasoline costs, excluding taxes.

Technical Advancements: For instance growth in size of typical commercial wind turbines.



RE costs have declined in the past and further declines can be expected in the future.



Integration characteristics for a selection of RE electricity generation technologies

Technology		Plant size range	Variability: Characteristic time scales for power system operation	Dispatchability	Geographical diversity potential	Predictability	Capacity factor range	Capacity credit range	Active power, frequency control	Voltage, reactive power control
		(MW)	Time scale	See legend	See legend	See legend	%	%	See legend	See legend
Bioenergy		0.1–100	Seasons (depending on biomass availability)	+++	+	++	50–90	Similar to thermal and CHP	++	++
Direct solar energy	PV	0.004–100 modular	Minutes to years	+	++	+	12–27	<25–75	+	+
	CSP with thermal storage*	50–250	Hours to years	++	+**	++	35–42	90	++	++
Geothermal energy		2–100	Years	+++	N/A	++	60–90	Similar to thermal	++	++
Hydropower	Run of river	0.1–1,500	Hours to years	++	+	++	20–95	0–90	++	++
	Reservoir	1–20,000	Days to years	+++	+	++	30–60	Similar to thermal	++	++
Ocean energy	Tidal range	0.1–300	Hours to days	+	+	++	22.5–28.5	<10	++	++
	Tidal current	1–200	Hours to days	+	+	++	19–60	10–20	+	++
	Wave	1–200	Minutes to years	+	++	+	22–31	16	+	+
Wind energy		5–300	Minutes to years	+	++	+	20–40 onshore, 30–45 offshore	5–40	+	++

* Assuming CSP system with 6 hours of thermal storage in US Southwest.
** In areas with Direct Normal Irradiation (DNI) > 2,000 kWh/m2/yr (7,200 MJ/m2/yr)

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Capacity credit is an indicator for the reliability of a generation type to be available during peak demand hours.

Technology		[...]	Capacity credit range
		[...]	%
Bioenergy		[...]	Similar to thermal and CHP
Direct solar energy	PV	[...]	<25–75
	CSP with thermal storage*	[...]	90
Geothermal energy		[...]	Similar to thermal
Hydropower	Run of river	[...]	0–90
	Reservoir	[...]	Similar to thermal
Ocean energy	Tidal range	[...]	<10
	Tidal current	[...]	10–20
	Wave	[...]	16
Wind energy		[...]	5–40

If a type of generation has a low capacity credit,
the available output tends to be low during high demand periods.

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Few, if any, fundamental technical limits exist to the integration of a majority share of RE, but advancements in several areas are needed.

- Transmission and distribution infrastructure
- Generation flexibility
- Energy storage technologies
- Demand side management
- Improved forecasting and operational planning methods

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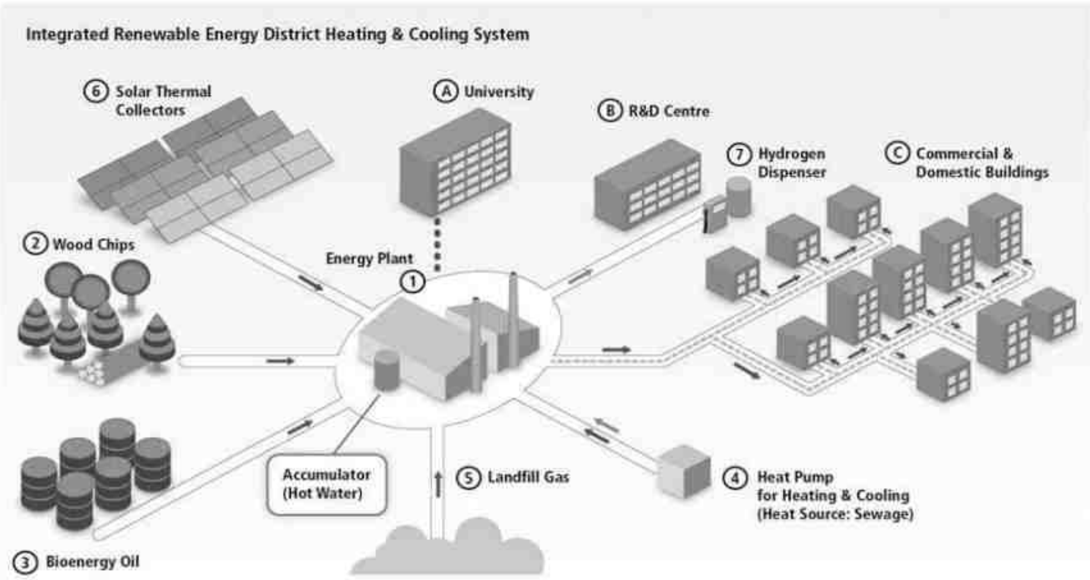
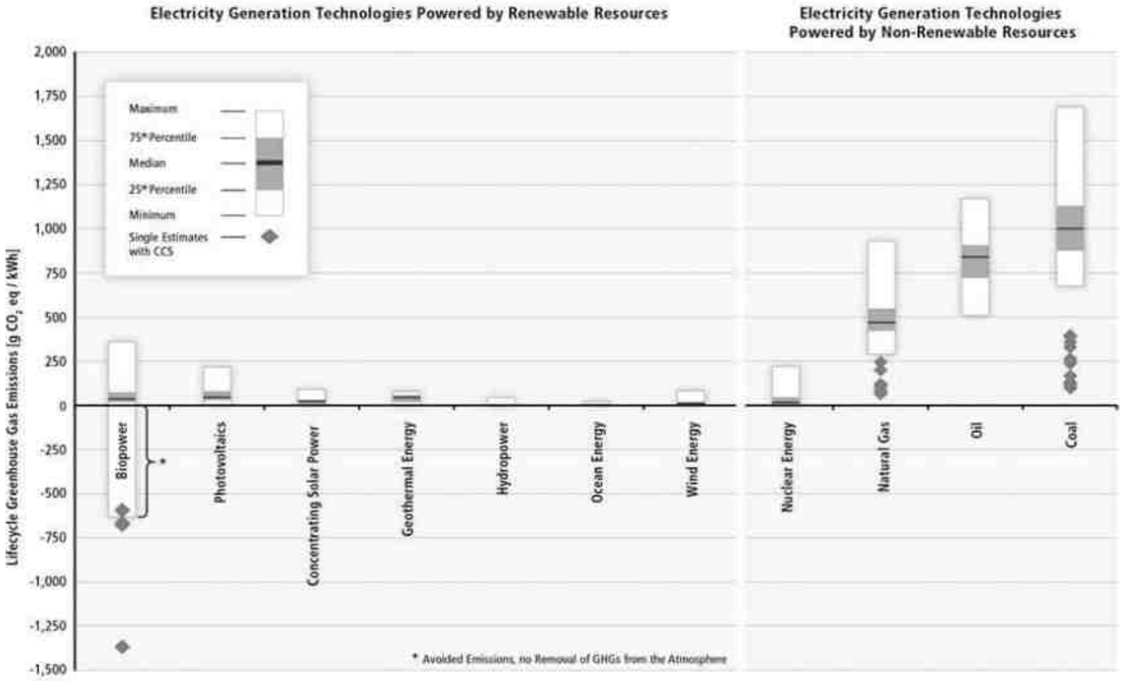
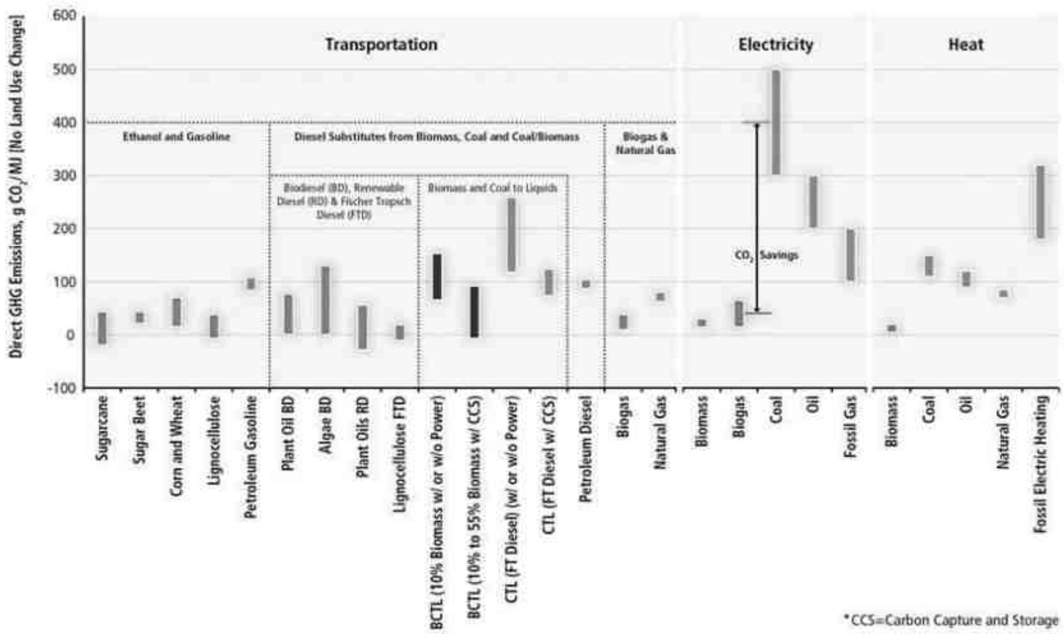
An integrated RE-based energy plant in Lillestrøm, Norway, supplying commercial and domestic buildings



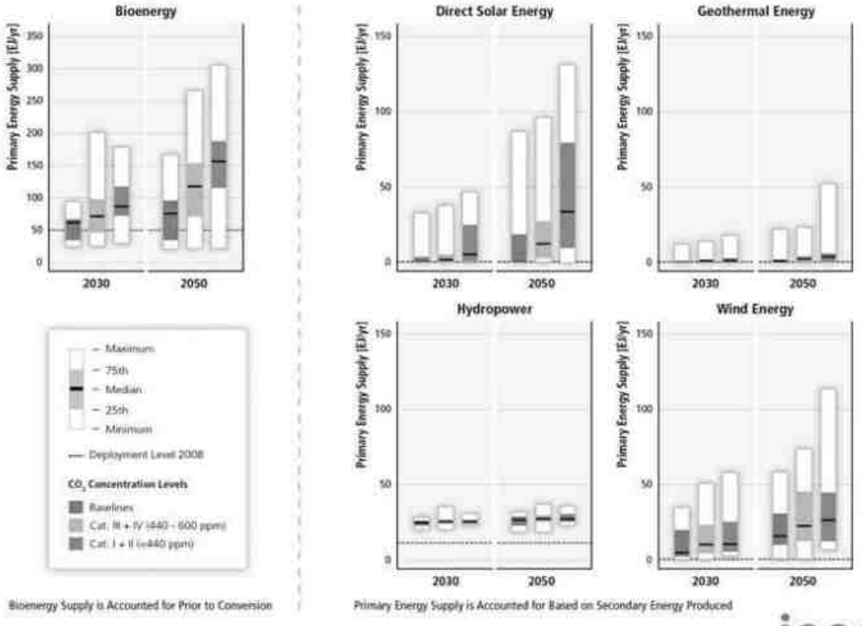
Lifecycle GHG emissions of RE technologies are, in general, considerably lower than those of fossil fuel options.



GHG emissions from modern bioenergy chains compared to fossil fuel energy systems, excluding land-use change effects.



RE deployment increases in scenarios with lower greenhouse gas concentration stabilization levels.



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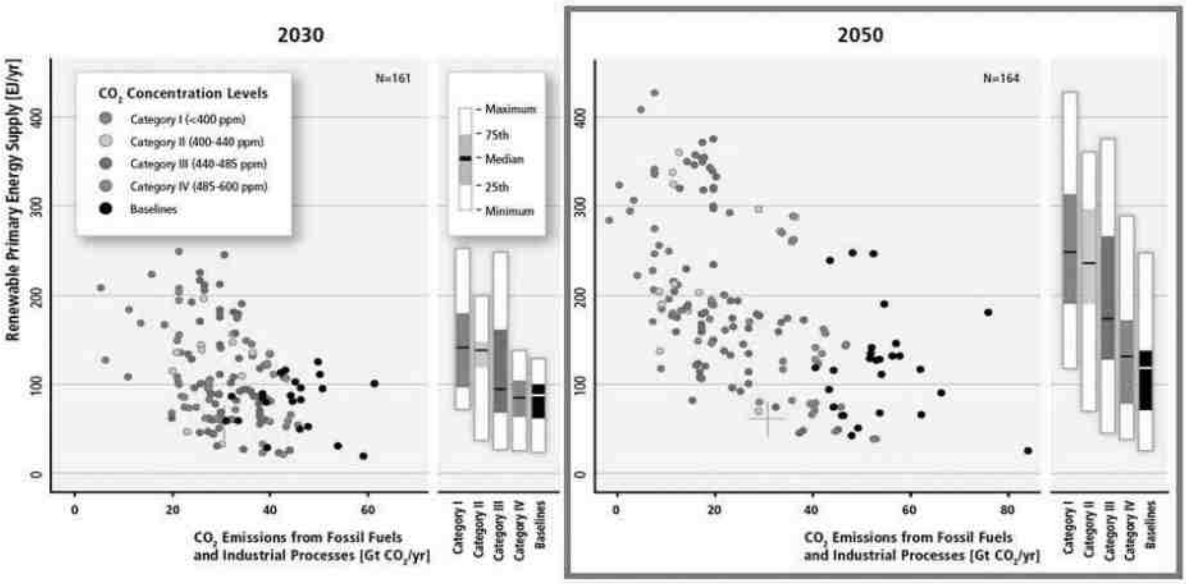
20

Global RE primary energy supply from 164 long-term scenarios versus fossil and industrial CO_2 emissions.



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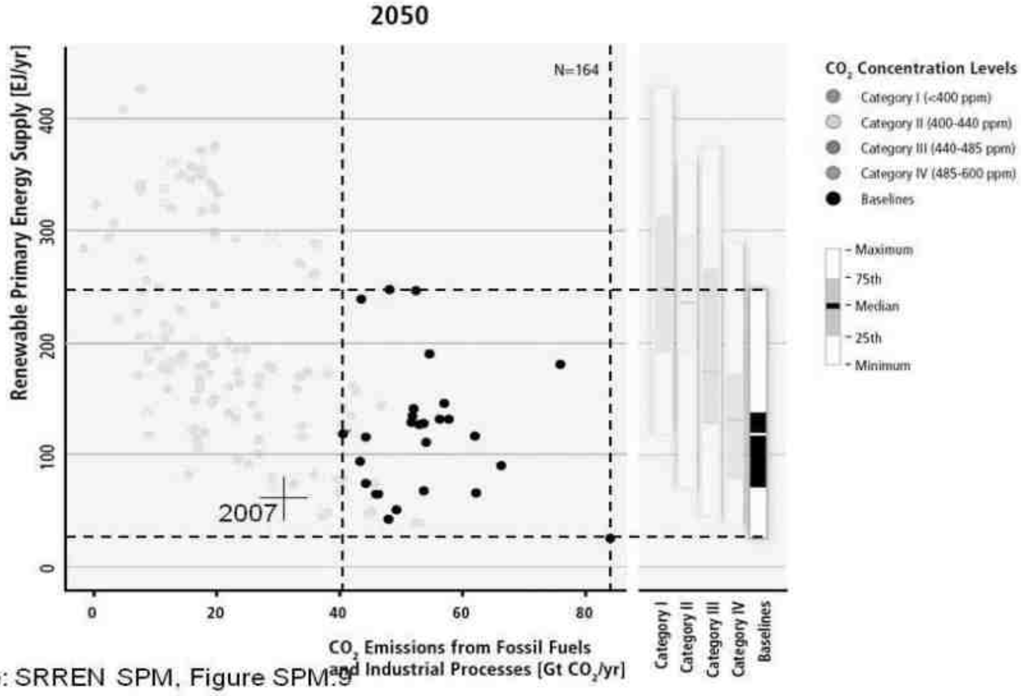
Source: SRREN SPM, Figure SPM.9

21

Global RE primary energy supply from 164 long-term scenarios versus fossil and industrial CO_2 emissions.



Source: SRREN SPM, Figure SPM.9

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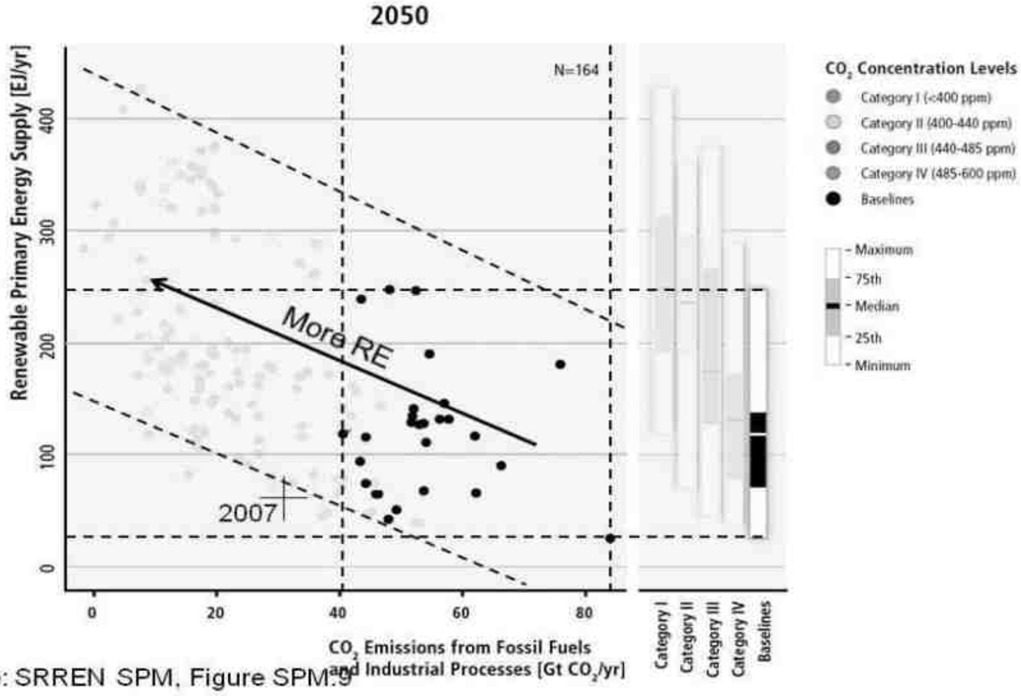
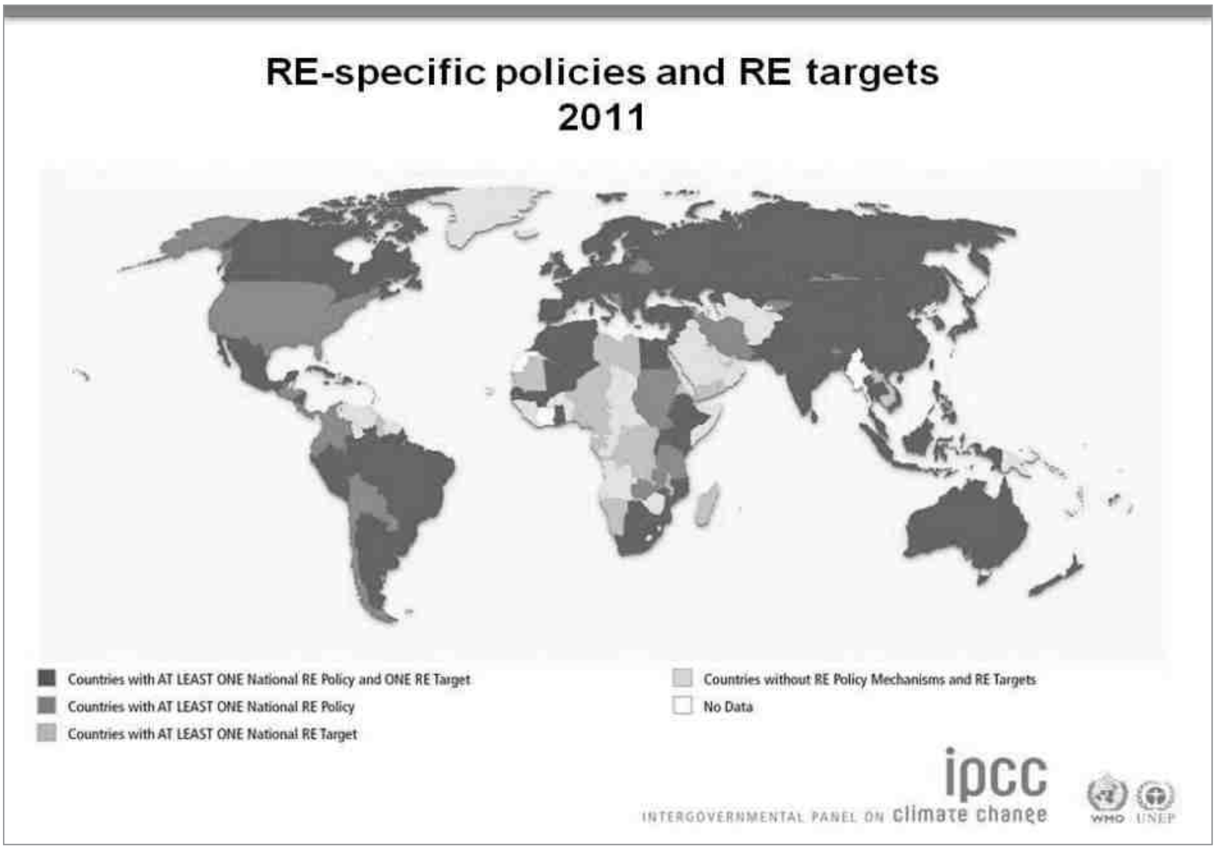
Global RE primary energy supply from 164 long-term scenarios versus fossil and industrial CO_2 emissions.



Source: SRREN SPM, Figure SPM.9


RE-specific policies and RE targets
2011
Countries with AT LEAST ONE National RE Policy and ONE RE Target
Countries with AT LEAST ONE National RE Policy
Countries with AT LEAST ONE National RE Target
Countries without RE Policy Mechanisms and RE Targets
No Data
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Keynote Session

Main Findings of the IPCC SRREN on Sustainable Development and Policies

Ramon Pichs-Madruga
IPCC WGⅢ Co-Chair

"Main Findings of the IPCC SRREN on Sustainable Development and Policies"

Dr. Ramón Pichs-Madruga
WG III Co-Chair
Seoul, 8 July 2011

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IPCC AR5 Cycle: Key Activities for WG III

- **Special Report on Renewable Energy Sources and Climate Change Mitigation (SRREN). Approved on 9 May 2011**
- **Contribution of WG III to the IPCC AR5, to be approved by 2014**
  - ✓ **Adaptation, mitigation and sustainable development (Cross-Cutting Theme for IPCC AR5)**
  - ✓ **Policy perspective**

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3

Special Report on Renewable Energy Sources and Climate Change Mitigation (SRREN) - Outline

1. Renewable Energy and Climate Change
2. Bioenergy
3. Direct Solar Energy
4. Geothermal Energy
5. Hydropower
6. Ocean Energy
7. Wind Energy
8. Integration of Renewable Energy into Present and Future Energy Systems
9. Renewable Energy in the Context of Sustainable Development
10. Mitigation Potential and Costs
11. Policy, Financing and Implementation

Technology Chapters Ch. 2-7

Integrative Chapters Ch. 8-11

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4

IPCC AR5 WG III Outline

I: Introduction	1. Introductory Chapter
II: Framing Issues	2. Integrated Risk and Uncertainty Assessment of Climate Change Response Policies 3. Social, Economic and Ethical Concepts and Methods 4. Sustainable Development and Equity
III: Pathways for Mitigating Climate Change	5. Drivers, Trends and Mitigation 6. Assessing Transformation Pathways 7. Energy Systems 8. Transport 9. Buildings 10. Industry 11. Agriculture, Forestry and Other Land Use (AFOLU) 12. Human Settlements, Infrastructure and Spatial Planning
IV: Assessment of Policies, Institutions and Finance	13. International Cooperation: Agreements and Instruments 14. Regional Development and Cooperation 15. National and Sub-national Policies and Institutions 16. Cross-cutting Investment and Finance Issues

Adaptation, Mitigation and Sustainable Development (CCT for IPCC AR5)

- **IPCC WG III Perspective:**
  AR4 main findings as a reference (Ch.12)
- **SRREN Chapter 9:** Renewable Energy in the Context of Sustainable Development
- **WG III AR5 Chapter 4:** Sustainable Development and Equity – Framing Chapter
- **New scenarios** assessment process (socioeconomic component)

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Assessment of Mitigation Policies

- **IPCC WG III Perspective:**
  AR4 main findings as a reference (Ch.13).
- **SRREN Chapter 11:** Policy, Financing and Implementation
- **WG III AR5 Section IV:** Assessment of Policies, Institutions and Finance
- **New scenarios** assessment process (policy perspective)

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IPCC SRREN

Renewable Energy and Sustainable Development

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RE Contribution to SD

- RE can help decouple the correlation between economic development, increasing energy use and growth of GHG emissions, contributing to sustainable development (SD)
- Country specific context
- RE => contribution to social and economic development, energy access, secure energy supply, climate change mitigation, and the reduction of negative environmental and health impacts
- Supporting the achievement of the Millennium Development Goals

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RE Contribution to Social and Economic Development

- Cost savings in comparison to non-RE use, under favourable conditions
- Reduction of costs associated with energy imports
- Positive impact on job creation

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Access to Energy

- RE can help accelerate access to energy, particularly for the 1.4 billion people without access to electricity and the additional 1.3 billion using traditional biomass
- The number of people without access to modern energy services is expected to remain unchanged unless relevant domestic policies are implemented, which may be supported or complemented by international assistance as appropriate

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Energy Security

- RE options can contribute to a more secure energy supply
- Potential to reduce vulnerability to supply disruption and market volatility
- Specific challenges to integration must be considered

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Environmental benefits

- In addition to reduced GHG emissions, RE technologies can provide other important environmental benefits
- Maximizing these benefits depends on the specific technology, management, and site characteristics associated with each RE project

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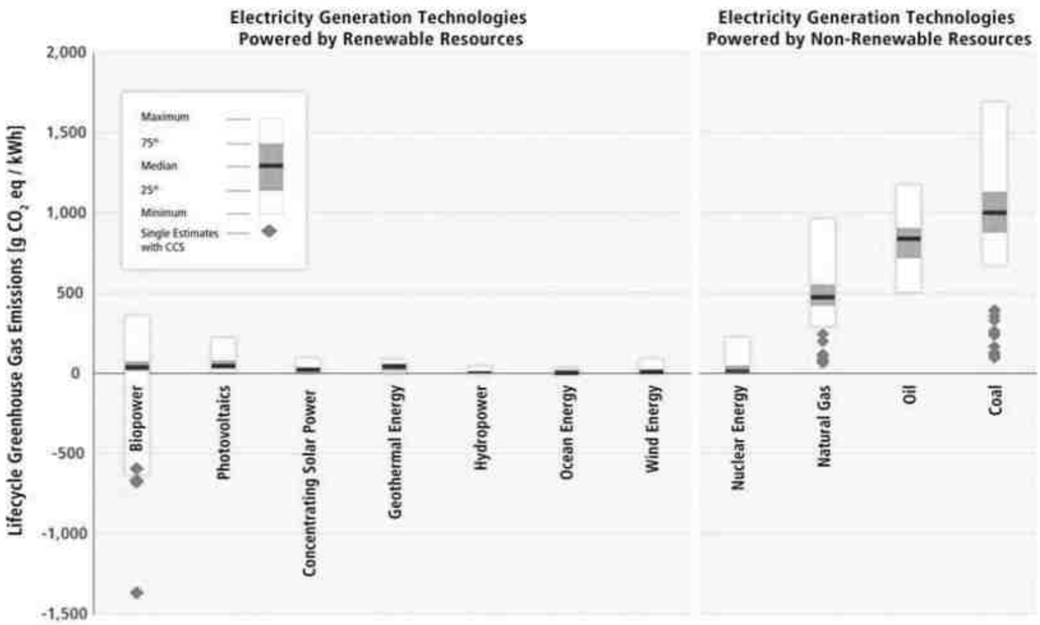
13

Lifecycle GHG emissions of RE technologies are, in general, considerably lower than those of fossil fuel options



IPCC SRREN

Policy Assessment

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RE Policies

- An increasing number and variety of RE policies - motivated by many factors - have driven escalated growth of RE technologies in recent years
- Government policies play a crucial role in accelerating the deployment of RE technologies
- There is no one-size-fits-all policy

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RE Policies – Main Drivers

Developing Countries:

- Energy access
- Social and economic development

Developed Countries:

- Secure energy supply
- Environmental concerns

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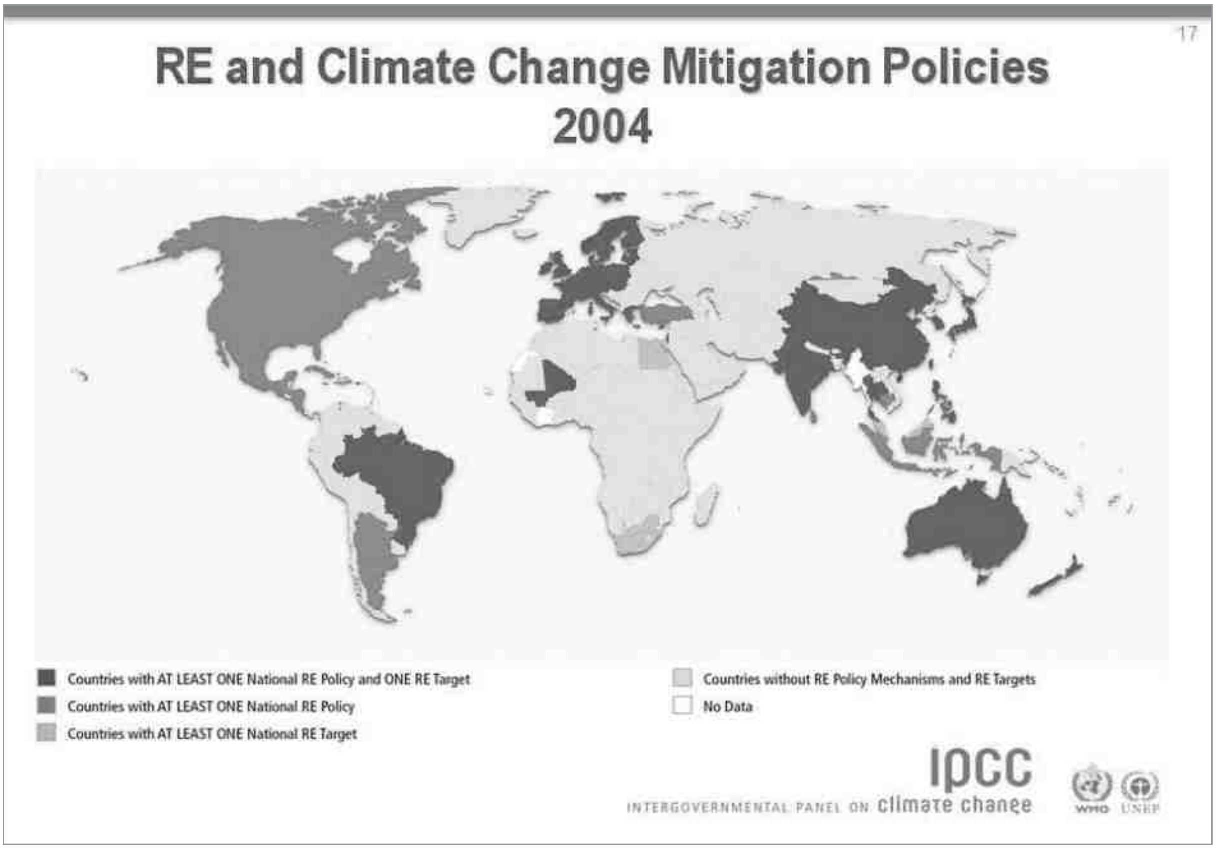
17
RE and Climate Change Mitigation Policies
2004
Countries with AT LEAST ONE National RE Policy and ONE RE Target
Countries with AT LEAST ONE National RE Policy
Countries with AT LEAST ONE National RE Target
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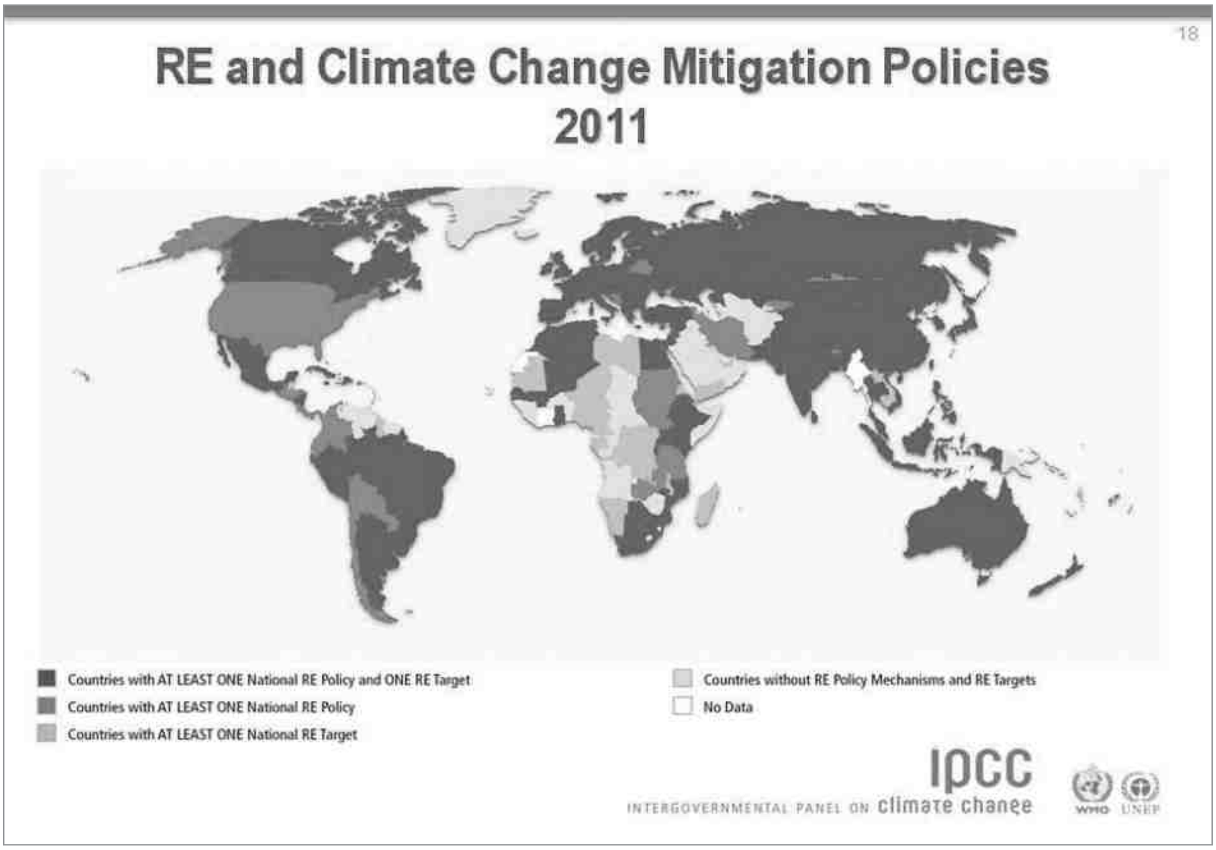
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RE and Climate Change Mitigation Policies
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Countries with AT LEAST ONE National RE Policy
Countries with AT LEAST ONE National RE Target
Countries without RE Policy Mechanisms and RE Targets
No Data
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RE Policy Scales

Policies can be:

- sector specific,
- local,
- state/provincial,
- national
- regional

Policies can be complemented by bilateral, regional and international cooperation

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Barriers to RE deployment

- institutional,
- market failures,
- lack of: general information, access to relevant data, technical and knowledge capacity,
- barriers related to societal and personal values and affecting the perception and acceptance of RE technologies

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Policy Efficiency and Effectiveness

- Flexibility to adjust as technologies, markets and other factors evolve
- The details of design and implementation
- Policy frameworks that are transparent and sustained
- Long-term objectives for RE
- Flexibility to learn from experience

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'Enabling' environment for RE

- addressing the possible interactions with other RE policies as well as with energy and non-energy policies (e.g., those targeting agriculture, transportation, water management and urban planning);
- easing the ability of RE developers to obtain finance,
- removing barriers for access to networks and markets,
- increasing education and awareness,
- enabling technology transfer

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Under most conditions increasing the share of RE in the energy mix will require policies to stimulate changes in the energy system

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WHO UNEP

Session 1

Bioenergy and Economic Development

Chair: Augusto Arzubiaga,
Ministry of Foreign Affairs

Ruth Delzeit, Kiel Institute
Jeong-Hwan Bae, Chonnam National University
Marie-Helene Hubert, University of Rennes

Session 1

Chair

Augusto Arzubiaga

Ministry of Foreign Affairs (Peru)

Current Position/Affiliation

National Director for the Environment of the Directorate-General for Multilateral and Global Affairs, Ministry of Foreign Affairs of Peru

Education

Universidad Católica de Lovaina, Belgian
Webster College, Vienna, Austria
Escuela Diplomática del Reino de Espana, Madrid, Spain
Universidad Nacional Agraria de la Molina, Lima, Peru
Escuela Superior de Guerra Aérea, Lima, Peru
Universidad Peruana de Ciencias Aplicadas, Lima, Peru
Swisspeace International Courses, Bern, Switzerland

- Masters in High Management and High Leadership with special mention in Defense Affairs and Aerospace Development
- Masters in Diplomacy and International Relations with special mention in Economic Promotion

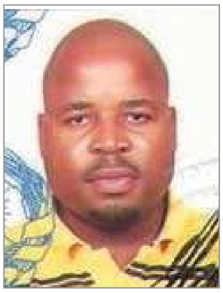
Highlighted Experience

Director of the Cabinet of the Vice-president of the Republic, President of the Council of Ministers and Minister of Economy and Finances of Peru
Member of the National Committee on Facilitating International Air Transport (CONAFAL), Lima, Peru
National Director and National Coordinator for the Affairs relating to the Initiative for Regional Infrastructural Integration of South America (IIRSA), Ministry of Foreign Affairs of Peru, Lima, Peru

Panelist

Abul Quasem Al-Amin

University of Malaya
(Malaysia)



Genito Amos Maure

Eduardo Mondlane University
(Mozambique)

Doo Hwan Won

Sung Shin Women's University

Presenter

Ruth Delzeit
Kiel Institute (Germany)

Current Position/Affiliation
Postdoc Researcher at the Kiel Institute of the World Economy, Research Area “The Environment and Natural Resources”

Education
Ph.D. in Resource and Environmental Economics, Theodor-Brinkmann-Graduate School, Agricultural Faculty, Rheinische Friedrich-Wilhelms-Universitat, Bonn

Highlighted Experience

2006 ~ 2010	Research assistant at Institute of Food and Resource Economics Institute, University of Bonn
2006	Consultant for the Wuppertal Institute for Environment, Climate and Energy

Recent Publications/Research

Delzeit, R., W. Britz, K. Holm-Müller (2011): Modelling regional input markets with numerous processing plants: The case of green maize for biogas production in Germany. In: Discussion Paper Series "Food and Resource Economics", Institute for Food and Resource Economics. Submitted to: Environmental Modelling and Software.

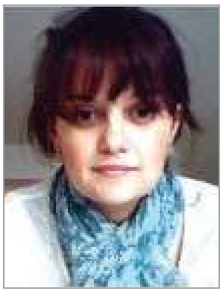
Delzeit, R., H, Gömann, K. Holm-Müller, P. Kreins, B. Kretschmer, J. Münch & S. Peterson (2010). Analysing Bioenergy and Land Use Competition in a Coupled Modelling System: The Role of Bioenergy in Renewable Energy Policy in Germany. Kiel Working Papers Nb. 1653, Kiel Institute for the World Economy, Kiel.

Presenter

Jeong-Hwan Bae
Chonnam National University

Education
Ph.D. in Economics, College of Agricultural Science, Penn State University
M.S. in Economics, University College of London

Highlighted Experience
2009 ~ Present Associate Professor, Economics Department, Chonnam National University
2005 ~ 2009 Research Fellow, Energy Policy Research Group at Korea Energy Economics Institute



Marie-Helene Hubert
University of Rennes (France)

Education
Ph.D., Toulouse School of Economics

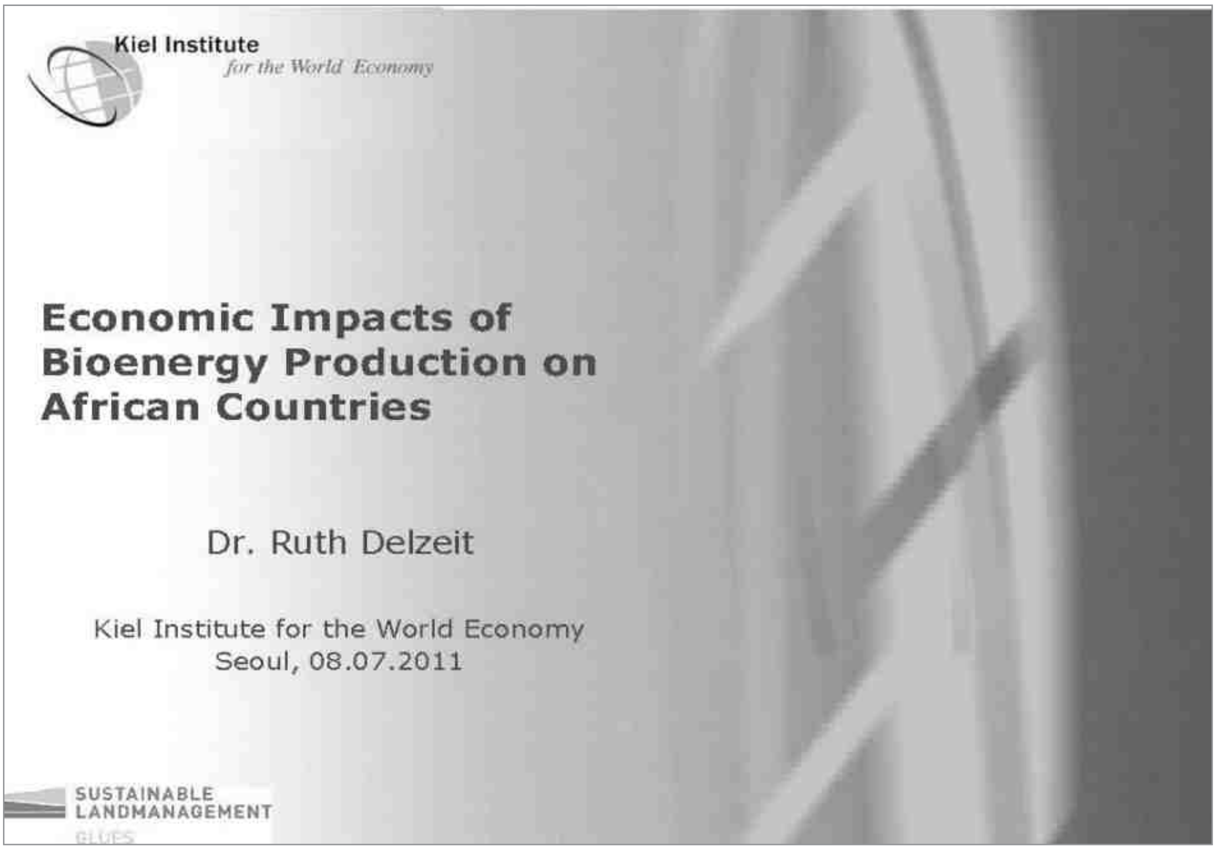
Highlighted Experience
2007 ~ 2009 Postdoc Researcher at University of Victoria and University of Alberta

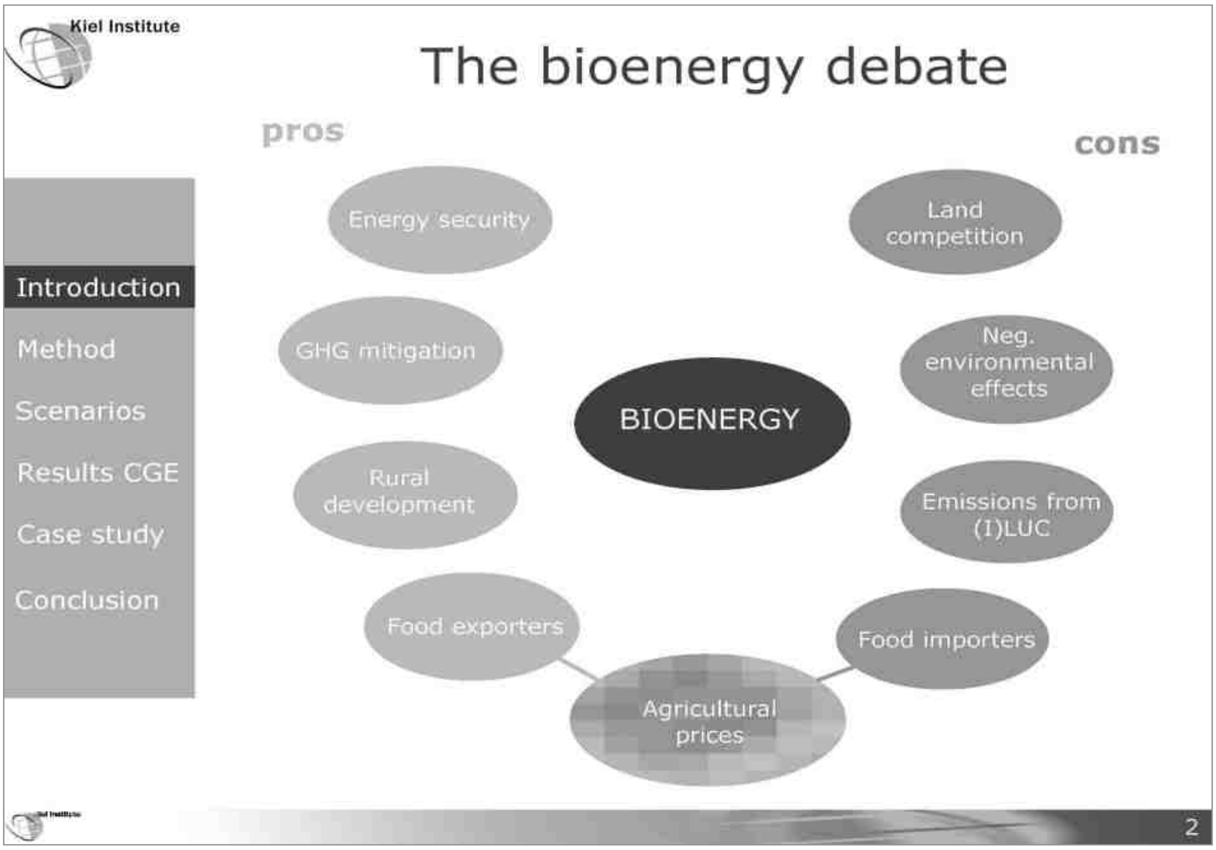
Recent Publications/Research
Chakravorty, Ujjayant & Hubert Marie-Helene & Moreaux, Michel & Nostbakken, Linda (2011)
"Will Biofuel Mandates Raise Food Prices?" Working Papers 2011-1, University Alberta, Department of Economics
Chakravorty, Ujjayant & Hubert Marie-Helene & Nostbakken, Linda. "Fuel versus Food"
Annual Review of Resource Economics, Vol. 1, No. 1, pp. 645-663 (2009)
Distributional impacts of biofuel mandates in India

Session 1

Economic Impacts of Bioenergy Production on African Countries

Ruth Delzeit
Kiel Institute


Kiel Institute
for the World Economy
Economic Impacts of
Bioenergy Production on
African Countries
Dr. Ruth Delzeit
Kiel Institute for the World Economy
Seoul, 08.07.2011
SUSTAINABLE
LANDMANAGEMENT


Kiel Institute
The bioenergy debate
pros
cons
Introduction
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Scenarios
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Case study
Conclusion
Energy security
GHG mitigation
Rural
development
Food exporters
BIOENERGY
Land
competition
Neg.
environmental
effects
Emissions from
(I)LUC
Food importers
Agricultural
prices
2

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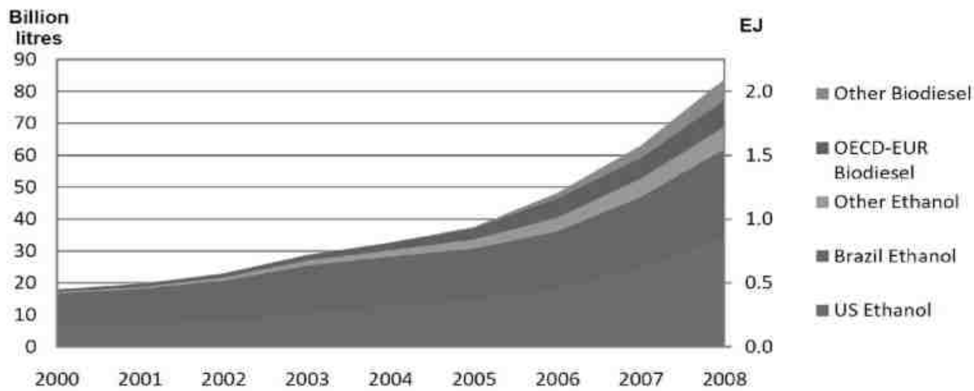
Global Biofuel Production

- Introduction
- Method
- Scenarios
- Results CGE
- Case study
- Conclusion



Source: International Energy Agency 2010

3

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Economic Impacts of Bioenergy

- Introduction
- Method
- Scenarios
- Results CGE
- Case study
- Conclusion

- **What are the effects of massive support of biofuels in developing countries on African counties?**
- What are economic chances and risks of bioenergy production in African countries?

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Case study
Conclusion

Method

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CGE models to simulate effects of biofuel policies

Introduction
Method
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- Account for international and inter-sectoral linkages of energy and agricultural markets
- Based on input-output table for the world economy (GTAP database)
- Based on microeconomic assumptions:
  - There is a market for each product
  - Agents: consumers, producers, government
  - Consumers maximise utility
  - Producers maximise revenue
  - In equilibrium prices are such that supply=demand in all input and output markets
  - Values of endogenous variables determined by equations that describe world economy

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DART with biofuels

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Conclusion

- Multi-region, multi-sector, recursive dynamic CGE model

➡ sequence of single-period equilibria connected through capital accumulation and changes in labour supply

- Model horizon: 2001-2020
- 21 sectors and 19 countries/regions representing the global economy that are linked via bilateral trade flows
- Disaggregation of GTAP database
  - 'Refined oil products' sector → 'diesel', 'gasoline' and 'other refined oil products'
  - 'Other grains' → 'corn' and 'other grains'
- Biofuels as latent technology

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Scenarios

Introduction
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Policy scenarios presented here:

REF:
biofuel shares frozen at their 2005 level
EU: 20% reduction in CO_2 emissions by 2020 relative to 1990 (EU climate package) via EU-ETS + national carbon taxes in non-ETS sectors

10Q:
Same as REF + 10% quota on biofuel **use** in all EU member states by 2020

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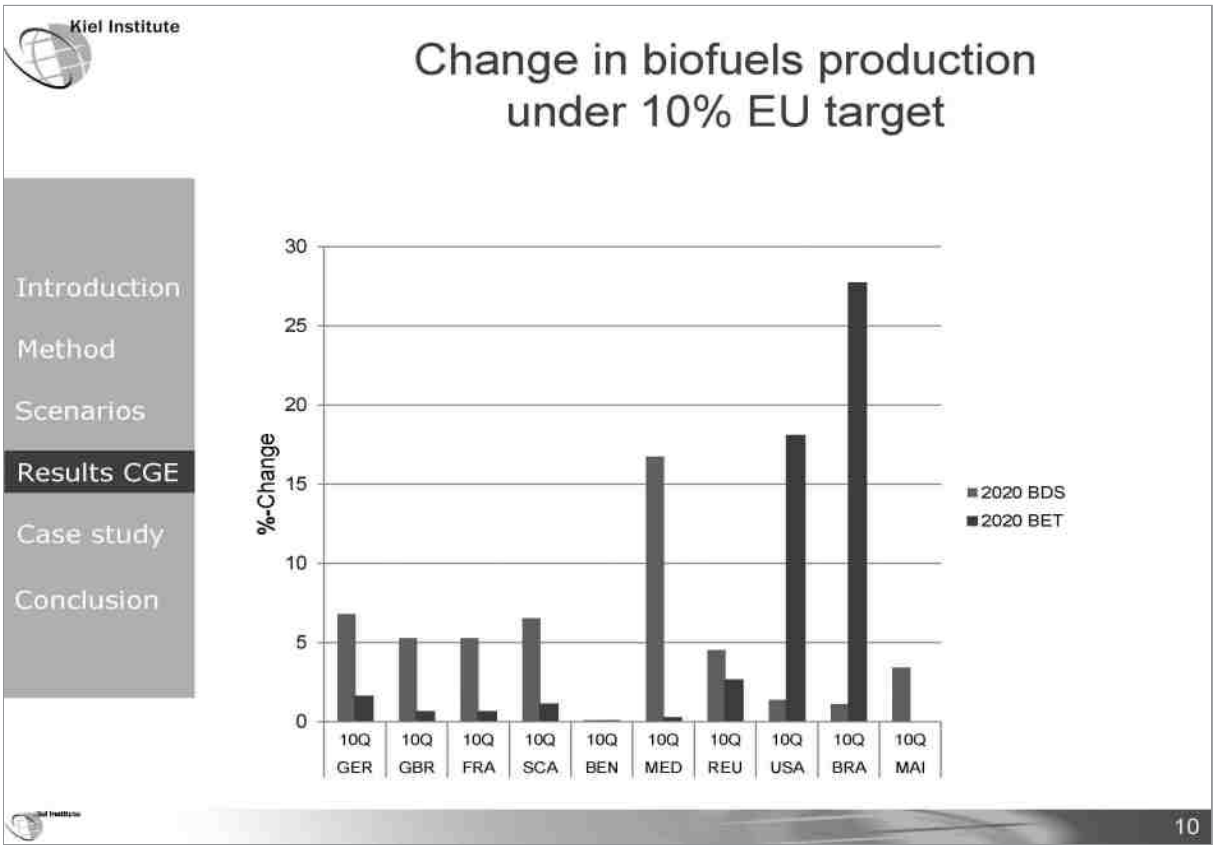
Kiel Institute
Change in biofuels production under 10% EU target
Introduction
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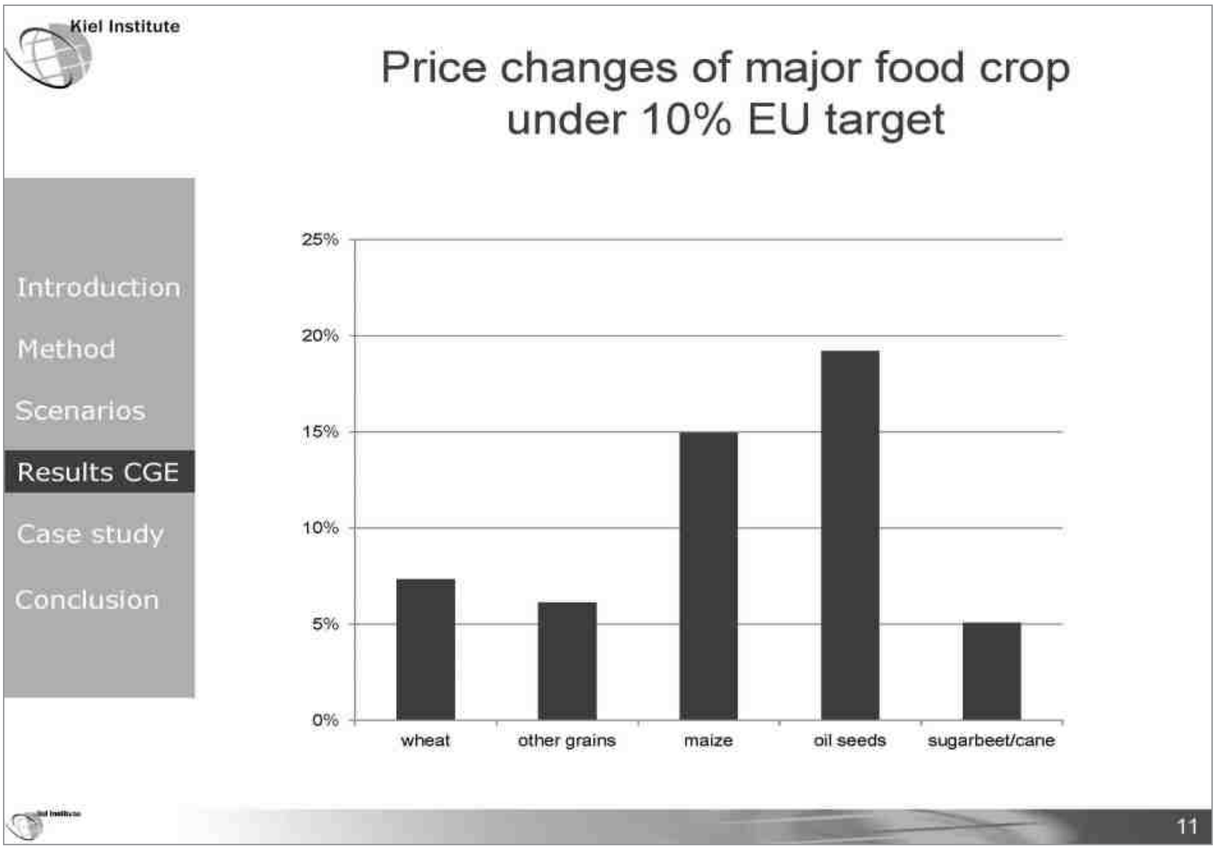
Conclusion
%-Change
30
25
20
15
10
5
0
10Q GER
10Q GBR
10Q FRA
10Q SCA
10Q BEN
10Q MED
10Q REU
10Q USA
10Q BRA
10Q MAI
2020 BDS
2020 BET
10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Price changes of major food crop under 10% EU target
Introduction
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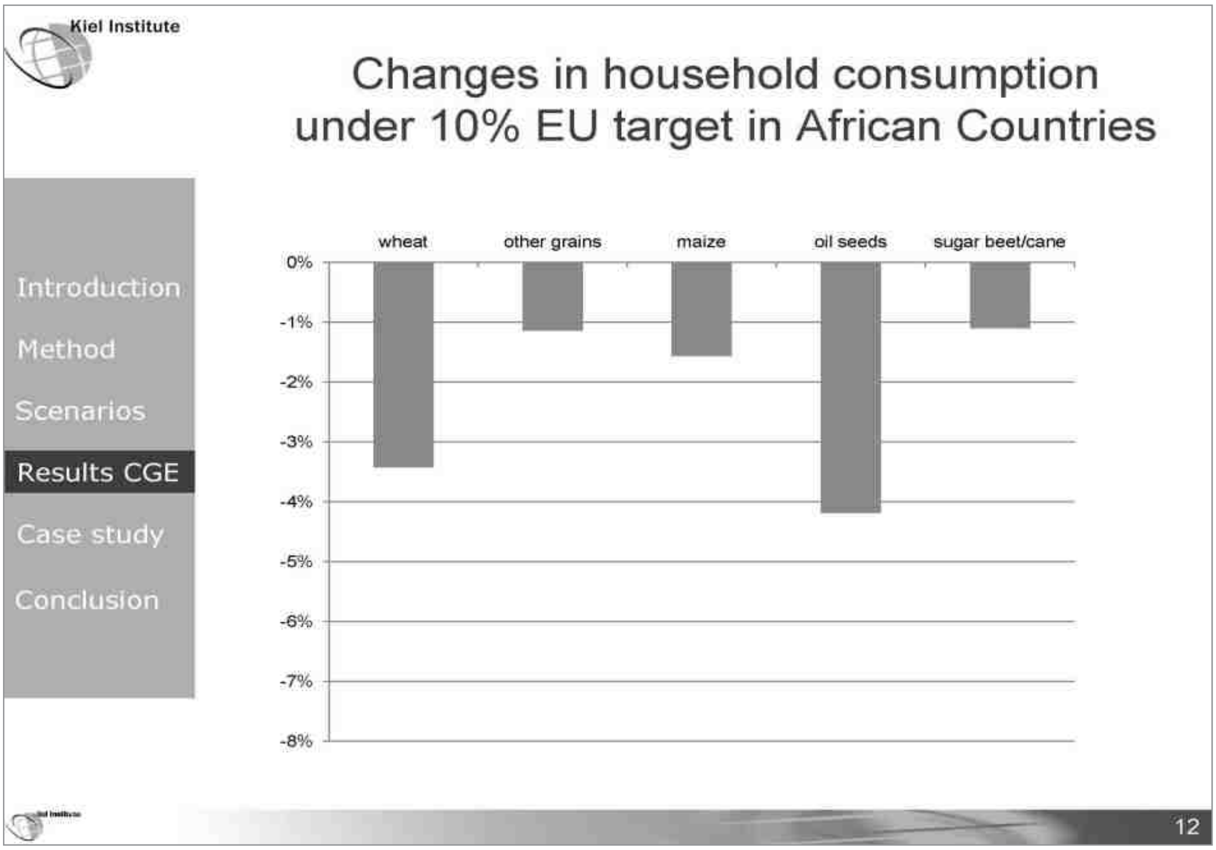
Conclusion
25%
20%
15%
10%
5%
0%
wheat
other grains
maize
oil seeds
sugarbeet/cane
11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Changes in household consumption under 10% EU target in African Countries
Introduction
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Conclusion
wheat
other grains
maize
oil seeds
sugar beet/cane
0%
-1%
-2%
-3%
-4%
-5%
-6%
-7%
-8%
12

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Does this hold for all countries?

Introduction
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- Disadvantages for net importers of agricultural products
- Advantages for net exporters
- For farmers depending on degree of self-sufficiency
- Disadvantages for landless
- Disadvantages for urban population

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Economic Impacts of Bioenergy

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- What are the effects of massive support of biofuels in developing countries on African counties?
- **What are economic chances and risks of bioenergy production in African countries?**

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Macro impacts and GHGs reduction in the scenario 2

Item		GHG emission	Relative changes in GHG emission(%)
Energy sector	Coal	211.00	-12.01
	Petroleum	208.62	-0.08
	LNG	70.95	-0.04
	Total	490.57	-12.13
Industrial process		79.76	-0.05
Agriculture and livestock		16.12	0.00
Forest		-31.96	-1.98
Total emission(Million TCO2)		586.44	-12.18
GDP reduction (trillion won)			0.34
GHG abatement cost relative to GDP loss (won/TCO2)			27,983
Welfare loss(billion won)			139
GHG abatement cost relative to welfare loss(won/TCO2)			11,436

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Introduction

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Scenarios

Results CGE

Case study

Conclusion

Case study Malawi*

*** Based on a study by Mareike Lange & Prof. Gernot Klepper (Institute for the World Economy) 2011**

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Background information

Introduction
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Case study
Conclusion

- Landlocked and one of the poorest countries in the world (GDP per capita 800 USD in 2010)
- 33.5% of GDP from agriculture, over 80% of population in rural areas
- Negative trade balance, main export good tobacco
- Small scale farmers; over 70% of farmer sell part of production

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Biofuels in Malawi

Introduction
Method
Scenarios
Results CGE
Case study
Conclusion

- Production of bioethanol since 1982 from bagasse
- Production volume 2011: 30 mio. litres
- Several projects on biodiesel from jatropha

→Does it benefit the Malawian economy to promote biodiesel production from jatropha?

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Economic effects of biodiesel production from jatropha

Introduction
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- Direct income effects compared to other cash crops higher at time horizon of 20 years (high risks)
- Positive non-cash benefits
  - Diversification from other cash crops
  - Investments into low input income possibilities
  - Income possibilities in periods with no harvest of other crops
- External benefits such as improvement in productivity in farming of other crops through training
- Under current policy setting low – moderate import substitution of fossil fuels

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Conclusions and recommendations

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- Economic impacts of biofuel production on African countries strongly depends on agricultural structure
- To benefit from increasing agricultural prices:
  - Market access for farmers need to be improved
  - Value-adding should take place at the farmers level
  - Use of by-product increases profitability (and GHG balance)
  - Long term knowledge transfer to local farmers
- Before supporting biofuels in African countries, land availability (food security) and macroeconomic effects need to be studies

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Session 1

Economic and Environmental Consequences of Eco-Friendly Tax Policy for Fostering Solid Biomass and Biogas Sectors in South Korea

Jeong-Hwan Bae
Chonnam National University

2011 International Modeling Conference:
Transition to Sustainable Energy & Low Carbon Systems in Developing Countries

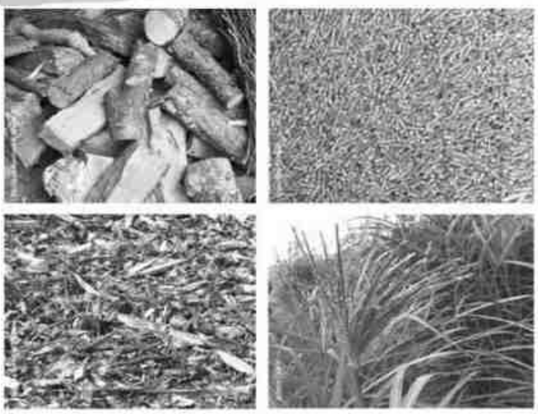
Economic and environmental consequences of eco-friendly tax policy for fostering biomass and biogas sectors in South Korea

2011. 7. 8.

Professor Jeong Hwan Bae (jhbae@jnu.ac.kr)
Economics Department
Chonnam National University

Background

- Biomass and biogas can contribute 'energy security' considerably in petroleum addicted countries
- Biomass: woodchip and wood pellet
- Biogas: methane (CH_4) derived from anaerobic process on organic wastes
- Normal range of heat contents
  - Wood chip: ≤ 2,700kcal/kg
  - Wood pellet: 4,000~4,500kcal/kg
  - Toreffied wood pellet: 5,000~5,500kcal/kg
  - Biogas: ≤ 5,000kcal/kg
  - Biomethane: ≤ 9,500kcal



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Background

- Total production of NRE: 6,086,249TOE (2.5% of TPE)
  - Production share of bioenergy: 9.54%
  - Biomass: 147,063TOE (woodchip: 20,075, pellet: 53,577)
  - Biogas: 82,690TOE (biogas: 50,865, LFG: 31825)
- Major promotion policy
  - Feed-In-Tariff / RPS
  - Financial supports: ESCO fund, grant, tenders (public projects)
  - R&D investment
- Promotion policy has limitation in the financial budget!
  - Increases of financial burdern to the government

3

Driving forces of bioenergy

- Biomass can replace coal more effectively with removing subsidy on coal production and consumption
  - Coal is one of the most carbon intensive fuels
  - Annual subsidy on coal prod/cons is 2,000bil.KW.
  - Gov. does not need to impose a new carbon tax on it
- Biogas can be produced more effectively throughout organic waste charge
- Factors supporting necessity of biogas production
  - Ban of dumping organic wastes in the ocean in 2012
  - Constraints in the capacity of landfill
  - Limitation in conversion of livestock wastes into organic fertilizer

4

Purposes of the research

- Economic consequences of removing subsidy on coal and substituting biomass
- Economic effects of imposing organic waste charge on the promotion of biogas
  - Integrating bottom-up approach (accounting cost of bioenergy) into top-down CGE modeling approach
- Compare Choice between direct expansion of public demand for biomass and price subsidy on the biomass production
- Imposition of organic waste charge on proxy variables
  - Choice between charge on livestock products and consumption on food
- Environmental impacts
  - GHGs emission reduction due to the substitution between bioenergy and fossil fuels

5

Methodology of the research

- **A static CGE model for biomass**
  - Aggregation of 168 sectors into 20 sectors using I/O table (2005)
  - Agri & Forest(2), energy (6), transportation (1), manufacture(11), and services
  - Biomass subjects to forest sector and regarded as inputs to electricity, agriculture, and steam sectors
  - Potential demand for biomass as fuels are reflected into the I/O table
- **A static CGE model for biogas**
  - Aggregation of basic sector (408) input-output table into 15 sectors using I/O table (2008)
  - Construction of input output information for biogas sector
  - Biogas production including LFG in 2008 (TOE)
  - Average biogas production costs (KW/TOE) for raw BG (LFG) and purified BG are derived from literature review

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Simulation I: Economic and environmental impact of removing subsidy on coal and recycling it with subsidizing promotion of solid biomass

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More on research questions....

- Comparison of welfare change between 1) conversion of coal subsidy into price subsidy on biomass 2) conversion of coal subsidy into public demand on biomass
  - Which option is better in non-environmental aspect as well as environmental aspect?
- **Integrate bottom-up with top-down approach**
  - Potential solid biomass energy derived from external sources is adjusted to the existing I/O table
  - Assume that production cost of biomass follows the same structure with that of forest sector(WOOD)
- **Total subsidy on coal is 240,153mil KW in 2005**
  - Remove subsidy on coal and use as price subsidy to biomass: 8% of subsidy rate to total output value
  - Remove the subsidy on coal and use as public demand for biomass: 1.4% of total tax revenue

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Potential demand for biomass

- **Total potential: 870thousand TOE**
- **Substitute biomass for coal fired power plant**
  - Replace 10% of coal input demand
  - About 110thousand TOE
- **Kerosene and coal demand of agricultural sectors**
  - About 220thousand TOE
- **Petroleum and coal demand of steam industry**
  - Replace 50% of total demand
  - About 542thousand TOE

Unit: TOE

Sector	Coal	Petroleum	total	Adjusted total
Electricity	1,094,610	0	1,094,610	109,461
Agriculture	96,911	120,613	217,524	217,524
Steam	683,342	399,998	1,083,339	541,670
Total	1,874,863	520,610	2,395,473	868,655

Unit: Mil. KW

Sector	Coal	Petroleum	total	Adjusted total
Electricity	226,593	0	226,593	22,659
Agriculture	20,061	55,316	75,377	75,377
Steam	106,093	283,029	389,122	194,561
Total	352,748	338,345	691,093	292,598

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Scenario1: Remove subsidy on coal + price subsidy on biomass

Sector	Domestic Sales	Absorption	Output	Export	Import
AGR	0.03	0.03	0.03	0.06	0.01
WOOD	4.13	3.1	4.27	10.69	-0.14
COAL	-5.62	-1.45	-5.66	-13.82	0.45
OIL	-0.01	-0.01	-0.01	-0.01	-0.01
LNG	-0.04	-0.04	-0.04	-0.04	-0.04
MINE	-0.06	-0.06	-0.06	-0.06	-0.06
FOOD	0.02	0.02	0.03	0.06	0
CLOTH	-0.01	-0.01	-0.01	0	-0.01
PULP	0.05	0.02	0.07	0.28	-0.11
CHEMICAL	-0.02	-0.02	-0.02	-0.01	-0.02
METAL	-0.06	-0.05	-0.07	-0.15	0
MACHINE	-0.03	-0.03	-0.04	-0.05	-0.02
ELEC	-0.12	-0.12	-0.12	-0.44	0.1
TOWNGAS	-0.04	-0.04	-0.04	-0.04	-0.04
STEAM	0.17	0.16	0.17	0.58	-0.12
CONSTRUCT	0	0	0	0	0.01
SALES	0	0	0	0.01	-0.01
TRANS	-0.02	-0.02	-0.01	-0.01	-0.02
COMM	-0.01	-0.01	-0.01	0	-0.01
SERV	0	0	0	0.01	-0.01

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Scenario1

Sector	Labor demand	Capital demand	Value-added	Intermediate demand
AGR	0.06	0.03	0.02	0.03
WOOD	4.3	4.27	4.26	0.17
COAL	-5.66	0	-5.69	-1.45
OIL	0.01	-0.02	-0.02	-0.01
LNG	-0.02	-0.05	-0.05	-0.04
MINE	-0.04	-0.07	-0.08	-0.06
FOOD	0.04	0.01	0.01	0.01
CLOTH	0	-0.03	-0.03	-0.01
PULP	0.08	0.05	0.05	0.01
CHEMICAL	0	-0.03	-0.03	-0.02
METAL	-0.05	-0.08	-0.09	-0.05
MACHINE	-0.02	-0.05	-0.06	-0.03
ELEC	-0.1	-0.12	-0.13	-0.03
TOWNGAS	-0.02	-0.05	-0.06	-0.06
STEAM	0.19	0.16	0.15	0.03
CONSTRUCT	0.01	-0.02	-0.02	-0.01
SALES	0.01	-0.01	-0.02	-0.01
TRANS	0	-0.03	-0.03	-0.02
COMM	0.01	-0.02	-0.03	-0.01
SERV	0.01	-0.02	-0.02	-0.01

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Scenario 2: Remove subsidy on coal + public demand for biomass

Sector	Do' Sales	Absorption	Output	Export	Import
AGR	-0.01	-0.01	-0.01	0	-0.02
WOOD	6.19	6.19	6.19	6.18	6.19
COAL	-5.66	-1.48	-5.69	-13.86	0.42
OIL	-0.04	-0.04	-0.04	-0.04	-0.04
LNG	-0.06	-0.07	-0.06	-0.05	-0.07
MINE	-0.12	-0.12	-0.12	-0.11	-0.12
FOOD	-0.02	-0.02	-0.02	-0.01	-0.03
CLOTH	-0.03	-0.03	-0.03	-0.02	-0.03
PULP	-0.03	-0.03	-0.03	-0.02	-0.03
CHEMICAL	-0.04	-0.04	-0.05	-0.05	-0.04
METAL	-0.12	-0.1	-0.13	-0.2	-0.06
MACHINE	-0.08	-0.07	-0.08	-0.08	-0.07
ELEC	-0.14	-0.14	-0.14	-0.5	0.1
TOWNGAS	-0.07	-0.07	-0.07	-0.07	-0.07
STEAM	-0.07	-0.07	-0.07	-0.16	-0.01
CONSTRUCT	-0.09	-0.09	-0.09	-0.09	-0.09
SALES	-0.02	-0.02	-0.02	-0.01	-0.03
TRANS	-0.03	-0.04	-0.03	-0.01	-0.05
COMM	-0.01	-0.01	-0.01	0	-0.02
SERV	0.04	0.04	0.04	0.06	0.02

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Scenario 2

Sector	Labor demand	Capital demand	Value-added	Intermediate dem and
AGR	0.02	-0.02	-0.04	-0.01
WOOD	6.23	6.18	6.16	0.16
COAL	-5.69	0	-5.75	-1.48
OIL	-0.01	-0.05	-0.07	-0.04
LNG	-0.02	-0.06	-0.08	-0.07
MINE	-0.09	-0.13	-0.15	-0.12
FOOD	0	-0.04	-0.06	-0.01
CLOTH	-0.01	-0.05	-0.07	-0.03
PULP	-0.01	-0.05	-0.07	-0.03
CHEMICAL	-0.02	-0.06	-0.08	-0.04
METAL	-0.1	-0.14	-0.16	-0.1
MACHINE	-0.06	-0.1	-0.12	-0.07
ELEC	-0.11	-0.15	-0.17	-0.05
TOWNGAS	-0.04	-0.08	-0.1	-0.09
STEAM	-0.04	-0.08	-0.1	-0.04
CONSTRUCT	-0.08	-0.12	-0.14	0.01
SALES	0	-0.04	-0.06	-0.02
TRANS	-0.01	-0.05	-0.07	-0.05
COMM	0.01	-0.03	-0.05	0
SERV	0.06	0.01	0	-0.01

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Macro impacts and GHGs reduction in the scenario 1

Item		GHG emission	Relative changes in GHG emission(%)
Energy sector	Coal	211.00	-11.94
	Petroleum	208.62	-0.02
	LNG	70.95	-0.03
	Total	490.57	-11.99
Industrial process		79.76	-0.01
Agriculture and livestock		16.12	0.00
Forest		-31.96	-1.36
Total emission(Million TCO2)		586.44	-11.99
GDP reduction (trillion won)			0.17
GHG abatement cost relative to GDP loss (won/TCO2)			14,208
Welfare loss(billion won)			23.57
GHG abatement cost relative to welfare loss(won/TCO2)			1,965

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Macro impacts and GHGs reduction in the scenario 2

Item		GHG emission	Relative changes in GHG emission(%)
Energy sector	Coal	211.00	-12.01
	Petroleum	208.62	-0.08
	LNG	70.95	-0.04
	Total	490.57	-12.13
Industrial process		79.76	-0.05
Agriculture and livestock		16.12	0.00
Forest		-31.96	-1.98
Total emission(Million TCO2)		586.44	-12.18
GDP reduction (trillion won)			0.34
GHG abatement cost relative to GDP loss (won/TCO2)			27,983
Welfare loss(billion won)			139
GHG abatement cost relative to welfare loss(won/TCO2)			11,436

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Implications for the choice between two biomass promotion measures

- Scenario 2 has more negative impacts from subsidy recycling policy than scenario 1
  - Since coal is used as intermediate inputs to extensive sectors, negative impacts of subsidy reduction of coal are significant
- Implication to real world
  - Price subsidy on biomass from increased gov. revenue due to the reduction of subsidy in coal is preferred to increases of public demand policy on biomass
  - In terms of competitiveness with foreign biomass industry, price subsidy policy is preferred to increases of public demand policy as well

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Implications for environmental dimension

- Scenario 1 is more cost effective in mitigating GHGs
  - Scenario 2 has more severe damage in GDP and welfare
  - Total amount of abatement of GHGs in the scenario 1 is larger that in the scenario 2
- Price subsidy policy is preferred to increases of public demand policy in the sense of economics as well as environment
- Before we consider additional carbon tax on fossil fuels which causes additional distortions, we need to reduce subsidy on fossil fuels first if consider distortions in the market

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Simulation II: Economic and environmental impact of imposing organic waste charge as a meaure of fostering a biogas sector

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Biogas production costs without purification

- **Conditions for deriving production costs**
  - Biogas plants in Canada. BC. Fraser Valley
  - Production of 240Nm3 of BD to convert to 140Nm3 of biomethane
  - Heating value of raw BD: 5500Kcal/m3

Item	total(CAD$)	unit(CAD$/TOE)	Ratio
Lab analysis	3,750	2.11	0.01
Electricity	9,800	5.50	0.03
Insurance	5,326	2.99	0.02
Maintenance	21,305	11.96	0.07
Labor	14,600	8.20	0.05
Debt service(capital)	267,711	150.34	0.83
total	322,492	181.11	1.00

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Purification costs

- **Conditions for purification costs**
  - Based on 15 of biogas plant costs
  - Heating value of purified BD: 9500Kcal/m3

Item	Total($)	Unit($/TOE)	Ratio
maintenance	33,129	18.60	0.07
energy(electricity)	85,730	48.14	0.17
h2s scrubber(chemical)	63,295	35.55	0.13
chemicals	7,500	4.21	0.02
personal	12,288	6.90	0.02
meterial	12,649	7.10	0.03
utilities(monitoring)	10,500	5.90	0.02
other	34,555	19.41	0.07
total operating cost	259,645	145.81	0.52
capital cost(yearly)	238,727	134.06	0.48
total	498,372	279.88	1.00

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Mapping to input-output table

- **Average production costs**
  - Raw BG production cost: 198KW/m3
  - BG purification cost: 306KW/m3
  - Total costs: 503KW/m3
  - Transmission, connection, and profits are excluded

Raw BG production cost (KW/TOE)

Items in IO Table	Cost per unit	Ratio
Capital cost	172,743	0.83
Labor cost	9,421	0.05
Electricity	6,324	0.03
Chemical and metal	2,420	0.01
Machine and electronic	13,747	0.07
Service and others	3,437	0.02
Toal	208,091	1.00

BG purification cost (KW/TOE)

Items in IO Table	Cost per unit	Ratio
Capital cost	154,041	0.48
Labor cost	7,929	0.02
Electricity	55,318	0.17
Chemical and metal	53,843	0.17
Machine and electronic	28,152	0.09
Service and others	22,297	0.07
Toal	321,579	1.00

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Biogas production

- **Total production of biogas: 165,000TOE in 2008**
  - Biogas 45,000TOE, LFG 120,000TOE

Item	Electricity	Heat	Total
Biogas	723	44,663	45,386
LFG	88,794	31,196	119,990
Total	89,517	75,859	165,376

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Input/output structure of biogas

- **Reflecting total biogas production and input costs**
  - Total production value: 44.7bill KW
  - Subsidy rate: 65% of total capital is subsidized for capital installation

Cost(mill. KW)	Biogas(electricity)	Biogas(heat)	LFG	Total
Capital cost	236	7,715	29,093	37,044
Labor cost	13	421	1,587	2,020
Electricity	45	282	1,065	1,392
Chemical and metal	41	108	408	556
Machine and electronic	30	614	2,315	2,960
Service and others	19	153	579	751
Toal	383	9,294	35,046	44,723

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Policy scenarios

- Tax policy for boosting biogas production
  - Livestock wastes and food wastes: Non-point pollution source
  - Point pollution source: explicit relation between source and emission → environmental tax on the emission is general
  - Non point pollution source: uncertainty between source and emission → Output tax or intermediate taxes are general
- Policy scenario
  - Scenario 1: output taxes on the production of livestock products (32.3%)
  - Scenario 2: consumption taxes on the consumption of food (1.77%)
  - Both scenarios suppose that the tax revenue is recycled to subsidize capital costs of biogas production
  - Total subsidy: 782.3 bill. KW (2009-2013 plan of Min. of Agri. & Food, Min. of Env.)

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Microeconomic results for scenario 1

Sector	Household consumption	Government demand	Invest demand	Export demand
AGR	-5.33	-	-7.93	-4.88
LIVE	-	-	-38.42	-7.37
COAL	-7.9	-	-10.43	-6.54
OIL	-7.64	-	-10.18	-0.55
LNG	-	-	-10.47	-5.72
MINE	-7.63	-	-10.17	-9.55
FOOD	-8.9	-	-11.4	-8.05
FLP	-7.92	-	-10.45	-6.92
CHEM	-7.14	-	-9.69	-6.5
MAC	-7.12	-	-9.68	-6.63
TRAN	-6.96	-	-9.52	-10.82
MAN	-8.39	-	-10.91	-7.18
ELEC	-7.49	-	-	-7.91
HEAT	-8.16	-	-	-7.53
SERV	-7.76	-6.66	-10.29	-
BIOGAS	-	-	-	-

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Microeconomic results for scenario 1

Sector	Domestic consumption	Absorption	Output	Value-added
AGR	-7.36	-7.74	-7.33	-13.09
LIVE	-13.37	-13.36	-13.37	-19.92
COAL	-7.51	-7.57	-7.51	-8.49
OIL	-7.11	-7.35	-6.91	-11.18
LNG	-5.06	-8.02	-5.05	-12.05
MINE	-6.98	-7.68	-6.92	-9.48
FOOD	-8.77	-8.7	-8.8	-8.34
FLP	-8.09	-8.1	-8.08	-7.44
CHEM	-7.71	-7.84	-7.53	-9.3
MAC	-7.56	-7.87	-7.02	-7.73
TRAN	-7.55	-7.68	-7.05	-6.84
MAN	-10.5	-10.5	-10.51	-8.29
ELEC	-7.52	-7.52	-7.52	-9.26
HEAT	-7.76	-7.76	-7.76	-2.82
SERV	-7.69	-7.7	-7.68	-7.88
BIOGAS	3255.53	3255.53	3255.53	3005.1

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Microeconomic results for scenario 1

Sector	Intermediate demand	Labor demand	Capital demand	Import demand
AGR	-8.65	-18.79	-5.63	-9.03
LIVE	-8.79	-25.17	-13.04	4.46
COAL	-7.53	-14.48	-0.63	-7.6
OIL	-7.32	-17	-3.56	-7.5
LNG	-7.76	-17.81	-4.5	-8.03
MINE	-7.61	-15.41	-1.71	-7.84
FOOD	-8.43	-14.35	-0.47	-8.23
FLP	-8.14	-13.51	0.51	-8.12
CHEM	-7.82	-15.24	-1.51	-8.24
MAC	-7.33	-13.78	0.19	-8.28
TRAN	-7.19	-12.95	1.16	-8.17
MAN	-8.08	-14.3	-0.42	-10.29
ELEC	-7.53	-15.21	-1.47	-7.76
HEAT	-7.6	-9.19	5.52	-7.66
SERV	-7.79	-13.92	0.03	-7.8
BIOGAS	-7.61	2801.61	3271.69	-

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Microeconomic results for scenario 2

Sector	Household consumption	Government demand	Invest demand	Export demand
AGR	-5.08	-	-7.26	-4.83
LIVE	-	-	-9.07	-7.02
COAL	-7.46	-	-9.58	-6.25
OIL	-7.22	-	-9.35	-0.56
LNG	-	-	-9.61	-5.49
MINE	-7.2	-	-9.34	-8.56
FOOD	-9.1	-	-11.19	-7.73
FLP	-7.53	-	-9.66	-6.61
CHEM	-6.78	-	-8.92	-6.25
MAC	-6.79	-	-8.93	-6.49
TRAN	-6.71	-	-8.85	-10.08
MAN	-7.97	-	-10.09	-6.84
ELEC	-7.09	-	-	-7.52
HEAT	-7.71	-	-	-7.23
SERV	-7.39	-6.37	-9.52	0
BIOGAS	-	-	-	0

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Microeconomic results for scenario 2

Sector	Domestic consumption	Absorption	Output	Value-added
AGR	-7.12	-7.46	-7.08	-12.51
LIVE	-8.64	-8.64	-8.64	-15.15
COAL	-7.14	-7.2	-7.14	-8.02
OIL	-6.78	-6.99	-6.59	-10.6
LNG	-4.8	-7.59	-4.79	-11.4
MINE	-6.65	-7.28	-6.59	-8.97
FOOD	-8.6	-8.6	-8.6	-8.1
FLP	-7.71	-7.7	-7.71	-7.05
CHEM	-7.32	-7.43	-7.16	-8.79
MAC	-7.16	-7.43	-6.7	-7.33
TRAN	-7.23	-7.33	-6.83	-6.58
MAN	-9.74	-9.74	-9.75	-7.58
ELEC	-7.15	-7.15	-7.15	-8.75
HEAT	-7.37	-7.37	-7.37	-2.62
SERV	-7.32	-7.33	-7.32	-7.45
BIOGAS	3255.53	3255.53	3255.53	3019.67

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Microeconomic results for scenario 2

Sector	Intermediate demand	Labor demand	Capital demand	Import demand
AGR	-8.37	-18	-5.47	-8.65
LIVE	-8.57	-20.47	-8.32	-8.93
COAL	-7.16	-13.78	-0.61	-7.22
OIL	-6.97	-16.21	-3.41	-7.14
LNG	-7.37	-16.95	-4.27	-7.6
MINE	-7.23	-14.68	-1.64	-7.44
FOOD	-7.98	-13.86	-0.7	-8.63
FLP	-7.75	-12.88	0.43	-7.69
CHEM	-7.43	-14.51	-1.45	-7.8
MAC	-6.98	-13.14	0.13	-7.78
TRAN	-6.94	-12.44	0.94	-7.73
MAN	-7.68	-13.38	-0.14	-9.51
ELEC	-7.16	-14.47	-1.4	-7.36
HEAT	-7.23	-8.73	5.22	-7.27
SERV	-7.41	-13.26	0	-7.39
BIOGAS	-7.23	2824.08	3270.83	-

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Macroeconomic results

Scenario 1 →

GDP	-7.73
Employment	-8.01
Capital	-7.91
Gov Revenue	-6.87
CV	725.51

Scenario 2 →

GDP	-7.35
Employment	-7.56
Capital	-7.45
Gov Revenue	-6.49
CV	-375.93

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Estimation of GHGs in scenario 1

- Basic assumption
  - 2007 sectoral GHGs net emission
  - Non-fuel sector emissions of agricultural and livestock, and absorptions are excluded
  - Lacuna emissions are excluded as well

Fuel emission	Intermediate demands	HHC
COAL	-7.16	-7.46
OIL	-6.97	-7.22
LNG	-7.37	-
ELEC	-7.16	-7.09
HEAT	-7.23	-7.71
average change rate(%)	-7.18	
TRAN	-6.83	-7.39
MINE	-7.23	-
AGR	-8.37	-
LIVE	-8.57	-
average change rate(%)	-8.06	-7.37

Manufacture, construction and etc	Intermediate demands
FOOD	-8.60
FLP	-7.71
CHEM	-7.16
MAC	-6.70
MAN	-9.75
SERV	-7.32
average change rate(%)	-7.87

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Estimation of GHGs mitigation potential in scenario 1

- 42,074,000TCO2 can be mitigated with the cost of 1.89mill KW/TCO2 (GDP basis)

Item	Net emission (1,000t)	Change(%)	Mitigation (1,000t)
Fuel combustion –Energy sectors	190,557	-7.55	- 14,383
Fuel combustion –Manufacture and construction sectors	159926	-8.27	- 13,227
Fuel combustion –transportation sectors	100807	-6.83	- 6,886
Fuel combustion –Agriculture, mining, sectors, household, commercial, public and etc	67454	-7.84	- 5,291
Industrial process-mining	29333	-7.23	- 2,121
Industrial process-chemistry	2047	-7.43	- 152
Industrial process-metal	194	-7.68	- 15
total	550318	-	- 42,074

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Estimation of GHGs in scenario 2

Fuel emission	Intermediate demands	HHC
COAL	-7.16	-7.46
OIL	-6.97	-7.22
LNG	-7.37	-
ELEC	-7.16	-7.09
HEAT	-7.23	-7.71
average change rate(%)	-7.18	
TRAN	-6.83	-7.39
MINE	-7.23	-
AGR	-8.37	-
LIVE	-8.57	-
average change rate(%)	-8.06	-7.37

Manufacture, construction and etc	Intermediate demands
FOOD	-8.60
FLP	-7.71
CHEM	-7.16
MAC	-6.70
MAN	-9.75
SERV	-7.32
average change rate(%)	-7.87

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Estimation of GHGs mitigation potential in scenario 2

- 40,646,000TCO2 can be mitigated with the cost of 1.86mill KW/TCO2 (GDP basis)

Item	Net emission (1,000t)	Change(%)	Mitigation (1,000t)
Fuel combustion –Energy sectors	190,557	-7.18	- 13,678
Fuel combustion –Manufacture and construction sectors	159926	-7.87	- 12,590
Fuel combustion –transportation sectors	100807	-6.83	- 6,886
Fuel combustion –Agriculture, mining, sectors, household, commercial, public and etc	67454	-7.72	- 5,204
Industrial process-mining	29333	-7.23	- 2,121
Industrial process-chemistry	2047	-7.43	- 152
Industrial process-metal	194	-7.68	- 15
total	550318		-40646

35

Implications on the choice of two promotion policies

- Economic impacts of Scenario 2 (consumption tax on food) are less harmful for GDP, employment, and capital
- However, welfare change is more favorable in scenario 1 than scenario 2
- Scenario 1 is also more favorable in mitigation of GHGs relative to scenario 2
  - However average mitigation cost of GHGs is lower in scenario 2
- On the other hand, taxes on livestock industry will cause fairness problem since those people who are involved in the livestock are usually poor income groups
- Therefore, organic waste taxes on the consumption of food are more extensive and equitable

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Conclusion and limits

- Bioenergy is abundant in most developing countries, expecially in Southeastern Asian countries
- Direct financial supports have limits in the context of government budget restriction
- Removing subsidy on fossil fuels and recycling it with boosting bioenergy is more effective than introducing a new carbon tax
- Imposing organic waste charge and recycling it with fostering biogas sector would lead to activate biogas production effectively
- However, the static CGE model couldn't reflect dynamic changes in food consumption pattern, economic growth, inflation, and population growth
- In order to calculate GHGs mitigation due to the extension of biogas, environment-energy-economy integrated IO table should be constructed

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Session 1

Will Biofuel Mandates Raise Food Prices?

Marie-Helene Hubert
University of Rennes

Session 2

Sustainable Energy Supply Systems

Chair: Sang Yul Shim,
Korea Energy Economics Institute, KEEI

Junichi Fujino, National Institute of Environmental Studies, NIES
Nyun-Bae Park, Sejong University
Lae Bong Han, Sudokwon Landfill Site Management Corporation

Session 2

Chair

Sang Yul Shim
Korea Energy Economics Institute, KEEI

Current Position/Affiliation

Senior Research Fellow, Korea Energy Economics Institute, KEEI

Education

Ph.D. in Energy Management & Policy, University of Pennsylvania
M.A. in Economics, Seoul National University

Highlighted Experience

Vice President, KEEI
Managing Director of Green Growth Research Group
Director of Center for Energy Cooperation in North-east Asia
Director of Center for Climate Change Studies
Director of Department of Energy Policy Studies
Director of Department of Research Planning and Coordination

Recent Publications/Research

"An Analysis of Sectoral GHG Emission Intensity from Energy Use in Korea" (2008)
Utilizing waste heat from nuclear energy supply plan for the establishment of collective research services (2007)
United Nations Framework Convention on Climate Change (UNFCCC) Response
Strategy and the Kyoto Protocol, Ministry of Commerce Trustee assignments (2001)

Panelist

Nguyen Thi Thu Huyen
Institute of Energy (Vietnam)

Panelist

Nicolas Di Sbroiavacca

Institute of Energy Economics at Foundation Bariloche (Argentina)

Cheolhung Cho

Greenhouse Gas Inventory & Research Center of Korea, GIR

Presenter

Junichi Fujino

National Institute of Environmental Studies, NIES (Japan)

Current Position/Affiliation

Senior Researcher, Center for Social and Environmental Systems Research
Visiting Associate Professor, Japan Advanced Institute of Science and Technology (JAIST)
Fellow, IGES

Education

Ph.D. in Engineering, the University of Tokyo, Faculty of Engineering
Masters in Engineering, the University of Tokyo, Faculty of Engineering

Recent Publications/Research

Asia-Pacific Integrated Model (AIM) referenced by the IPCC AR4 WGIII report.
IPCC Special Report on Renewable Energy Sources (SRREN), Lead Author
"Japan Low-Carbon Society Scenario Project" to reduce GHG emissions around 60-80% by 2050 in Japan and structuring "a dozen actions" to realize technical change (2004-2008)
"Low-Carbon Asia Scenario Project" (2009- 2013)
Simulation results for Japanese target "25%" GHG emissions reduction by 2020 compared to 1990 levels

Presenter

Nyun-Bae Park
Sejong University

Education

Ph.D. in City Planning, Seoul National University
Masters in City Planning, Seoul National University

Highlighted Experience

2011 ~ Present	Research Professor, Specialized Graduate School of Climate Change, Sejong University
2009	Researcher of International Research Project, Comparative Study of Climate Change Policy Network
2003 ~ 2007	Project Coordinator, Korea Energy Management Corporation
2002 ~ 2003	Researcher, Seoul Development Institute

Lae Bong Han
Sudokwon Landfill Site Management Corporation

Education

M.S. in Environmental Engineering, Inha University

Recent Publications/Research

CDM project focusing on conversion of waste resources into energy and refuse-derived fuel (RDF)

Session 2

Low Carbon Society Roadmap for Developing Countries in Asia: Lessons Learned from Fukushima

Junichi Fujino
National Institute of Environmental Studies, NIES

Low Carbon Society Roadmap in Japan and Asia: Lessons Learned from Fukushima

1. If we cannot go to LCS,...
2. LCS offers higher QOL with less energy demand and lower-carbon energy supply
3. LCS needs good design, early action, and innovations

Designed by Hajime Sakai

AIM ASIA-PACIFIC INTEGRATED MODEL

NIES JAPAN

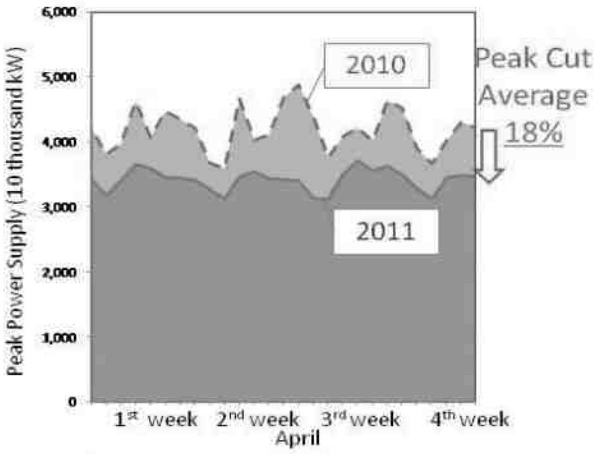
Junichi FUJINO (fuji@nies.go.jp)
NIES (National Institute for Environmental Studies), Japan

2nd Annual International Modeling Conference: Modeling Sustainable Energy Systems in Developing Countries on July 8, 2011 in Seoul, Republic of Korea

1

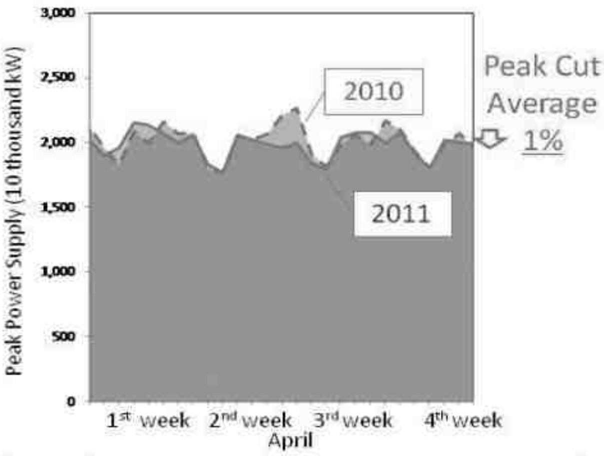
Electricity Consumption – April 2011 and April 2010

Peak Power Supply by Tokyo Electric Power Company



Monthly Total Electricity Consumption		
2010	23billion kWh	15% Cut
2011	19.5billion kWh	

Peak Power Supply by Kansai Electric Power Company

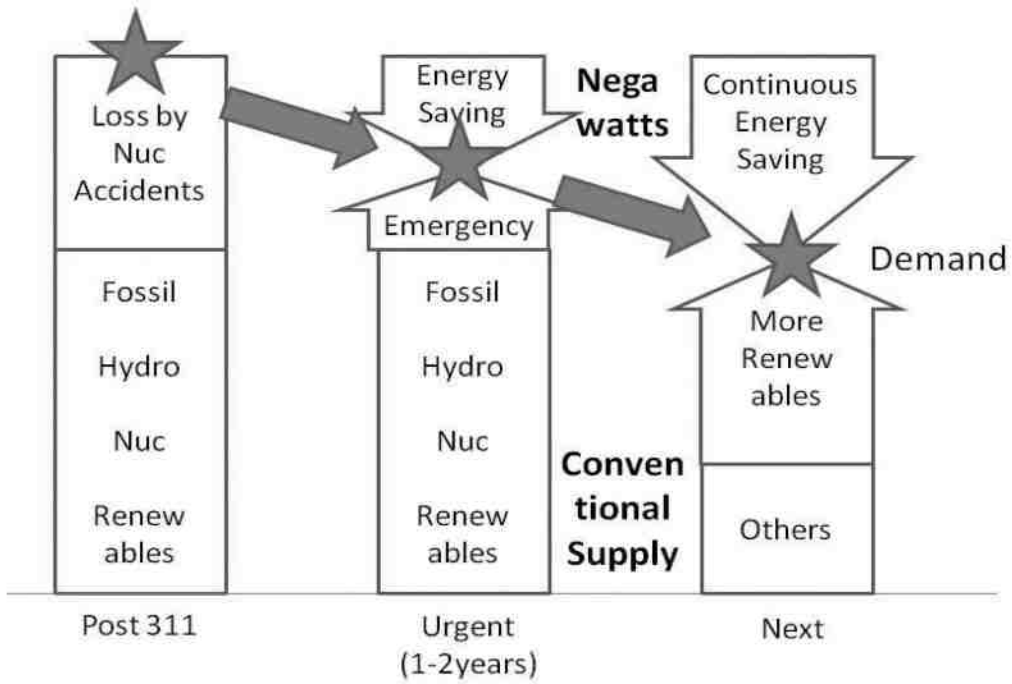


Monthly Total Electricity Consumption		
2010	11.4 billion kWh	0.2% Cut
2011	11.3 billion kWh	

reference: Electric Power System Council of Japan (ESCJ)

2

Triage of Energy Supply and Demand



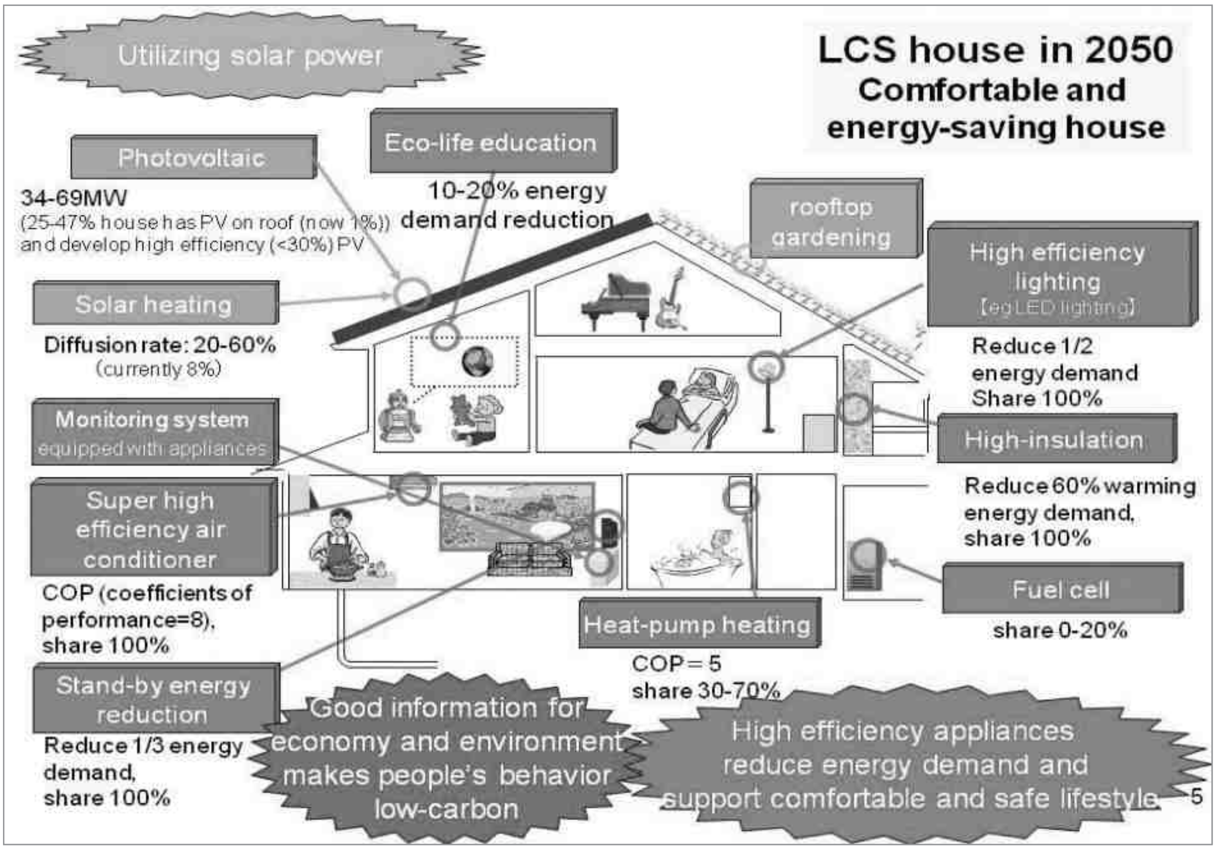
Japan LCS research project

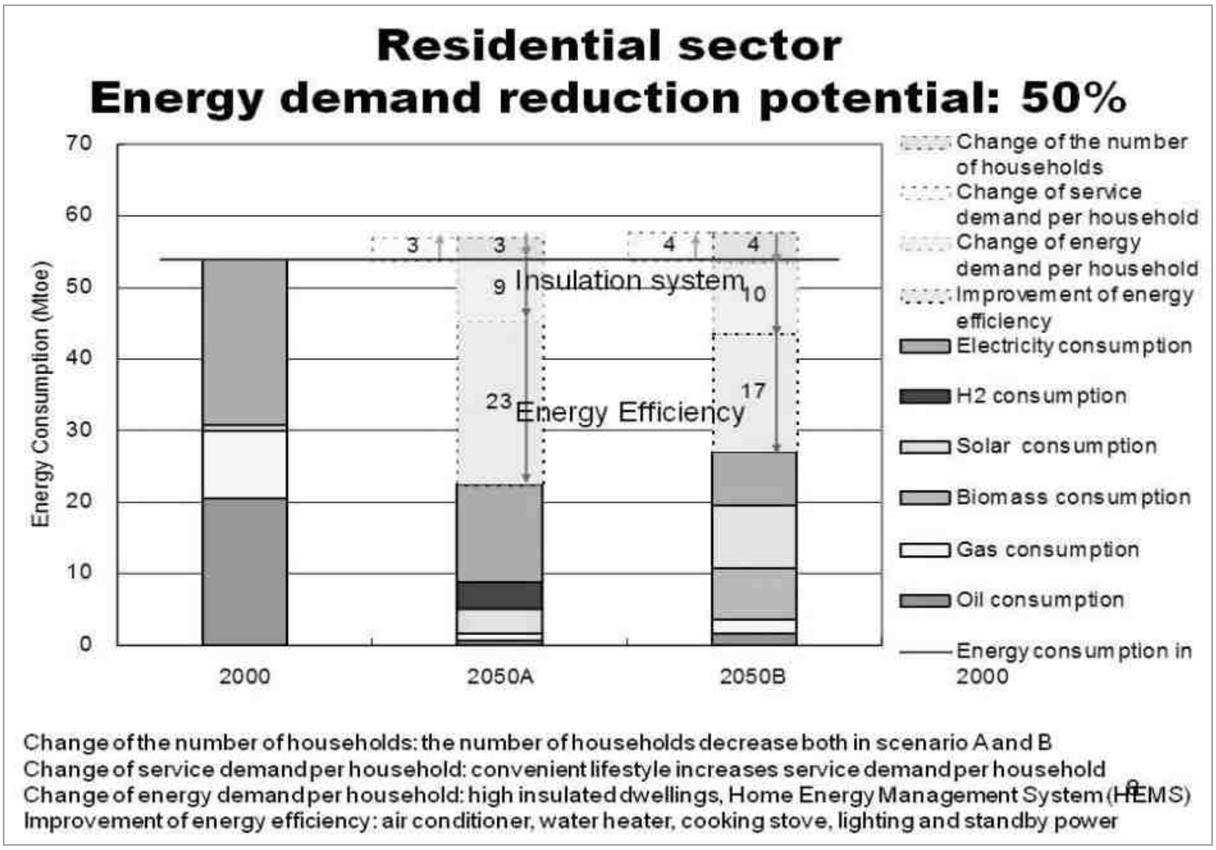
- Japanese target: 25% cut by 2020 and 80% cut by 2050
- Local LCS roadmap development for Shiga, Kyoto and Tsukuba
- International LCS research network Japan-UK -> LCS-RNet

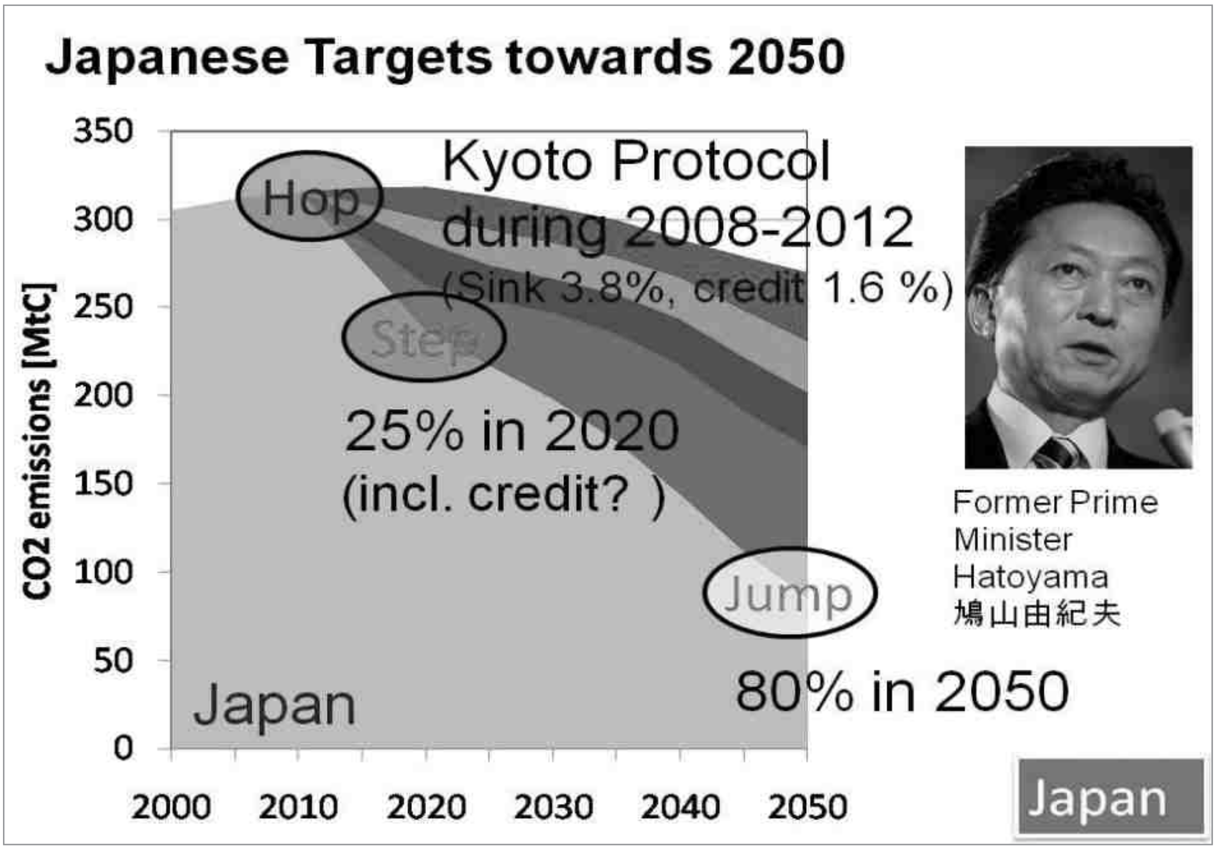
As for LCS visions, we prepared two different but likely future societies

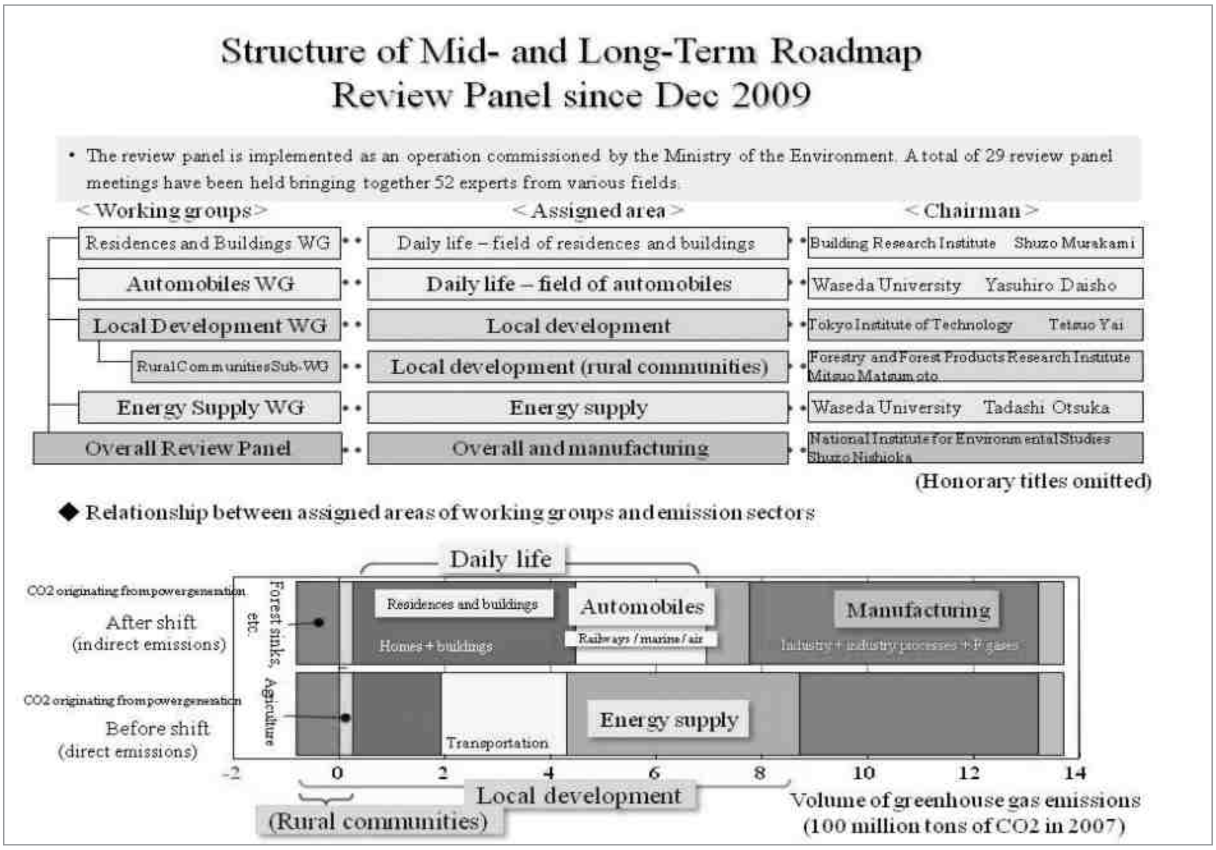
Vision A "Doraemon"	Vision B "Satsuki and Mei"
Vivid, Technology-driven	Slow, Natural-oriented
Urban/Personal	Decentralized/Community
Technology breakthrough Centralized production /recycle	Self-sufficient Produce locally, consume locally
Comfortable and Convenient	Social and Cultural Values
2%/yr GDP per capita growth	1%/yr GDP per capita growth

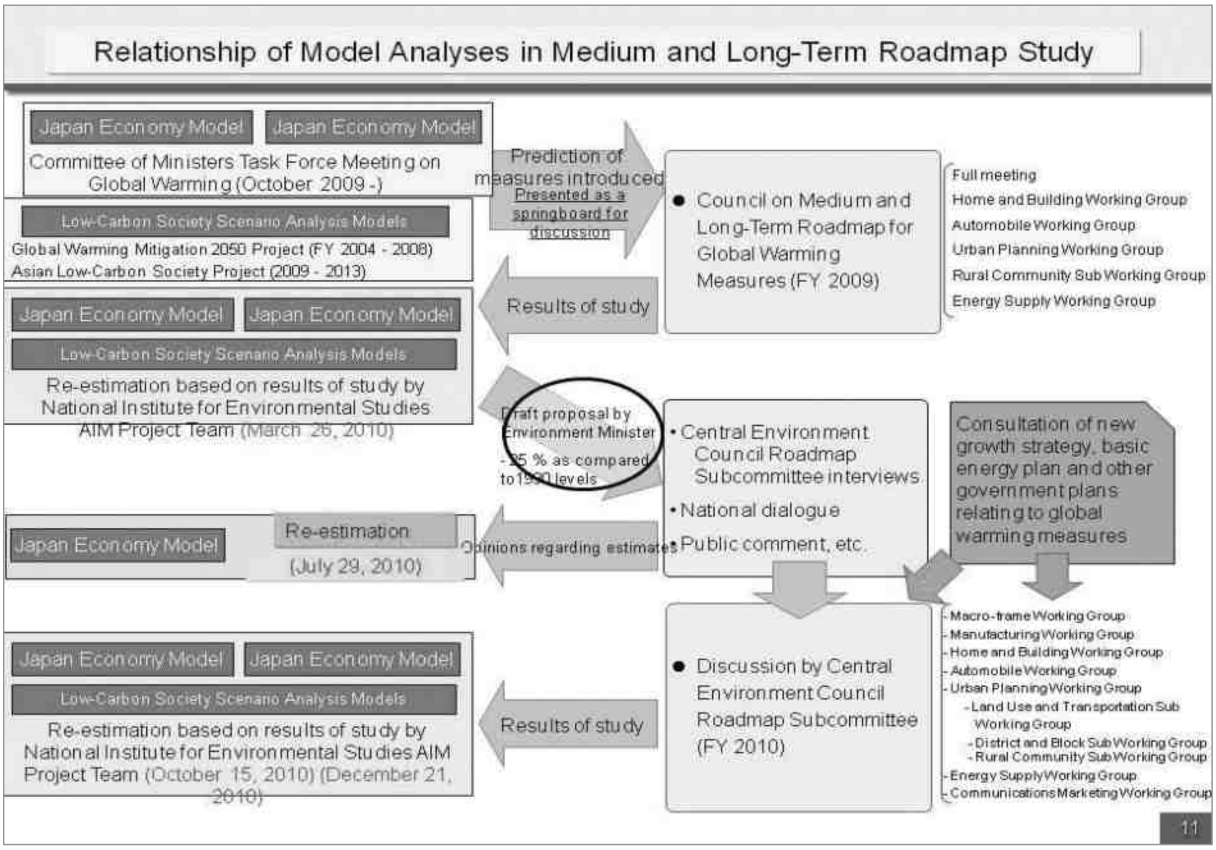
6


LCS house in 2050
Comfortable and energy-saving house
Utilizing solar power
Photovoltaic
34-69MW
(25-47% house has PV on roof (now 1%)) and develop high efficiency (<30%) PV
Eco-life education
10-20% energy demand reduction
rooftop gardening
High efficiency lighting
【eg LED lighting】
Reduce 1/2 energy demand
Share 100%
Solar heating
Diffusion rate: 20-60%
(currently 8%)
Monitoring system
equipped with appliances
High-insulation
Reduce 60% warming energy demand, share 100%
Super high efficiency air conditioner
COP (coefficients of performance=8), share 100%
Fuel cell
share 0-20%
Heat-pump heating
COP = 5
share 30-70%
Stand-by energy reduction
Reduce 1/3 energy demand, share 100%
Good information for economy and environment makes people's behavior low-carbon
High efficiency appliances reduce energy demand and support comfortable and safe lifestyle
5


Residential sector
Energy demand reduction potential: 50%
Energy Consumption (Mtoe)
70
60
50
40
30
20
10
0
2000
2050A
2050B
3
3
4
4
9
Insulation system
10
23
Energy Efficiency
17
Change of the number of households
Change of service demand per household
Change of energy demand per household
Improvement of energy efficiency
Electricity consumption
H2 consumption
Solar consumption
Biomass consumption
Gas consumption
Oil consumption
Energy consumption in 2000
Change of the number of households: the number of households decrease both in scenario A and B
Change of service demand per household: convenient lifestyle increases service demand per household
Change of energy demand per household: high insulated dwellings, Home Energy Management System (HEMS)
Improvement of energy efficiency: air conditioner, water heater, cooking stove, lighting and standby power
6


Japanese Targets towards 2050
CO2 emissions [MtC]
350
300
250
200
150
100
50
0
2000
2010
2020
2030
2040
2050
Hop
Kyoto Protocol during 2008-2012
(Sink 3.8%, credit 1.6 %)
Step
25% in 2020
(incl. credit?)
Jump
80% in 2050
Japan
Former Prime Minister Hatoyama
鳩山由紀夫
Japan


Structure of Mid- and Long-Term Roadmap
Review Panel since Dec 2009
• The review panel is implemented as an operation commissioned by the Ministry of the Environment. A total of 29 review panel meetings have been held bringing together 52 experts from various fields.
<Working groups>
<Assigned area>
<Chairman>
Residences and Buildings WG
Daily life – field of residences and buildings
Building Research Institute Shuzo Murakami
Automobiles WG
Daily life – field of automobiles
Waseda University Yasuhiro Daisho
Local Development WG
Local development
Tokyo Institute of Technology Tetsuo Yai
Rural Communities Sub-WG
Local development (rural communities)
Forestry and Forest Products Research Institute Mitsuo Matsumoto
Energy Supply WG
Energy supply
Waseda University Tadashi Otsuka
Overall Review Panel
Overall and manufacturing
National Institute for Environmental Studies Shuzo Nishioka
(Honorary titles omitted)
◆ Relationship between assigned areas of working groups and emission sectors
Daily life
CO2 originating from power generation
After shift
(indirect emissions)
Forest sinks, Agriculture etc.
Residences and buildings
Homes + buildings
Automobiles
Railways / marine / air
Manufacturing
Industry + industry processes + F gases
CO2 originating from power generation
Before shift
(direct emissions)
Transportation
Energy supply
-2
0
2
4
6
8
10
12
14
Local development
(Rural communities)
Volume of greenhouse gas emissions
(100 million tons of CO2 in 2007)


Relationship of Model Analyses in Medium and Long-Term Roadmap Study
Japan Economy Model
Japan Economy Model
Committee of Ministers Task Force Meeting on Global Warming (October 2009 -)
Prediction of measures introduced
Presented as a springboard for discussion
Low-Carbon Society Scenario Analysis Models
Global Warming Mitigation 2050 Project (FY 2004 - 2008)
Asian Low-Carbon Society Project (2009 - 2013)
Council on Medium and Long-Term Roadmap for Global Warming Measures (FY 2009)
Full meeting
Home and Building Working Group
Automobile Working Group
Urban Planning Working Group
Rural Community Sub Working Group
Energy Supply Working Group
Results of study
Re-estimation based on results of study by National Institute for Environmental Studies AIM Project Team (March 26, 2010)
Draft proposal by Environment Minister
-25 % as compared to 1990 levels
Central Environment Council Roadmap Subcommittee interviews
National dialogue
Public comment, etc.
Consultation of new growth strategy, basic energy plan and other government plans relating to global warming measures
Re-estimation (July 29, 2010)
Opinions regarding estimates
Macro-frame Working Group
Manufacturing Working Group
Home and Building Working Group
Automobile Working Group
Urban Planning Working Group
-Land Use and Transportation Sub Working Group
-District and Block Sub Working Group
-Rural Community Sub Working Group
Energy Supply Working Group
Communications Marketing Working Group
Discussion by Central Environment Council Roadmap Subcommittee (FY 2010)
Re-estimation based on results of study by National Institute for Environmental Studies AIM Project Team (October 15, 2010) (December 21, 2010)
11


地球温暖化対策に係る
中長期ロードマップ
各WGの現時点での
とりまとめ
平成22年12月21日

KEY CONCEPT FOR RESIDENTIAL AND COMMERCIAL SECTOR

- Diffusion of ZEB and ZEH
- Collaboration among central and local governments
- Labeling to encourage smart and rational choice

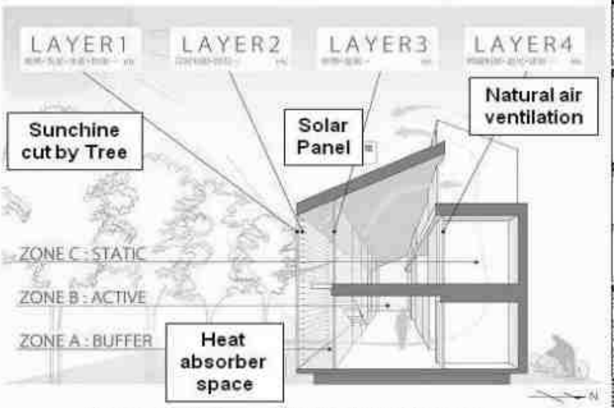
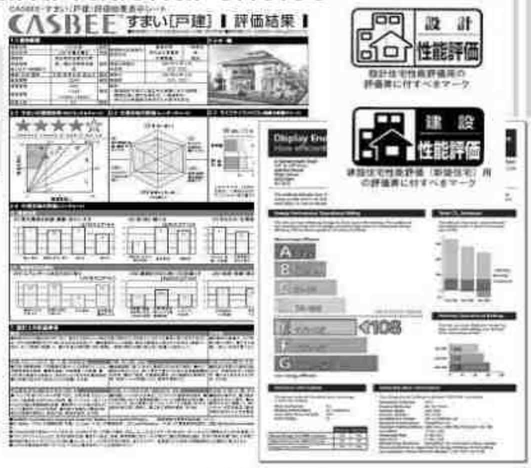


Image of Zero Emission House
（「LCCO2配慮建築物小委員会」資料、国交省）



"CASBEE"
building labeling system in Japan

13

Roadmap for residential and commercial sector

- 性能基準⇒性能表示⇒規制導入の流れで、住宅の環境基本性能の向上を図る仕組みを構築。

		2010	2020	2030	2040	2050
項目	住宅・機器性能の向上	目標	次世代基準以上 新築100%	ゼロエミ住宅 新築100%	ゼロエミ住宅 普及100%	
行程表	総合的環境性能基準の設定	環境基本性能の基準の向上 次世代基準（H11） 改次世代基準（総合化） ゼロエミ基準（創エネルギー必須化）		断熱性能から総合的環境性能の基準へ移行		
	性能表示	住宅ラベリング制度 新築住宅表示義務付 既存賃貸住宅流通時表示義務付 既存住宅売買時表示義務付		性能表示を資産価値向上に反映させる仕組み		
	規制導入	住宅トップランナー制度　拡大・強化 省エネ基準の新築時義務化 次世代基準又は改次世代基準の新築時義務化 省エネ基準の達成の義務化				
	トップランナー制度	トップランナー機器制度（基準の継続的見直し） CAFÉ（企業平均効率）導入 原単位方式見直し（機器別総量基準など）				

14

Reference Material

(6) A Low-Carbon Society: Sectoral perspective – Manufacturing

Measures and policies for becoming a Low-Carbon Smart-Manufacturing Nation by 2050

Current Situation / Measures / Targets	Today	2020	2050
	Improve Energy Efficiency	Use Highest Efficiency Products at time of Replacement	30% to 40% Reduction in Energy Consumption
	Reduce Carbon Intensity	Promote Shift of Fuels to Natural Gas	
	Key Concepts for becoming a Low-Carbon & Smart-Manufacturing Nation	Cultivate People & Platforms Actively Promote Low-Carbon Consumption Penetrate Low-Carbon Management and Finance Strategic International Contributions to Low-Carbon Technologies	Low-Carbon & Smart-Manufacturing Nation

Main Policies

- Promote Low carbon investment and lending
- Support using the corporate tax system and policy finance
- Strategic involvement in creating international standards and rules
- Develop and foster a Japanese-style low-carbon lifestyle and values
- Cultivate the people and generate platforms for low-carbon technologies

Source: Compiled based on Manufacturing WG materials

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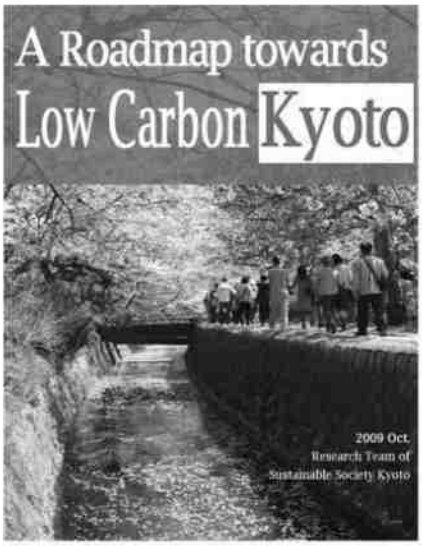
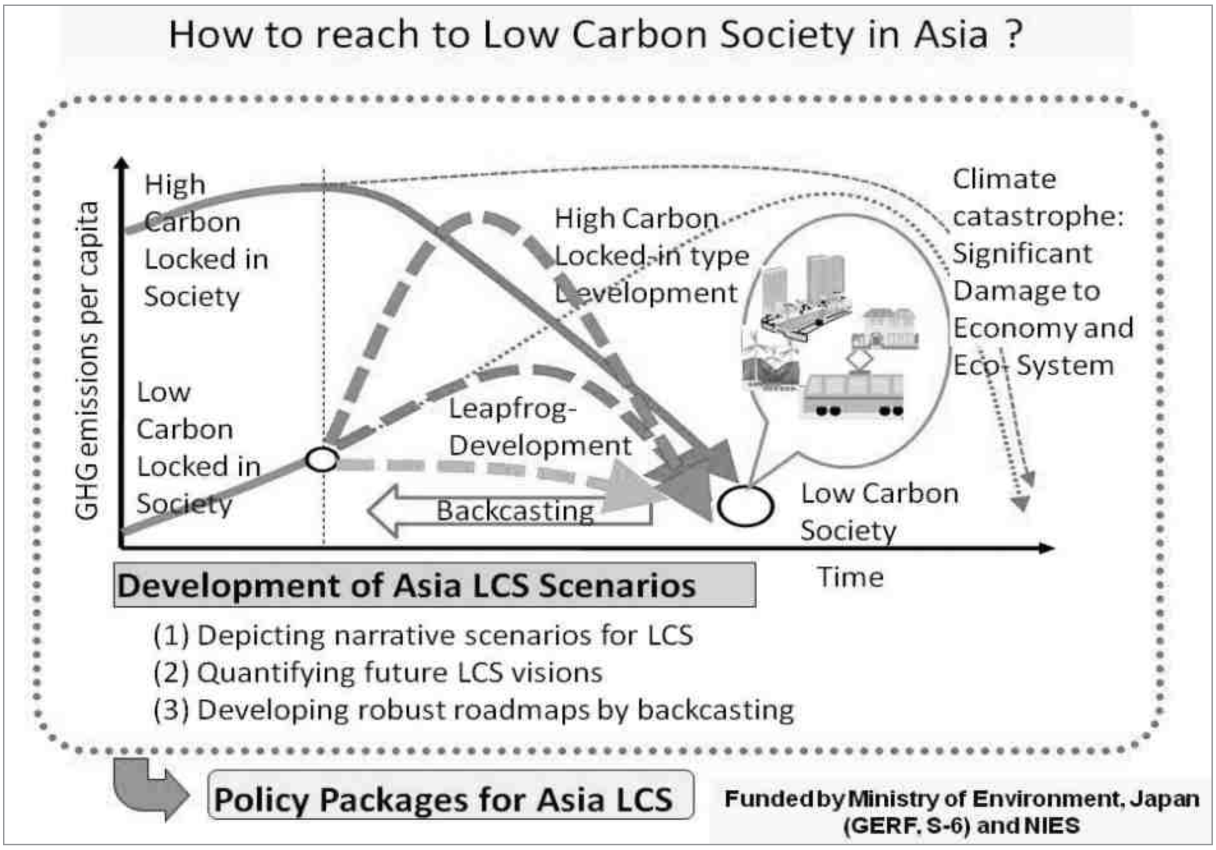
Local initiatives in Japan



GHG reduction ordinance (25% cut by 2020 and 40% by 2030) is proposed on 7th July 2010 and adopted on 30th Sep 2010

Mitigation roadmap is discussed at local congress and stakeholders dialogue



Low-carbon society model capacity building workshop

- Bridge simulation scenarios and sustainable LCS policy implementation using AIM (Asia-Pacific Integrated Model) -

Organized by TGO, SIIT-TU, JGSEE, NIES

November 19 (Friday) 2010 at Bangkok, Thailand

The presentations and model can be downloaded from the following website:

http://2050.nies.go.jp/sympo/101119/

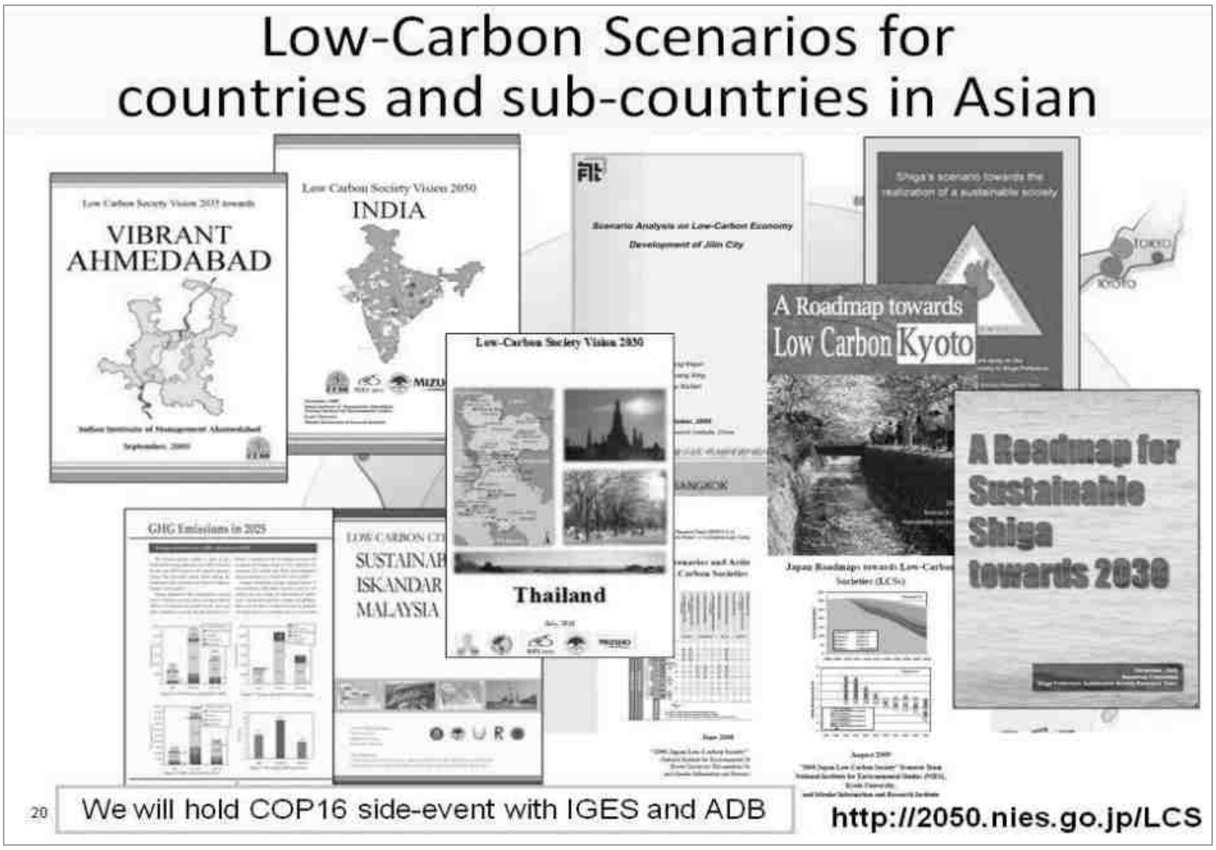
Objectives:

1) Introduce LCS scenario making process to stakeholders for better understanding how to use simulation studies for policy formulation and implementation

2) Learn to operate LCS simulation model (simple version) and assess the CO_2 reduction possibilities effected by change of driving forces (population, GDP etc.) and countermeasures (energy savings in buildings and industries, modal shift in transportation etc.)

3) Communicate between policymakers, business, researchers to discuss how to develop feasible LCS scenarios and policy options


Low Carbon Society Model Capacity Building Workshop
19 November 2010
Welcome speech
Presentations on LCS
Dr. Kei Gomi
Model operation lecture
80 participants
AIM
Low Carbon Society Model Capacity Building Workshop
19 November 2010
AIM Model Exercise


Low-Carbon Scenarios for countries and sub-countries in Asian
Low Carbon Society Vision 2035 towards
VIBRANT AHMEDABAD
Low Carbon Society Vision 2050
INDIA
Scenario Analysis on Low-Carbon Economy Development of Jilin City
Shiga's scenario towards the realization of a sustainable society
TOKYO
KYOTO
A Roadmap towards Low Carbon Kyoto
Low-Carbon Society Vision 2030
Thailand
BANGKOK
A Roadmap for Sustainable Shiga towards 2030
GHG Emissions in 2025
LOW CARBON CITY
SUSTAINABLE ISKANDAR MALAYSIA
Japan Roadmaps towards Low-Carbon Societies (LCSs)
20
We will hold COP16 side-event with IGES and ADB
http://2050.nies.go.jp/LCS

LCS is not only to avoid dangerous climate change, but also to…

- Avoid energy resource battles by using resources in efficient ways
- Develop many innovations to support global sustainable development
- Build safe and sound society considering appropriate land-use and city planning
- And our happy life!

We need good systems to pledge people's activity for LCS

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LCS study by AIM team

- 1990 start AIM (Asia-Pacific Integrated Model) project
- 2000 provide IPCC/SREN A1B maker scenario

  2003 UK released "Low-Carbon Economy" Paper
- 2004.4-2009.3 "Japan LCS research project" coordinated by AIM/NIES funded by MOEJ and provide 70% CO2 cut scenario by 2050
- 2006.2-2008.3 "Japan-UK joint LCS research project" submitted "call for action" to G8 Japan summit
- 2009.4-2014.3 "Low-Carbon Asia research project" coordinated by AIM/NIES funded by MOEJ
- 2010.4-2015.3 SATREPS "Development of Low Carbon Society Scenarios for Asian Region" especially focused on Iskandar and Malaysia funded by JST/JICA

AJISS-Commentary

The Association of Japanese Institutes of Strategic Studies

IIPS	JIIA	RIPS
Institute for International Policy Studies	The Japan Institute of International Affairs	Research Institute for Peace and Security

No.106. 26 November 2010

KEEP THE SUMMIT IN SIGHT AT COP16

Junichi Fujino

It is highly likely that there is going to be a gap between the Kyoto Protocol commitment period (2008-2012) and the commitment period thereafter. Industrialized countries such as Japan and the United States are facing difficulties passing climate change bills. Under such circumstances, it will be difficult to expect an agreement on a post-Kyoto framework at the coming 16th United Nations Climate Change Conference (COP

Concept comes true
by planning and actions.
Let's realize happy LCS
by imagination,
creativity,
and our actions.

Junichi Fujino
FB: Junichi Fujino

Session 2

Sustainable Energy Scenario for Power Sector of Korea

Nyun-Bae Park
Sejong University

[2011 International Modeling Conference]

Sustainable Energy Scenario for Power Sector of Korea
한국의 전력부문 지속가능 에너지 시나리오

Nyun-Bae Park
Specialized Graduate School of Climate Change,
Sejong University
8 July 2011

Contents

2

Background and Purpose

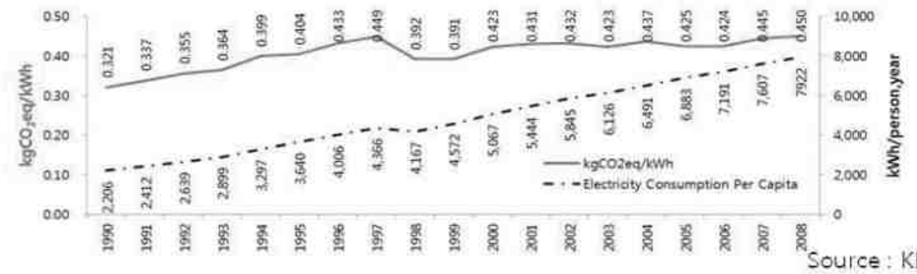
- Many studies about GHG reduction and RE (Renewable Energy) expansion by 2050 in global (IPCC, IEA etc.) and national level (UK, Germany, USA, Japan etc.)
  - For Climate change mitigation, Energy security, Green jobs and Industrial competitiveness etc.
- Energy Master Plan('08), GHG Reduction Target('09), 5th Electricity Plan('10)
  - 1990~2008. Electricity consumption per capita 3.6 times. GHG emissions of generation 5.5 times
  - 2008. GDP-PPP World 12th. Primary Energy, World 10th, CO_2 (fuel emission) World 10th
  - GHG emissions Reduction Target : 30% lower than BAU by 2020

Generation	'08	'24 (5th Electricity)	'30 (1st Energy)
Nuclear	35.7% (World 7th)	48.5%	59%
New and RE	1.0% (OECD 30th)	8.9%	-

- Domestic technological potential of RE is 7.3 times of Primary Energy in 2008 (KEMCO 2008).
  - Supply from RE in 2008 is less than 0.1 % of technological potential.
- Scenario Analysis for Renewables Transition in Power Sector by 2050 : Energy, Environment and Economic Analysis
  - Considering technologies' lifespan (average about 30 years)

3

Electricity trend and plan of Korea



Source : KEEI, KPX

		Nuclear	Bituminous	Anthracite	LNG	Oil	Pumped	New & RE	Group	Totlal
Capacity (MW, %)	2008	17,716 (24.8)	22,580 (31.6)	1,125 (1.6)	17,969 (25.2)	5,340 (7.5)	3,900 (5.5)	1,900 (2.7)	835 (1.2)	71,364 (100.0)
	2022 (4th)	32,916 (32.6)	28,820 (28.6)	600 (0.6)	23,062 (22.9)	3,591 (3.6)	4,060 (4.0)	4,700 (4.7)	3,142 (3.1)	100,891 (100.0)
	2022 (5th)	34,416 (31.2)	30,320 (27.5)	1,125 (1.0)	23,517 (21.3)	4,108 (3.7)	4,700 (4.3)	7,425 (6.7)	4,846 (4.4)	110,457 (100.0)
Generation (GWh, %)	2008	144,756 (34.0)	161,984 (38.0)	5,589 (1.3)	92,316 (21.7)	8,110 (1.9)	1,710 (0.4)	6,016 (1.4)	5,303 (1.2)	425,783 (100.0)
	2022 (4th)	265,180 (47.9)	195,646 (35.4)	3,176 (0.6)	34,132 (6.2)	887 (0.2)	7,112 (1.3)	25,844 (4.7)	21,320 (3.9)	553,297 (100.0)
	2022 (5th)	282,314 (47.1)	196,553 (32.8)		62,170 (10.4)	2,915 (0.5)	7,125 (1.2)	47,892 (8.0)	-	598,968 (100.0)

Source : MKE 2008, 2010

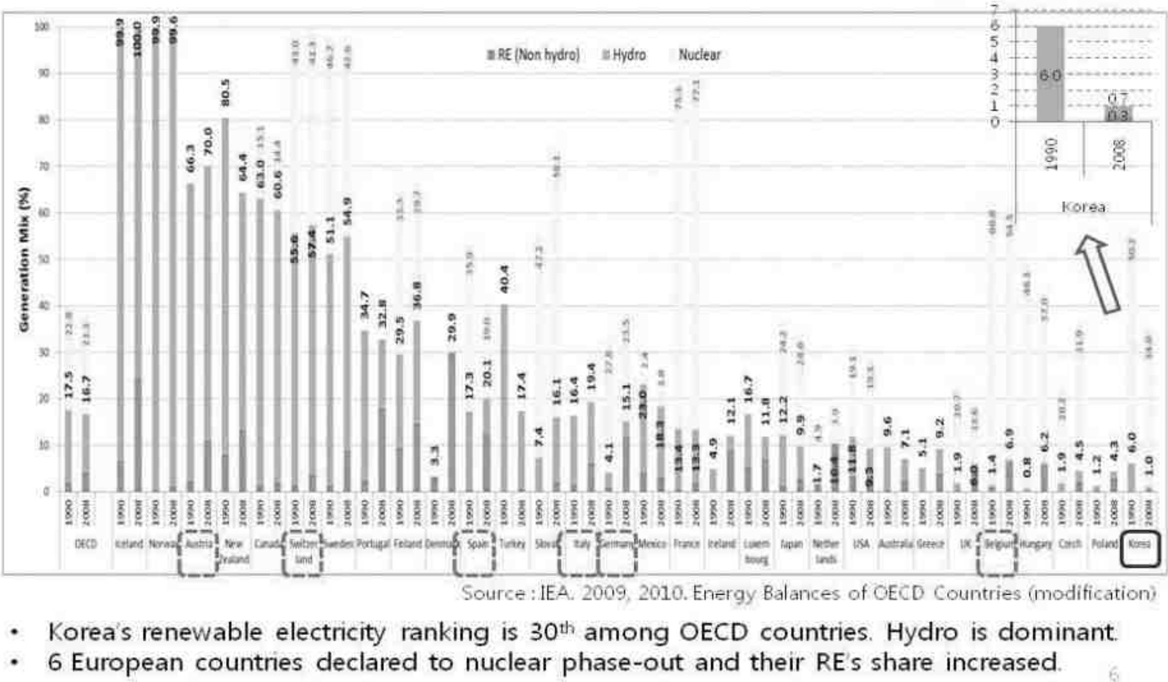
4

GHG Reduction Option in Energy Sector

- To limit below 2°C increase against pre-industrialization, Stabilizing CO_2eq. to 450 ppm and Reducing CO_2 50% Globally by 2050 against 2000 (IPCC 2007; UNDP 2007)
- GHG Reduction Option in Energy Sector : Efficiency, Fuel Substitution, Renewable Energy, Nuclear, Carbon Capture and Storage (CCS) etc. (IEA 2010; IPCC 2007; Mckinsey 2009; Pacala & Socolow 2004)
  - Power Sector : End-use Efficiency Improvement, Transmission and Distribution Loss Decrease, Low Carbon Generation Technology, Carbon Sequestration (Ekins 2004; Hadley & Short 2001; METI 2005)
- Debate about the role of Nuclear, CCS and RE in terms of GHG Reduction
  - Nuclear and CCS are very important (ECF 2010; ECN 2007; EPRI 2007; Eurelectric 2010; IEA 2010; IEP 2009; METI 2005 etc.)
  - Efficiency Improvement, RE, CHP (LNG) without Additional Nuclear Power (FoE 2006; Greenpeace 2009; Heaps et al. 2009; Sawin et al. 2009; WWF 2009)
    - Requesting USA to switch to 100% Renewable Electricity in 10 years (Al Gore 2008)
- Zero Carbon Society is not a technological problem but a political and economic problem (Eilperin 2008).

5

OECD Countries' Renewable Electricity Share

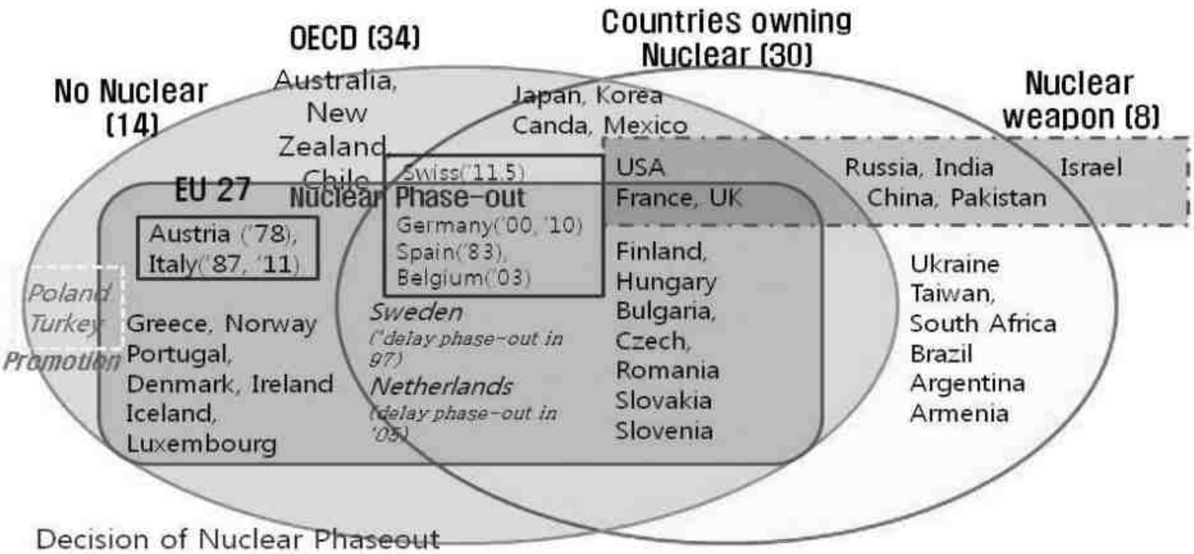


Source : IEA. 2009, 2010. Energy Balances of OECD Countries (modification)

- Korea's renewable electricity ranking is 30th among OECD countries. Hydro is dominant.
- 6 European countries declared to nuclear phase-out and their RE's share increased.

6

Status of Nuclear Power (June 2011)



Decision of Nuclear Phaseout

Referendum : Austria, Italy	Ruling Party: Spain, Belgium, Germany, Swiss

Methodology and Scope

	Contents
Meth od	• Model : LEAP (Long-range Energy Alternatives Planning System) • Bottom-up, Scenario based, Accounting Model for Energy / GHG • Scenario : Forecasting and Backcasting approach
Scope	• Time : 2008 (reference year) ~ 2050 • Geological : South Korea (Domestic Electricity Market) • Power Supply in National Energy Supply and Demand System • Assessment : Power System, Environmental, Economic
Data	• Plan & Long-term Key Assumption : National Energy Master Plan, 4^{th} & 5^{th} Electricity Plan etc. • Statistics : Energy Statistics (MKE & KEEI), Statistics of Electric Power (KEPCO) etc. • Tech Characteristics : KEMCO, KPX, IEA, US EPRI, UK ERC etc. • Energy Price, Tech Cost Outlook : IEA, DOE/EIA etc.

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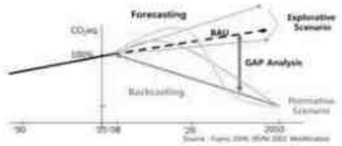
Scenarios



		Scenario	Storyline (Power Supply Mix and Demand Management)
1	Forecasting	Baseline (BL)	***4th Basic Plan for Long-term Electricity Supply and Demand (MKE 2008)*** - Nuclear power : 20 plants (2008) → 32 plants (2022)
2	Forecasting	Governmental Policy (GP)	***5th Basic Plan for Long-term Electricity Supply and Demand (MKE 2010)*** - Electricity Demand Projection in 5th Plan increases more than in 4th Plan - Nuclear power : 20 plants (2008) → 34 plants (2024) - Renewables Capacity in 5th Plan is 2 times higher than 4th Plan
3	Backcasting	Sustainable Society (SS)	***Reducing GHG Emission in Power 80% against 2008 by 2050*** ***Renewables Transition under the Domestic RE Potential*** ***Only 8 Nuclear Plants under Construction are accepted.**** No Nuclear Power Plants' License Renewal (Except Gori 1st, 10 years extension (2007)) Demand Side Management Improvement T&D Loss Rate Decrease

* 8 Nuclear Plants under Construction : New Gori 1('11.2), 2('11.12), 3('13), 4('14); New Wolsung 1('12), 2('13); New Uljin 1('16), 2('17)

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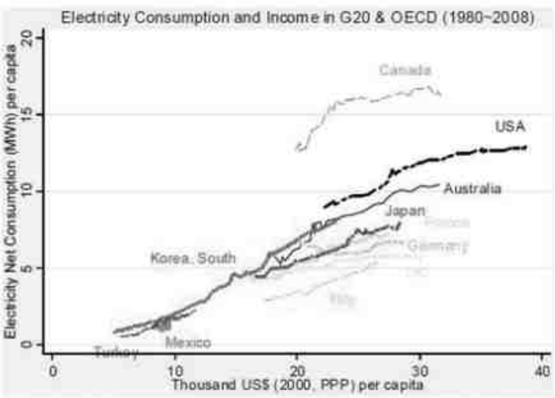
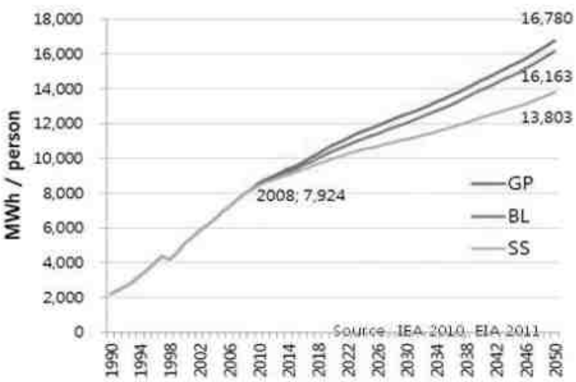
Electricity Consumption per capita Trend and Outlook





- Korea's electricity consumption per capita is higher than Germany, UK and Japan's (higher income).
- Future growth rate of electricity consumption per capita in Korea (1.33~1.80%) is less than that of GDP per capita (2.96~2.99%). But electricity consumption of 2050 in SS is higher than today, though less than in BL and GP.

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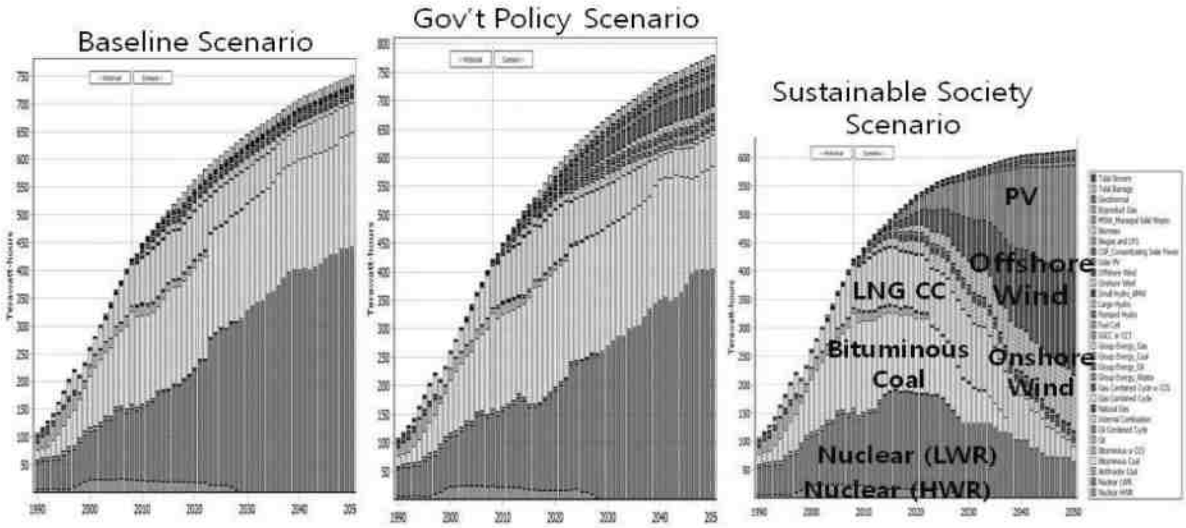
Electricity Generation by Scenario



- In recent gov't plan, future electricity consumption will increase more.
- SS : Demand Reduction, Nuclear Phase-out, LNG CHP (Bridge Technology), RE

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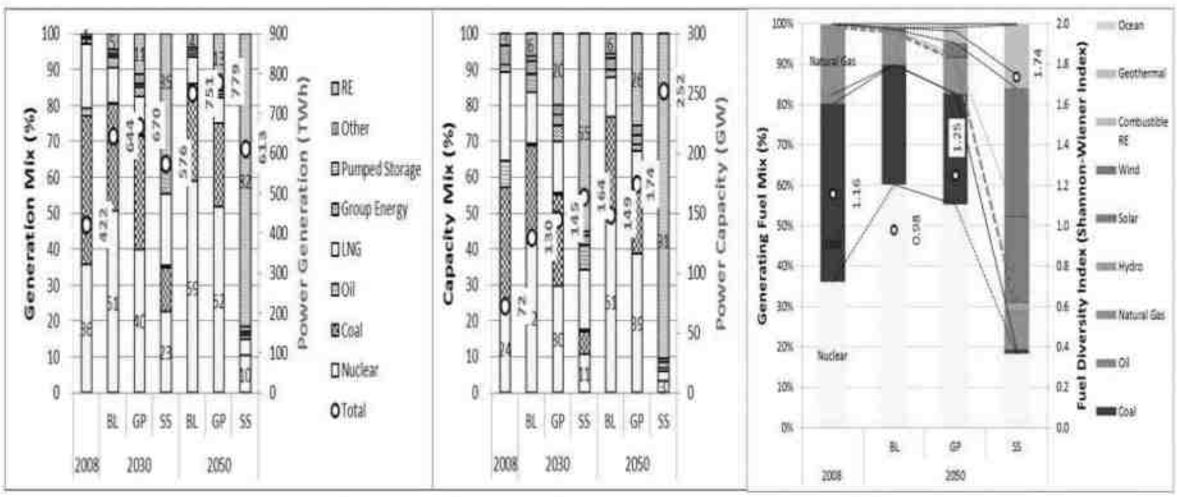
Generation, Capacity and Fuel Diversity



- In 2050, Numbers of Nuclear Power Plants : BL 55, GP 49, SS 7 (2057, Nuclear Free)
- In 2050, Renewables Capacity in Sustainable Society Scenario
  - About 10 million of PV (10 KW), 80 thousands of Wind Turbine (1.5MW), 2 hundreds of 8 MW Geothermal
- SS Scenario
  - In 2027, generation share of RE is larger than that of Nuclear.
  - less vulnerable to Energy Price Shock owing to fuel diversity and lower import dependency

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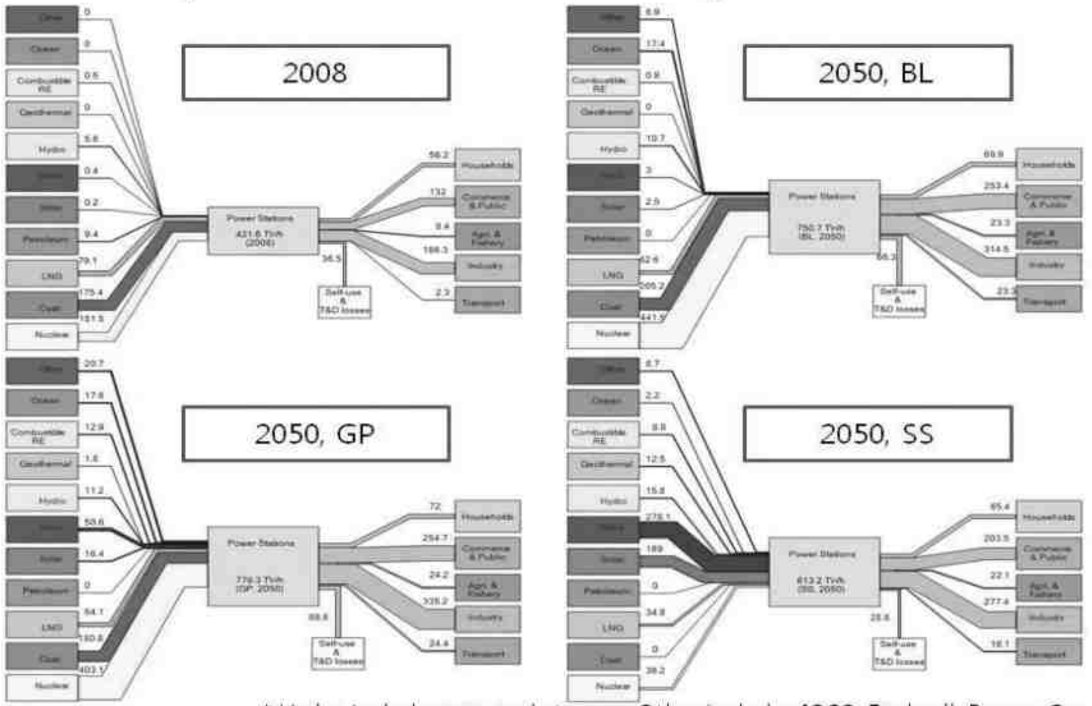
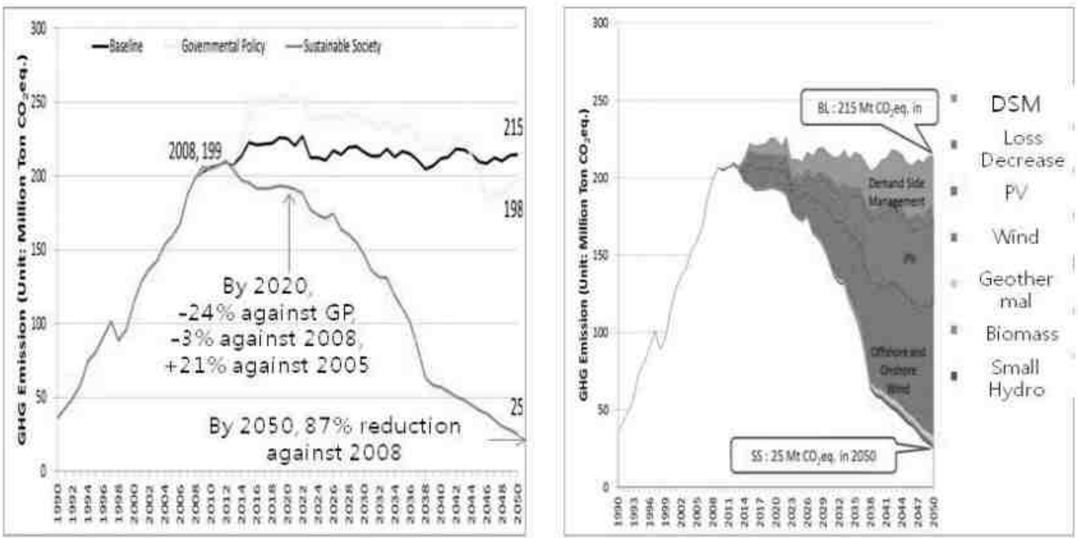
Comparison of Electricity flow chart



* Hydro includes pumped storage. Other includes IGCC, Fuel cell, Bypass Gas.

GHG Emissions by Scenario
: Contribution of Reduction Option



- Demand Side Management and RE are important for emission reduction.
- In this research, RE transition is the most dominant factor among reduction options.

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Other Environmental Impact from Power Sector

	2005	2008	2020			2050		
	Index (2005=1)		BL	GP	SS	BL	GP	SS
SO_2	1.00	1.19	1.25	1.43	0.95	1.22	1.09	0.02
NOx	1.00	1.25	1.41	1.60	1.19	0.10	0.10	0.02
NMVOCs	1.00	1.25	1.45	1.62	1.31	1.31	1.22	0.22
CO	1.00	1.26	1.47	1.66	1.32	1.34	1.34	0.23
Thermal Effluent	1.00	1.13	1.50	1.45	1.24	2.34	2.13	0.29
Land Use	1.00	1.23	1.78	1.90	1.86	2.66	2.74	3.59

- BL and GP Scenario : Air Pollution and Thermal Effluent get worse by expansion of Nuclear and Bituminous Coal Plant
- SS Scenario : Land use area increases owing to Renewables (PV, Onshore Wind etc.)
  - Land required in SS by 2050 is about 2% of national area (about 12% except forest and farmland)

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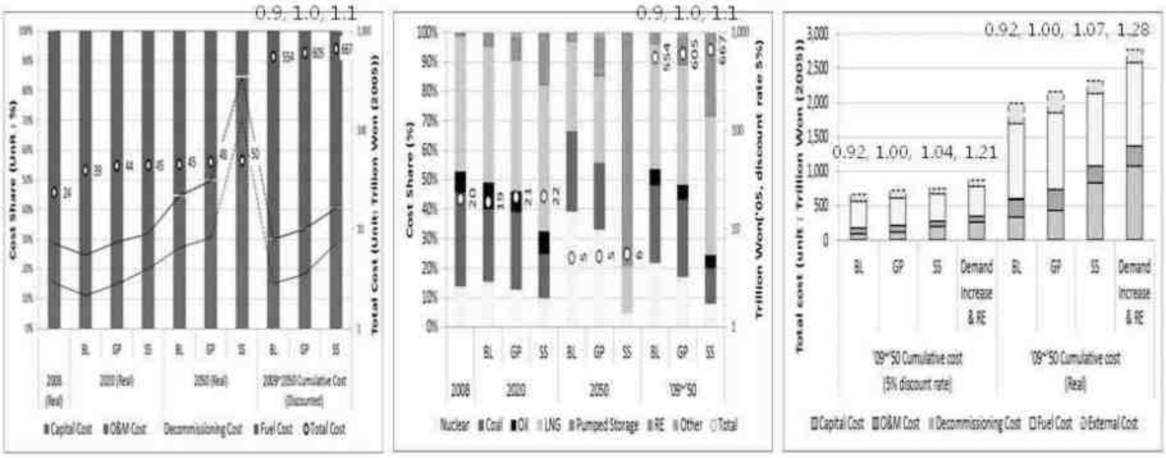
Economic Analysis (Cost)



- 2009~2050. Cumulative Discounted Total Cost Ratio (cf. GDP about 3 times)
  : SS/GP=1.1 (Excluding external cost, DM cost and land cost) (Sensitivity Analysis 1.0~1.2)
- The Dominant Item : Fuel Cost > Capacity Cost; LNG plants > Coal, RE
- Demand management results in cost reduction of power generation.
- Cost of Generating Electricity (Won/kWh, Real) : 2008. 56 Won/kWh (Calculated)
  - Average Real Cost (2009~2050) : BL, 64 Won, GP, 68 Won, SS, 89 Won

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Summary

- In terms of energy security, environment and economy, Sustainable Society Scenario is desirable and economically affordable.

		2008=1	BL (2050)	GP (2050)	SS (2050)
Energy	Electricity Consumption	1.00	1.78	1.84	1.52
	Nuclear Generation	1.00	2.92	2.67	0.42
	RE Generation	1.00	6.99	25.39	121.16
	Fuel Diversity	1.00	0.85	1.08	1.50
Environ ment	GHG	1.00	1.08	0.99	0.13
	SO_2	1.00	1.02	0.91	0.02
	NOx	1.00	0.08	0.08	0.01
	NMVOCs	1.00	1.05	0.98	0.18
	CO	1.00	1.06	1.06	0.18
	Thermal Effluent	1.00	2.08	1.89	0.26
	Land Use	1.00	2.17	2.24	2.92
Economy	Total Cost (Power)	1.00	1.93	2.03	2.11
	GDP per capita	1.00	3.40	3.45	3.40

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Conclusion

- Modeling result and foreign countries' cases (Germany, Denmark etc.) show that nuclear phase-out, renewables transition and GHG reduction (Sustainable Society Scenario) are technologically possible within domestic RE potential and economically affordable.
- Stakeholders' participation and Political will are important.
- Reducing electricity demand is the most important because it reduces the cost and environmental impact of renewable energy and other plants.
- It is required to set up a progressive national GHG reduction target (ex. Reducing emission or emission intensity 50% against 2005 by 2050), energy independence target and renewable electricity target by 2050.
  - To set up higher renewable electricity target by 2020
- Future Research Agenda
  - ✓ Demand side management potential, Integration with Storage & Grid etc.
  - ✓ Scenarios Upgrade

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Thank you very much.

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Session 2

Landfill Gas Electricity Generation (50MW) CDM Project in Sudokwon Landfill Site

Lae Bong Han
Sudokwon Landfill Site Management Corporation

Landfill Gas CDM Project of SLC

- 50MW Electricity Generation -

2011. 07

수도권매립지관리공사
SUDOKWON Landfill Site Management Corp.

1

CONTENTS

- Introduction Of SLC
- Overview of CDM Projects
- Landfill Gas CDM Project of SLC

2

Location & Status
Business

Introduction of SLC

3

Location & Status

Waste generation: Seoul, Incheon & Gyeonggi province (58 cities, towns, etc),

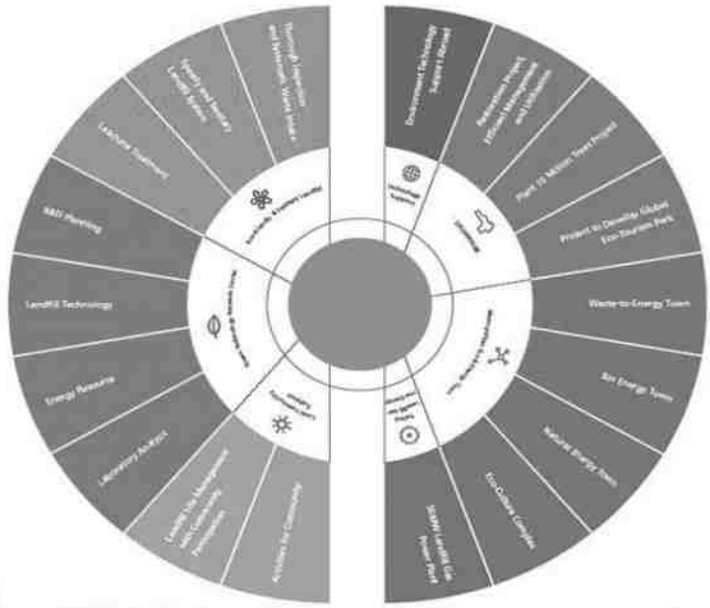
Population: 22millions

Location	#58 Baekseok-Dong, Seo-Gu, Incheon, South Korea				
History	Started its operation in 1992 in order to dispose wastes generated in metropolitan area after the closure of Nanjido landfill				
Facilities	Area(mil m^2)			Capacity (mil ton)	Lifetime of Landfill
	Total	Landfill	Others	228	52 years (about 37years from now)
	19.9	15	4.9		

4

Business – 7 Key Business Areas of SLC

- Eco-friendly and Sanitary Landfill
- Green Technology Research Center
- Local Community Support
- Turning Landfill Gas into Energy
- DREAMPARK
- Metropolitan Eco & Energy Tow
- Environment Technology Support Abroad



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Eco Friendly Sanitary Landfill

► **Thorough Inspection & systematic Waste Intake**

✓ Waste Generation from 22 million population (58 districts in Sudokwon)

✓ Solid Waste Intake (18,000 t/d)

► **Speedy & Sanitary Landfill**

✓ Cell Type & Soil Covering

✓ Landfill Gas Collection

✓ Leachate Collection

✓ Rainwater Drainage

✓ Pesticide & odor Control

✓ Environmental Monitoring

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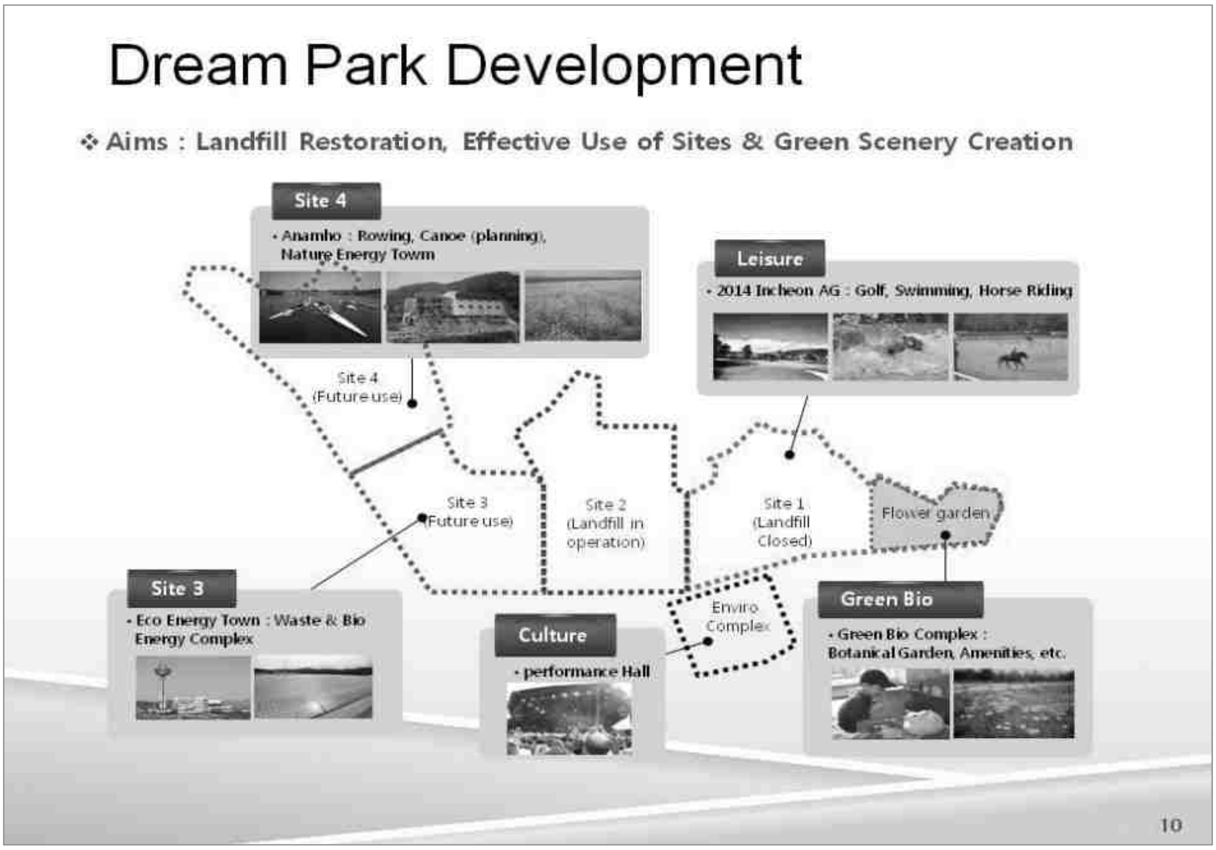
Eco Friendly Sanitary Landfill
SLC Leachate Treatment Plant (6,700t/d)
Leachate + Food waste water
Anaerobic digestion tank
De/Nitrificatio tank
Chemical coagulation
Oxidation tank
Discharge
BOD 100~30,000
CODcr 1,000~40,000
NH4+-N 300~2,100
Raw
BOD 10~20
CODcr 500~700
NH4+-N <5
Biological T
BOD < 10
NH4+-N < 5
Chemical T
BOD < 5 (70)
NH4+-N < 5 (100)
Final discharge
7


Green Technology Research Center
Patents & New Technologies : 24
R&D Planning
Development plan, Research Project Management, Cooperation with other research Center, etc.
Landfill Tech.
Landfill design, architectural standards, etc.
Energy Resource
Renewable energy, natural energy, biomass, etc.
Laboratory Analysis
Intake waste analysis, leachate, odor & air quality, etc.
8


Local Community Support
Conducting EIA
New Projects Or Important Issues
Public Events
Participation in Decision Making
Through Steering committee
드림파크 야생식물 전시회
드림파크 국화축제
주민설명회 개최
'드림파크장학회' 장학금 수여
주민지원협의체 운영지원
수재민을 위한 복구지원 활동
어버이날 맞이 무의탁 노인 위문
Cooperation !
"SLC Steering Committee"
"Community Meeting",
Public hearings, etc.
Community Support !
Dream Park Scholarship,
volunteering work,
Support programs
9


Dream Park Development
❖ Aims : Landfill Restoration, Effective Use of Sites & Green Scenery Creation
Site 4
• Anamho : Rowing, Canoe (planning), Nature Energy Town
Leisure
• 2014 Incheon AG : Golf, Swimming, Horse Riding
Site 4 (Future use)
Site 3 (Future use)
Site 2 (Landfill in operation)
Site 1 (Landfill Closed)
Flower garden
Enviro Complex
Site 3
• Eco Energy Town : Waste & Bio Energy Complex
Culture
• performance Hall
Green Bio
• Green Bio Complex : Botanical Garden, Amenities, etc.
10

LFG to Energy

► SLC LFG Power Plant

Power Effects !!!

Energy Supply: 180,000 home/d
(= 30 million USD profit/year)

CDM Project: 850,000 CO2tons
(= 12 million USD profit/year)

Major Facilities :

- Power Plant (50MW, max. 1.2million KWh/d power generation)
- Transmission (29 Towers, 8 km)
- Gas Collection (1,028 units Vertical Collection Pipelines, 308km gas transmission pipe.)
- Gas Incinerator (6 units)

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Metropolitan Eco Energy Town

Eye-Catching scenery	Clean Environment	Incomes & Job Opportunities

Low Carbon, Green Growth

Effects :

- Economic (2.61 million Gcal of renewable energy)
- Social (30,000 new jobs by 2020 construction, management & research)
- Environment (CO2 emission reduction by 1.2 million t/y)

Good waste management practice means "Three births with one stone, namely both environmental, social and economic benefits to the public"

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Kyoto Mechanism
Clean Development Mechanism

OVERVIEW OF CDM PROJECT

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Kyoto Mechanism

- Objectives
  - Mitigate burden of Annex 1 countries to reduce greenhouse gas emissions
  - Minimize cost required to achieve the target of greenhouse gas emissions (market based system)

Emission Trading (ET)

Emission permits allocated to each country is regarded as an intangible commodity and traded based on market principle by countries directly or through the carbon exchange

Now in force in EU countries

Clean Development Mechanism (CDM)

Annex I countries invest on emission reduction projects in Non-Annex I countries. The reduction result is considered as achievement of Annex I countries

Support sustainable development of developing countries

Joint Implementation (JI)

Emission reduction projects jointly implemented by Annex I countries

OECD developed countries invest in EIT which are having economic difficulty in transition to market economy

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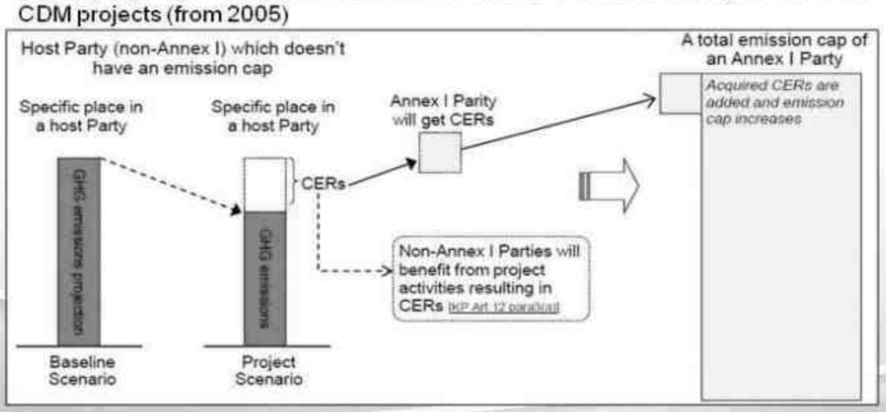
Clean Development Mechanism

- CDM Project?
  - Annex I countries invest their technologies and capitals in Non-Annex I countries to implement greenhouse gas emission reduction projects
  - Emission reductions, result of the project, are considered as achievement of Annex I countries

    ※ Developing countries can make investment on their own and then register them as CDM projects (from 2005)



※ Source: CDM in Charts(IGES, 2011)

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Clean Development Mechanism (Cont.)

- CDM Project Scope
  - UNFCCC specified 15 scopes (categories)
  - A single project can be included in more than two scopes

Scope	Number of projects	Scope	Number of projects
(01) Energy industry (new and renewable energy)	**2,396**	(09) Steel	9
(02) Energy distribution	0	(10) Fuel leakage	161
(03) Energy demand	39	(11) HFC, SF6 leakage	26
(04) Manufacture	175	(12) Solvent use	0
(05) Chemistry	70	**(13) Waste disposal**	**538**
(06) Construction	0	(14) Afrostation / reforestation	22
(07) Transportation	6	(15) Agriculture	140
(08) Mining	45	**Total (including overlap)**	**3,079**

Source : UNFCCC Website(2011. 5. 9.)

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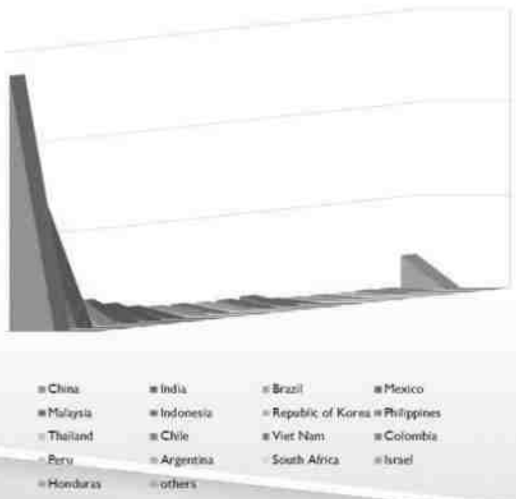
Registered CDM Projects by Countries



Country	Number	Country	Number
China	**1372**	Chile	49
India	**656**	Vietnam	56
Brazil	191	Columbia	28
Mexico	126	Peru	23
Malaysia	93	Argentina	21
Indonesia	66	South Africa	19
R. Korea	**55**	Israel	21
Philippines	52	Honduras	17
Thailand	48	Etc.	186
Total			**3,079**

Source : UNFCCC Website(2011. 5. 9.)

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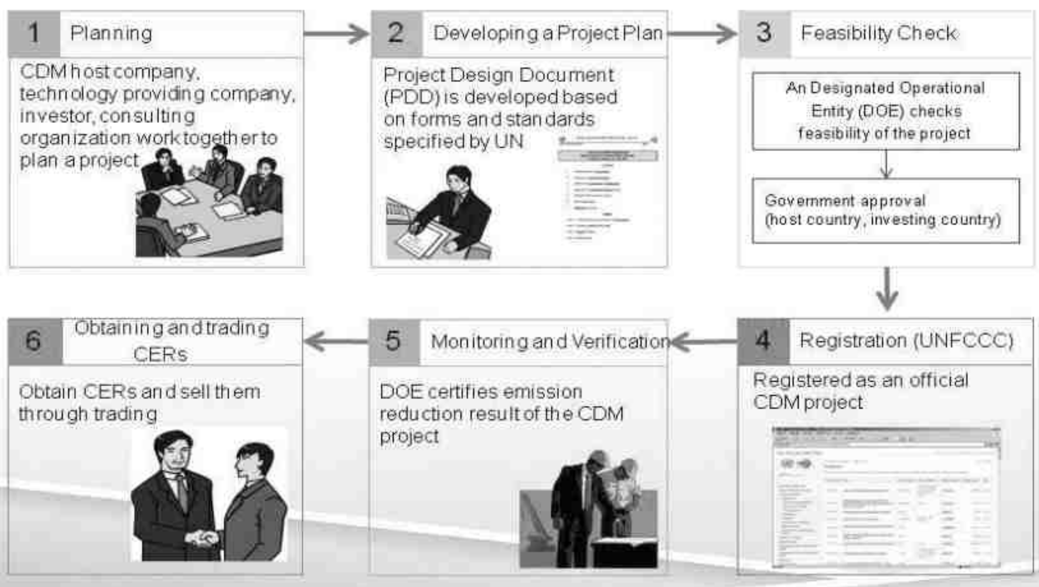
CDM Project Process



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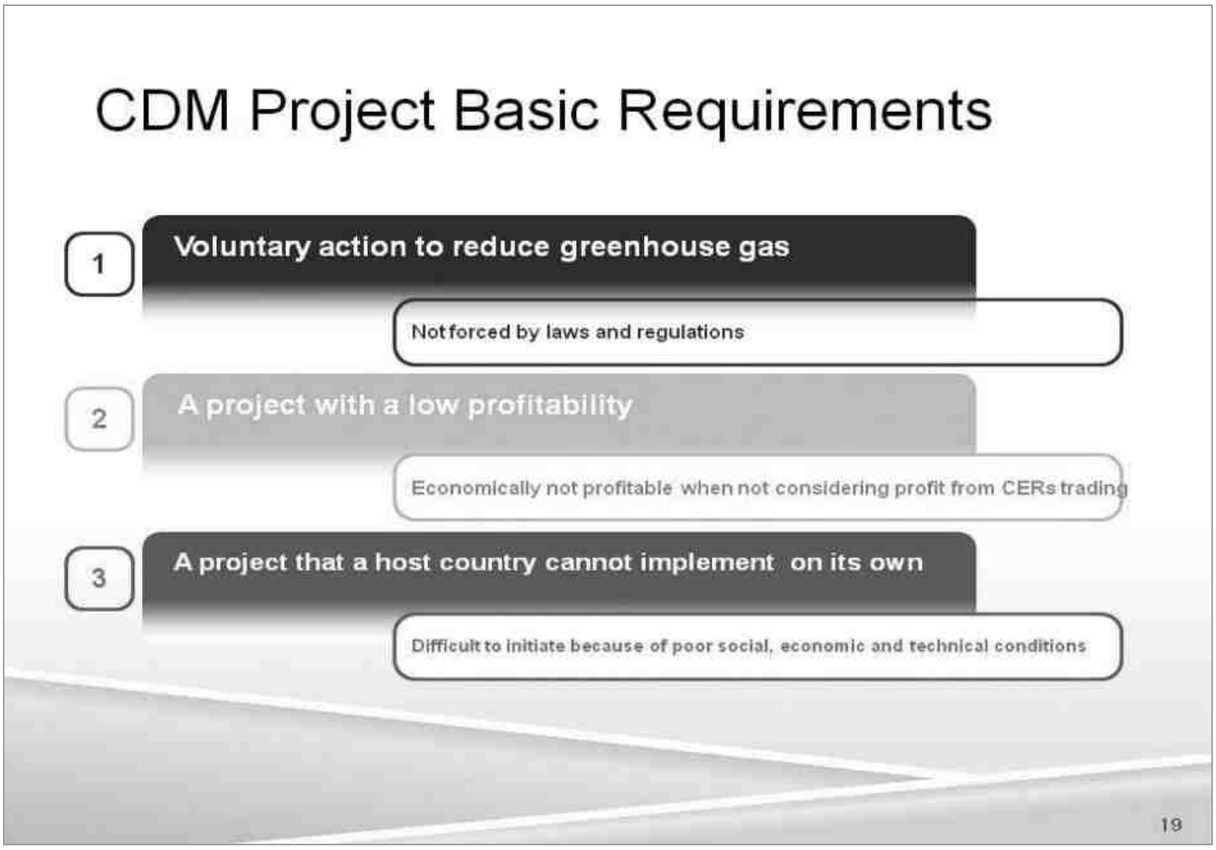
CDM Project Basic Requirements
1
Voluntary action to reduce greenhouse gas
Not forced by laws and regulations
2
A project with a low profitability
Economically not profitable when not considering profit from CERs trading
3
A project that a host country cannot implement on its own
Difficult to initiate because of poor social, economic and technical conditions
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Background, Objectives and Project Overview
Status of Facilities
Meaning and Expected Effects
Future Plan
Landfill Gas CDM Project of SLC
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Background and Objectives

- Background
  - Korea ratified Kyoto Protocol ('02. 11)
  - Established DNA ('04. 6)
    - laid the foundation to implement CDM projects
  - Kyoto Protocol took effect ('05. 2. 16)
  - Unilateral CDM projects introduced ('05. 2)
    - allowed developing countries to implement CDM projects by themselves without investment of developed countries
- Objectives
  - Receiving CERs by registering landfill gas CDM project with improvement of gas collection efficiency

Responding to UNFCCC and creating profit through CERs trade

2005. 11	•Developed basic plan of the landfill gas CDM project of SLC
2006. 5	•Started feasibility check of the project (DOE : DNV)
2006. 11	•Obtained government approval •Completed feasibility check
2007. 4	•Registered as CDM project to UNFCCC (No. 0941)
2009. 11	•Validated and certified for the 1st period monitoring result (DOE : TUV-SUD)
2010. 5	•CERs issued for the 1st period(394,672tCO_2) Period : 2007. 4. 30 ~ 2007. 11. 30
2011. 2	•Created profit by selling a part of CERs (200,000tCO_2)

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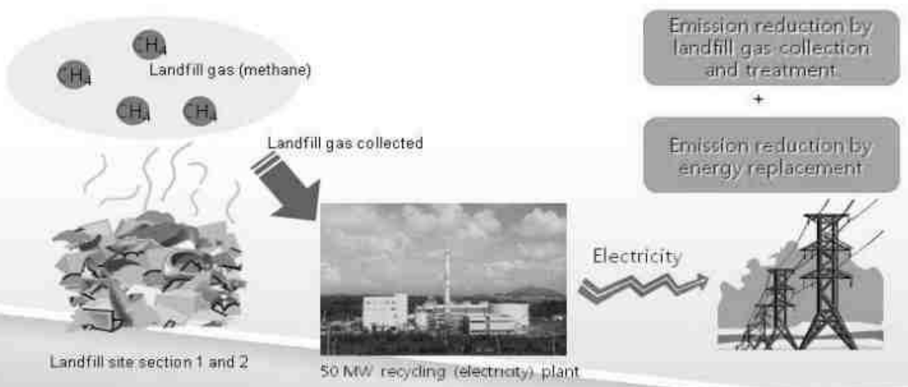
Project Overview

- **Greenhouse Gas Emission Reduction Method**
  - Reduce methane gas emission (CH_4, 50% of landfill gases) by collecting landfill gases from 1st and 2nd landfill and transferring them to power plants and flares
  - Reduce CO_2 by replacing fossil fuel in power plant



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Status of Facilities – Landfill Gas Collecting Facilities

- Overview of Collecting Facilities
  - Collection Target : 1st and 2nd Landfill
  - Collection Method : forced extraction (blower)
  - Collection Status (As of Oct 2010)
    - Collection amount : about 600Nm³/min , Methane concentration : about 50%
- Status of Collecting Facilities

	Project Design Document		2009	
	1st LF	2nd LF	1st LF	2nd LF
Landfill gas transfer pipes	18.6km	7.6km	**80.5km**	**194km**
External header pipes			18.6km	**15.1km**
Horizontal collection pipes	48ea(12ea)	39ea	60ea	36km
Auxiliary header pipes				5km
Vertical collection well	389ea	326ea	329ea	**699ea**
Distanced gas collection pipes			60ea	
Condensate removal unit	503ea	27ea	114ea	52ea
Gas distribution station	31ea	20ea	31ea	**44ea**
Blower	4 set	2 set	6 set	**5 set**



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Status of Facilities – Landfill Gas Treating Facilities

- Priority of Landfill Gas Treatment
  - Collected gas is transferred to power plant and remaining gas is flared
- Status of Power Plant(50MW)
  - Generation type : Steam Turbine
  - Investment cost : 77.3 billion won (private investment BTO method)
  - Private operation period : Mar 07 ~ Mar 18 (Supervised by Ministry of Environment (SLC))
- Status of Flares

	Capacity	Flares	Completion date
1st	340m³/min	4 units (85m³/min)	'96. 8
2nd	340m³/min	2 units (170m³/min)	'98. 11
Total	680m³/min	6 units	

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Meaning and Expected Effects

- Meaning of Landfill Gas CDM Project of SLC
  - The first Korean project in waste disposal area that registered to UNFCCC
  - The world's biggest estimated emission reductions among CDM projects in the same area as for now

    → Laid the foundation for SLC to become a leading player in low-carbon and green growth area
  - Stable implementation model of the project was recognized according to the CER issuance for the 1st period
- Expected Effects
  - Responding to climate change by reducing greenhouse gases
  - Improving the environment by proper treatment of landfill gases (preventing bad smell)
  - Improving data credibility by establishing the monitoring system
  - Creating additional profits by receiving CERs and trading them

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Future Plan - Landfill Gas CDM Project

- Consistent Implementation of Monitoring, Verification and Certification
  - Verification/certification for 2nd period : April 2010 ~ now (about 430,000tCO_2)
  - Verification/certification for 3rd period : Sep. 2010 ~ now (about 530,000tCO_2)
    - A smooth progress is expected as the most issues were resolved in the 1st period
  - Verification/certification for 4th period : planned to start in the first half of 2011
- Establishment and Standardization of Monitoring System
  - Update procedure and instruction documents related to monitoring (upon changes)
  - Check revised instructions related to UNFCCC (upon changes)
- Trade and Use of CERs
  - Create profit by selling CERs issued for 1st period (within this year)
  - Review investment in low-carbon and green growth areas

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Future Plan – Development of New CDM Projects

- Digested gas treatment of Food waste effluent CDM Project
  - Project overview
    - Reduce methane in gases generated from treatment processes of effluent which is generated from processes to turn food waste into compost or fuel
    - Replace fossil fuel using digested gases
  - Current stage : modifying the project design document (PDD)
- Refuse Derived Fuel(RDF) Project
  - Project overview
    - Minimize landfilled waste through pre-treatment of the combustibles in municipal wastes to ultimately reduce methane generation
    - Replace fossil fuel with RDF
  - Current stage : project feasibility review (outsourcing)
- Landfill gas CDM project development for other countries
  - Field visit to landfill sites in Sichuan provinces in China and project development (underway)
  - Field visit to landfill sites in Russia & South Africa(project feasibility review)

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Session 3

GHG Mitigation Potential in the Agriculture/Forestry Sector

Chair: Thevarack Phonekeo,
Water Resources and Environment Administration, WREA

Hector Ginzo, Argentinian Academy of Environmental Science
Beomseok Yoon, Greenhouse Gas Inventory & Research Center of Korea, GIR
Eduardo Calvo, National University of San Marcos

Session 3

Chair

Thevarack Phonekeo

Water Resources and Environment Administration, WREA (Lao PDR)

Current Position/Affiliation

Director of Socio-Environment Division, National Secretariat for GMS

Education

M.S. in Urban Environment Management, Asian Institute of Technology (AIT)

Highlighted Experience

2005-present	Coordinator for ASEAN Sustainable Environment City
2007-2009	Deputy Director of International Cooperation Division, Science Technology and Environment Agency (STEA)
2005-2007	Acting Deputy Director of International Cooperation Division, Science Technology and Environment Agency (STEA)
2000-2005	Official, Science Technology and Environment Agency (STEA)

Panelist

Anthony Maina

Mau Forest Complex Interim Coordinating Secretariat (Kenya)

Chan Thou Chea

Ministry of Environment (Cambodia)

Duk-Bae Lee

National Academy of Agricultural Science

Presenter

Hector Ginzo
Argentinian Academy of Environmental Science (Argentina)

Current Position/Affiliation

Certified Reviewer UNFCCC
LULUCF Expert

Education

Agricultural Engineer, University of Buenos Aires
M.S., University of Bangor, UK

Highlighted Experience

2005 ~ 2010 Editorial board of the IPCC Emission Factor Database
1974 ~ 2006 Scientific research on subjects as diverse as grassland ecology, crop eco-physiology and plant physiology at the Argentinean National Research Council (CONICET)

Recent Publications/Research

Chapter on scenarios for Latin America and the Caribbean for the International Assessment of Agriculture Science and Technology for Development, Co-Author (IAASTD; 2007)
2003 IPCC Good Practice Guidance for LULUCF; and the AFOLU sector, 2006 IPCC Good Practice Guidelines for National Greenhouse Gas Inventories, Co-Author

Use of forests and tree plantations for the sequestration of carbon dioxide, and impacts of land-use change on emissions/removals of GHG, procedures and modalities for aforestation/reforestation CDM projects
Future impacts of climate change in Argentina and plausible strategies

Use of forests and tree plantations for the sequestration of carbon dioxide, and impacts of land-use change on emissions/removals of GHG, procedures and modalities for afforestation/reforestation CDM projects

Presenter

Beomseok Yoon

Greenhouse Gas Inventory & Research Center of Korea, GIR

Education

B.S., Seoul University, Department of Forestry Science
M.S., Department of Agricultural Economics

Recent Work/Publications

"Impact Analysis of Bioethanol Production on the U.S. Maize Market," Agricultural Economics (2010)
"Understanding the REDD+ Mechanism and Future Expected Negotiations in the Climate Change Convention," Korea Institute for Agricultural Economics (2010)
National Mitigation Target Selection Analysis: Agricultural, Waste, and Forestry Sectors

Eduardo Calvo

National University of San Marcos (Peru)

Current Position/Affiliate

Associate Professor, National University of San Marcos
Advisor to the General Directorate of the Ministry of Foreign Affairs

Education

Ph.D. (ABD), Faculty of Economy and Agricultural Management, University of Agriculture Nitra, Slovakia
M.S., Faculty of Natural Sciences, Comenius University, Bratislava, Czechoslovakia

Highlighted Experience

2005	World Bank Institute, Paris, Environmental and Natural Resources Economy
1997 ~ 2008	IPCC WG III Vice Chair
2009 ~	IPCC WG II Vice Chair

Recent Publications/Research

Third and Fourth Assessment Report, IPCC, Cambridge, UK (2001, 2007), Review Editor
Special Report on Carbon Dioxide Capture and Storage, IPCC, Cambridge, UK, Review Editor
Special Report on Safeguarding the Ozone Layer and the Global Climate System, IPCC, Cambridge, UK (2005), Review Editor
Special Report on Land Use, Land Use Change and Forestry IPCC, Cambridge, UK, Review Editor
Special Report on Emission Scenarios, IPCC, Cambridge, UK (2000), Review Editor

Session 3

Mitigating Climate Change in Argentina: Some Options with Tree-formations and Agricultural Practices

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Argentinian Academy of Environmental Science

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Mitigating Climate Change in Argentina

Some options with tree-formations and agricultural practices

Mitigating Climate Change in Argentina

Tree-formations

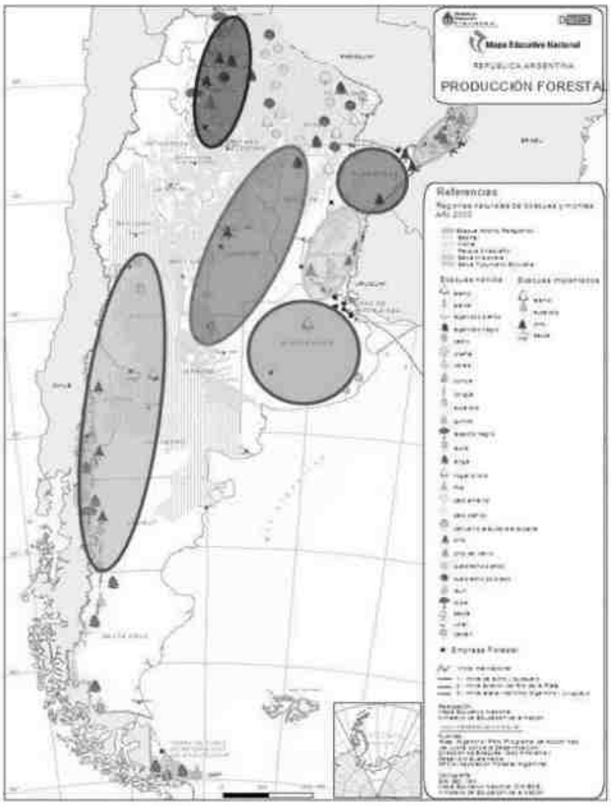
Tree-plantations

- Continental Argentina has an extension of ≈2.8 Mkm^2 (= 280 Mha)
- The **area** considered to be **suitable** for **tree-plantations** is **≈20 Mha** (or 7% of the country's area)

An overview of tree-plantations

Region (∩) or *province*	%[1]
Misiones	30.5
Corrientes	24.7
Entre Rios	17.6
Buenos Aires	13.5
∩(*Chubut, Mendoza, Neuquén & Rio Negro*)	3.5
∩(*Jujuy, Salta & Tucumán*)	3.0
∩(*Córdoba, La Pampa & Santa Fe*)	7.2

[1] Relative to the total plantation area (642,394.5 ha) in 1998.



Tree-plantations

Tree type	Proportion (%)[1]
pines[2]	54
eucalypts[3]	32
willows	9
Other[4]	5

[1] Of all plantations
[2] *P. elliotti*, *P. taeda*, *P. caribea*, *P. hondurensis*, *P. ponderosa* & *P. patula*
[3] *E. grandis*, *E. saligna*, *E. dunii*, *E. globulus*, *E. viminalis* & *E. teretricornis*
[4] poplars, chinaberry (*Melia azedarach*), kiri (*Paulownia tomentosa*), Australian red cedar (*Toona ciliata*), Australian silver oak (*Grevillea robusta*), algarrobo (*Prosopis alba*; native), Parana pine (*Araucaria angustifolia*) & Oregon pine (*Pseudotsuga menziesii*)

Tree-plantations

Mean annual increment ($m^3.ha^{-1}.yr^{-1}$)[1]

province or region	pine	eucalypt	willow	poplar	oregon pine
Misiones	13.4	25.1			
Corrientes	13.9	17.4			
Entre Rios	10.6	12,1			
Buenos Aires	5.9	13.8	6.6	9.6	
CW Region[2]	3.4			7.7	4.7
NOA Region [3]	10.6	7.4			
C Region [4]	8.1	8.4			

[1] Volume under bark, up to 0.1m in the thinnest end.
[2] Provinces of Mendoza, Neuquén, Rio Negro and Chubut
[3] Provinces of Jujuy, Salta and Tucumán
[4] Provinces of La Pampa, Córdoba and Santa Fe

Tree-plantations

Mean production ($m^3.ha^{-1}$)[1]

region	pine	eucalypt	Willow & poplar
Littoral[2]	257[†]	109[‡]	
Littoral & Buenos Aires[3]			102[†]
NOA Region [4]	252[†]	90[‡]	

[1] Volume under bark, up to 0.1m at the thinnest end
[2] Provinces of Misiones, Corrientes & Entre Rios
[†] Site Index: 20; age: 20 yr; dominant height: 23m
[‡] Site Index: 20; age: 20 yr; dominant height: 20.8m
[3] Province of Buenos Aires
[†] Site Index: 15; age: 15 yr; dominant height: 20.3m
[4] Provinces of Jujuy, Salta & Tucumán
[†] Site Index: 20; age: 20 yr; dominant height: 23m
[‡] Site Index: 20; age: 20 yr; dominant height: 20.8m

Domestic scenarios foresee increases in mean air temperature and relatively stable rainfall over most of the country (RA, 2007) This combination very likely results in generalised water stress conditions.

BISPECIFIC PLANTATIONS – A SIMPLE MODEL

Bispecific plantations – a simple model

- Multispecific plantations are better suited to cope with climate anomalies produced by Global (regional) warming (Locatelli et al., 2008)
- Mixed plantations may show a decrease of transpiration at the stand edges (Vanclay, 2009)
- Mixed plantations generate their own biodiversity identity (Watson et al., 2000)

Bispecific plantations – a simple model

- ✓ One hectare square plot
  - ✓ 144 individuals of A
  - ✓ 396 individuals of B
- ✓ Species A is a slow-growing, high wood-density type for sequestering CO_2
- ✓ Species B is a fast growing type apt for producing timber
- ✓ The model equation (Waterworth et al., 2007):

$$M_a = M_0 + M * e^{\left(\frac{-k}{a}\right)}$$

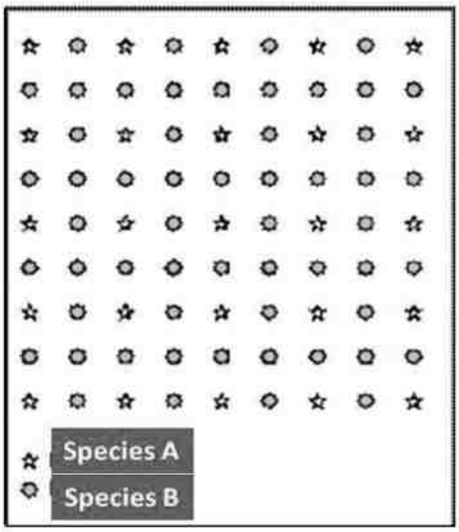
M_a is the amount of dry-biomass produced in year a

M_0 is the amount of planted dry-biomass

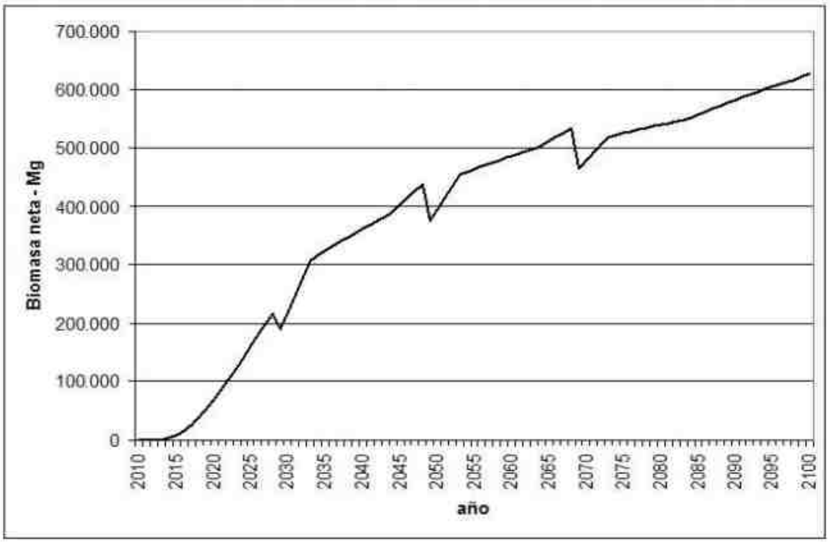
M is the potentially maximal dry-biomass

k is related to the age at which the plantation attains its maximal annual growth rate

Plant layout



Bispecific plantations – a simple model



The reference case

Species	M_0 ($Mg.ha^{-1}$)	M ($Mg.ha^{-1}$)	$G^{[+]}$ (yr)
A	0.0216	144	88.75
B	0.0297	190	28.75

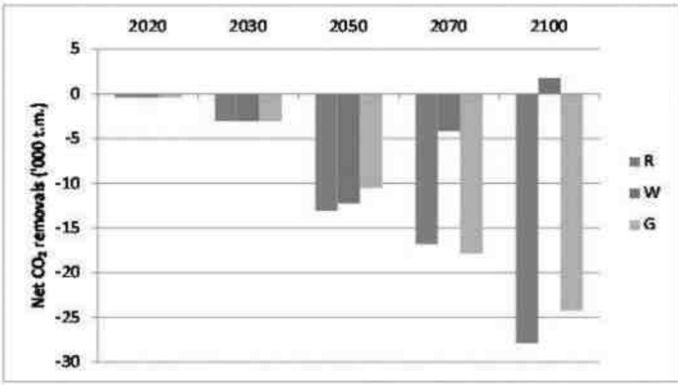
$^{+}k = 2 * G - 1.25$

Bispecific plantations – a simple model

Net CO_2 removals =

CO_2 removed by species A +

CO_2 emitted by HWP of species B



Bar key: R, reference escenario; W, water deficit scenario; G, genetic improvement scenario

Year	Planted area (ha)
2020	55,000
2030	105,000
2050	205,000
2070	305,000
2100	455,000

An estimation of the domestic opportunity cost of implementing a REDD process.

The area covered with native forests is 96 Mha or 34% of the continental area of Argentina (RA, 2005)

MITIGATION AND ADAPTATION WITH REDD+

Mitigation and adaptation with REDD+

A map of Argentina's ecoregions

The ecoregions containing valuable native tree species under threat from deforestation and degradation are:

#3. *Monte* in hills and *bolsones*

#4. *The Yungas* subtropical forest

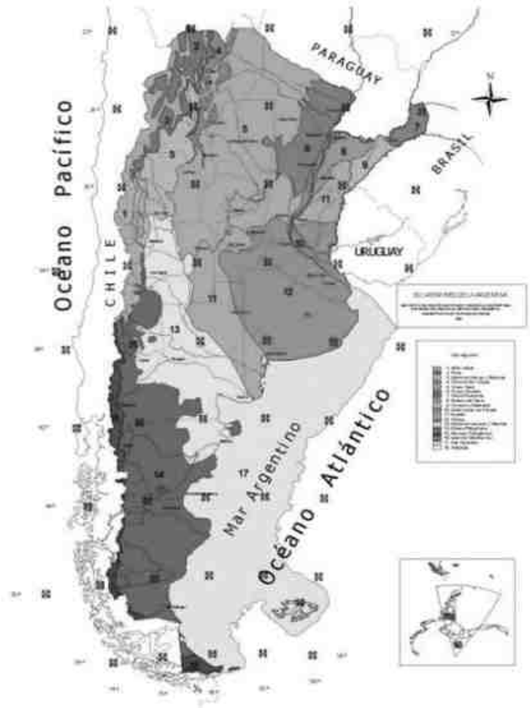
#6. Humid chaco

#7. Paranaense subtropical forest

#10. Delta of the Paraná river and its islands

#11. *Espinal*

#15. Patagonian forest



MITIGATION AND ADAPTATION WITH REDD+

The **rate of deforestation of native forests** has increased steadily in the period 1937-2002

Period	Rate ($\%.yr^{-1}$)
1937-1987	0.16
1987-1998	1.02
1998-2002	1.11

Mitigation and adaptation with REDD+

Estimated annual gross income ($USD.ha^{-1}.yr^{-1}$) from production systems likely to be implemented on some forest lands

Forest apt for producing:			
Timber (Paranaense forest)		Firewood (Other forest lands)	
Light timber extraction	Pine plantation in deforested land	Soyabean crop in forest lands	Cattle raising
42.2	205.2	186.2	50.2

Mitigation and adaptation with REDD+

- Recent domestic law → **fund for the enrichment and conservation of native forests**
- This **fund** distributed USD 75M among provincial governments in 2010
- Assume that a forester's net income is ≈10% of gross income (*see preceding slide*) or USD $20ha^{-1}.yr^{-1}$

Mitigation and adaptation with REDD+

- **Selva Paranaense** = 1.5Mha
- Avoiding its deforestation → 1.5Mha * USD $20ha^{-1}.yr^{-1}$ = USD 30M
- USD 30M ≈ 40% of the fund for the conservation of **1.6% of the country's native forestlands (!)**

Mitigation and adaptation with REDD+

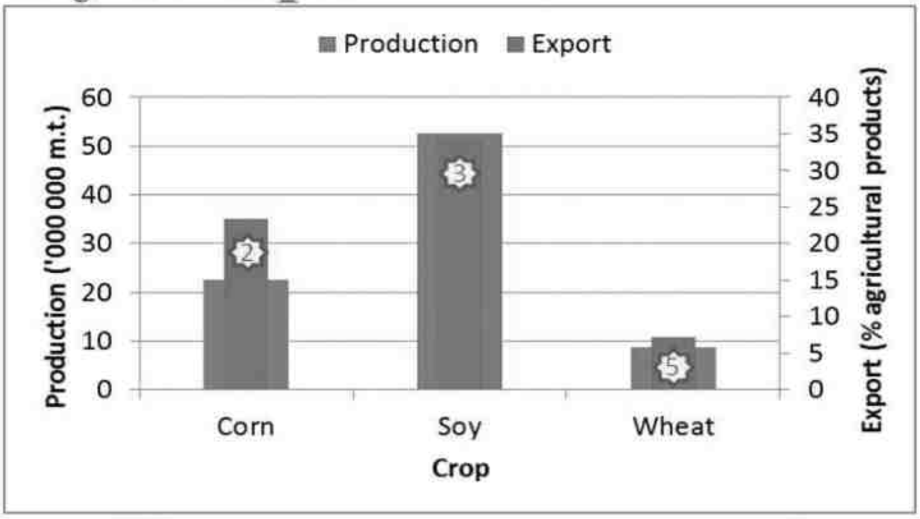
- Argentina would benefit from REDD+
- Adhesion to the Forest Carbon Partnership Fund.
- Definitive R-PP (*readiness proposal*) not yet submitted for approval (as of June 2011).

Mitigating Climate Change in Argentina

Agriculture & Livestock

Agriculture & Livestock

- **Major crops**



5 : Rank among exporting countries (2009/2010)

Agriculture & Livestock

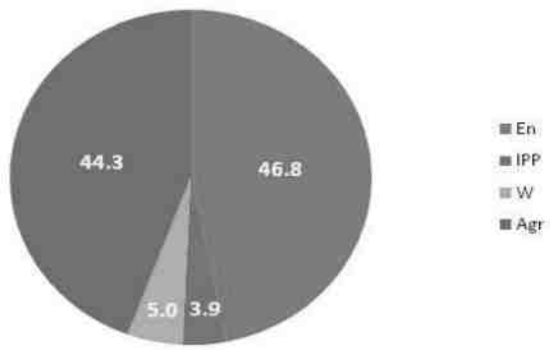
- **Major livestock (2010)**

Type	Quantity (No. of heads)
Cattle	48,949,743
Sheep	12,558,904

Agriculture & Livestock

The latest Argentinean GHG inventory (2000) showed the following distribution (% of national 282,000 m.t. net emissions of CO_{2eq}) among energy (**En**), industrial products & processes (**IPP**), waste (**W**) and agiculture & livestock (**Agr**)

- GHG emissions from energy ≈ GHG emissions from agriculture & livestock



Agriculture & Livestock

Key:

EF: Enteric fermentation

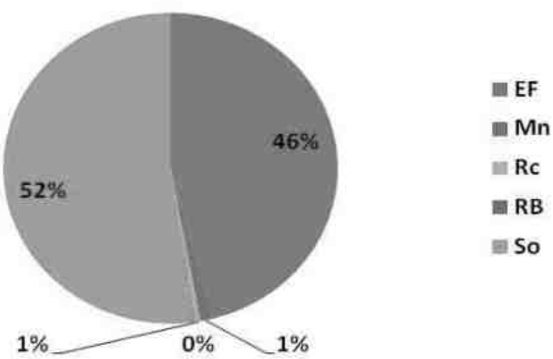
Mn: Manure management

Rc: Rice cultivation

RB: Residue burning

So: Soils

- Distribution of GHG emissions from agriculture & livestock (124,919.39 m.t. CO_{2eq})



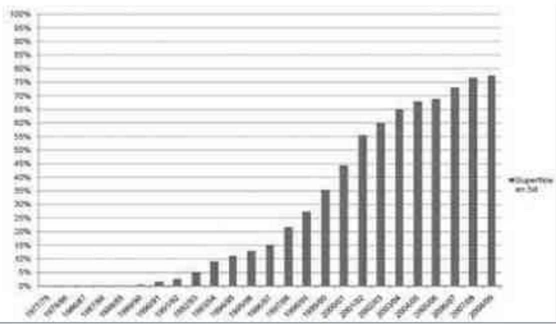
Agriculture & Livestock

Some mitigation options in Argentinian agriculture are:

- To increase the efficiency of N-fertilisers (economic produce/N input; w/w), because crops are not heavily fertilised, by:
  - Reducing N-losses as gaseous {N_2O or NH_3} or solid NO_3^- by the implementation of Best Magement Practices (Still experimental)
  - Using ammonia-N (widespread use of urea; sporadic use other ammonia sources)

Agriculture & Livestock

- To enhance and keep the size of the soil carbon pool by:
  - Generalisation of no-tillage practices. In Argentina there is a ≈20 yr experience with no-tillage cultivation in the major crop area

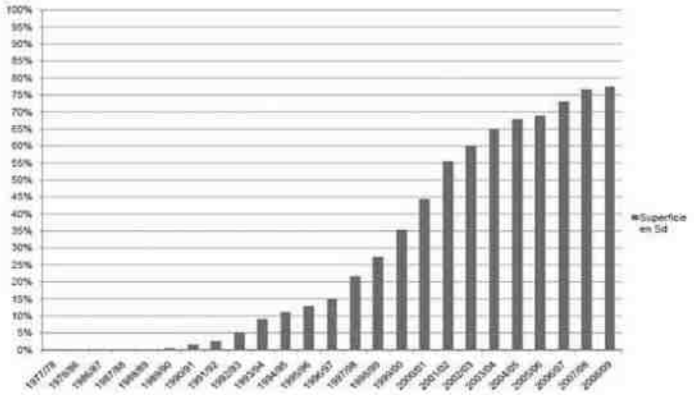


Agriculture & Livestock

- To enhance and keep the size of the soil carbon pool by:

  Generalisation of no-tillage practices. In Argentina there is a ≈20 yr experience with no-tillage cultivation in the major crop area

- The area under zero-tillage presently accounts for ≈75% of the area sown to corn, soybean, wheat, sorghum and sunflower (graph: evolution of relative area under zero-tillage with time)



Agriculture & Livestock

- To enhance and keep the size of the soil carbon pool by:
  - Using organic soil amendments (some pilot experiments done)
  - Integrating grazing of cover crops with no-till cultivation in monocultures (it is an interesting but unexplored mitigation approach)

Agriculture & Livestock

- ✓ Mitigation options in Argentinian cattle production are many, but they have not been explored
- ✓ The development of silvo-pastoral systems potentially is an readily feasible approach. There is some basic but incomplete research on them

Session 3

GHG Mitigation from the Agricultural Sector in Korea

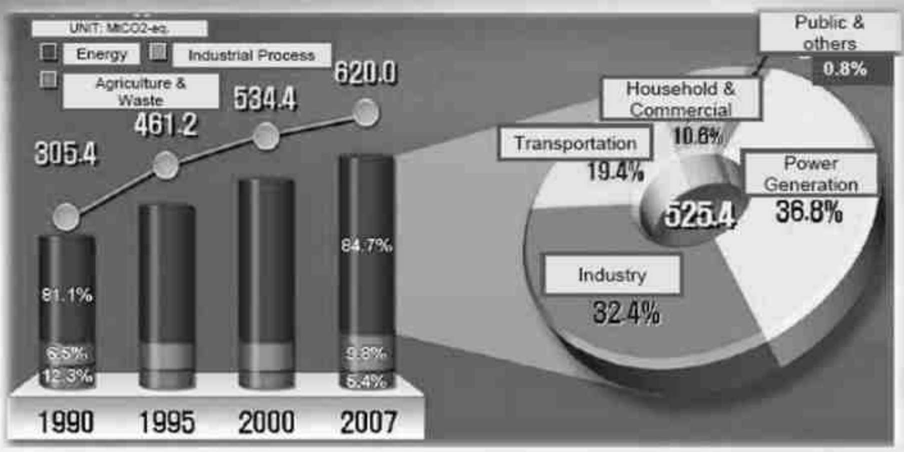
Beomseok Yoon
Greenhouse Gas Inventory & Research Center of Korea, GIR


GHG Mitigation from the
Agricultural Sector in Korea
2011. 7. 8.
GHG Inventory & Research Center of Korea
Beomseok Yoon

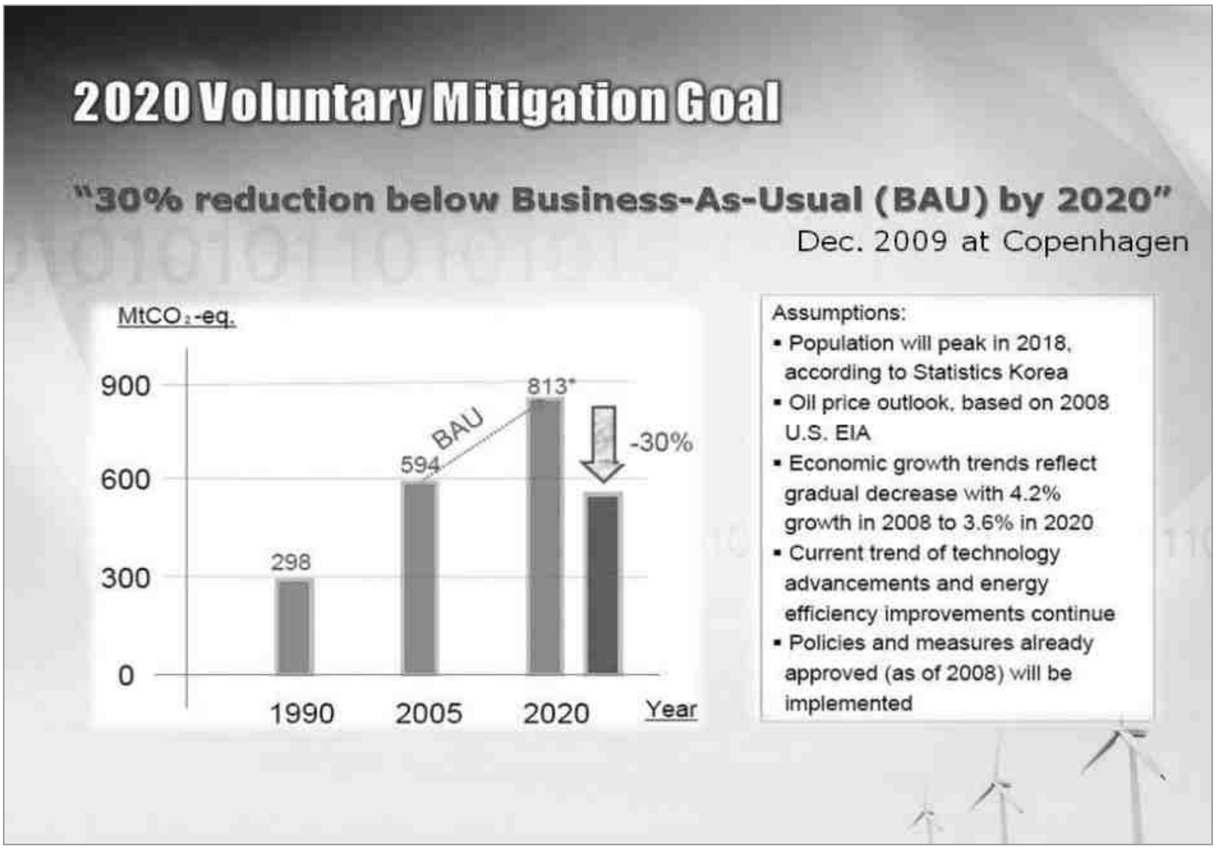

Table of Contents
1 Background
2 BAU Estimation
3 Mitigation Potential
4 Lessons & Next Steps

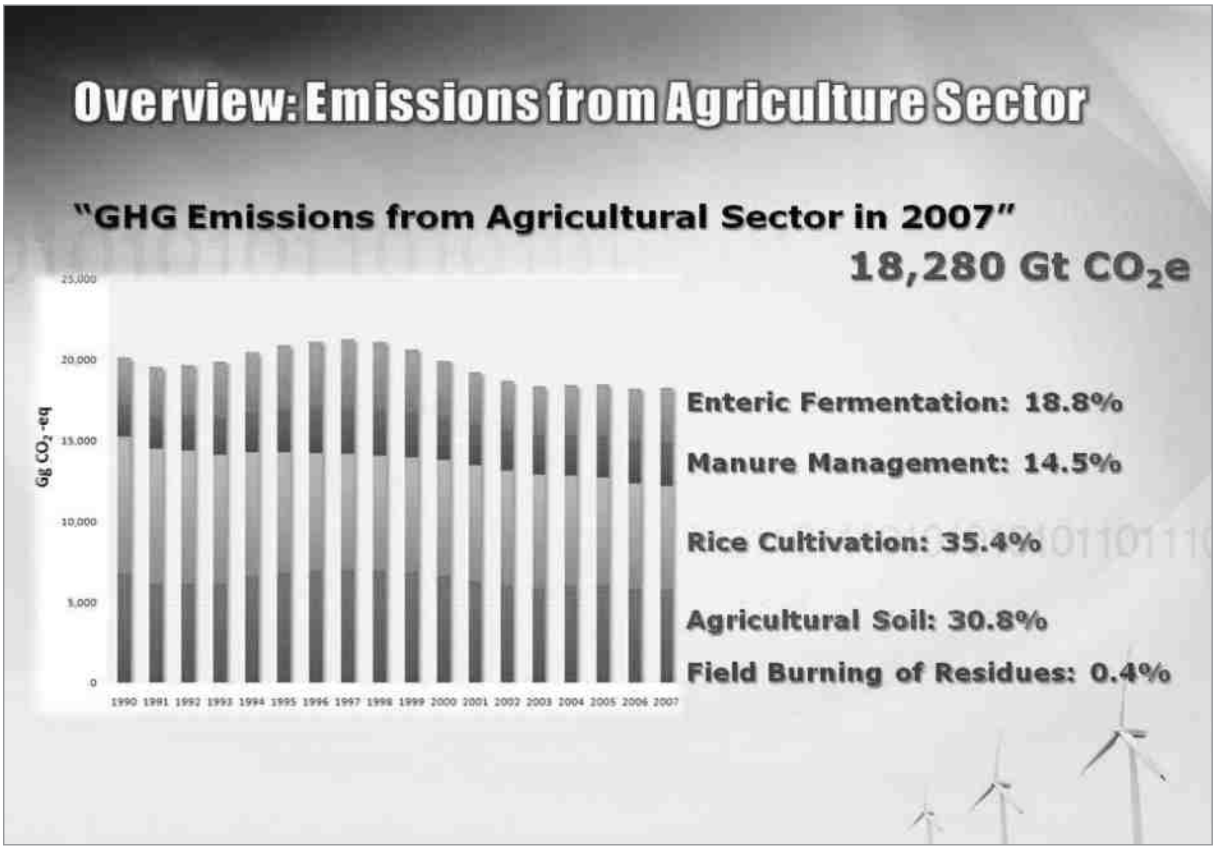
1. Background

National Emissions Trend



- 84.7% of GHG emissions from the Energy sector in 2007
- Energy-intensive economic structure
- **Agriculture Sector: 2.5%**


2020 Voluntary Mitigation Goal
"30% reduction below Business-As-Usual (BAU) by 2020"
Dec. 2009 at Copenhagen
MtCO2-eq.
900
600
300
0
298
594
813*
BAU
-30%
1990
2005
2020
Year
Assumptions:
▪ Population will peak in 2018, according to Statistics Korea
▪ Oil price outlook, based on 2008 U.S. EIA
▪ Economic growth trends reflect gradual decrease with 4.2% growth in 2008 to 3.6% in 2020
▪ Current trend of technology advancements and energy efficiency improvements continue
▪ Policies and measures already approved (as of 2008) will be implemented


Overview: Emissions from Agriculture Sector
"GHG Emissions from Agricultural Sector in 2007"
18,280 Gt CO2e
Gg CO2-eq
25,000
20,000
15,000
10,000
5,000
0
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007
Enteric Fermentation: 18.8%
Manure Management: 14.5%
Rice Cultivation: 35.4%
Agricultural Soil: 30.8%
Field Burning of Residues: 0.4%

Assumptions

- Scope : GHG(CH_4, N_20) from Agriculture Sector on IPCC GL 96
- Base year : 2007
- Period : 2007 ~ 2030
- Discount rate : 5.5%
- Practices/Technologies Data : Expert consultation + Various reports under
  - RDA (Rural Development Administration)
  - KREI (Korea Rural Economic Institution)
  - NFRDI (National Fisheries Research & Development Institute)

2. BAU Estimation

Agriculture modules

Composed of 5 Modules

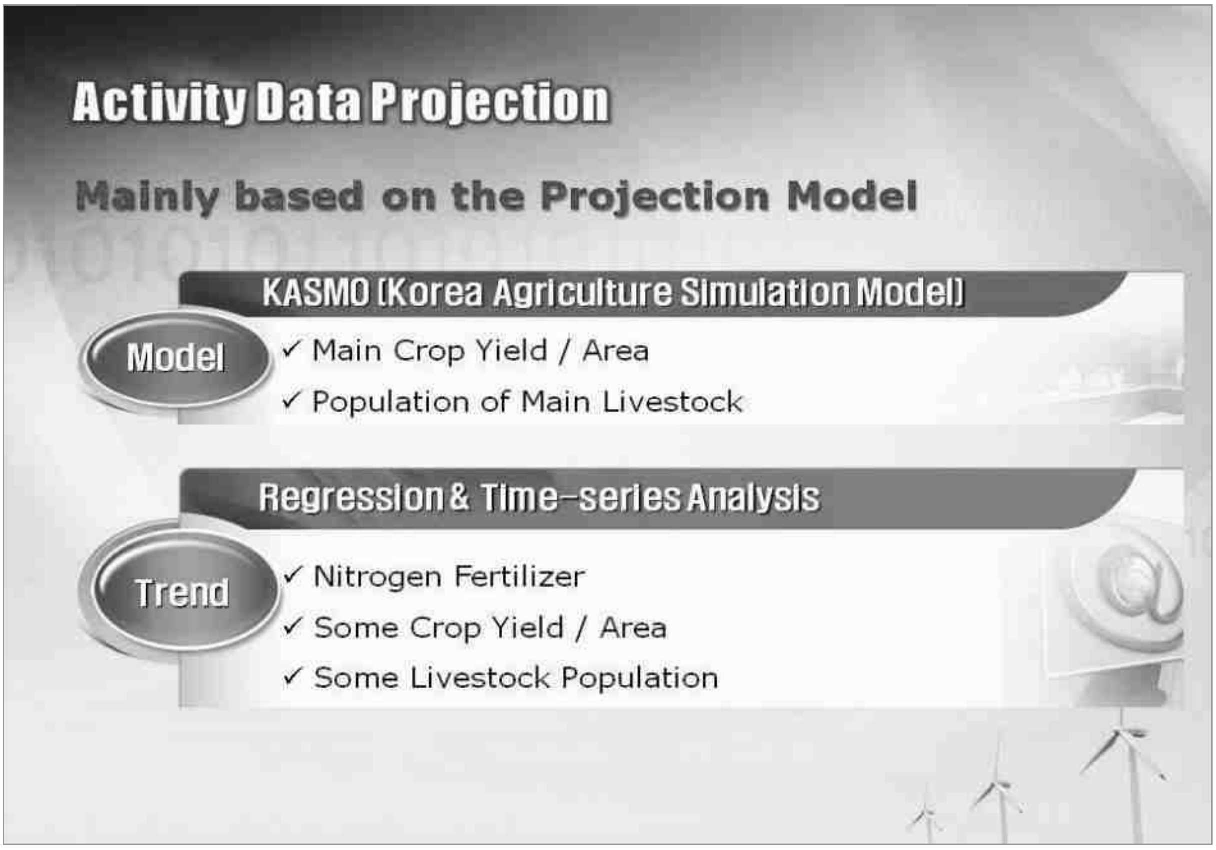
	Module	Activity Data
4A	① **Enteric Fermentation**	Livestock Population
4B	② **Manure Management**	Livestock Population
4C	③ **Rice Cultivation**	
	- Irrigation method	Continuous flooded area Intermittently flooded area
	- Amount of Organic amendment applied	Area by type
4D	④ **Agricultural Soil**	Amount of - synthetic fertiliser nitrogen - Animal manure nitrogen used as fertiliser - N fixed Crop - N in Crop Residues Returned to Soil
4F	⑤ **Field Burning of Agricultural Residues**	Amount of Residue

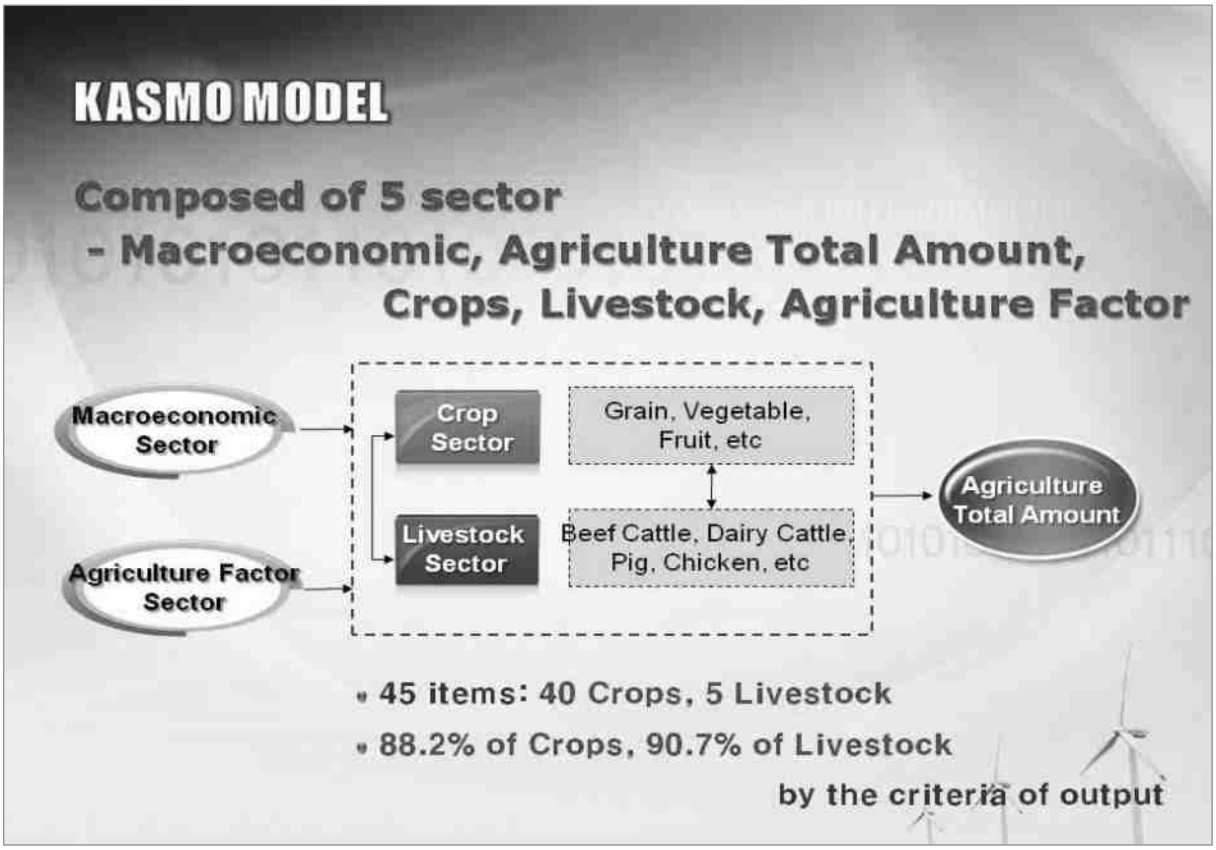
Methodology : Activity × Emission Factor

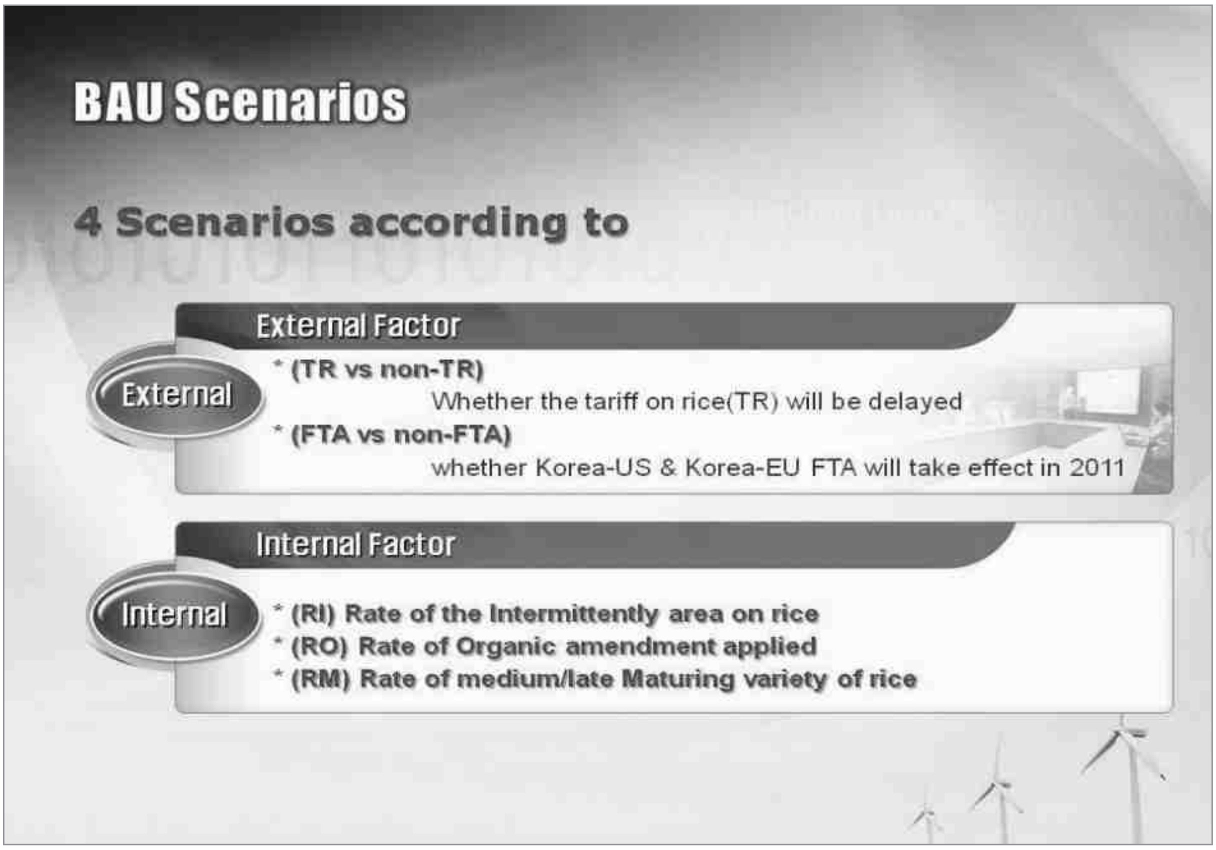
Basically based on IPCC 96 GL and Tier 1 level

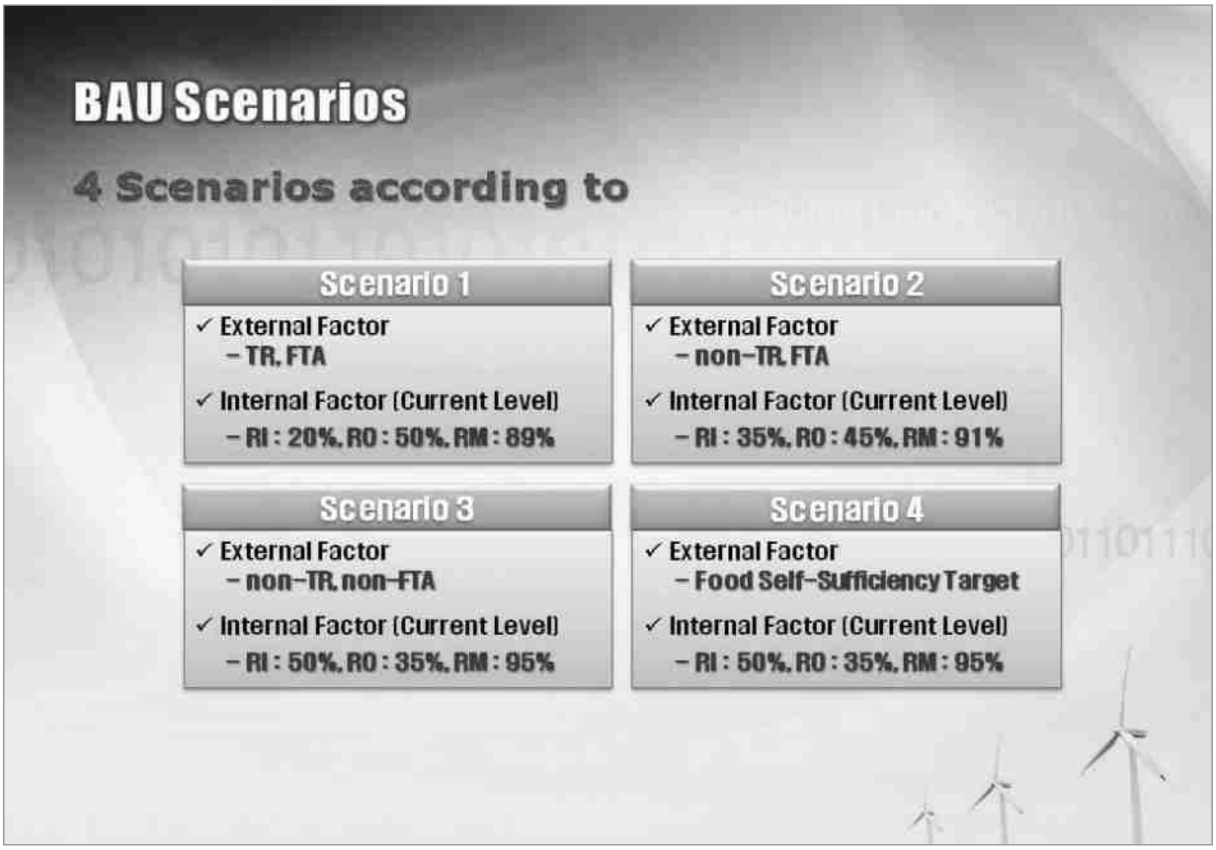
	Module	Method
4A	① **Enteric Fermentation**	IPCC 96 GL
4B	② **Manure Management**	IPCC 96 GL
4C	③ **Rice Cultivation**	
	- Irrigation method	GPG2000
	- Amount of Organic amendment applied	GPG2000
4D	④ **Agricultural Soil**	IPCC 96 GL
4F	⑤ **Field Burning of Agricultural Residues**	IPCC 96 GL

- **Excluding the Carbon sequestration of the agricultural soil**


Activity Data Projection
Mainly based on the Projection Model
KASMO [Korea Agriculture Simulation Model]
Model
✓ Main Crop Yield / Area
✓ Population of Main Livestock
Regression & Time-series Analysis
Trend
✓ Nitrogen Fertilizer
✓ Some Crop Yield / Area
✓ Some Livestock Population


KASMO MODEL
Composed of 5 sector
- Macroeconomic, Agriculture Total Amount, Crops, Livestock, Agriculture Factor
Macroeconomic Sector
Agriculture Factor Sector
Crop Sector
Livestock Sector
Grain, Vegetable, Fruit, etc
Beef Cattle, Dairy Cattle, Pig, Chicken, etc
Agriculture Total Amount
• 45 items: 40 Crops, 5 Livestock
• 88.2% of Crops, 90.7% of Livestock by the criteria of output


BAU Scenarios
4 Scenarios according to
External Factor
External
* (TR vs non-TR)
Whether the tariff on rice(TR) will be delayed
* (FTA vs non-FTA)
whether Korea-US & Korea-EU FTA will take effect in 2011
Internal Factor
Internal
* (RI) Rate of the Intermittently area on rice
* (RO) Rate of Organic amendment applied
* (RM) Rate of medium/late Maturing variety of rice


BAU Scenarios
4 Scenarios according to
Scenario 1
✓ External Factor
– TR, FTA
✓ Internal Factor (Current Level)
– RI : 20%, RO : 50%, RM : 89%
Scenario 2
✓ External Factor
– non-TR, FTA
✓ Internal Factor (Current Level)
– RI : 35%, RO : 45%, RM : 91%
Scenario 3
✓ External Factor
– non-TR, non-FTA
✓ Internal Factor (Current Level)
– RI : 50%, RO : 35%, RM : 95%
Scenario 4
✓ External Factor
– Food Self-Sufficiency Target
✓ Internal Factor (Current Level)
– RI : 50%, RO : 35%, RM : 95%

BAU Scenarios

4 Scenarios according to

Scenario 1
- ✓ External Factor
  - TR, FTA
- ✓ Internal Factor (Current Level)
  - RI : 20%, RO : 50%, RM : 89%

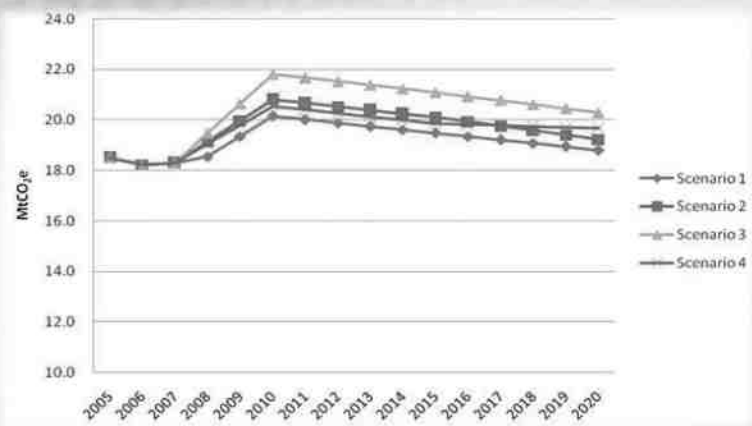
Scenario 2
- ✓ External Factor
  - non-TR, FTA
- ✓ Internal Factor (Current Level)
  - RI : 35%, RO : 45%, RM : 91%

Scenario 3
- ✓ External Factor
  - non-TR, non-FTA
- ✓ Internal Factor (Current Level)
  - RI : 50%, RO : 35%, RM : 95%

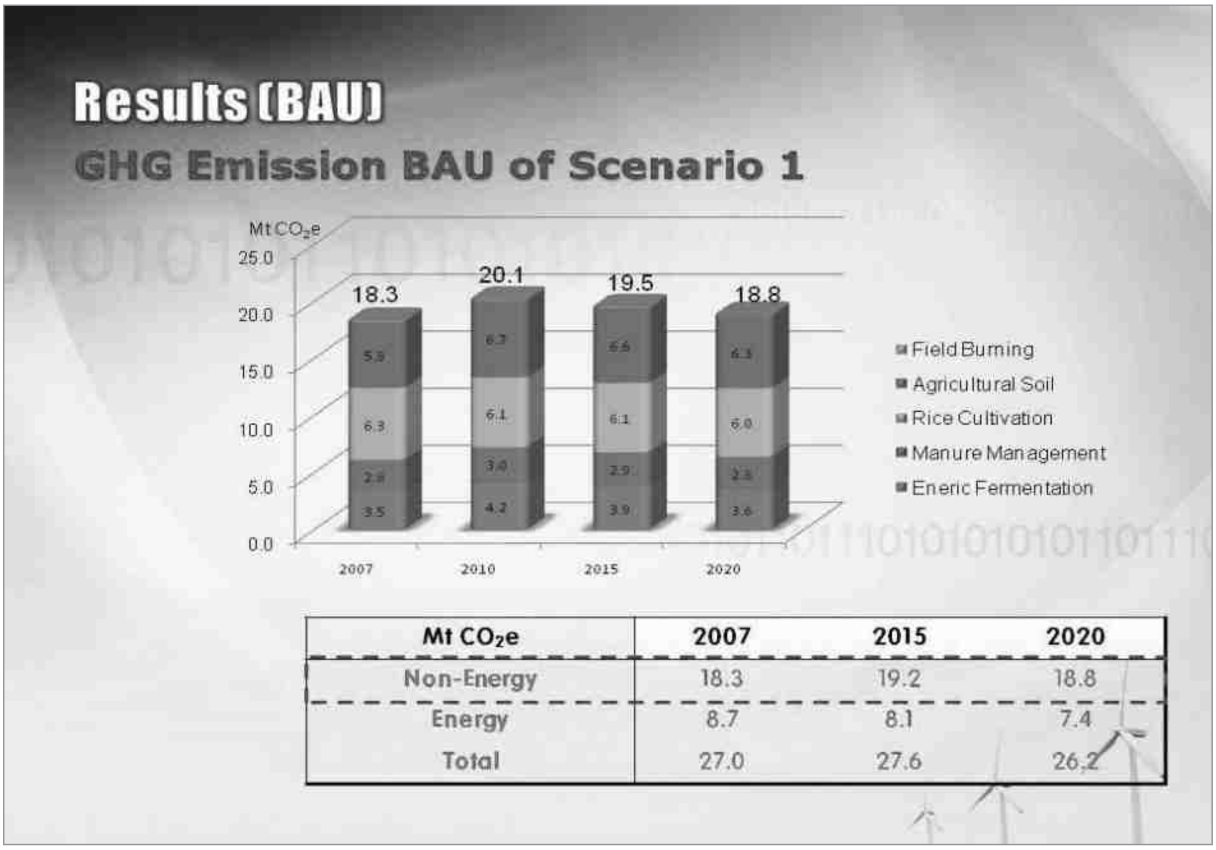
Scenario 4
- ✓ External Factor
  - Food Self-Sufficiency Target
- ✓ Internal Factor (Current Level)
  - RI : 50%, RO : 35%, RM : 95%

Results (BAU)

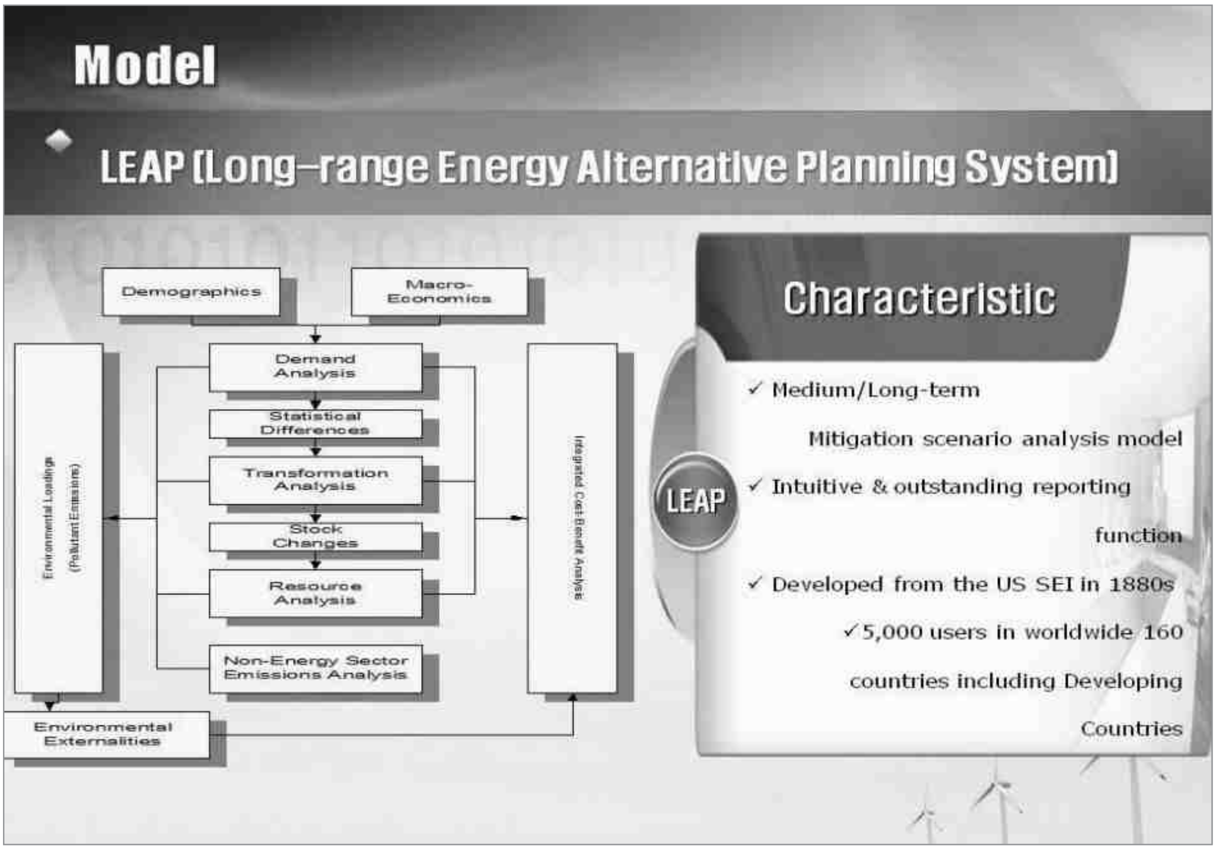
Baseline : Scenario 1

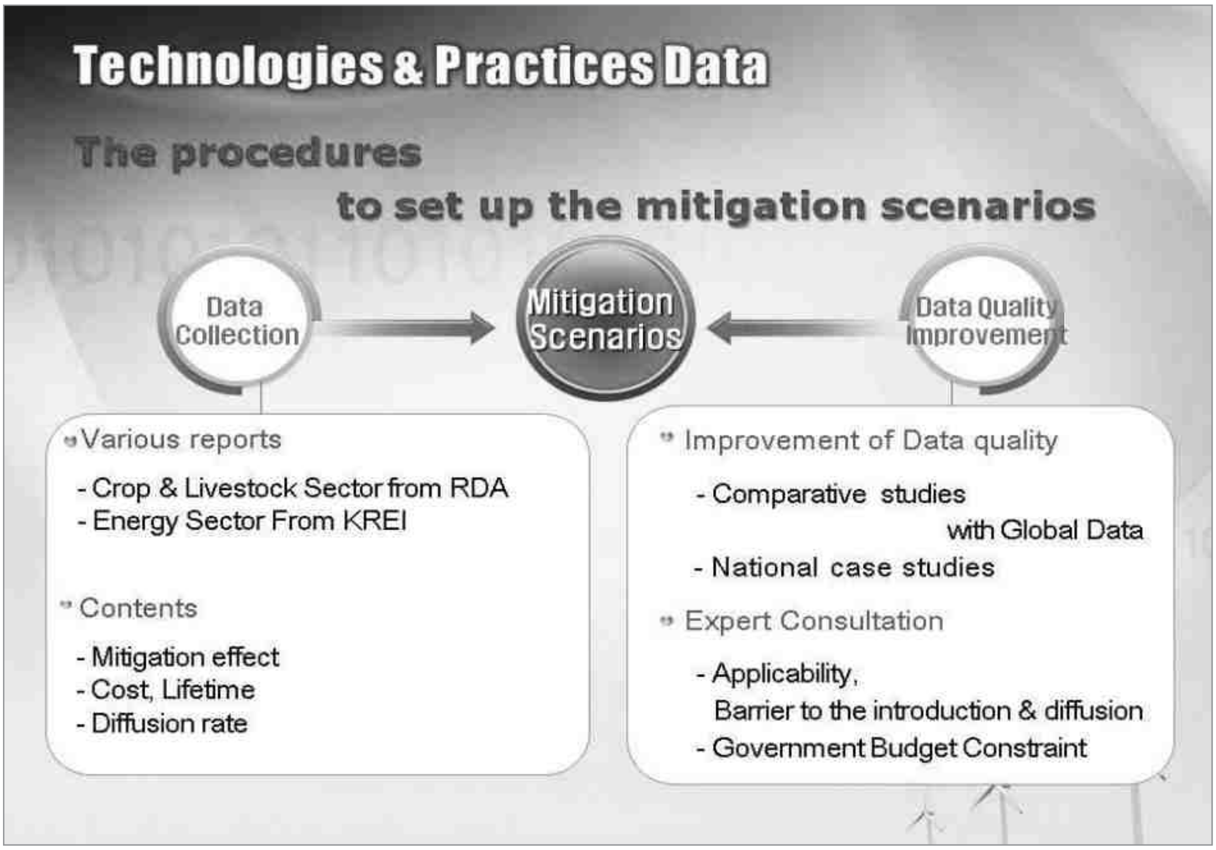


- BAU range (2020) : 18.8 ~ 20.3 $MtCO_2e$ by 4 scenarios



Mt CO_2e	2007	2015	2020
Non-Energy	18.3	19.2	18.8
Energy	8.7	8.1	7.4
Total	27.0	27.6	26.2


Model
LEAP (Long-range Energy Alternative Planning System)
Demographics
Macro-Economics
Demand Analysis
Statistical Differences
Transformation Analysis
Stock Changes
Resource Analysis
Non-Energy Sector Emissions Analysis
Environmental Loadings (Pollutant Emissions)
Integrated Cost-Benefit Analysis
Environmental Externalities
Characteristic
LEAP
✓ Medium/Long-term Mitigation scenario analysis model
✓ Intuitive & outstanding reporting function
✓ Developed from the US SEI in 1880s
✓5,000 users in worldwide 160 countries including Developing Countries


Technologies & Practices Data
The procedures to set up the mitigation scenarios
Data Collection
Mitigation Scenarios
Data Quality Improvement
Various reports
- Crop & Livestock Sector from RDA
- Energy Sector From KREI
Contents
- Mitigation effect
- Cost, Lifetime
- Diffusion rate
Improvement of Data quality
- Comparative studies with Global Data
- National case studies
Expert Consultation
- Applicability, Barrier to the introduction & diffusion
- Government Budget Constraint

Technologies & Practices Data

Energy Sector

Energy

- ✓ Replacing fossil-fuel Energy with Bio-energy
  - **Wood pellet boiler**
- ✓ Improvement of Energy Efficiency
  - **low-efficiency → high- efficiency equipment**

Non-Energy Sector

Non-Energy

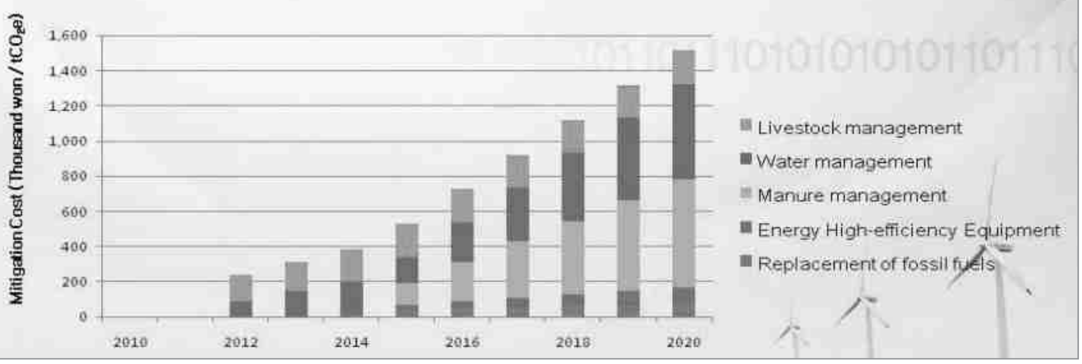
- ✓ Cropland management
  - **Water management on rice**
- ✓ Livestock management
  - **Improved feeding practices**
    - · Improving pasture quality
    - · Dietary additives
- ✓ Manure management
  - **Improved feeding practices**
    - · More efficient use as nutrient source
    - · Improved storage and handling
  - **Bio Energy (Biogas from livestock manures)**

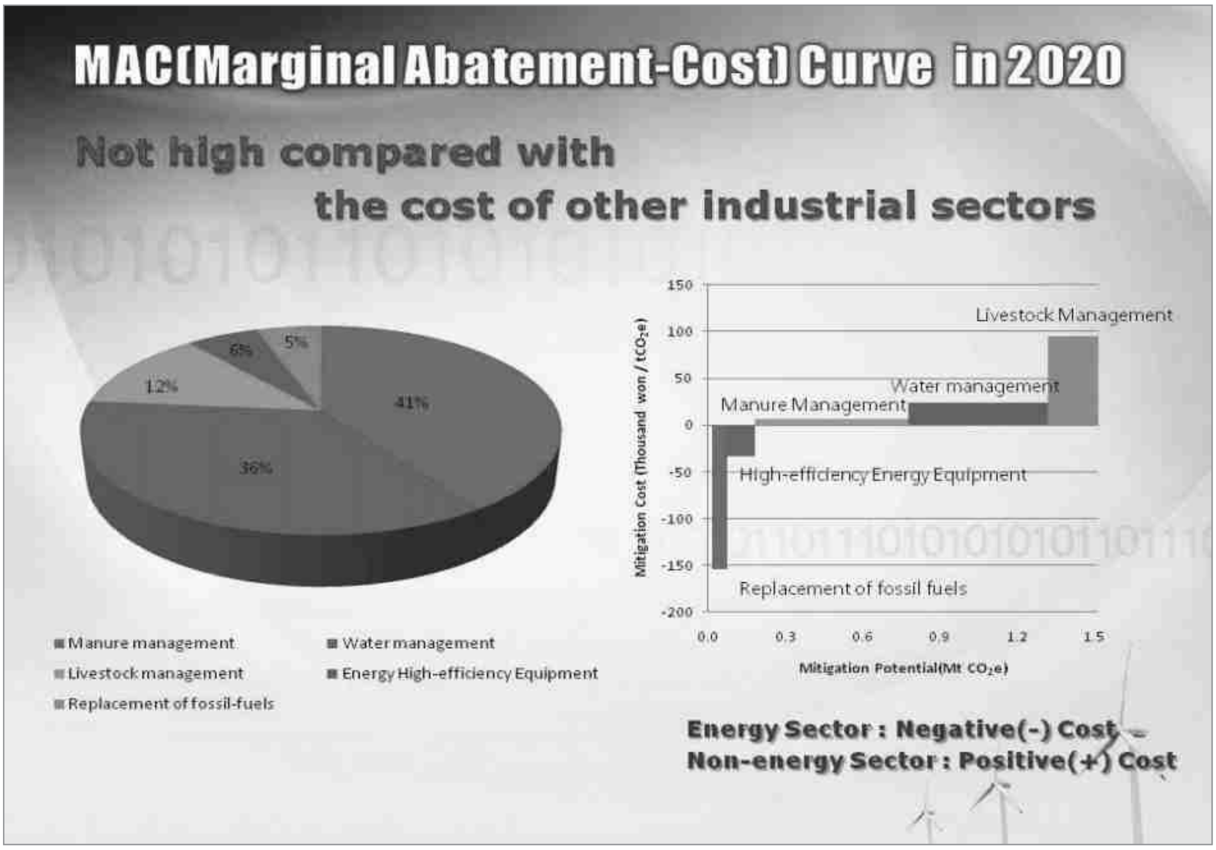
Annual Mitigation Potential

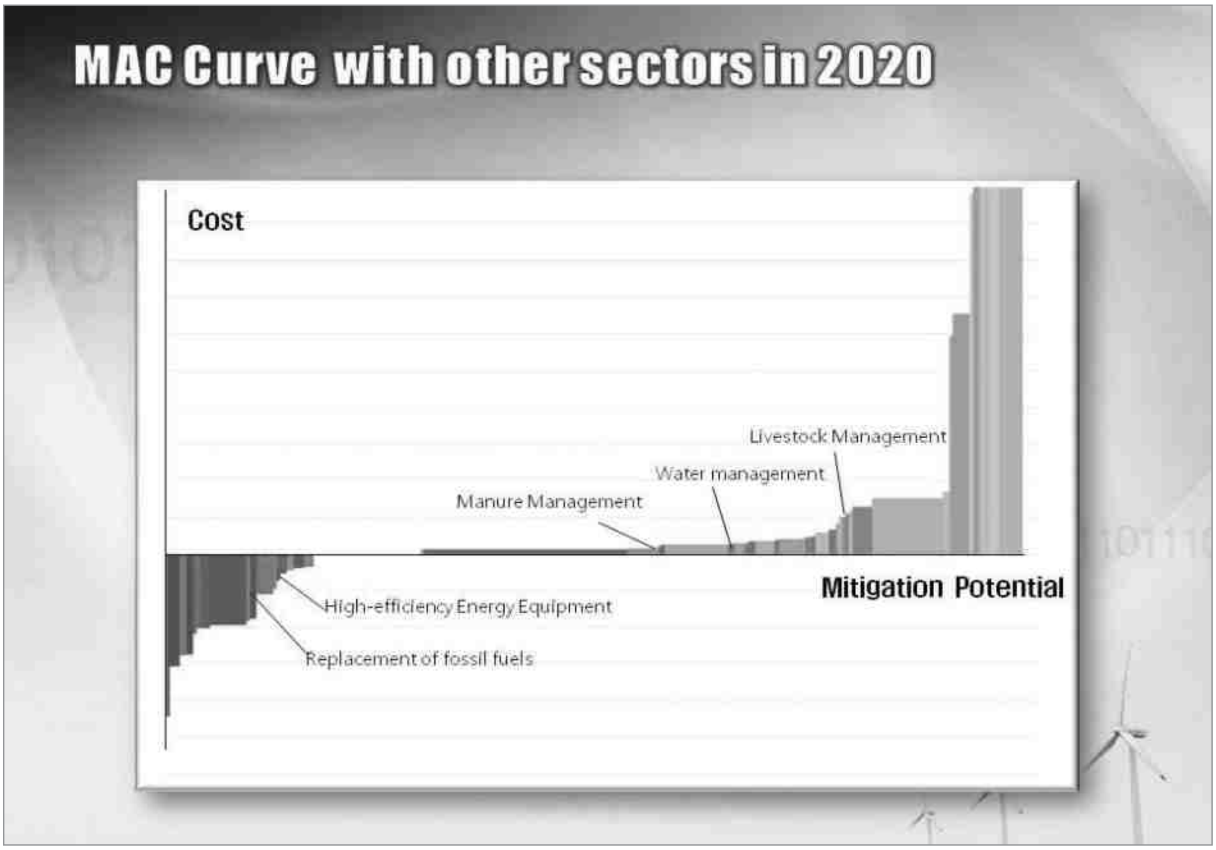
(thousand tCO_2e)

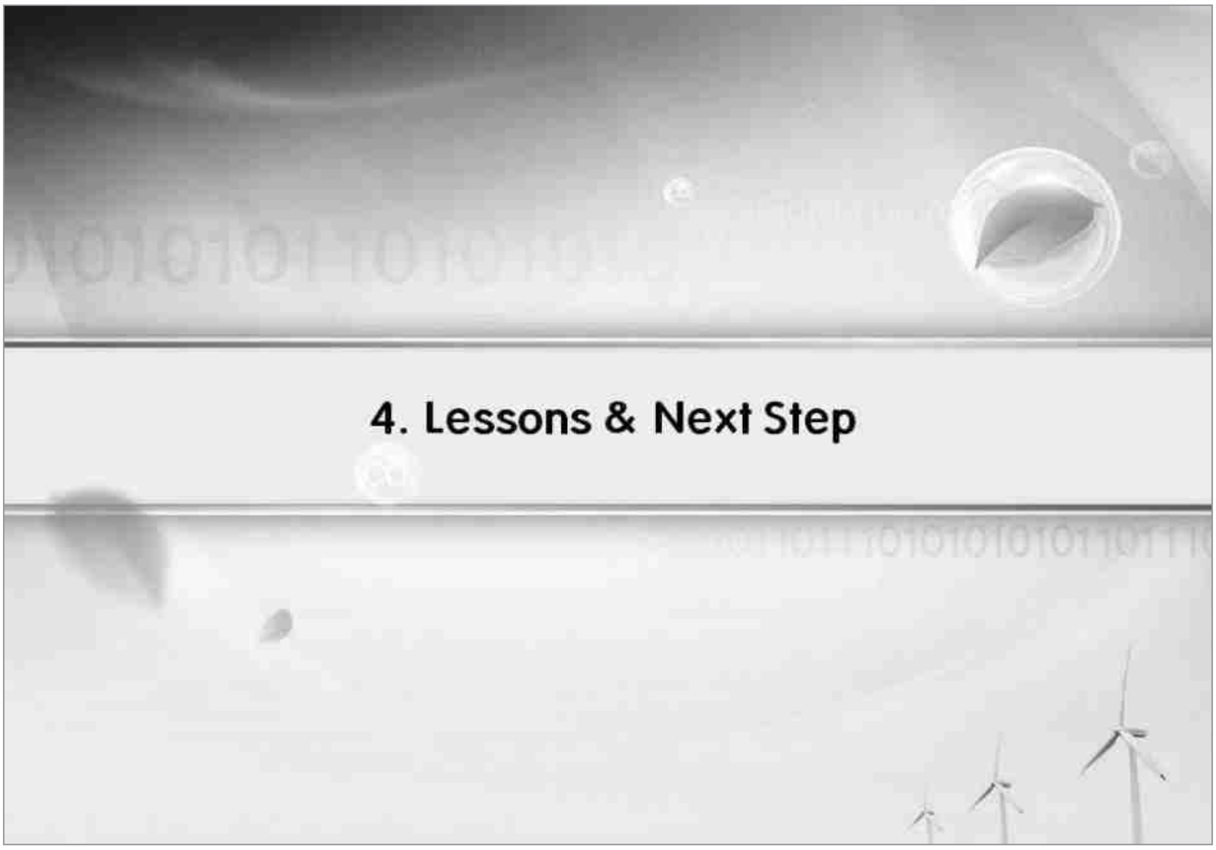
	2015		2020	
	Mitigation Potential	Mitigation Rate (below BAU)	Mitigation Potential	Mitigation Rate(%) (below BAU)
Total	**529**	**1.9%**	**1,516**	**5.8%**
Replacement of fossil fuels	44	0.2%	79	0.3%
Energy High-efficiency Equipment	20	0.1%	88	0.3%
Manure management	130	0.5%	613	2.3%
Water management	142	0.5%	548	2.1%
Livestock management	193	0.7%	188	0.7%

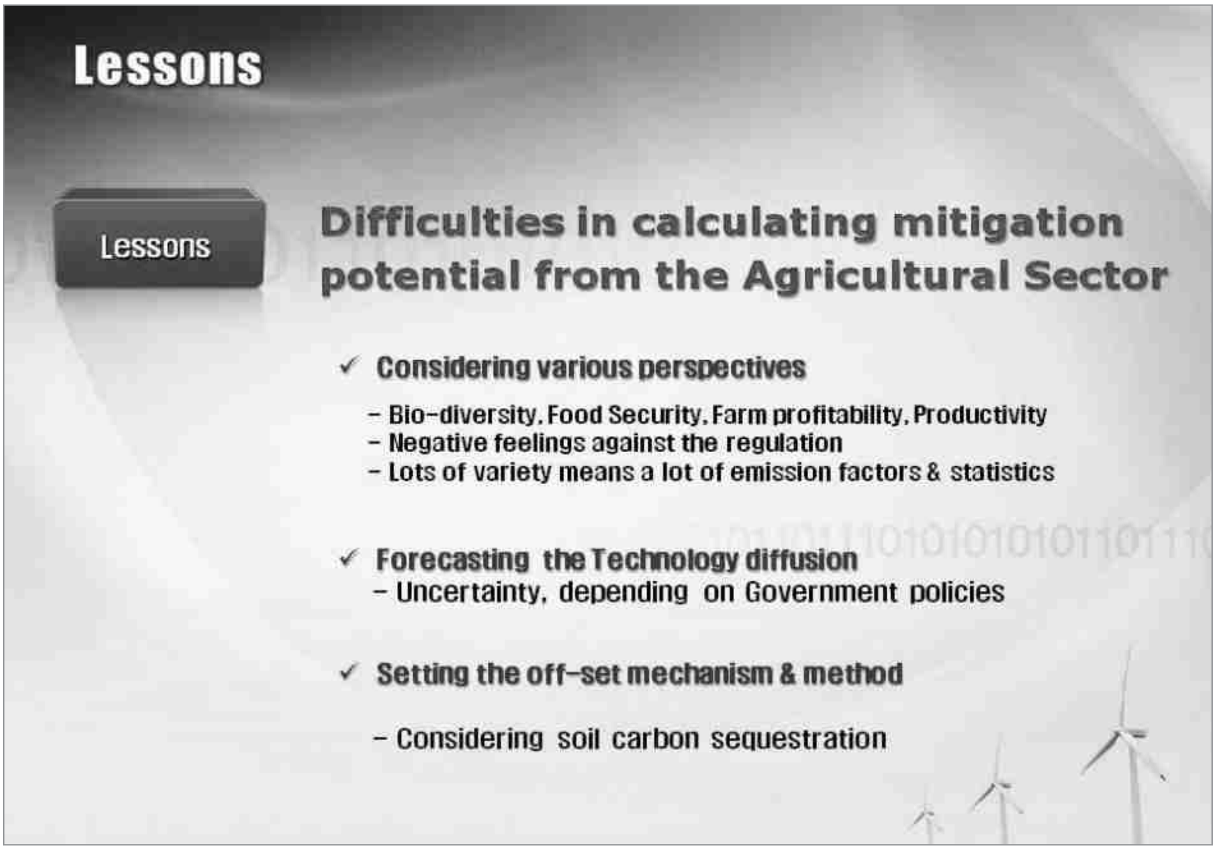
- **Including BAU of Energy Sector**

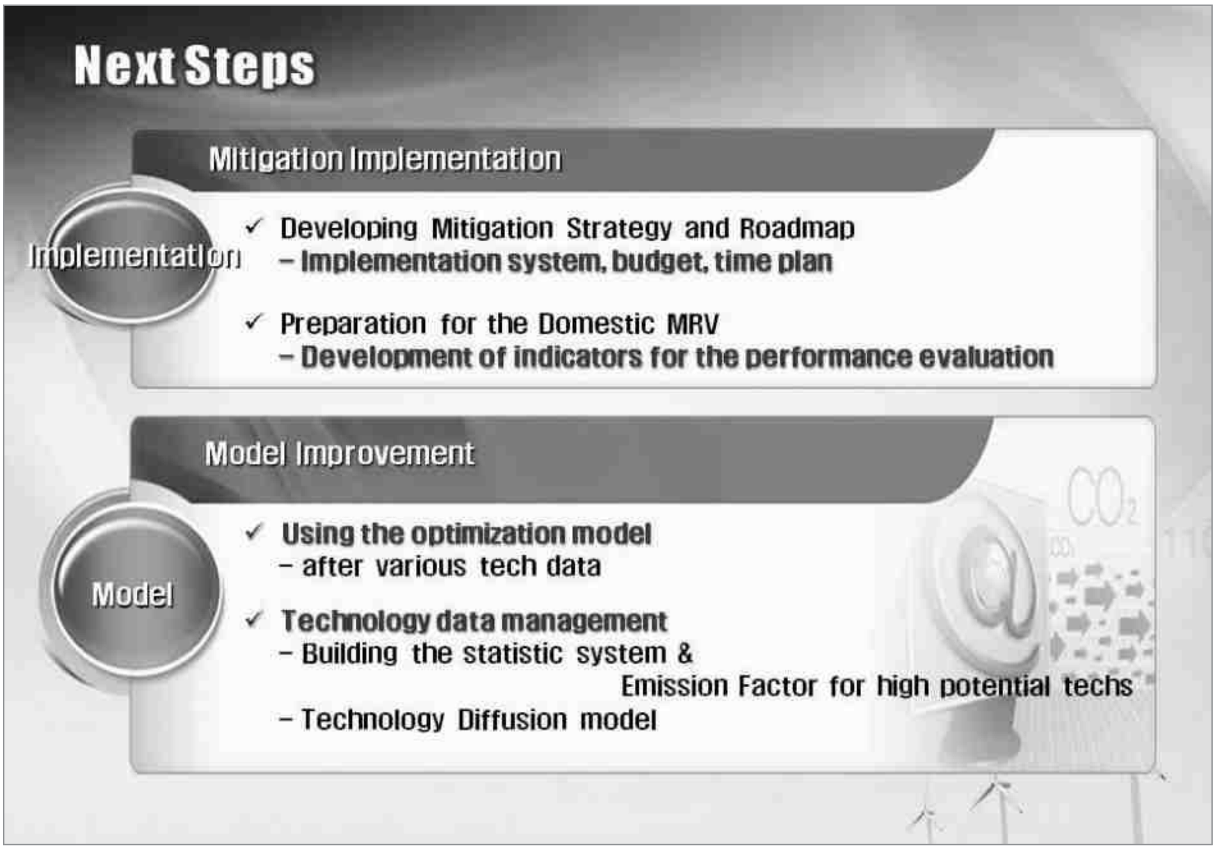



MAC(Marginal Abatement-Cost) Curve in 2020
Not high compared with
the cost of other industrial sectors
41%
36%
12%
6%
5%
Manure management
Water management
Livestock management
Energy High-efficiency Equipment
Replacement of fossil-fuels
Mitigation Cost (Thousand won / tCO_2e)
Mitigation Potential(Mt CO_2e)
Livestock Management
Water management
Manure Management
High-efficiency Energy Equipment
Replacement of fossil fuels
Energy Sector : Negative(-) Cost
Non-energy Sector : Positive(+) Cost


MAC Curve with other sectors in 2020
Cost
Livestock Management
Water management
Manure Management
Mitigation Potential
High-efficiency Energy Equipment
Replacement of fossil fuels


4. Lessons & Next Step


Lessons
Lessons
Difficulties in calculating mitigation potential from the Agricultural Sector
✓ Considering various perspectives
- Bio-diversity, Food Security, Farm profitability, Productivity
- Negative feelings against the regulation
- Lots of variety means a lot of emission factors & statistics
✓ Forecasting the Technology diffusion
- Uncertainty, depending on Government policies
✓ Setting the off-set mechanism & method
- Considering soil carbon sequestration


Next Steps
Mitigation Implementation
Implementation
✓ Developing Mitigation Strategy and Roadmap
– Implementation system, budget, time plan
✓ Preparation for the Domestic MRV
– Development of indicators for the performance evaluation
Model Improvement
Model
✓ Using the optimization model
– after various tech data
✓ Technology data management
– Building the statistic system &
Emission Factor for high potential techs
– Technology Diffusion model


Thank you!

Session 3

Transition from Conventional Biomass Use to Biofuels: Health, Economics and Sustainability Implications

Eduardo Calvo
National University of San Marcos

Transition from conventional biomass use to biofuels:

Health, economics and sustainability implications

Eduardo Calvo

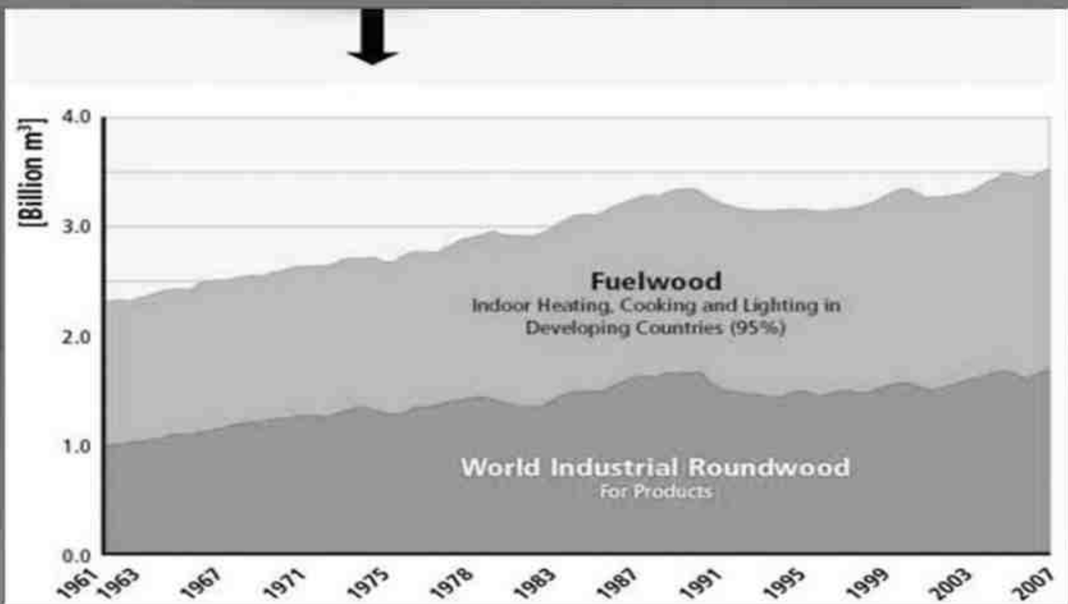
Index

- Conventional biomass
- Economy
- Health
- Sustainability
- Biofuels
- Advanced biofuels
- Sustainability frameworks

Conventional biomass

- Biomass provided about 10.2% (50.3 EJ/yr) of the annual global primary energy supply in 2008 (SRREN from IEA)
- Main sources:
  - Fuelwood 67%
  - Charcoal 7%
  - Other forest and wood 12%
  - By products from agriculture 7%
  - Modern (Energy crops, biogas, etc.) 7%

Industrial wood vs. Fuelwood (SRREN)



Traditional biomass vs. modern

	Primary Energy EJ/yr	Efficiency %	Secondary
Conventional	37-43	10-20	3.6-8.4
Modern	11.3	58	6.6

Economy

- Over two-thirds (32 EJ) of biomass energy is used for cooking and heating in developing countries.
- Remaining 15 EJ is consumed in industrialized countries both for industrial applications within the heat, power and road transportation sectors and for the heating purposes of the private sector.
- (Heinimo in SRREN)

Estimated number of people depending on biomass for cooking in selected countries or regions (IEA, 2009)	Region/ country No. of people *(Millions)*	Share of total population *(%)*
Sub-Saharan Africa	575	76
India	740	69
China	480	37
Indonesia	156	72
Rest of Asia	489	65
World	**2 528**	**52**

Health

- Woodfuels for cooking is a major source of indoor air pollution
- Hazardous pollutants, include carbon monoxide, sulfur and nitrogen oxides, and particulate matter
- Women and children are exposed 3 to 7 hours each day (Bruce, Perez-Padilla and Albalak, 2002)
- Causal relationship between high concentrations of particulate matter and acute respiratory infections (ARIs) were reviewed in Smith et al. (2000)
- Accounting for an estimated 10 percent of disease-related deaths in Africa (Bruce et al., 2002)
- ARIs pose a major threat to women and children in developing nations

Health

- Children are particularly susceptible to acute lower respiratory infections (ALRIs), a specific type of ARI
- ALRIs are a leading cause of death among children younger than five (Bruce et al., 2002)
- Studies by Ezzati and Kammen of 55 rural Kenyan households showed a concave curve increasing with exposure to indoor concentration of particulates, transition to charcoal reduced the incidence by up to 65%
- Cleaner cooking fuels offer the potential for even greater reductions
- Gas-burning stoves, produces 50 times fewer pollutants
- Several other diseases are attributed to smoke
  - Chronic bronchitis, emphysema and chronic obstructive pulmonary disease.
- Relation with asthma remains controversial

Sustainability

- Collecting fuelwood is affected by deforestation and forest degradation that increase distances that must be travelled to obtain sufficient supply.
- Fuelwood collection in remote and politically unstable areas poses significant safety risks to women and children.
- The amount of time spent and distance travelled in the collection of fuelwood vary between regions.

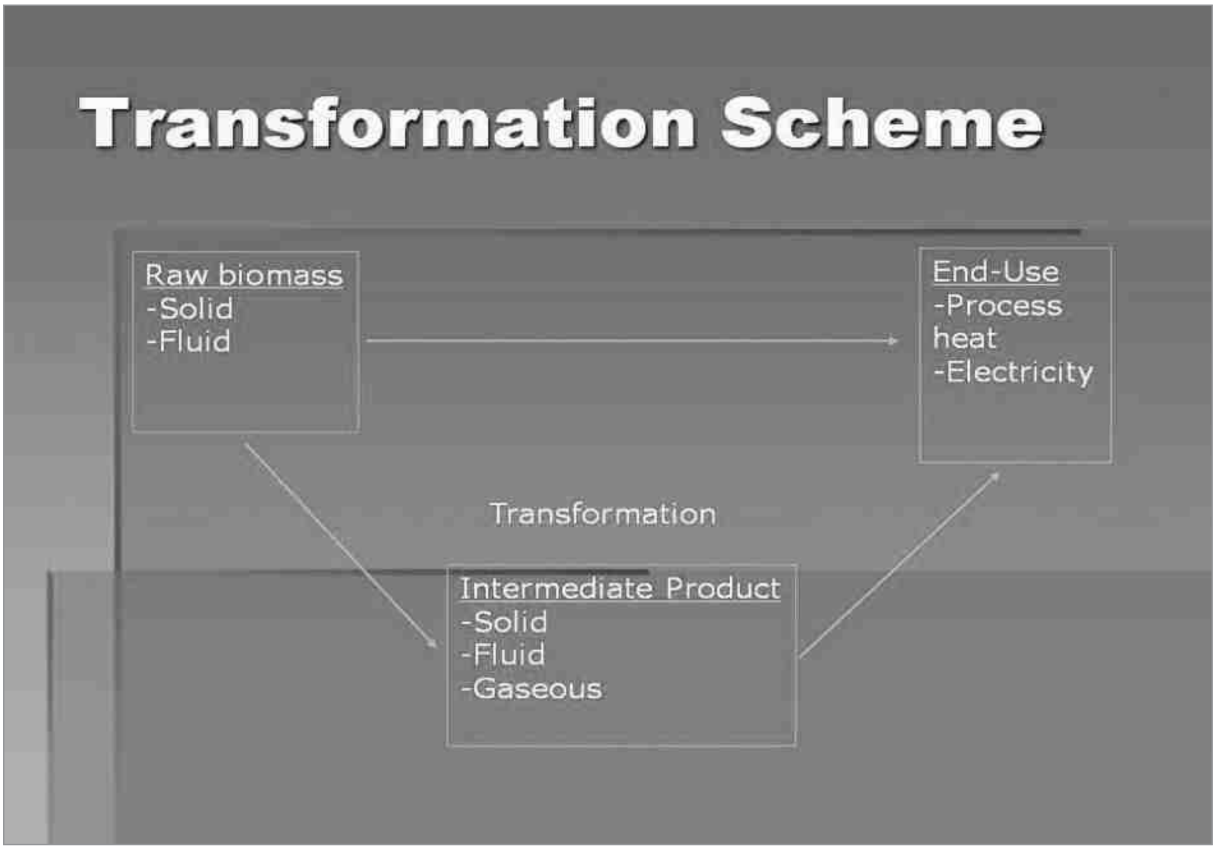
Sustainability

- The unsustainable extraction of woodfuel, may lead to forest degradation and permanent loss of biodiversity.
- Products of incomplete combustion (PICs) have much higher global-warming potentials (GWP) than CO2.
- According to IPCC (2007), the 100-year GWPs of methane and nitrous oxide are 25 and 298 times that of carbon, respectively.
- Because of incomplete combustion of woodfuels, between 10 and 20 % of carbon released is in the form of PICs (Smith *et al*., 2000b).
- Molar ratio of PIC emitted to total carbon emitted is defined as the k-factor of a fuel; it varies according to technology used to burn the fuel.
- Alternative cooking fuels typically have much lower k-factors than woodfuel.

K-factors for cooking fuels

Fuel	K-factor
Woodfuel	0.1–0.2
Kerosene (wick stove)	0.051
Kerosene (pressure stove)	0.022
LPG	0.0231
Biogas	0.00562

Source: Smith *et al*., 2000


Transformation Scheme
Raw biomass
-Solid
-Fluid
End-Use
-Process heat
-Electricity
Transformation
Intermediate Product
-Solid
-Fluid
-Gaseous


Transformation
From raw form into end-product
Added-value justifies the transformation costs
Trees into firewood
Firewood into charcoal
Residues into chips, briquettes, pellets, or charcoal briquettes
Seeds into bio-oil
Dung into methane
Solid biomass into producer gas or into pyrolysis oil

Transformation economy

	€/ton	€/ GJ
firewood	30	1.9
charcoal	100	3.3
briquettes	75	3.8
petroleum	600	17.1
LPG	1200	28.6

Markets exist, from €10-100 million per country

Biofuels production

- Conditions for Production of biofuels:
  - Availability and condition of biomass
  - Markets (volumes, prices)
  - Economic and political conditions
  - Reliable local partner(s)
  - Investment climate

End Use Applications

- Cooking
  - Houses
  - Institutions
  - Restaurants
- Heating
  - Space heating
  - Process heat
- Power production
  - Stand-alone
  - Grid supply

Advanced biofuels

- Advanced biofuels are biofuels with high production potential, less significant lifecycle GHG emission and minimum competition for agricultural land.
- Competitive in terms of cost with conventional fossil fuels – e.g. as ethanol from sugar cane in Brazil is now.
- Advanced biofuels may be produced from waste, agricultural (food crops) residues, (ligno) cellulosic biomass, crops grown on marginal land and algae.

Advanced bioethanol

- Key difference between first and advanced generations of bioethanol is feedstock:
  - first generation is based on sugar (sugarbeet, sugar cane) or starch (corn, wheat, sorghum) derived from foodcrops,
  - advanced generation biofuels are based on ligno-cellulosic materials such as agriculture and forest residues, industrial wastes, or dedicated crops.
- Crops include:
  - switch grass,
  - short rotation coppice or
  - new varieties of corn or sugar cane

Advanced biodiesel

- Conventional biodiesel is made by trans-esterification procedure.
- Hydrogenation novel processes are an alternative.
- Product is a high quality syndiesel from low quality feedstocks like tallow, used cooking oils and fats.
- Complete convertion of biomass (from crop residues or wood) into a "biodiesel" is the BTL (biomass to liquid) technology.
- Gasification or pyrolysis (chemical decomposition of organic materials by heating in absence of oxygen or any other reagents) is used to transform biomass into syngas (synthetic gas) and retransform it into diesel or gasoline.

World distribution

- http://biofuels.abc-energy.at/demoplants/projects/mapindex

Sustainability frameworks

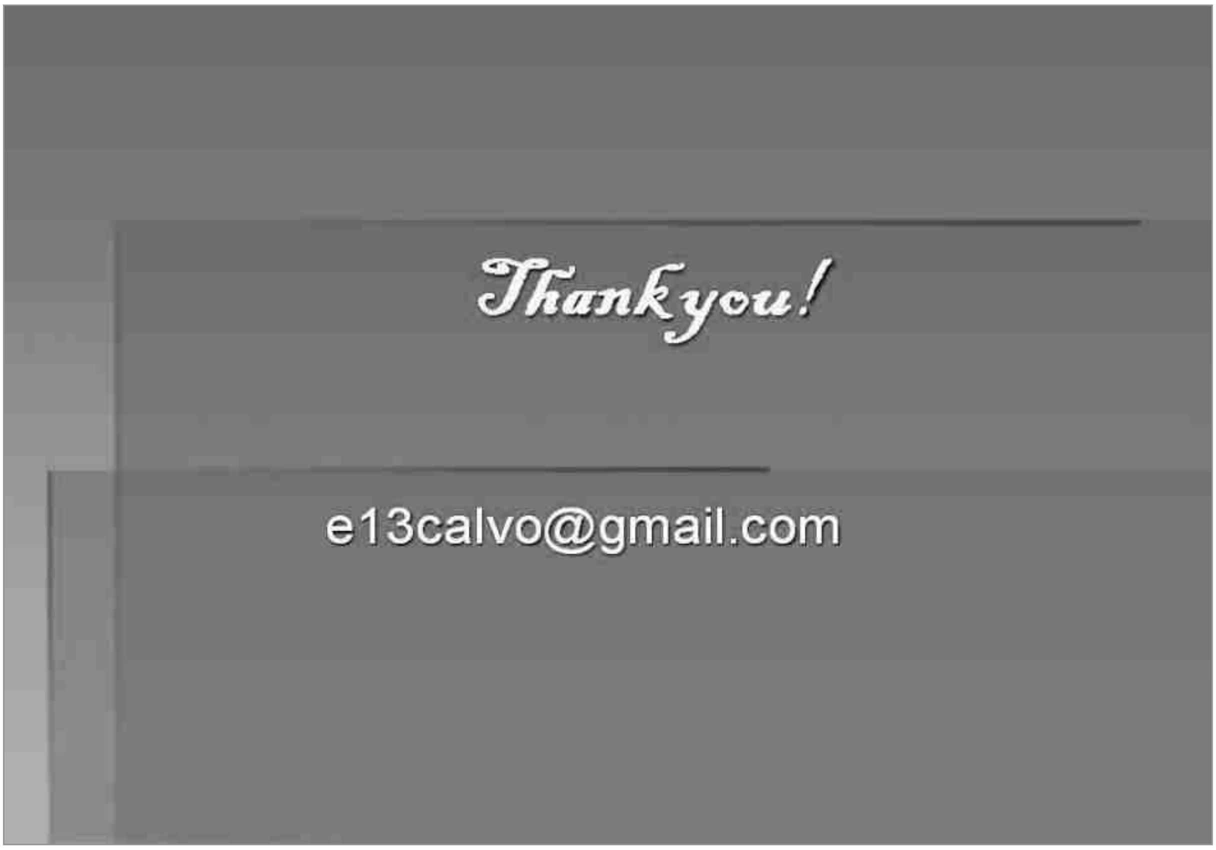
- Sustainability criteria and methodological frameworks for assessing GHG mitigation benefits of bioenergy include:
- Global Bioenergy Partnership (GBEP from the G8+5),
- IEA Bioenergy Agreement,
- International Bioenergy Platform at the Food and Agriculture Organization (FAO),
- OECD Roundtable on Sustainable Development,
- European Committee for Standardization and
- International Organization for Standardization (ISO).

Impact assesment

- The development of impact assessment frameworks and sustainability criteria involves significant challenges in relation to methodology, process development and harmonization.
- As of a 2010 review, nearly 70 ongoing certification initiatives exist to safeguard the sustainability of agricultureand forestry products, including those used as feedstock for the production of bioenergy (van Dam et al., 2010).

Requirements

- For an efficient certification system there is a need for:
  - further harmonization,
  - availability of reliable data,
  - linking indicators at micro, meso and macro levels.


Thank you!
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Closing

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Greenhouse Gas Inventory & Research Center of Korea, GIR

Closing

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M.A. in Economics (International Economics), Yonsei University

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2007~ 2010 Senior Research Fellow, Korea Energy Economics Institute, Division of Climate Change and Conservation
2006 ~ 2007 Visiting Scholar, Australian National University
2005 ~ 2006 Chief Advisor, Presidential Committee on Northeast Asian Cooperative Initiative
1996 ~ 1999 Research Economist, Department of Agricultural and Resource Economics
University of California, Berkeley

Recent Publications/Work

National & Sectoral GHG Reduction Target Setting, Climate Change Policy and Measure, National Energy Strategy and Policy, Energy Security Issues, Regional Energy cooperation, Cogeneration of Heat and Electricity, National Planning for Energy Efficiency Improvement
"A Probabilistic Approach to Optimal Orchard Management, Ecological Economics, 60(3), 483-6, January 2007. (with Amitrajeet A. Batabyal)
"Indivisibility and Divisibility in Land Development Over Time and Under Uncertainty," Journal of Environmental Management, 76: 185-190, 2005. (with Amitrajeet A. Batabyal)