CRDS-FY2008-WR-08

環境問題に関する国際ワークショップ「気候変動抑制に対する技術と大学の役割」報告書

平成20年12月2日開催

独立行政法人科学技術振興機構 研究開発戦略センター
Center for Research and Development Strategy Japan Science and Technology Agency

エグゼクティブ・サマリー

科学技術振興機構研究開発戦略センターは、スウェーデン国ルンド大学国際産業環境経済研究所（IIIEE）と共同して、国際ワークショップ「気候変動抑制に対する技術と大学の役割」を開催した。京都議定書に続く 13 年以降の温暖化防止の次期枠組みづくりに向けて、国連気候変動枠組み条約第 14 回締約国会議がポーランドのポズナニで開催される時期に、欧州において議論する機会を設けた。

いかに有効な技術を開発し、途上国に移転し、地球規模で普及させ、経済と社会の持続的発展を実現するのか。この重要な課題に対して技術と大学はどのような役割を果たすべきか、欧州や国連の取り組みとその成果が報告され、参加した研究者や学生の間で議論が行われた。

その結果、気候変動の抑制とそれへの適応に必要な 5 つのキーワード「IIIEE」が得られた。

Integrate
　産学官それぞれの主体が培った知識や技術を統合すること
Interact
　異なる研究分野、主体、地域、国家の間の交流・連携を促進すること
Innovate
　統合と交流・連携を通じて、新たな知識から新たな価値を創出すること
Ensure
　気候変動の抑制とそれへの適応に向けた具体的な行動を確実に推進すること
Enjoy
　気候変動の抑制とそれへの適応に向けた試みや努力を楽しむこと

また、気候変動問題の解決に向けて全世界で共有すべき 4 つの重要な指針「CRDS」が明らかになった。

Cooperation for adaptation to climate change
　気候変動への適応のための協力連携
Relations among developed and developing countries
　先進国と途上国との関係
Demand for a new type of civilization
　これまでとは異なる新たな文明・生活の要求
Strategy for global and local environments
　全地球的環境と地域環境に対する戦略

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1. 開催概要

1.1. 経　緯

科学技術振興機構（JST）は内閣府、日本学術会議、日本経済団体連合会等と連携して、グローバル・イノベーション・エコシステムに関する国際会議を 2006 年から 3 年間にわたり毎年開催した。過去 3 回の会議における議論を通じて、今後特に重点的に推進すべき課題として、（1）経済と技術の両面からのイノベーションの計測、（2）地球規模の環境問題の解決、が明らかになった。この 2 つの課題のうち、地球規模の環境問題の解決について、国連の気候変動枠組み条約締約国会議（COP14、ポーランド）の会期中に、会場である欧州において国際ワークショップ「気候変動抑制に対する技術と大学の役割」を開催した。

当初は、COP14 会場内で国立環境研究所および財団法人地球環境戦略研究機関と共催することを検討してきた。しかし、会場内での開催が困難であること等の理由により、ヨーロッパ内の大学において共同して開催することとした。また、国連大学スタッフに国際ワークショップへの参加と共に、COP14 への出席とレポートの作成を依頼し、その概要を把握することとした。

1.2. 趣　旨

気候変動による地球温暖化の抑制に向けて、省エネルギー技術をはじめとする技術に対する期待は大きい。いかに有効な技術を開発し、途上国に移転し、地球規模で普及させ、経済と社会の持続的発展を実現するのか。この重要な課題に対して技術と大学はどのような役割を果たすべきか、環境技術に優れた日本の研究開発戦略立案機関と地球温暖化抑制に関心の高い北欧を代表する研究機関との間で議論する。

1.3. 日時・場所

2008 年 12 月 2 日（火）8：45～17：00
ルンド大学国際産業環境経済研究所（IIIEE）Aula ホール
（スウェーデン国スコーネ県ルンド市）

2. 講演要旨および資料

2.1. Long Term Prospects of Mitigation Strategies for Global Climate Change: Technology Development and Role of Universities

スピーカー

安井　至（JST 研究開発戦略センター上席フェロー）

要　旨

2050 年までに地球全体で温室効果ガスの排出量を半減させるとの長期目標について、G8 洞爺湖サミットで一定程度の合意に達した。この目標を達成するには、先進国でのイノベーションと途上国への技術移転が必要である。しかし、技術にも発展の限界があり、人口問題や文化生活のあり方も考慮しなければならない。特に、二酸化炭素発生半減に向けたマインドセットや生活様式は大きな課題であり、西洋的発想を越えて、自律的な地域とそれを結ぶ情報網の構築等、あるべき社会の姿を検討すべきである。

資　料

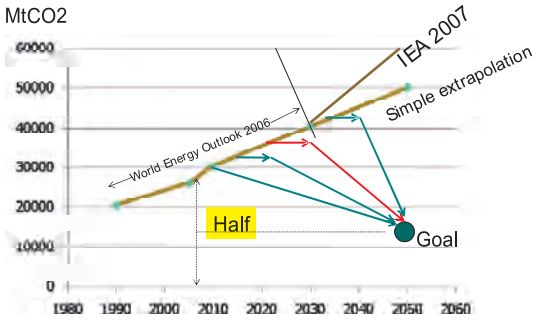
Continued

- Substantial progress toward such a long-term goal requires the acceleration of the deployment of existing technologies and will depend on the development and deployment of low-carbon technologies.

Fukuda Vision & Low Carbon Society Plan

- Long Term Plan = Halving GHG by 2050
- Medium Term Plan = to be announced
- Massive Introduction to Market
  - Photo Voltaic Cells / Fuel Cells
  - High Efficiency Coal Gasification Power Generation / Carbon Capture & Storage
  - Heat Pump with Higher Efficiency
- Low Carbon Partnership

Schematic Drawing up to 2050



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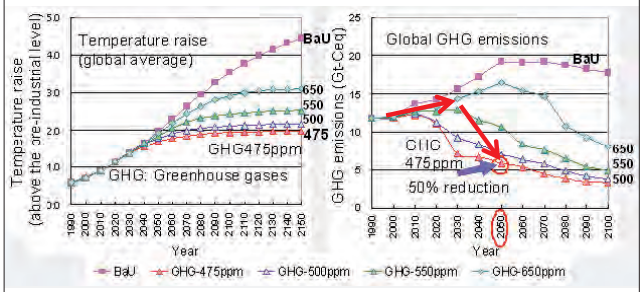
475ppm – 国環研によるシナリオ

475ppm GHG Scenario by NIES



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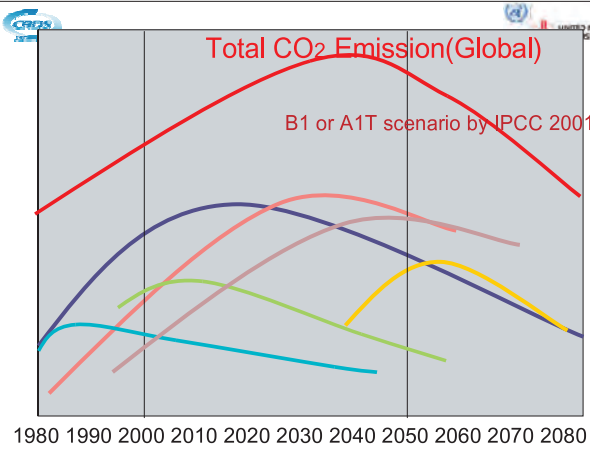
Total CO_2 Emission(Global)



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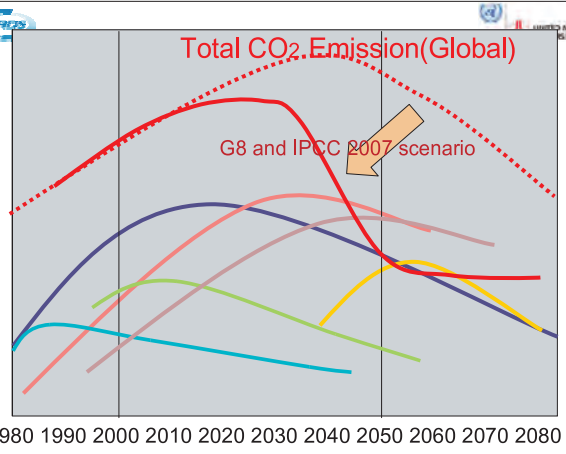
Total CO_2 Emission(Global)



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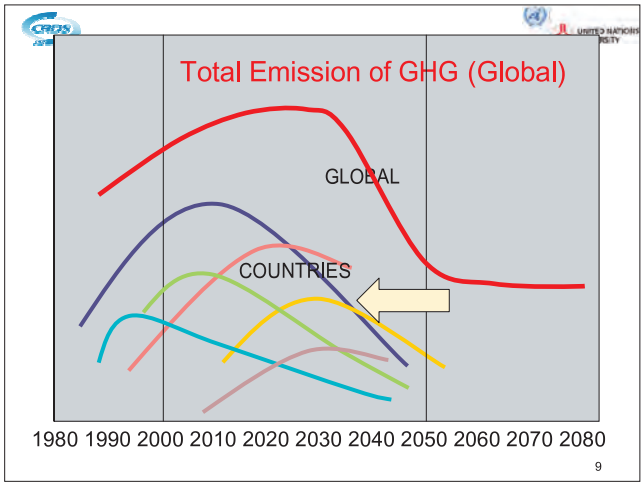
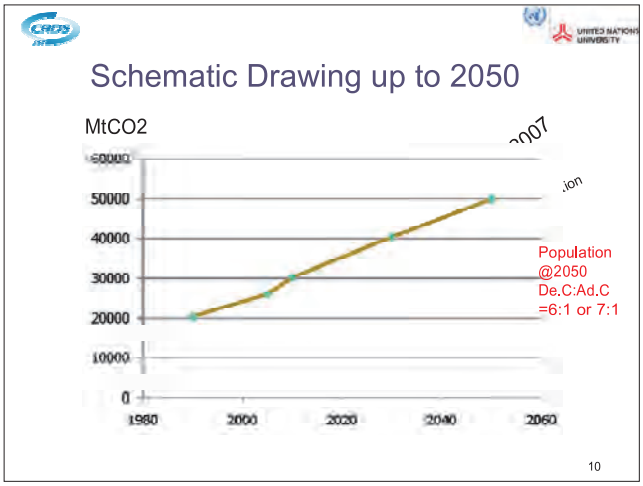
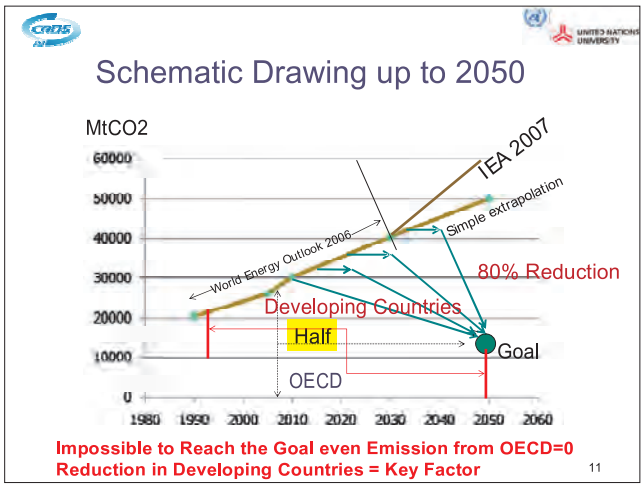
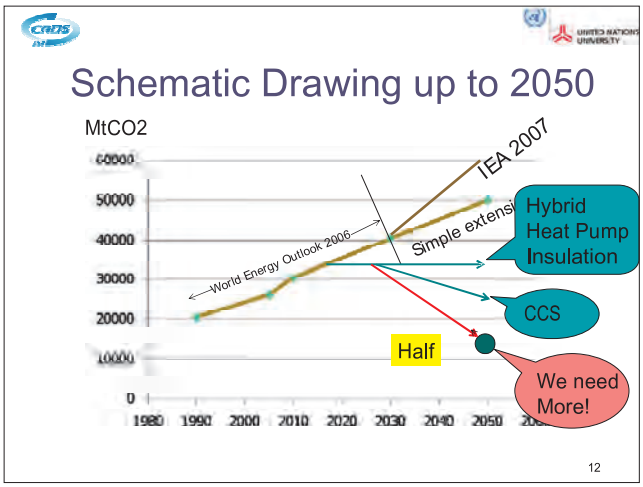
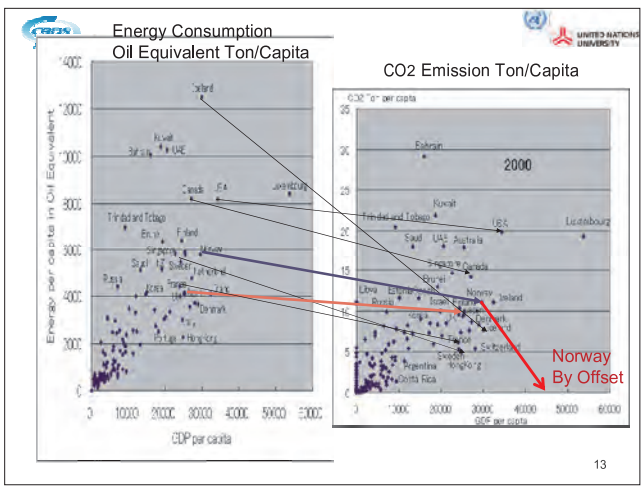

Total Emission of GHG (Global)
GLOBAL
COUNTRIES
1980 1990 2000 2010 2020 2030 2040 2050 2060 2070 2080
9


Schematic Drawing up to 2050
MtCO2
Population
@2050
De.C:Ad.C
=6:1 or 7:1
10


Schematic Drawing up to 2050
MtCO2
IEA 2007
Simple extrapolation
World Energy Outlook 2006
80% Reduction
Developing Countries
Half
Goal
OECD
Impossible to Reach the Goal even Emission from OECD=0
Reduction in Developing Countries = Key Factor
11


Schematic Drawing up to 2050
MtCO2
IEA 2007
World Energy Outlook 2006
Hybrid
Heat Pump
Insulation
CCS
Half
We need
More!
12


Energy Consumption
Oil Equivalent Ton/Capita
CO2 Emission Ton/Capita
2000
Norway
By Offset
13

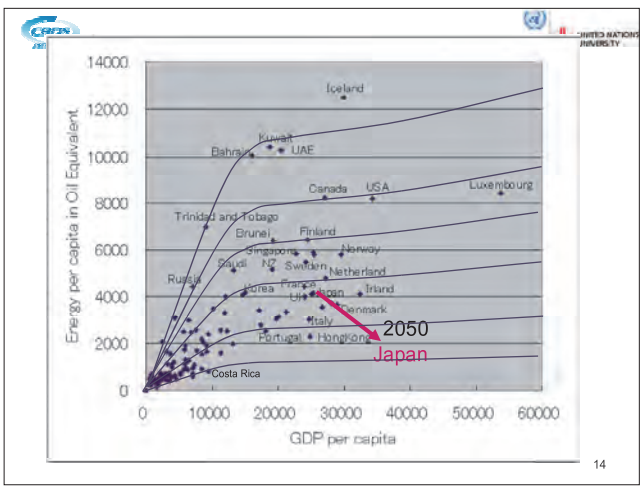
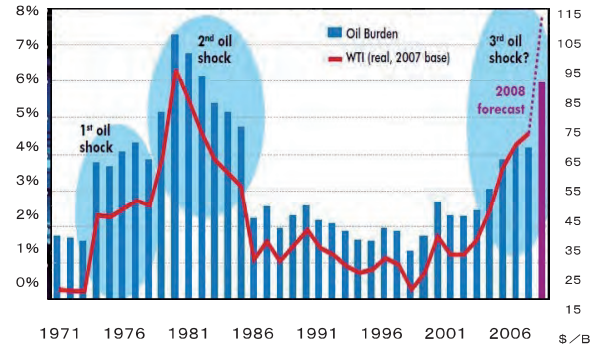

Energy per capita in Oil Equivalent
GDP per capita
2050
Japan
14

Fig. Oil Burden and Price of Oil by IEA 2008



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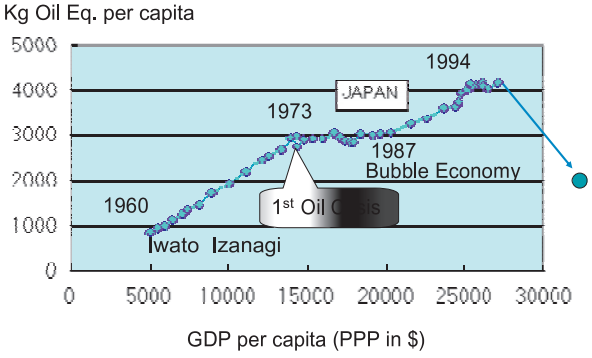

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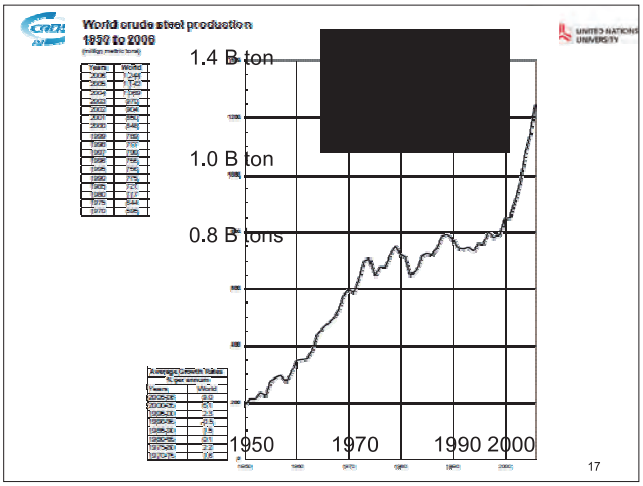

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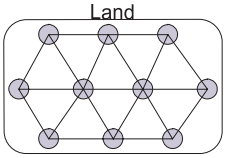
Western Civilization : Grid Type

- Electric Power Grid
- Express Way
- Bullet Train
- Sewage System



- Impossible to Realize this type of Development in Whole World.
- Too Expensive, Too Much Resources

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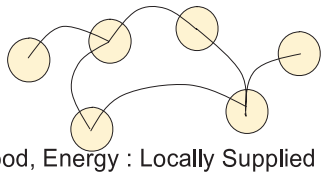
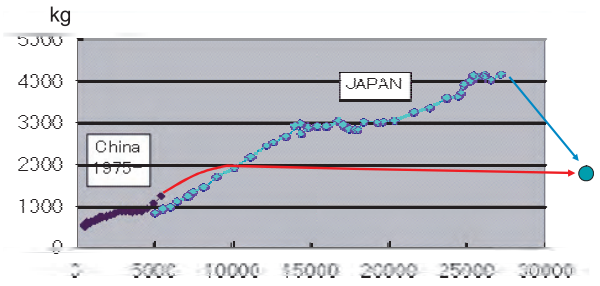
Alternative Type of Civilization ?

- Locally Self Sufficient but Connected by Information System



- Food, Energy : Locally Supplied
- Basic Generic Products such as Steel, Automobiles, Home Appliances : Transported by Railroad Freight Train

一人当たりのGDP(PPP)とエネルギー消費量(kgOE)
Provide "Tunneling Route to China, India etc."



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Herman Daly's Definition
Steady State Economics since 1970s

- Harvesting rates should not exceed regeneration rates.
- Waste emissions should not exceed the renewable assimilative capacity of the local environment.
- Nonrenewable resources should be depleted at a rate equal to the rate of creation of renewable substitutes.

Dilemma: Environment(Energy, CO_2, Pollution) and Economy(Population)

Trilemma: Environment(E., CO_2, P.), Economy(Pop) and Mineral Resources

Tetralemma: Environment(E., CO_2, P.), Economy(Pop), Mineral Resources and Water

Pentalemma: Environment(E., CO_2, P.), Economy(Pop), Mineral Resources, Water and Land Use(Renewable Resources)

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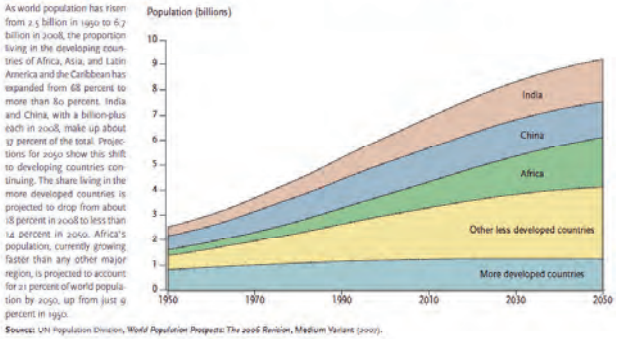
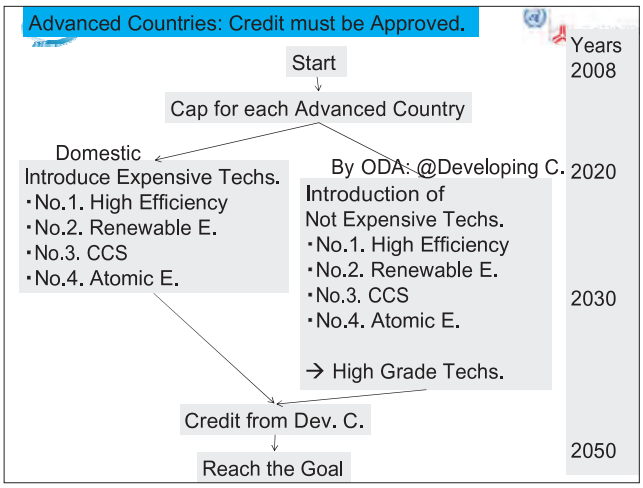
Conclusions

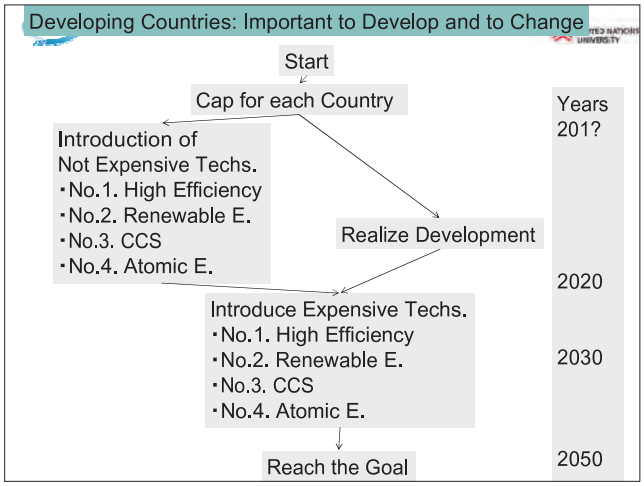
- Limitations = Already No-doubt
  - in Environment: Climate Change
  - in Resource: Mineral, Energy, Water, Land
- Key components: to be Lead by Academia
  - 1. Technology Development; Innovation
  - 2. Technology Transfer Scheme
  - 3. Creation of Different Civilizations other than Western Style ? = Mindset and Lifestyle?
- It's time to consider "ultimate sustainability".

Africa and Other Developing Regions Make Up an Increasing Share of World Population.



PRB's World Population Data Sheet 2008




Developing Countries: Important to Develop and to Change
Start
Cap for each Country
Years
201?
Introduction of
Not Expensive Techs.
・No.1. High Efficiency
・No.2. Renewable E.
・No.3. CCS
・No.4. Atomic E.
Realize Development
2020
Introduce Expensive Techs.
・No.1. High Efficiency
・No.2. Renewable E.
・No.3. CCS
・No.4. Atomic E.
2030
Reach the Goal
2050

2.2. Cost Reduction of Energy Efficiency Technologies and Challenges of Technology Transfer

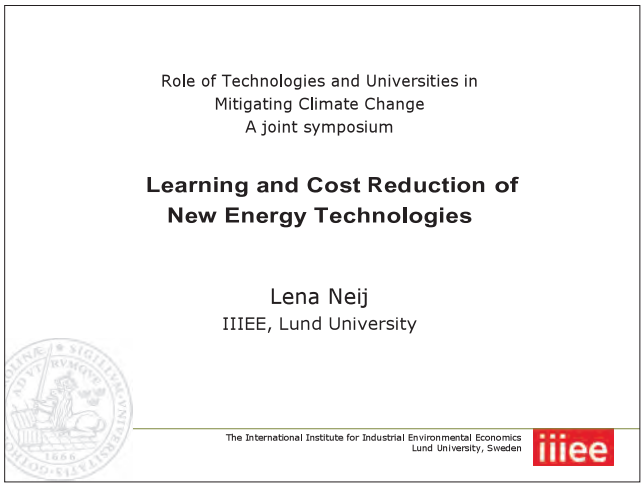
スピーカー

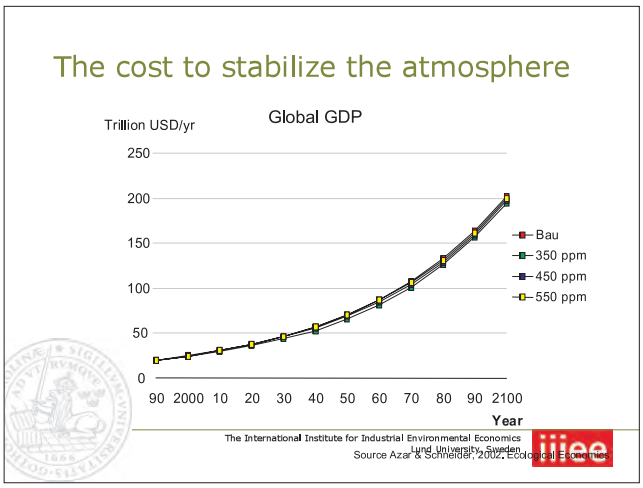
Lena Neij（IIIEE 教授）

要　旨

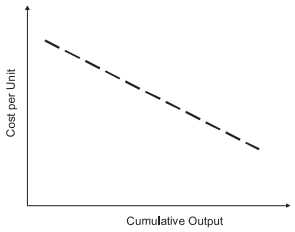
気候変動問題の解決に向けて、エネルギー代替技術への期待は大きいが、新しい技術の普及と活用においてはコスト削減が課題となる。コスト削減には、経験と学習が大きく寄与する。技術の開発や社会への実装を通じて自らが経験し学習した知識だけでなく、他の国や企業の経験からの学習もコストの削減を促し、価格低下を実現する。このような学習効果を最大化する投資や支援が必要である。

資　料



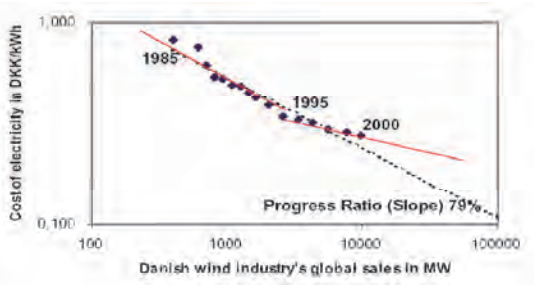


Learning curve /Experience curve

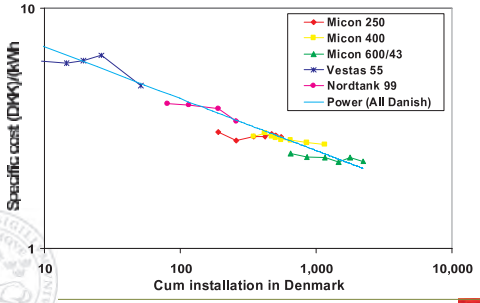


Experience curve for wind turbines in Denmark

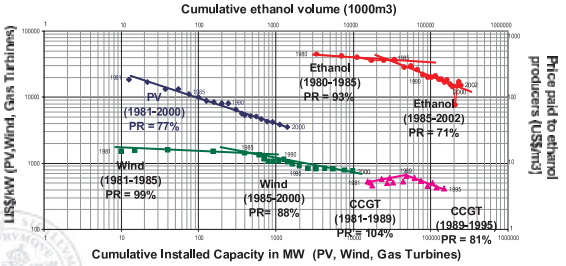
Progress ratio wind turbines: 0.8-0.9
Progress ratio wind generated electricity: <0.8



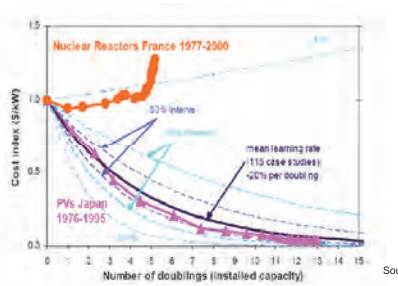
Cost reduction patterns for Danish wind turbines



Experience curves

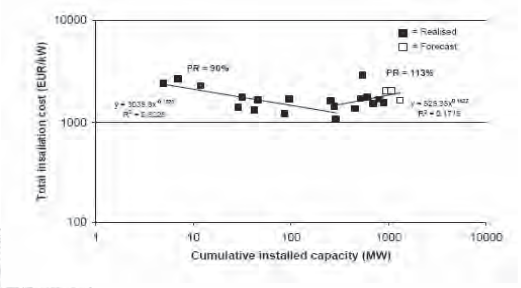


Cost development of nuclear 1977-2000



Source: (Grübler, 2005)

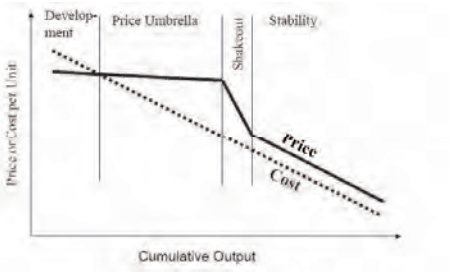
Cost development of offshore wind farms 1990-2006



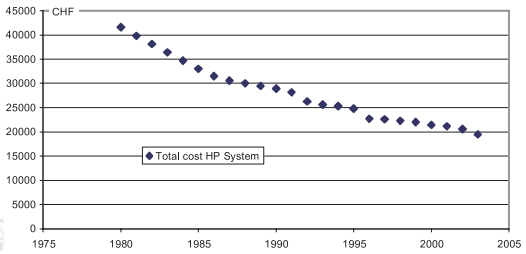
Source: (Isles, 2006)

The price-cost cycle

(Boston Consulting Group, 1968)

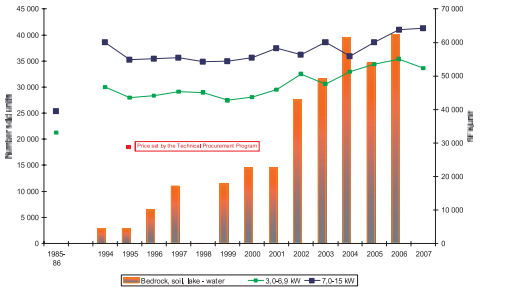


Cost development of heat pumps in Switzerland



Estimated total cost development of HP systems using vertical borehole as a heat source (example new single family house, including drilling and installation costs). Source: FWS (2008).

Cost development of heat pumps in Sweden



Source: (Kiss el al., 2008)

Learning also relates to implementation

Wind turbines

Technology cost 75%
System cost 25%

Solar cells

Technology cost 50%
System cost 50%

Alternative energy futures

- The introduction of new technology and systems does not have to cost more
- We need to invest in learning processes
  - Learning-by-searching
  - Learning-by-doing
  - Learning-by-using
  - Learning-by-interacting


Thank you!
Professor Lena Neij
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Fax: +46 46 222 02 30
E-mail: Lena.Neij@iiiee.lu.se
Homepage: http://www.iiiee.lu.se
The International Institute for Industrial Environmental Economics
Lund University, Sweden
iiiee

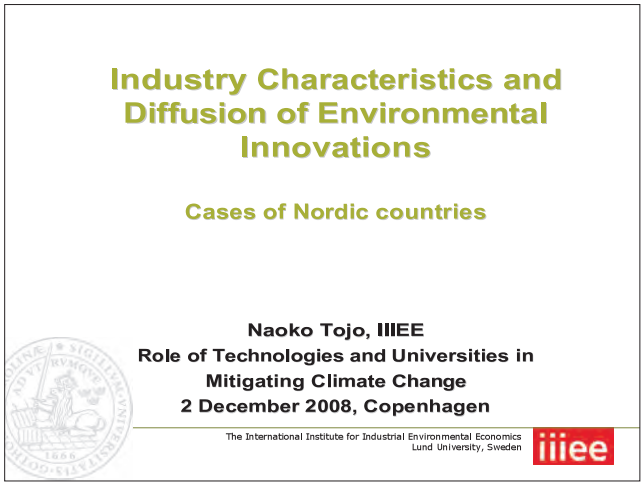
2.3. Industry Characteristics and Diffusion of Eco-innovation - Cases of Nordic Countries

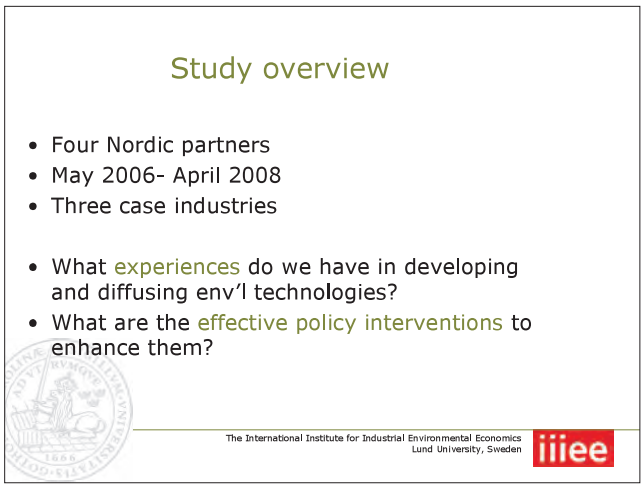
スピーカー
東條　なお子（IIIEE 准教授）

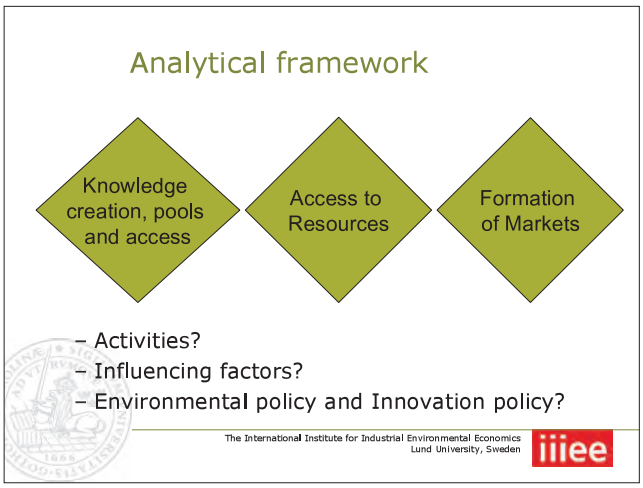
要　旨

北欧理事会が支援する環境技術の開発と普及の促進のための研究プロジェクトにおいて、建設、パルプ･製紙、携帯電話の 3 業種を対象にケーススタディを行った。知識創造、資源へのアクセス、市場形成の 3 つの観点から 3 業種を比較した結果、3 業種とも複数の組織から知識を獲得し、政府の介入がイノベーションに貢献している場合が認められた。業種ごとにイノベーションの現象と要因を観察し効果的な介入すべきポイントを把握することが重要である。

資　料







Case sectors

Mobile phones
Pulp and paper
Buildings

- Relevance to Nordic countries
- Availability of existing information
- Possibility of cross-sectoral comparison
- Coverage of various types of env'l technologies and innovations

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Lund University, Sweden

Sector innovation characteristics

	Buildings	Pulp & paper	Mobile phones
R&D expenditure	Low, but cluster	Low, but cluster	High
Type of innovation	Various	Primarily process	Primarily products
[illegible]	Complicated, long-life, knowledge lock-in	Simple but capital intensive, installation lock-in	Complicated, many components, rapid change
[illegible] relations	Wide range, project-based collaboration	Wide range, vertical integration	Globally spread supply chain
Relation w/ non-ind. Actors	Rather weak w/ R&D, lack of direct link w/ consumers	Close relation w/ public education & R&D	Cooperative w/ gov't, close relation with R&D

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Key findings: knowledge

Knowledge creation:
- Multi-disciplinary/cross-sectoral/ business-non-business collaborations

Knowledge pool & transfer:
- Vertical integration (P) vs. fragmented value chain (B, M)
- Broken knowledge loop (B)
  - Project-based industry
  - Economic down-cycle

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Key findings: resources

Financial resources
- Importance of public funding
  - Avoidance of installation capital lock-in (P) and knowledge capital lock-in (B)
- Industry-own resources (M)

Human resources
- Close tie with education (P, M)
- Economic down-cycle (B)

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Key findings: market

- Nature, users and scope of innovation
  - Closeness to core business
  - Number of users and information problems (B)
  - Necessity of systemic changes (B)
- Discrepancy between risk bearer and beneficiary (M, B)
- Influence of dominating actors (M)
- Demand on low cost

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Reflections on policy interventions (1)

- Important to know the industry!
  - Influential actors
  - Value-chain and nature
- Standards needed/helpful
  - In the fragmented value chain (facilitate communication: B)
  - To reduce uncertainty for new solutions (B, P)
  - When innovation is not core business interest
- Stringent regulation may facilitate activities in knowledge as well as commercialisation

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Reflections on policy interventions (2)

- Education is the key.
- Public funding criteria, a powerful tool for knowledge activities
  - Engagement of various actors/disciplines
  - Direction of innovation
- Timing of intervention
- Lack of demand
  - Information facility needed
  - Use of economic instruments

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iiiee

For more information…

www.norden.org/pub/sk/index.asp?subject=Milj%F8

2.4. Economic Growth, Energy Consumption and CO2 Emissions in Sweden 1800-2000

スピーカー

Astrid Kander（ルンド大学経済史学部准教授）

要　旨

技術の変化はエネルギー強度を削減する主因である。技術によるエネルギー効率の向上によって、経済発展とエネルギー消費のデカップリングが実現できる。経済の規模とエネルギー効率との関係を示すエネルギークズネッツカーブの成立には、産業構造の変化が関与しており、ICT の普及とサービス経済化の進展によってエネルギー消費量の削減は期待できる。また、エネルギー供給源の変化や温室効果ガス発生の主要因の時間的変化も考慮する必要がある。

資　料

Economic growth and energy in Sweden 1800-2000

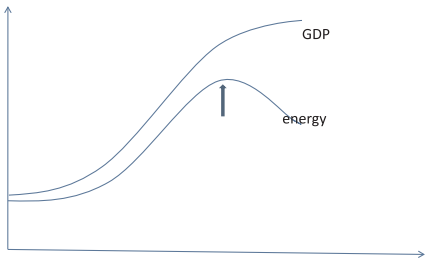
Astrid Kander

Department of Economic History and CIRCLE, Lund University

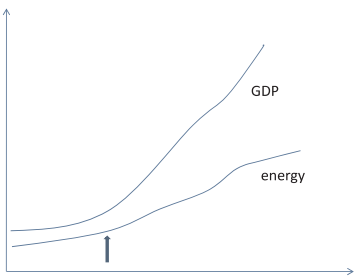
Does time matter?

- Medium or long time perspective– does it matter for decoupling?
- Decoupling: a pair drifts apart

Absolute decoupling



Relative decoupling



”Energy kuznets’ curve”: relative measures!

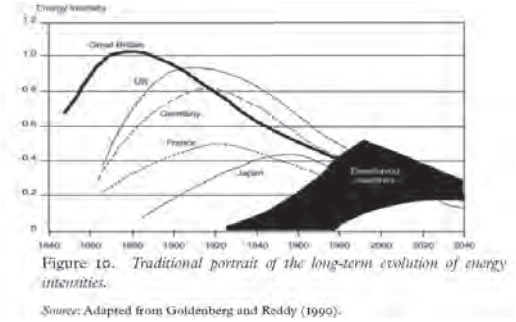


Figure 10. *Traditional portrait of the long-term evolution of energy intensities.*

Source: Adapted from Goldenberg and Reddy (1990).

Energy intensities in Sweden

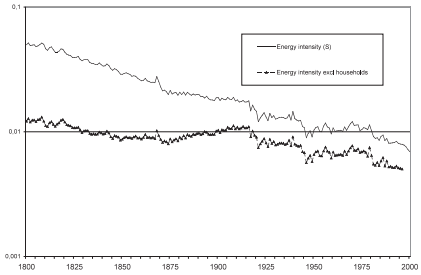
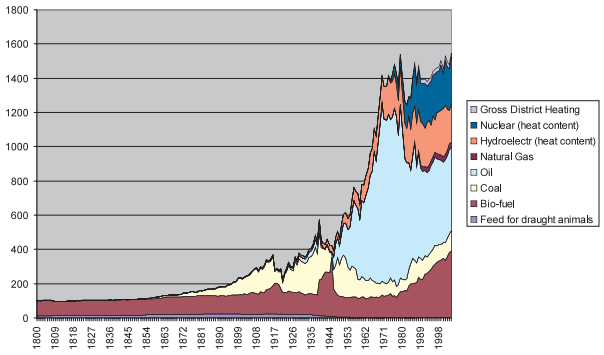
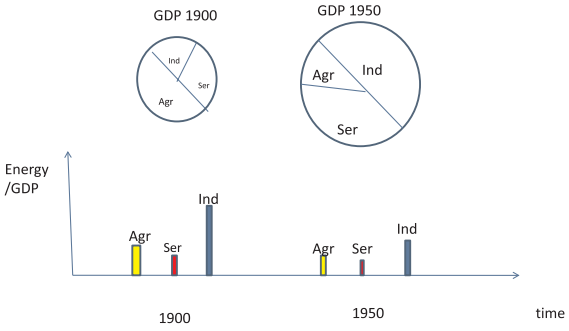


Figure 1: Swedish energy consumption 1800-2004, in PJ



Production structure, scale and technical change

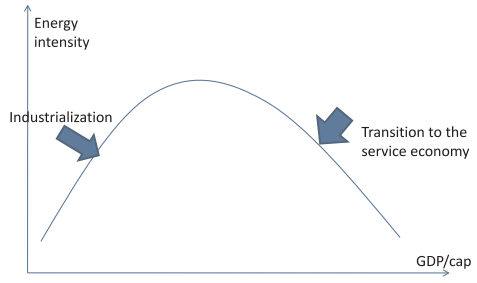


Decomposing energy intensity changes in Sweden: Production structural changes versus Technical change

Table 1. *Impacts of structural shifts and changes within sectors on the annual percentage change in energy intensity.*

	1800-1870	1870-1913	1913-1970	1970-1998
Annual change in energy intensity	-0.61	0.48	-0.74	-1.6
Of which changes within sectors:				
Agriculture	-0.28	-0.16	< 0.01	-0.02
Industry	-0.32	-0.41	-0.42	-1.1
Services	-0.02	-0.07	<0.01	-0.4
Transport	0.01	0.67	-0.86	-0.07
Structural shifts	<0.01	0.45	0.54	-0.02

The ”Energykuznets” curve and service economy



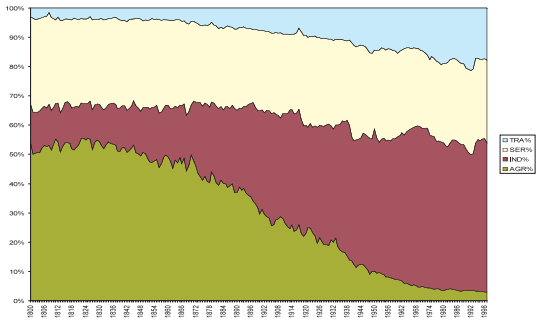
The service transition

*Employment shares increase for the service sector

*Share of GDP in current prices increases for the service sector, but this is largely a price dillusion (services become relatively more expensive)

* Best assessment is to look at sector shares in constant prices – that is as close to ”actual” physical production shares as we can get

Swedish sector shares (constant prices)



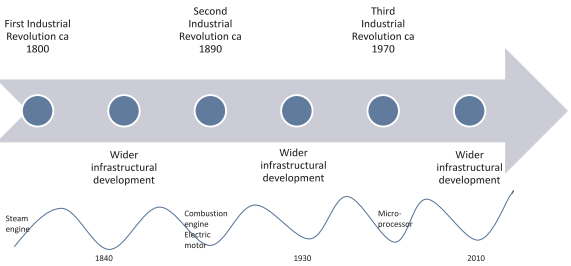
If not service transition then what?

- Importing more energy intensive goods from abroad?
- Third industrial revolution?

Foreign trade and energy intensity decline 1970-2000

	Net exported energy embodied in goods, PJ	Net exported energy as percentage of energy consumption in industry; %
1970	167	29.9
1987	173	35.5
2000	157	29.0

Development blocks and industrial revolutions



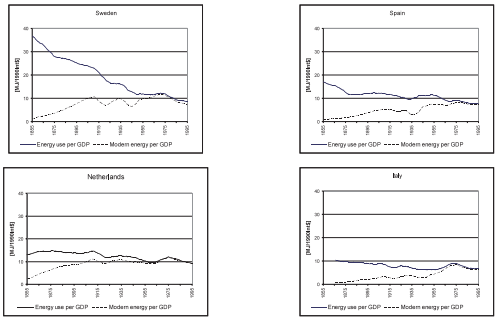
The third industrial revolution?

- IT and biotechnology expanding branches
- Microprocessors used in traditional industry
- Less energy requirements at the point of consumption for computors and cell phones than for cars and cooking/washing/cleaning machines

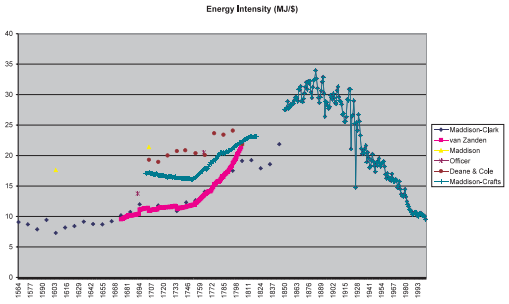
What will happen next?

- Wider infrastructural developments around ICT and more integration with other emerging technologies in for instance biotechnology, nano-technology, renewable energy and energy saving technologies.

Gales, Kander, Malanima, Rubio (2007)



Coal economies different



Source: Warde P (2007) Energy Consumption in England and Wales 1560-2004

CO2 and CO2/GDP Sweden

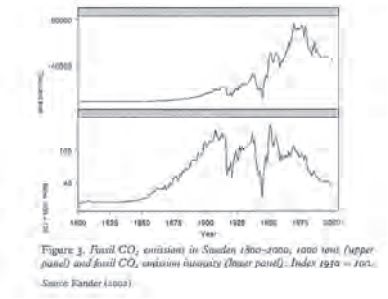


Figure 3. Fossil CO_2 emission in Sweden 1800–2000; 1000 tons (upper panel) and fossil CO_2 emission intensity (lower panel). Index 1950 = 100.

Source: Kander (2002)

Is it simply getting worse?

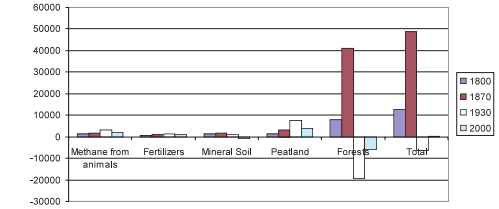
Agriculture and Swedish greenhouse gas emissions over 200 years

Kander, A (2007) EcHR

- Methane (CH_4) from domesticated animals
- Nitrous oxide (N_2O) from fertilisers
- Greenhouse gas emissions from agricultural peatlands
- Carbon dioxide (CO_2) from other agricultural land
- Carbon dioxide (CO_2) emissions from forestry (including draining of forest land)

Relative importance of emission factors

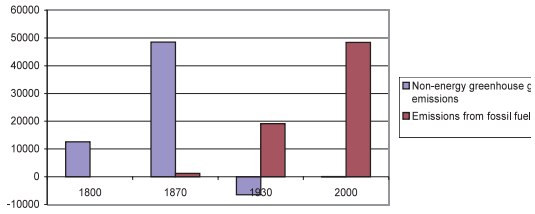
Figure 1: Net emissions of non-energy related greenhouse gases in agriculture with subsidiary activities 1800, 1870, 1930 and 2000, thousand tonnes of CO_2 equivalents



Comment: In 2000 the net total emission flow was only 83 thousand tonnes, and therefore not visible in the graph.

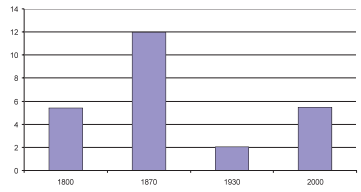
The N-curve

Figure 2: Non energy-related greenhouse gas emissions versus emissions from fossil fuels in the Swedish economy, in thousand of tonnes of CO_2 equivalents.



Per capita greenhouse gases

Figure 3: Total greenhouse gases per capita, tonnes of carbondioxide equivalents



2.5. Sustainable Buildings in Aqaba, Jordan

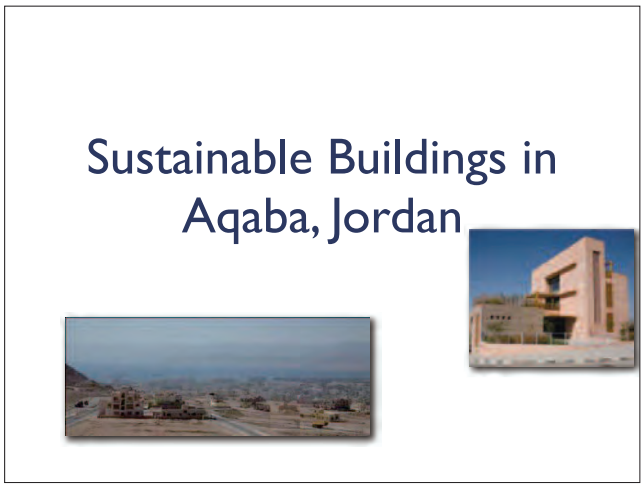
スピーカー

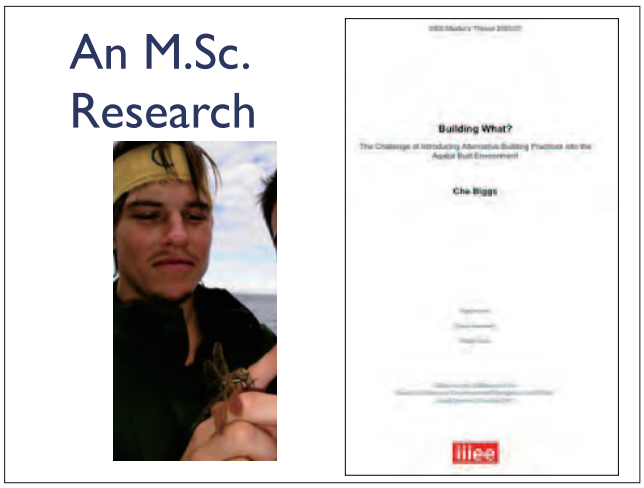
Murat Mirata（IIIIEE 研究員）

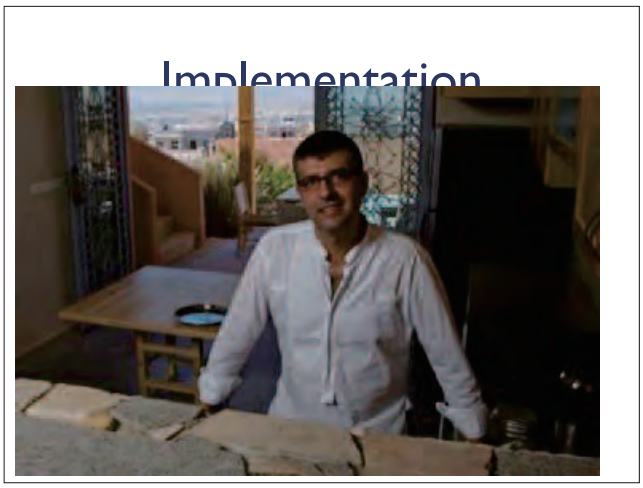
要　旨

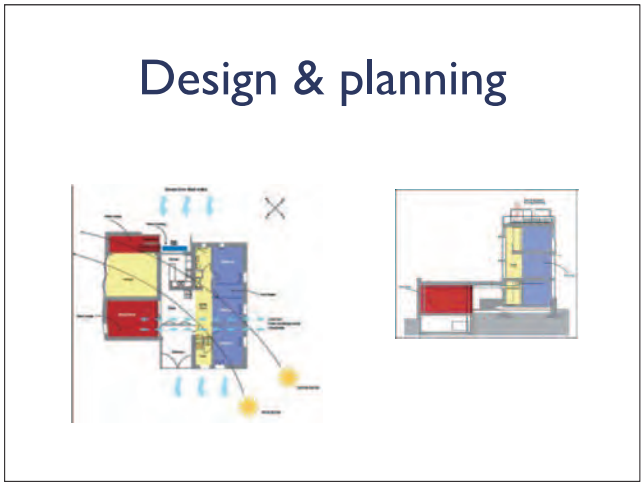
持続可能な建築に関するプロジェクトをヨルダン国アカバで実施した。先進国で得られた知識を途上国に根付かせるためには、現地の社会や文化の特性を理解し、また現地の人々に対して十分に説明し、様々な試みを行うこと必要である。プロジェクトを通じて積み重ねた努力と成果を紹介する。

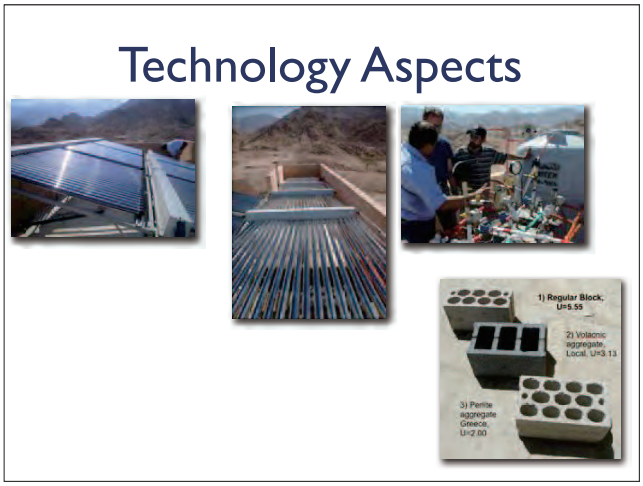
資　料





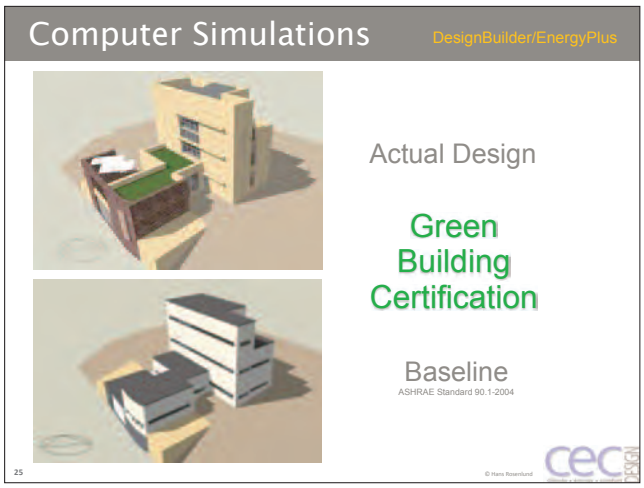


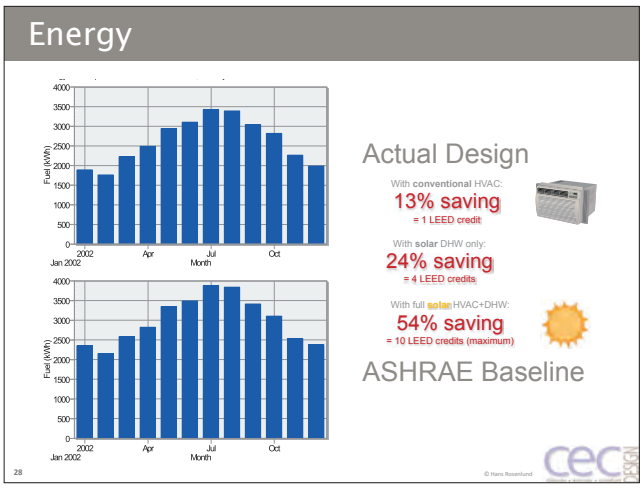

Design & planning


Technology Aspects
1) Regular Block, U=5.55
2) Volacnic aggregate, Local, U=3.13
3) Perlite aggregate Greece, U=2.80

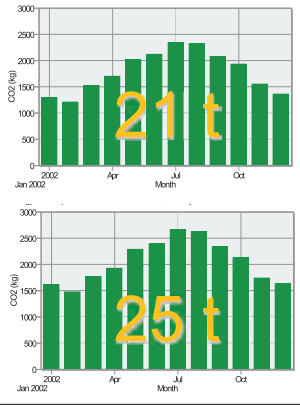

Technology Aspects
PHILIPS


Monitoring
Outdoor air
Data logger
Room air
Surfaces


Computer Simulations
DesignBuilder/EnergyPlus
Actual Design
Green Building Certification
Baseline
ASHRAE Standard 90.1-2004
25


Energy
Fuel (kWh)
Jan 2002
Apr
Jul
Oct
Month
Actual Design
With conventional HVAC:
13% saving
= 1 LEED credit
With solar DHW only:
24% saving
= 4 LEED credits
With full solar HVAC+DHW:
54% saving
= 10 LEED credits (maximum)
ASHRAE Baseline
28

CO_2 Emissions



Actual Design

With **conventional** HVAC:
13% saving
= 1 LEED credit

ASHRAE Baseline

29

© Hans Rosenlund

Things have gone fundamentally wrong

What is "not so right?"

- Quality: a subordinate to cost;
- Increasing concentration of power & production;
- Loss of flexibility;
- Loss of economic & cultural diversity;
- Distancing production & consumption;
- Ever increasing movement of goods;

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New principles guiding development

- Re-distribution part of the production to the regions in the form of small scale, flexible production units;
- Concentrate on adding value to local resources
- Gain currency by satisfying needs in novel ways.
- Strengthen ties between products, production, & local quality of life.
- Establish a renewed balance between:
  - Large- and small-scale production.
  - Resource flows within and across regional boundaries

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Rethinking…

- Industrial structure and scale;
- Better profit from flexibility, speed and creativity;
- Economies of scale by networking smaller units;
- Bringing sustainability closer to the individual – quality of life and place

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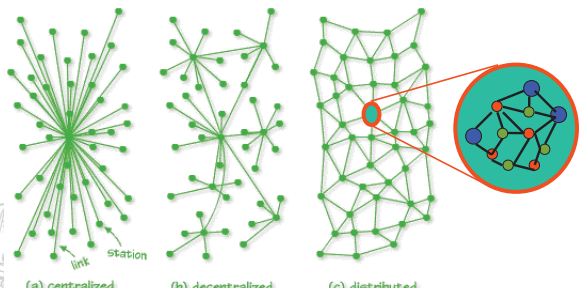
Distributed Systems



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Technology - one of the key enablers

- Energy availability and efficiency
- ICT
- Minuaturisation

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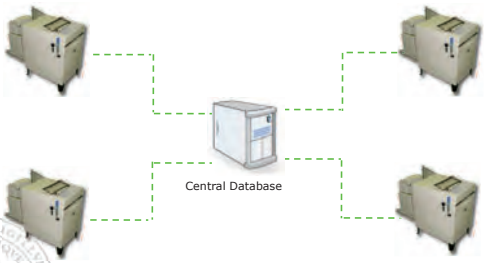
Distributed production



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The Espresso Book Machine

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Distributed precision manufacturing

- Fab-labs.

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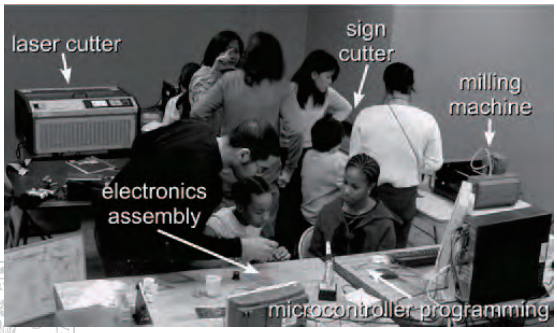

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Shrinking size & miniaturisation

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Electric Arc Furnaces

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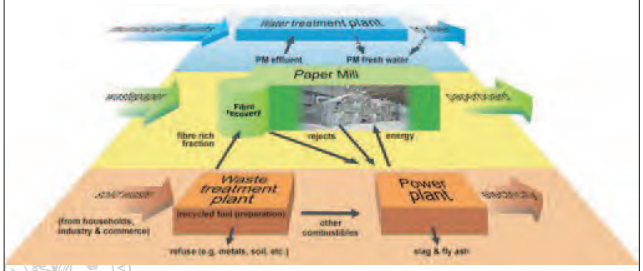
Urban Paper Mills



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Mobile plants






Sanitary material


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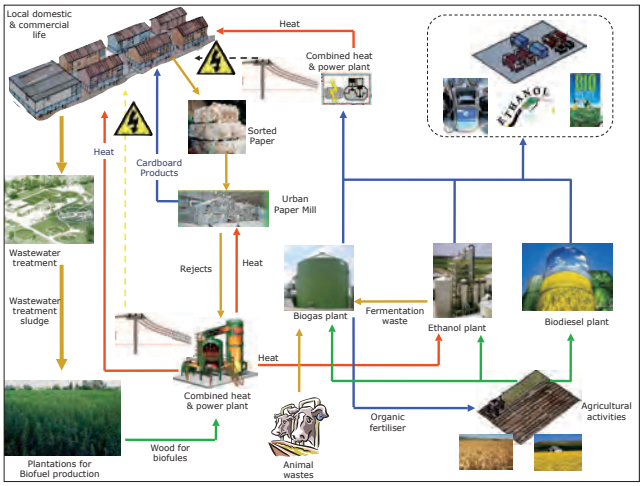

Energy Systems

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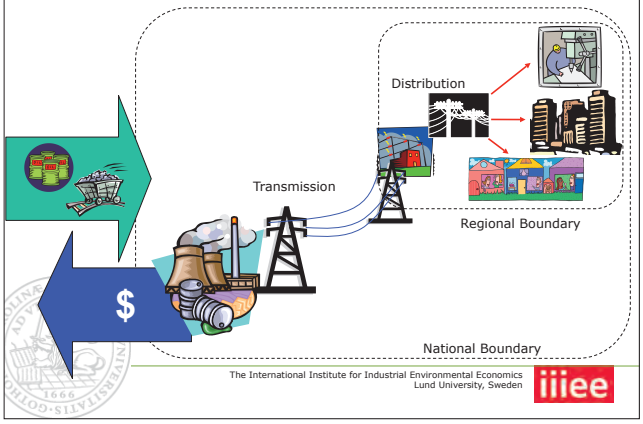
Conventional Energy Systems



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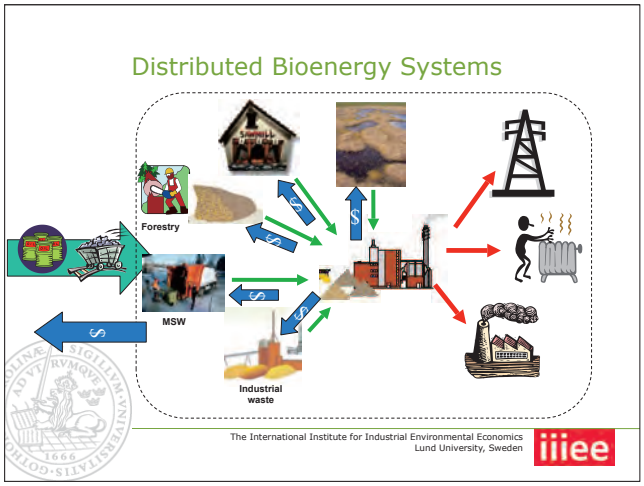
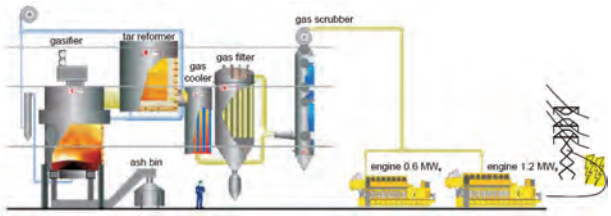


Background:

- VTT Finland: efficient wood gasifier "Novacat", suitable for small scale CHP
- Local change agent: perceived a potential, weak local understanding & capacity
- IIIEE: shared professor w.VTT, experience in local interaction & initial feasibility studies

Novacat

~ 1 MW electricity
~ 3 MW thermal heat



The Novacat gasifier

- Considered suitable:
  - Lots of residual low-quality wood
  - Agricultural changes
  - High price for electricity and natural gas
  - Small-size operation
- But:
  - Local resistance (perceived as waste incinerator)
  - Not common practice

What IIIEE did:

- Feasibility studies for:
  - 4 municipal applications
  - 1 major herbal product company
  - 1 major integrated farm
- Socio-economic studies:
  - Mapping capacity & partners
  - Local policy-makers and influential parties
- Introduced additional bio-energy solutions
- Concluded:
  - Good potentials and economy

What the Change Agent did:

- Initiated an Italian agent for "Novacat"
- Established bio-energy networks of municipalities, local businesses, co-operatives & large farms, etc.
- Capacity building: local bio-energy education, connecting relevant universities
- Outreach activities to politicians and interest groups

What happened:

- Raised awareness in the region
- Overcome the mental resistance
- Fueled interest in the diffusion of technology in Italy

Difficulties

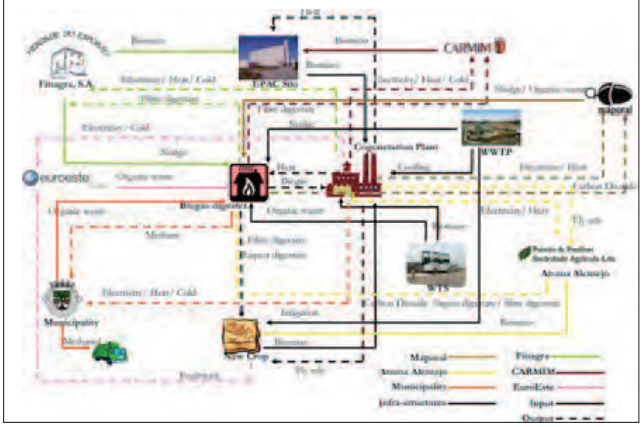
- Reconstruction of the Finnish innovation company (lack of financial resources)
- All arrangement for the Novacat gasifier in Italy postponed/stalled/ruined
- Economic recession in Italy: investments on hold
- Yet: not the end of the story…to be continued.

Bioenergy inReguengos de Monsaraz, Portugal

A rural, agricultural region

M.Sc. Thesis

- Concentrating on interorganisational cooperation for effective bio-energy development



Results

- A local consortia if formed
- In the process of sourcing a biomass gasifier and a CHP plant;
- Increasing the parter base of the project
  - Improving both technical and economic feasibility.

2.6. Swedish Experience of Biogas as a Vehicle Fuel

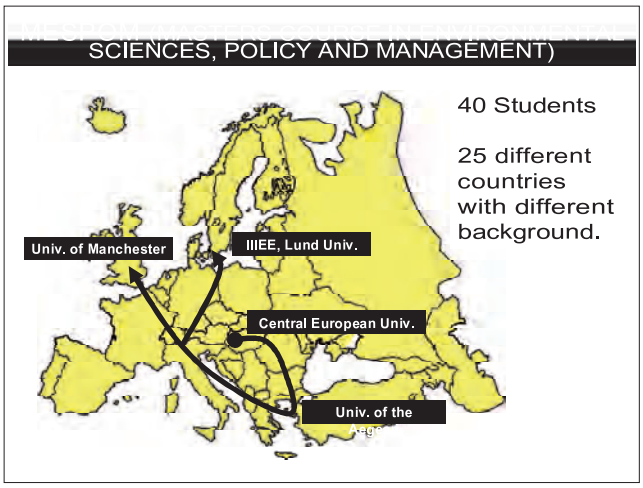
スピーカー

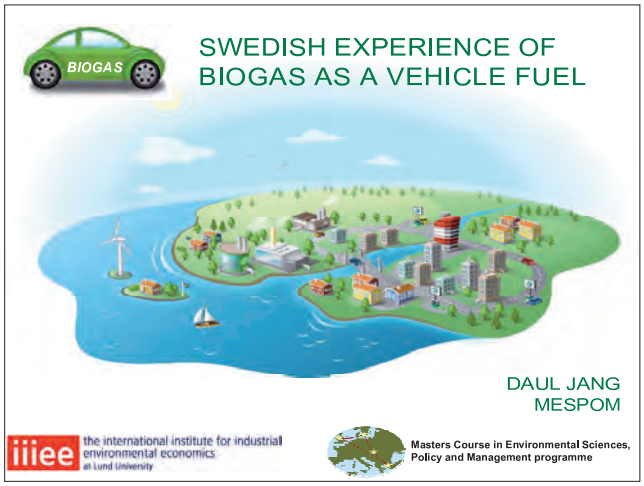
Jaehyun Jang（IIIEE 研究員）

要　旨

スウェーデンではバイオガスが輸送用機器燃料として広く普及し活用されている。それには、バイオガスの原料が豊富であることや規制・税制等による政策誘導等が寄与している。韓国でもバイオガスの導入への期待が高まっており、最適な環境を整備できれば普及する可能性がある。

資　料



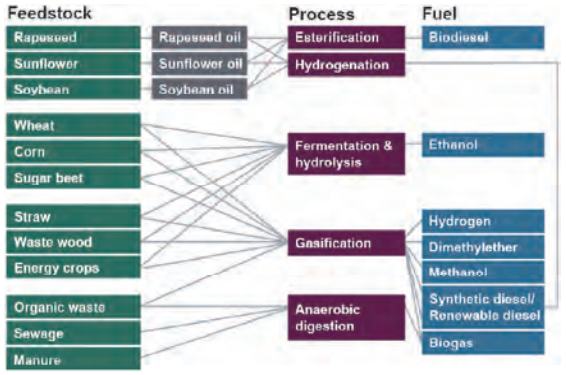


WHAT IS BIOGAS?

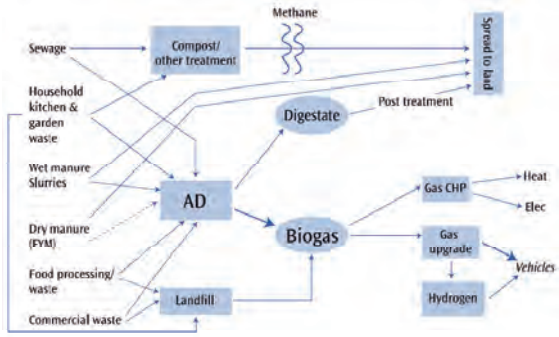
Biogas typically refers to a gas produced by the **biological breakdown of organic matter** in an **anaerobic environment**

Biogas is typically composed of **55–70 % methane**, **30–45 % carbon dioxide** and various other gases (hydrogen sulfide, ammonia, etc)

BIOFUELS PRODUCTION PATHWAYS

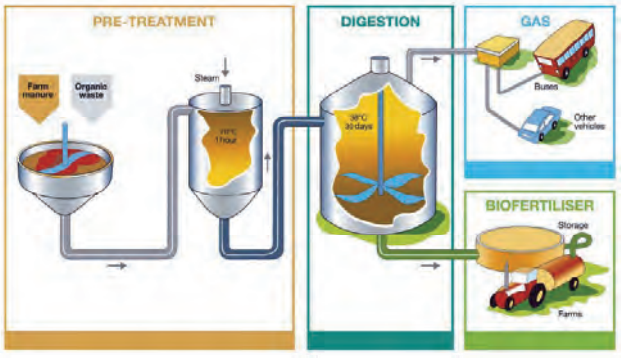


BIOGAS ROUTE MAP



Source: NSCA. (2006). Biogas as a road transport fuel

BIOGAS PRODUCTION PROCESS



Source: Sven-Göran Sjöholm, Swedish Biogas International

PRODUCTION & USE OF BIOGAS IN SWEDEN (2005)

Biogas plants	Number	Energy in biogas (TWh/year)
Municipal sewage treatment plants	139	0.56
Landfills	70	0.46
Industrial wastewater	4	0.09
Co-digestion plants	13	0.16
Farm plants	7	0.01
Sum	233	1.3 TWh

Source: Swedish Energy Agency, Produktion och användning av biogas år 2005 (Production and use of biogas in 2005); ER 2007:05.

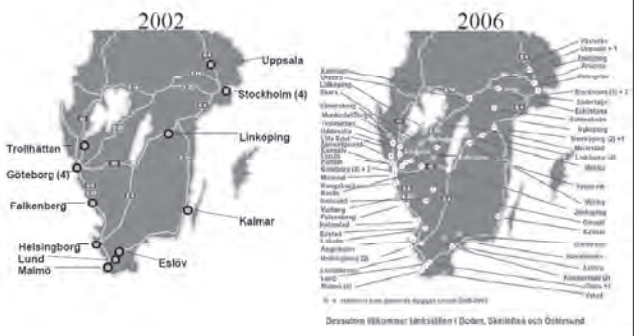
UPGRADING PLANTS IN SWEDEN

Water scrubber	
- recirculating	14
- simple	6
PSA	8
Selexol	1
Chemical absorption	2
	31

The first upgrading plant was built in 1992

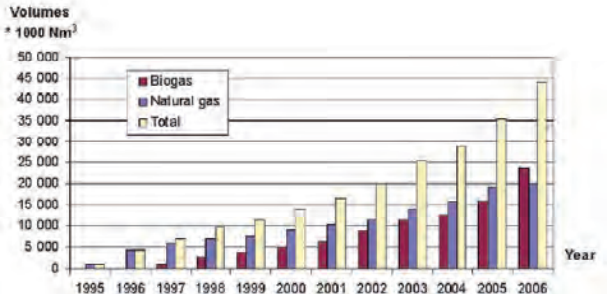
SGC

BIOGAS MARKET DEVELOPMENT



Source: Swedish Energy Agency, Produktion och användning av biogas år 2005 (Production and use of biogas in 2005); ER 2007:05.

DELIVERED VOLUMES OF GAS FOR VEHICLES



Source: Swedish Gas Association, 2007

POTENTIAL BIOGAS PRODUCTION

Substrate	Potential biogas production (TWh/year)
Cultivated crops	7.2
Manure	2.6
Tops, rejected potatoes	0.92
Chaff, husks	0.06
Food wastes from households, restaurants and shops	0.94
Garden wastes	0.23
Park wastes	0.24
Sludge from sewage treatment plants	0.97
Sludge from septic tanks	0.03
Pulp and paper industry	0.09
Other industries	0.82
Sum	14 TWh

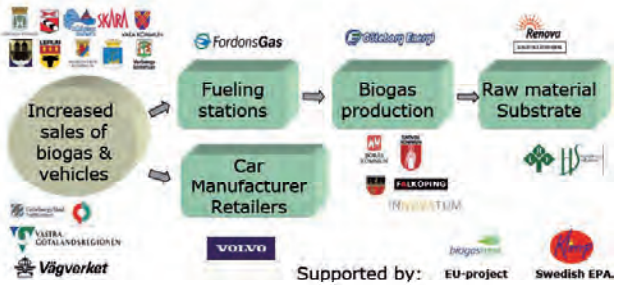
Source: M. Linné, O. Jönsson, Sammanställning och analys av potentialen för produktion av förnyelsebar metan (biogas och SNG) i Sverige (Summary and analysis of the potential production of renewable methane (biogas and SNG)) BioMil, Swedish Gas Centre, 2004.

In 2008, the Associations for Gas, Waste Management and Water recalculated previous estimates of the potential for biogas from waste.

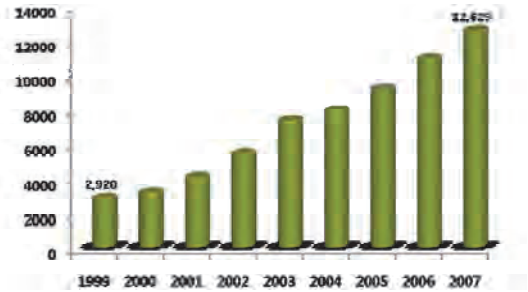
- From waste is 10,6 TWh
- From forestry waste is estimated at 59 TWh.

total energy for road transport in Sweden(100

BIOGAS WEST IN GÖTEBORG

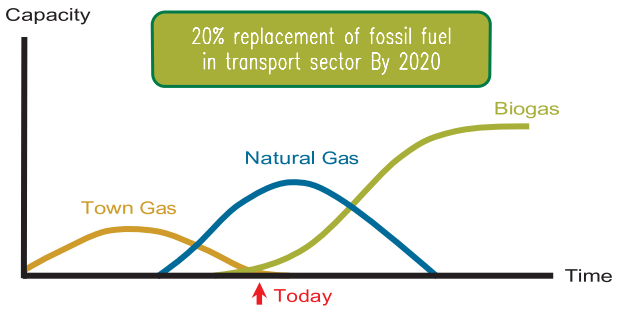


USE OF NGVS IN GÖTEBORG



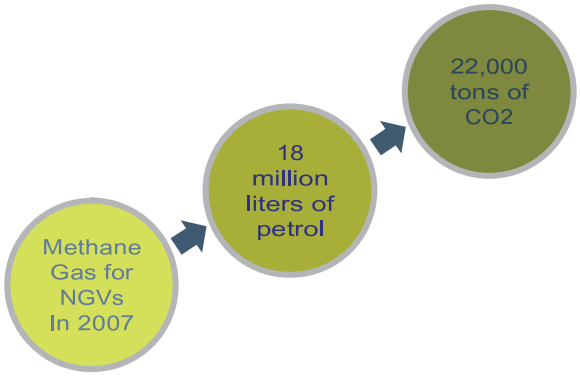
Data Source: Eric Zinn, Göteborg Energi

GÖTEBORG'S VISION FOR BIOGAS



Source: Eric Zinn, Göteborg Energi

GHGS EMISSION REDUCTION FROM BIOGAS USE



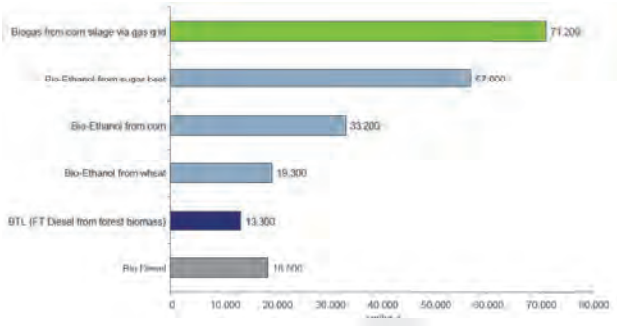
DRIVING FORCES

1) A surplus of gas from existing biogas plants
2) A low electricity price

1) Zero taxes on biofuels and lower taxes on CNG
2) Increased prices for petrol and diesel
3) State subsidies for vehicles, fuelling stations production plants
4) Reduction of income tax for company car users (40%)
5) Free parking and no congestion charges
6) Governmental organizations - 75 % clean vehicles
7) Municipalities change policies for fleets

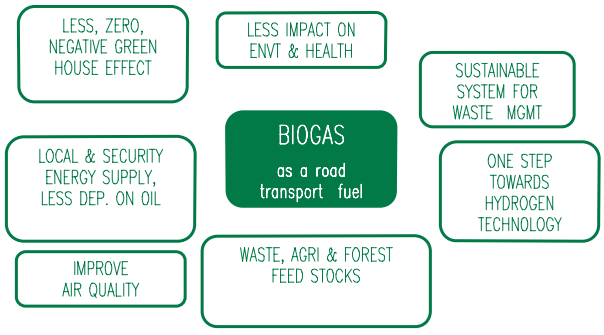
BIOGAS: BEST ENERGY EFFICIENCY FROM BIOMASS

How many km will a car run with the fuel produced on 1 ha?



Source: Österreichische Energieagentur, October 2006

ADVANTAGES OF BIOGAS AS A VEHICLE FUEL



CONCLUSION

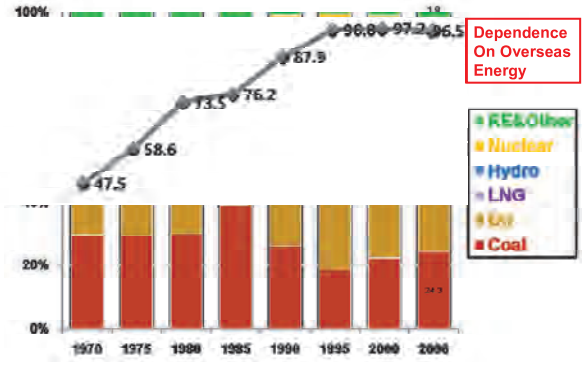
- Sweden is in the forefront of upgrading biogas to use as a vehicle fuel and the conditions for technology export are good (SBI from Linkoping → Michigan and CA in the US, S. Korea).

- Biogas will most likely be an important part of the transfer to a sustainable energy system in Sweden.

5.3 MILLION NGVS IN 2006

BIOGAS AS A VEHICLE FUEL IN SOUTH KOREA

COMPOSITION OF PRIMARY ENERGY IN S. KOREA (From 1970 to 2006)



Source: Korea Energy Economics Institute(KEEI), Major Energy Indicators, Composition of Primary Energy, http://211.35.39.27/keei/stat/statview.nsf/EnsearchStat?CreateDocument

REFINERY CAPACITY, NET EXPORTERS AND NET IMPORTERS OF OIL*

Source: Key World Energy Statistics 2007, IEA

Crude Distillation Capacity	kb/cd	% of World total
United States	17 287	20.1
Former USSR	7 740	9.0
Peoples Rep. of China**	7 200	8.4
Japan	4 670	5.4
India	2 980	3.5
Germany	2 430	2.8
Italy	2 320	2.7
Saudi Arabia	2 100	2.4
Canada	2 020	2.3
Rest of the World	31 765	10.1
World	86 092	100.0

2006 data

Net Exporters	Mt
Saudi Arabia	424
Russia	335
Islamic Rep. of Iran	140
Venezuela	131
Norway	124
Nigeria	115
Kuwait	114
United Arab Emirates	102
Mexico	88
Algeria	75
Rest of the World	576

2005 data

Net importers	Mt
United States	624
Japan	253
Peoples Rep. of China	142
Germany	120
France	94
India	90
Italy	80
Spain	00
Netherlands	48
Rest of the World	588

2005 data

*Crude oil and petroleum products.
**Does not include unlisted small teapot refineries which are estimated at between 200 and 500 kb/cd (1000 barrels per calendar day).

TOP 10 COUNTRIES WITH HIGH CO2 EMISSIONS (FROM THE CONSUMPTION AND FLARING OF FOSSIL FUELS)

	1990				2005						
Country	Total	PC CO_2	GDP PC	WR	% of world	Total	T △ 90-05	PC CO_2	PC △ 90-05	GDP PC	GDP△ 90-05
US	5002	20.0	28263	1	21.1%	5957	19%	20.1	1%	37267	32%
CHINA	2241	2.0	1625	2	18.9%	5323	137%	4.1	105%	6012	270%
RUSSIA	2044	13.8	10270	3	6.0%	1696	-17%	11.9	-14%	9648	-6%
JAPAN	1009	8.2	23691	4	4.4%	1230	22%	9.6	17%	27817	17%
INDIA	575	0.7	1655	5	4.1%	1166	103%	1.1	57%	3072	86%
GERMANY	924	11.6	21303	6	3.0%	844	-9%	10.2	-12%	26210	23%
CANADA	469	16.9	22833	7	2.2%	631	35%	19.2	14%	29693	30%
UK	599	10.4	21605	8	2.0%	577	-4%	9.5	-9%	29571	37%
S. KOREA	241	5.6	9814	9	1.8%	500	107%	10.3	84%	19598	100%
ITALY	413	7.3	21701	10	1.7%	467	13%	8.0	10%	25381	17%

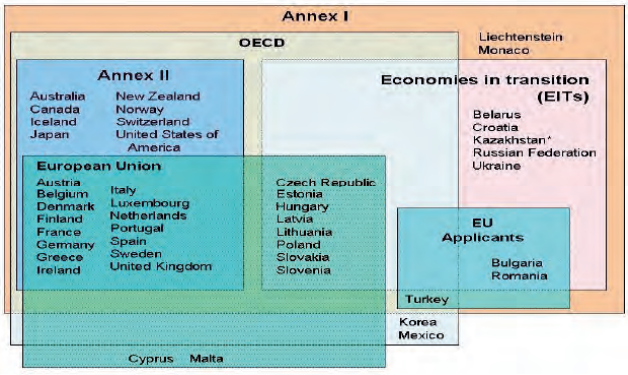
1) Total - million metric tons, Per Capita(PC) - metric tons (Data Source: Energy Information Administration in the US)
2) GDP PPP per capita, Constant 2000 International US$ (Data Source: World Bank)
3) Highlighted countries: Annex I Parties, Non-highlighted countries: Non-Annex I Parties
4) Russian and German figures of CO_2 emission in 1990 are from 1992(RU) and 1991(GE) figures respectively.

By Daul, MESPOM

ENERGY INDICATORS IN SELECTED COUNTRIES

	TPES/ Pop (toe/ capita)	TPES/ GDP (toe/ 000 2000$)	TPES/ GDP(PPP) (toe/ 000 2000$ PPP)	Elec.Cons./ Pop (kWh/ capita)	CO2/ TPES (tCO2/ toe)	CO2/ Pop (tCO2/ capita)	CO2/ GDP (kg CO2/ 2000$)	CO2/ GDP(PPP) (kg CO2/ 2000$ PPP)
WORLD	1.78	0.32	0.21	2596	2.37	4.22	0.75	0.50
OECD	4.74	0.20	0.18	8365	2.33	11.02	0.45	0.43
Korea	4.43	0.34	0.22	7779	2.10	9.30	0.70	0.47
Japan	4.15	0.11	0.15	8233	2.29	9.50	0.24	0.35
US	7.89	0.21	0.21	13640	2.49	19.61	0.53	0.53
Canada	8.43	0.33	0.27	17307	2.02	17.00	0.67	0.55
Australia	5.96	0.26	0.20	11439	3.09	18.41	0.80	0.61
New Zealand	4.12	0.27	0.18	9733	2.06	8.51	0.56	0.37
Austria	4.17	0.16	0.14	7889	2.25	9.38	0.37	0.31
Belgium	5.41	0.23	0.19	8515	1.97	10.67	0.45	0.38
Denmark	3.62	0.11	0.12	6659	2.42	8.77	0.28	0.29
Finland	6.67	0.25	0.23	16123	1.59	10.56	0.40	0.36
France	4.40	0.19	0.16	7707	1.41	6.19	0.27	0.23
Germany	4.18	0.18	0.16	7111	2.36	9.87	0.41	0.37
Greece	2.79	0.17	0.11	5242	3.09	8.62	0.53	0.34
Italy	3.16	0.16	0.12	5676	2.45	7.76	0.40	0.30
Netherlands	5.02	0.20	0.17	6989	2.24	11.21	0.45	0.38
Norway	6.95	0.17	0.18	25145	1.15	8.01	0.20	0.21
Portugal	2.58	0.23	0.14	4663	2.32	5.97	0.54	0.32
Spain	3.35	0.21	0.15	6147	2.35	7.87	0.50	0.34
Sweden	5.78	0.19	0.19	15430	0.98	5.64	0.19	0.19
Switzerland	3.62	0.10	0.12	8235	1.66	6.00	0.17	0.19
UK	3.88	0.14	0.14	6254	2.27	8.80	0.33	0.31

POSITION OF S. KOREA IN THE KYOTO PROTOCOL



Source: Zsuzsanna Ivanyi, The Regional Environmental Center

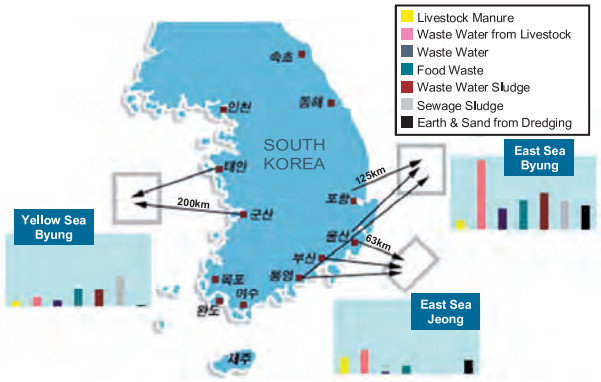
INTERESTING COMPARISON

INTERESTING COMPARISON

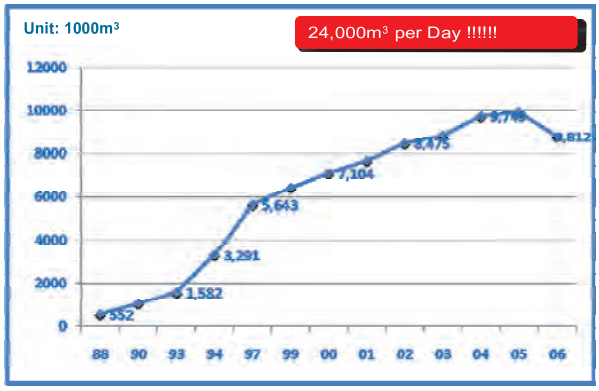
OCEAN DUMPING IN S. KOREA

- Started in 1988
  .to protect rivers and the coast &
  to decrease the burden of waste mgmt
  in land.
- Amount increased 10 times
  100 M m^3(1990) → 993 M m^3(2005)
- High level of heavy metals & 2003 scandal
- London protocol put into force in 2006
- 2 to 10 times cheaper than WM in land
- will be prohibited by 2012

OCEAN DUMPING IN S. KOREA



OCEAN DUMPING IN ROK = ANNUAL DUMPED AMOUNT OF WASTE



FAVORABLE CONDITIONS

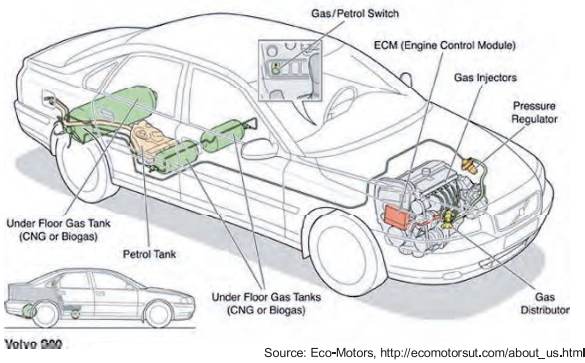
- High Energy Dependency → Energy Security
- Ocean dumping
- One of strategies to meet the Post-Kyoto Mechanism
- Decentralization & Local development
- CDM opportunities
- Alternative to declining agriculture industry
- Existing national NG grid
- Car manufacturing ability
- A great amount of food waste, WW, livestock waste
- Positive experience from CNG buses
- Increasing interests in municipalities
- National Plan toward Green Economy
- Bus-centered transportation system
- Strike of freight truck drivers in summer

ARE THERE NGVS AVAILABLE?

Light duties	Passenger cars	Busses
		
15 models from :	15 models in Europe from:	Models from:
Iveco FIAT Ford Mercedes VW	Citroën FIAT Ford Mercedes Opel Peugeot Volvo Cars VW	Ekobus Irisbus Iveco MAN Mercedes Volvo

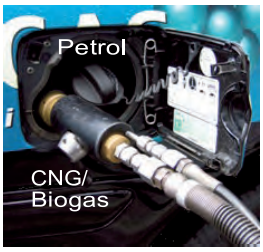
Source: Sven-Göran Sjöholm, Swedish Biogas International

BI-FUEL SYSTEM (CNG/BIOGAS-PETROL)



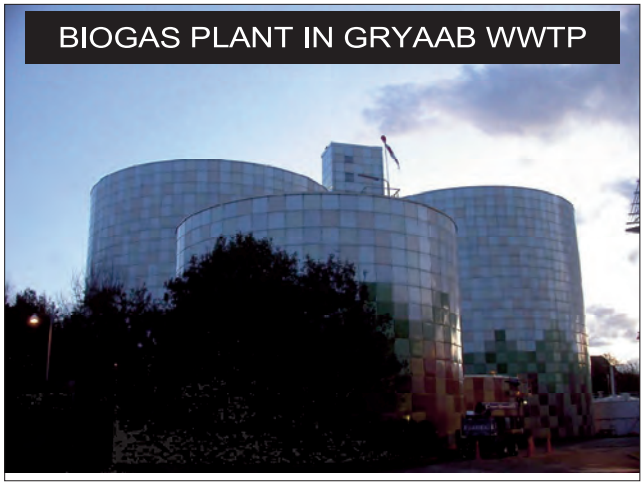
Source: Eco-Motors, http://ecomotorsut.com/about_us.html

HOW TO FILL A BIOGAS CAR



Source: Sven-Göran Sjöholm, Swedish Biogas International

BIOGAS PLANT IN GRYAAB WWTP



A FUELLING STATION


A NG/BIOGAS COMPRESSOR
STÄNG AV MOTORN UNDER TANKNING
36.73
Kronor
3.37
Volym Nm³
10.90
Kr / Nm³
1 Nm³ GAS MOTSVARAR ca 1,25 LITER BENSIN
Jämförpris
9,20
/liter bensin


NGVS IN GÖTEBORG
NATURGASBIL


NGV DRIVER
GFD 193
V70


NG/BIOGAS TAXI
Miljötaxi


NG/BIOGAS GARBAGE TRUCK
NATURGASBIL
447
VOLVO
GYP 223
FLG
INTERCOOLER


BIOGAS TRAIN IN LINKOPING
Biogas-ren drivkraft


BIOGAS PLANT LINKOPING


BIOGAS DIGESTER IN LINKOPING


BIOGAS GARBAGE TRUCK IN LINKOPING


BIOGAS BUS IN LINKOPING


FUELLING STATION FOR BUS IN LINKOPING


THANK YOU
Any Questions and Comments?
jangjaehyun@gmail.com

2.7. GIES - Global Innovation EcoSystem: A Proposal of A Framework for Technology Transfer

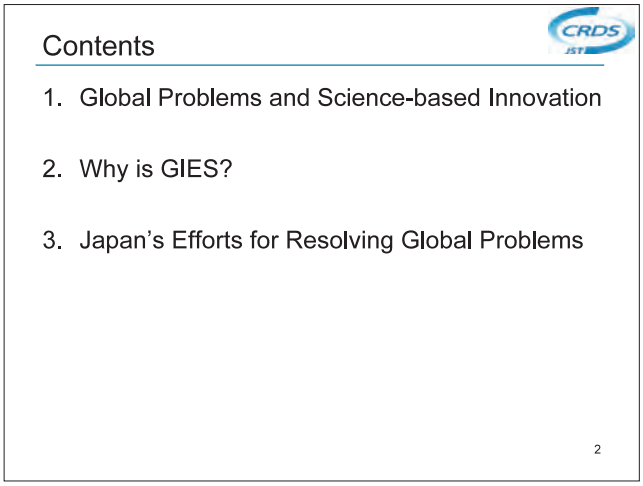
スピーカー

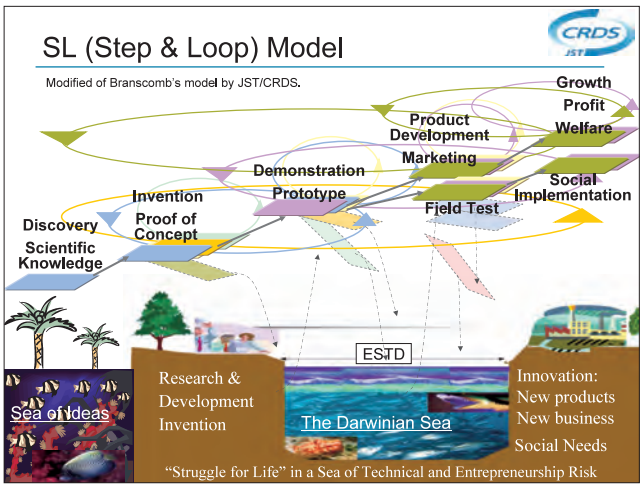
福田　佳也乃（JST 研究開発戦略センターフェロー）

要　旨

グローバル・イノベーション・エコシステム（GIES）とは、地球規模の問題解決と持続可能な発展を実現するために必要なシステムである。科学技術の知識に基づいたイノベーションとそれを実現するシステムを各国から地域へ、さらには世界へと拡大しなければならない。実際には GIES での活動の主体を民間部門が担っている例が多いが、温暖化抑制のためには、公的部門がより積極的に GIES に参加し、環境技術の先進国でのイノベーションと途上国への技術移転を促進する必要がある。

資　料





Innovation Ecosystem

Input
Knowledge Creation

Proof of Concept

"Ba"
Interaction Field

Prototypes

Output
Value Creation

Profit and Welfare/QOL Sustainability

Funding
Education, Human Resource Training, Mobility
Public Acceptance for New Things
International Competition & Collaboration

5

Innovation Ecosystem

Input
Knowledge Creation
Vision
Policy/Strategy
University/Enterprise
Research

Proof of Concept

"Ba"
Interaction Field
Human Networks
Networks of Technologies
Networks of Funds
Regional Clusters
Industry-Academia Collaborations
IP/Standard
Regulation/Deregulation

Prototypes

Output
Value Creation
Innovation-friendly Markets
Public Procurement

Profit and Welfare/QOL Sustainability

Funding
Human Resources/Education: nurture talents, brain circulation
Public Acceptance: consensus, consumer education, cultural issues
International Competition & Collaboration

6

Global Innovation Ecosystem

Sustainable Development: Resolution of Global Problems

Social Value
Socioeconomic Value
Economic Value

Global Innovation Ecosystem
Regional Innovation Ecosystem
National Innovation Ecosystem

Science & Technology
Market / Society

Talent, Infrastructure, Capital

Public Sectors
Private Sectors

International Collaboration Framework

7

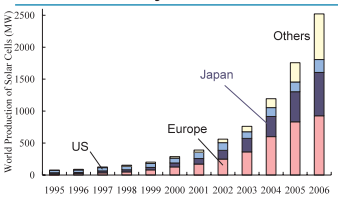
2. Why is GIES?

To Resolve Global Problems

- Global Vision For a Longer Term and From a Broader Perspective
- Work together toward the Common Goals
- Simultaneously Achieve Economic Growth and Sustainability

8

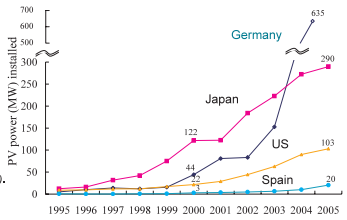
PV Industry Facts



Japan
- *The largest producer of solar cells in the world since 1999*
- *Accounted for roughly 50 % of the global shipment in 2004*

China and other countries are rapidly increasing their production.

Fig.
Trends in World Production of Solar Cells *(1995-2006).*
Source: NEDO, PV News



Germany
- *Increasing PV installation dramatically*
- *Passed Japan in 2004 as the most installed country*

Fig.
Trends in Installed PV Power *(1995-2005).*
Source: IEA Photovoltaic Power Systems Programme

PV Industry in GIES

Sustainable Development: Resolution of Global Problems

Social values
Economic values

China
Business with Foreign Markets
Innovation-friendly Market
Networks of Technologies

Science & Technology
Market / Society

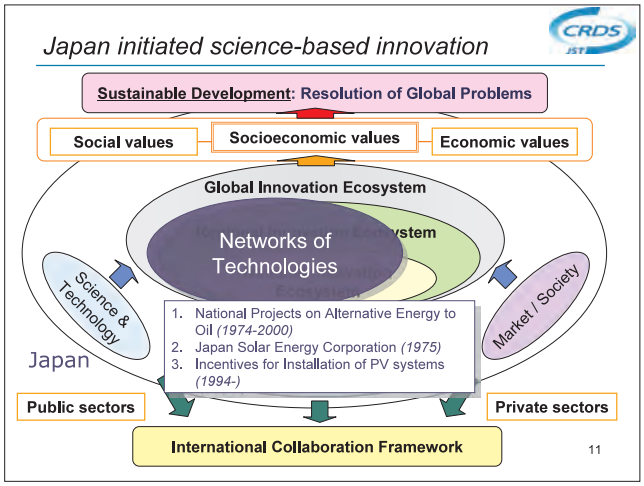
Japan
Germany

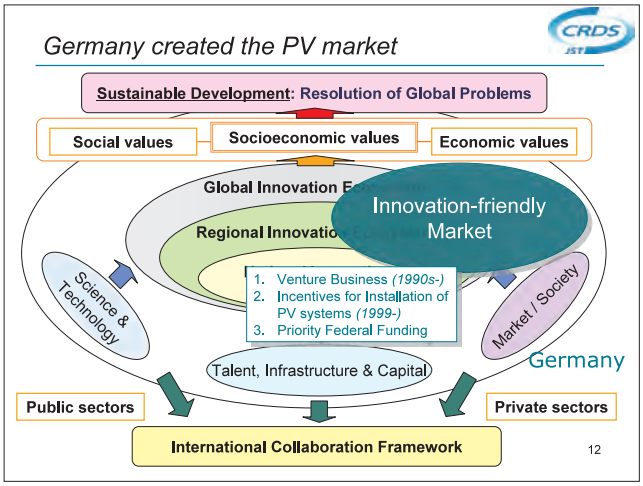
Talent, Infrastructure & Capital

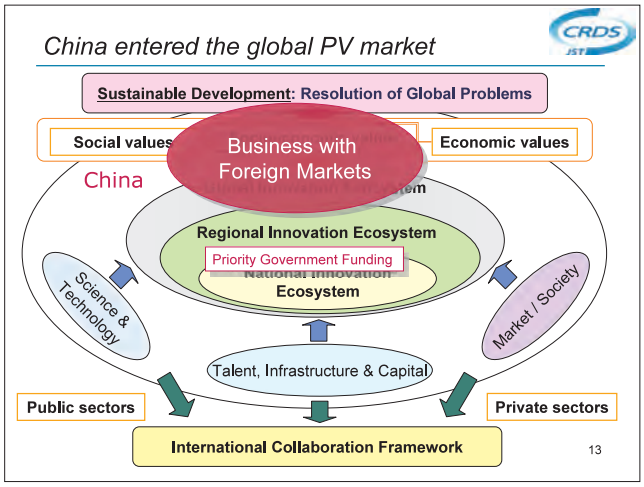
Public sectors
Private sectors

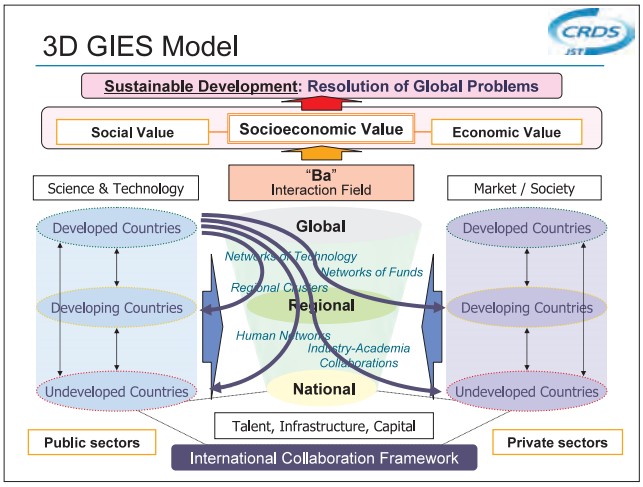
International Collaboration Framework

10

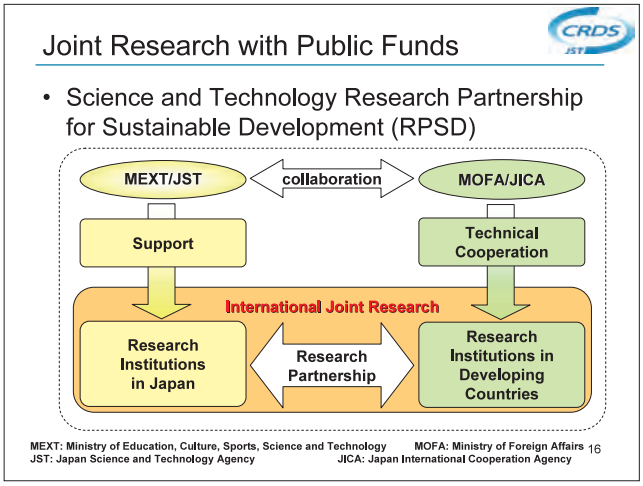

Japan initiated science-based innovation
Sustainable Development: Resolution of Global Problems
Social values
Socioeconomic values
Economic values
Global Innovation Ecosystem
Networks of Technologies
Science & Technology
Market / Society
1. National Projects on Alternative Energy to Oil (1974-2000)
2. Japan Solar Energy Corporation (1975)
3. Incentives for Installation of PV systems (1994-)
Japan
Public sectors
Private sectors
International Collaboration Framework
11


Germany created the PV market
Sustainable Development: Resolution of Global Problems
Social values
Socioeconomic values
Economic values
Innovation-friendly Market
Science & Technology
Market / Society
1. Venture Business (1990s-)
2. Incentives for Installation of PV systems (1999-)
3. Priority Federal Funding
Talent, Infrastructure & Capital
Germany
Public sectors
Private sectors
International Collaboration Framework
12


China entered the global PV market
Sustainable Development: Resolution of Global Problems
Social values
Economic values
Business with Foreign Markets
China
Regional Innovation Ecosystem
Priority Government Funding
Ecosystem
Science & Technology
Market / Society
Talent, Infrastructure & Capital
Public sectors
Private sectors
International Collaboration Framework
13


3D GIES Model
Sustainable Development: Resolution of Global Problems
Social Value
Socioeconomic Value
Economic Value
"Ba" Interaction Field
Science & Technology
Market / Society
Developed Countries
Developing Countries
Undeveloped Countries
Global
Networks of Technology
Networks of Funds
Regional Clusters
Regional
Human Networks
Industry-Academia Collaborations
National
Talent, Infrastructure, Capital
Public sectors
Private sectors
International Collaboration Framework


3. Japan's Efforts for Resolving Global Problems
Collaboration Across Borders
• Cooperation with Developing Countries
• Engagement Across Offices and Ministries
• Integration of Knowledge, Skills, and Tools
15


Joint Research with Public Funds
• Science and Technology Research Partnership for Sustainable Development (RPSD)
MEXT/JST
collaboration
MOFA/JICA
Support
Technical Cooperation
International Joint Research
Research Institutions in Japan
Research Partnership
Research Institutions in Developing Countries
MEXT: Ministry of Education, Culture, Sports, Science and Technology
JST: Japan Science and Technology Agency
MOFA: Ministry of Foreign Affairs
JICA: Japan International Cooperation Agency
16

RPSD Programs

Research Areas

- Environment and Energy
  - Adaptation to or Mitigation of Climate Change
  - Conservation and Sustainable Utilization of Bio-resources
- Natural Disaster Prevention
- Infectious Diseases Control

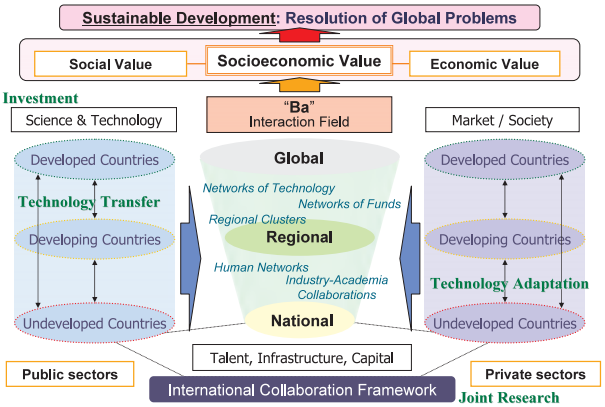
Countries

- Asia
  - Indonesia, Thailand, Bhutan
- Africa
  - Egypt, Gabonese, Zambia
- Others
  - Brazil, Croatia, Tuvalu

17

Effective Utilization of Environmental Technology

Toward Mitigating Climate Change



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- Agency for Natural Resources and Energy
- Graduate School of Commerce and Management, Hitotsubashi University (1993)
- JFE Techno-Research Corporation (2001)
- Central Research Institute of Electric Power Industry (2006)
- Development Bank of Japan (2006)
- The Chunichi Shimbun (2007)
- Nikkei Shimbun (2007)
- Invest in Germany Magazine (2006)
- JST RSPD HP; http://www.jst.go.jp/global/english/index.html

19

2.8. Adaptation Strategies for Global Climate Change: Capacity Building and Role of Universities in Advanced Countries

スピーカー

Srikantha Herath（国連大学学術審議官）

要　旨

気候変動への適応はその抑制よりも複雑な問題を含有している。特に発展途上国は農業に依存している場合が多く、経済・社会の持続的発展に向けて気候変動に適応するための迅速な行動が急務である。各国・地域の能力開発を支援するため、研究プロジェクトを推進すると共に、その成果を社会に実装するために必要な手法や手段を開発しなければならない。また、人材育成が必須であり、高等教育の機会の拡大を先進国は積極的に支援すべきである。

資　料

Adaptation Strategies for Global Climate Change: Capacity Building and Role of Universities in Advanced Countries:

Srikantha Herath
Senior Academic Programme Officer
Environment and Sustainable Development Programme
United Nations University
December 2, 2009

Outline

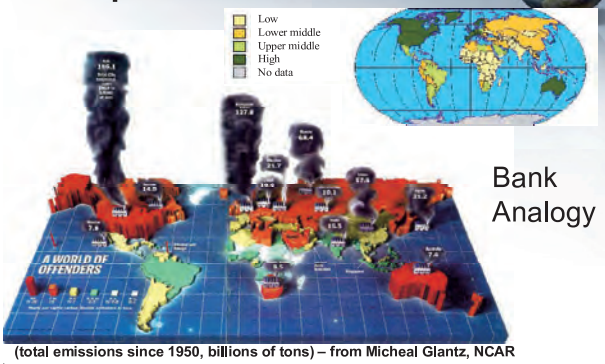
- Background
- Adaptation to climate change is complex
  - In comparison mitigation is easy to understand and implement
  - Adaptation is multifaceted and multi-dimensional
- Science: Climate change discussion is Model based
  - Climate – weather – impacts
- Adaptation Strategies and their impacts (beyond adaptation)
- Implementation > Mainstreaming
- Higher education

Background

- Climate change is environmental as well as a political challenge
- Sr. David King (**UK Government's Chief Scientific Adviser and Head of the Government Office of Science from October 2000 to 31 December 2007**) Climate change is a far greater threat to the world's stability than international terrorism (2004).
- April 2007, UN Sec. Council on climate change.
- Yoweri Musevini (2007, AUS) President of Uganda, Climate change is an act of aggression by the developed world against the developing world. Demanded compensation for the damage global warming would cause African nations.
- Kaire Mbuede (2007) Namibian representative to the United Nations, "developing countries, in particular, had been subjected to what could be described as "low intensity biological or chemical warfare".

3

Cumulative Co2 emissions and Development level



Bank Analogy

(total emissions since 1950, billions of tons) – from Micheal Glantz, NCAR

4

Issues for developing countries

- Developing countries are the most affected from CC, although they have the least contribution to GH gas emissions.
- Most countries depend heavily on agriculture and the poorest depend on it. Agriculture will be the most affected by CC.
- Currently available financial support mechanism related to mitigation is not much useful.
- Measures for adaptation financing need to be seriously considered.
- Capacity development may be one of the most appropriate adaptation support mechanisms

5

How do we respond to CC Mitigation Vs. Adaptation

- Mitigation was the early focus on managing climate change
- Aim: By reducing the production and use of Green House Gasses (GHG) reduce the rate of climate change and finally halted.
  - Easy to understand and implement.
  - Measures can be quantified in terms CO_2 reductions
  - Local actions have global benefit : Anyone can contribute
  - Potential to trade mitigation impacts: CDM
- Contribution to mitigation based on ability to pay and past use - bank analogy - Prof. Kirk Smith, published by UNU more than a decade ago

6

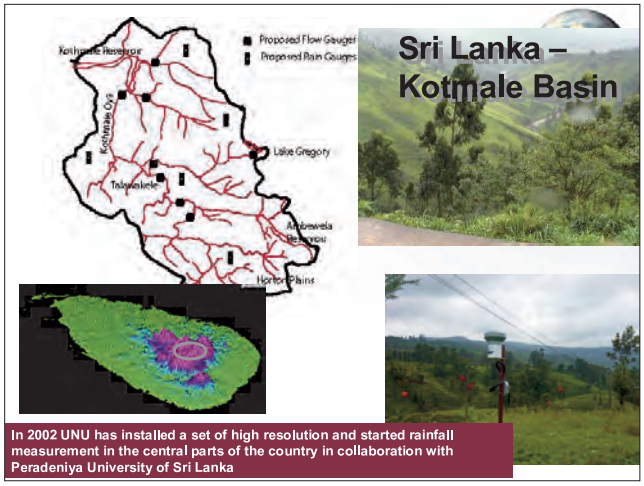
How do we respond to CC Mitigation Vs. Adaptation

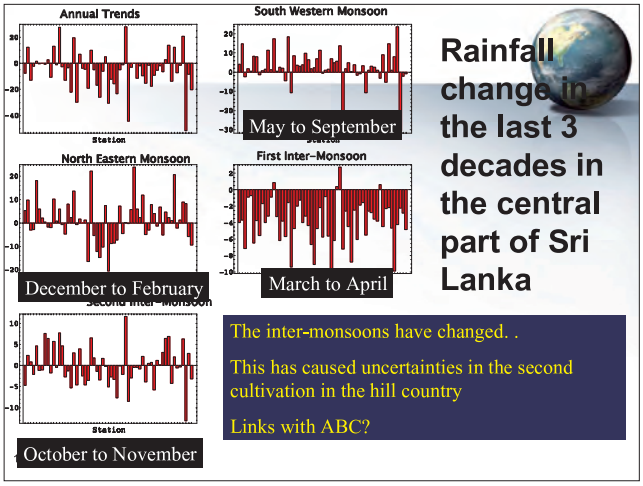
- Spatial scale
  - Benefits are local
  - Measures can be Local, regional, national
- Competing Sectors
  - Water supply, Agriculture, Transportation
- Type of intervention options
  - Physical, Technological, Investment, Regulatory, Market
- Responsible entity for funding and implementing
  - Government (national/local), International funds, Development agencies, private sector, NGO, community, individual)
- Measures differ for different Climatic Zones
  - Artic, floodplains, dry lands, tropical
- Different Strategies for Economic zones
  - Least-developed countries, middle income countries, developed countries

7

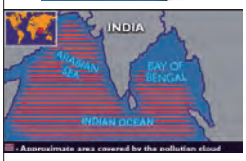
ABC Impacts – Sri Lanka An example of issues

8





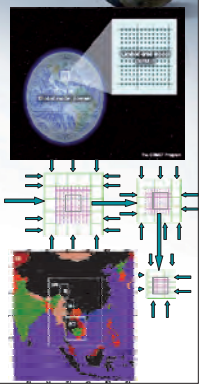
Atmospheric Brown Cloud



- The Indian Ocean Experiment INDOEX identified a thick layer of haze in dry season, from December to April.
  - Due to Biomass burning (gas), fossil fuel and bio mass (aerosol)
- Impacts
  - Less radiation
  - Induce surface cooling
  - Reduce total mean evaporation and thus rainfall
  - Reduction of agriculture productivity (less photo synthesis)

Better explanation of ABC impacts on climate

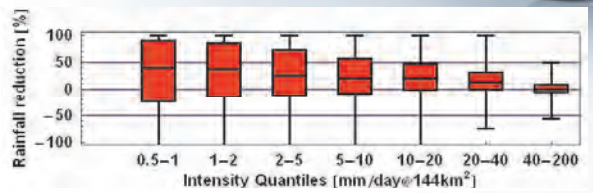
- We used local area atmospheric model, WRF, to down scale climatic variables for Sri Lanka for a period of 6 months, using 3 level nested scheme producing climatic data at 5 km grid resolution.
- The radiation scheme was changed to accommodate scattering and absorption of radiation – Impact of ABC
- Scenarios with and without haze effects were generated.



12

Result 2: Reduction of Rainfall

Results of a six months period simulation over southern part of Sri Lanka.



- For large rainfalls the % effect is small (for 100mm/day ~ 4%)
- For small rainfalls % effect is large (for 1-2mm/day ~ 40%)

13

How do we prioritize intervention?

- Allocating resources: Identify most vulnerable/critical
  - **Action Impact Matrix** - development and climate change
  - **Sustainable development** assessment through consideration of **efficiency, effectiveness, equity and legitimacy** dimensions to response actions

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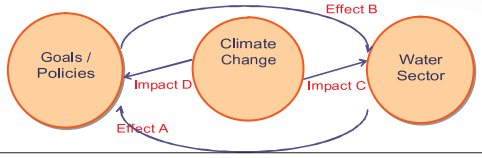
Action Impact Matrix to Prioritize Policies considering economic, environmental and social aspects.

MIND (Mohan Institute for National Development) study

- Two types of matrices
  - **Water Using Sectors Vulnerability, Impacts and Adaptation and effects on development (WED)**
  - **Development Effects on Water Using Sectors Vulnerability, Impacts and Adaptation (DEW)**

• WED-AIM = Effect A + Impact C
• DEW-AIM = Effect B + Impact D



15

Effect of water using sectors on Development

		Vulnerability, Impacts & Adaptation (VIA) in Water Using Sectors				
		(1)	(2)	(3)	(4)	
		Agriculture	Hydro Power	Water for Humans (Esp. Poor)	Water for Bio- & Eco-logical Res.	Row Totals (With CC)
(S0)	Status (No CC Impacts)*	-1	0	-1	-1	
(S1)	Status (+CC Impacts =>)**	-2	-1	-3	-2	
=> Dev. Goals/Policies (+CC Impacts)						
(A)	Growth	-2	-1	-2	-2	-8
(B)	Poverty alleviation	-2	-1	-2	-1	-7
(C)	Food Security	-2	-1	0	-1	-5
(D)	Employment	-2	0	-1	-1	-4
(E)	Trade & Globalisation	-1	-1	0	-1	-3
(F)	Budget Deficit Reduction	-1	-1	-1	-1	-4
(G)	Privatisation	0	0	0	-1	-1
Column Totals (With CC)		-10	-5	-5	-7	

* Row (S0) is used ONLY as the baseline to estimate Row (S1).
** Row (S1) is used to estimate impacts on goals/policies in the matrix cells below it.
Water using VIA areas that are most harmed
Development Goals/Policies that are most damaging
Key matrix cells that need policy interventions

NOTES
Water for Humans (Esp. Poor) => drinking, health, livelihood, etc.
Water for Bio- & Eco-logical Res. => forests, wetlands, coastal zones, biodiv., etc.

Risks: In a predominantly small holder system, agriculture is the finest instrument for PA. Disturbance of rainfall patterns adversely affect the rainfed and Chena farmers, the poorest among the farming community. Loss of crops due to floods and droughts saps the farmers of the meager savings and leads them to abject poverty.

16

Effect of water using sectors on Development

		Vulnerability, Impacts & Adaptation (VIA) in Water Using Sectors				
		(1) Agriculture	(2) Hydro Power	(3) Water for Humans (Esp. Poor)	(4) Water for Bio- & Eco-logical Res.	Row Totals (With CC)
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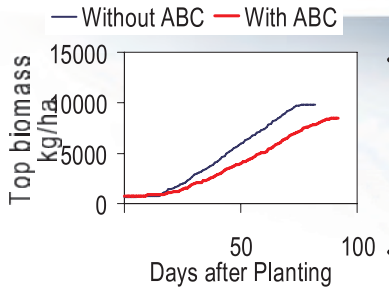
(-3) Risks: Primary food security comes from locally grown foods such as rice. 70-80% of total rice production comes from major and minor irrgation schemes. Non staples such as yams and legumes are grown in rainfed highlands. Changing patterns of rainfall distribution negatively affects food security. ABC reduces both inter-monsoonal rainfall and solar radiation, each of which will reduce crop yields. CC impacts are compounded by the ABC effect, making management of Yala and Maha seasonal cropping more difficult, and leading to lower production and food security.

Yield Change due to ABC



- **"Maha" (October – March) season rice yield reduces from 5573 kg/ha to 4599 kg/ha [17% reduction]**
- **Studies in India – 15% reduction (Ramanathan et. Al)**

Need different rice varieties, water management facilities and other supporting policies to overcome this deficit.

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Challenges

- In the study area two major crops, rice and tea are cultivated.
- They both are affected by climate change in different ways:
  - Rice production reduces due to radiation reduction.
  - Loss of inter-monsoon rain require shifting rice planting dates
  - Tea is affected by temperature variability, moisture gradients as well as rain intensity.
- Social tensions may escalate as traditionally the cultivation is practiced by different ethnic groups (rice by Sinhalese farmers and tea by Tamil factory workers) due to competition for jobs.
- It is extremely difficult to prescribe appropriate adaptation strategies from outside - they must be developed locally.

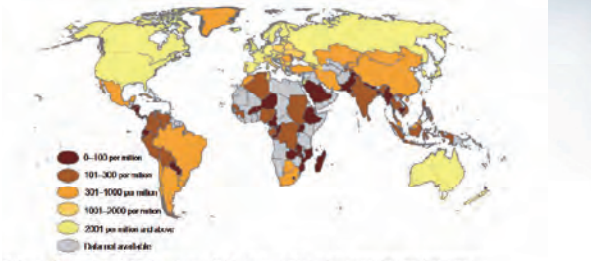
Mainstreaming adaptation

- It is important to develop local capacity
  - To downscale climate change forecasts to local scale
  - To assess impacts
  - To study alternate strategies and their appropriateness (beyond adaptation)
- Mainstreaming adaptation strategies in to development planning, also has many challenges.
  - Inadequacy of qualified researchers
  - Lack of dialog between research and implementation communities

Human Resources in R&D

Figure 1 presents a global map of the distribution of researchers (measured per million inhabitants). Researchers are professionals engaged in the conception or creation of new knowledge, products, processes, methods and systems (*Frascati Manual*, 2002).

Figure 1: How many researchers are there?
Researchers per million inhabitants, 2005 or latest available year



Note: About 70% of countries report full-time equivalents, the remaining use headcounts.
Source: UNESCO Institute for Statistics, September 2007.

North-South Scientific Gap

- High income countries have a much higher share of their populations studying science and technology at the tertiary level.
- Developed vs Developing countries
  Number of scientists – 3.8 vs 0.4 per 1000 people
  R&D as a percent of GDP – 2% vs 0.5% or less

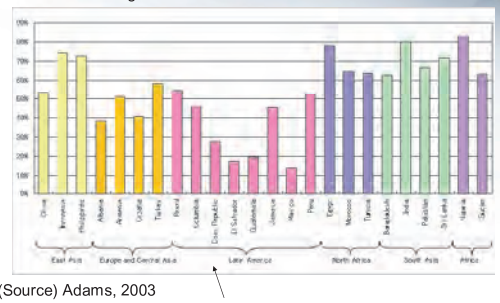
The number of publication and citation on research in Science (%)

	% of publications		% of citations	
	1981	1995	1985	1995
Low and middle income	16	14	8	5
High income	84	86	95	95

(Source) ISI

Brain-Drain

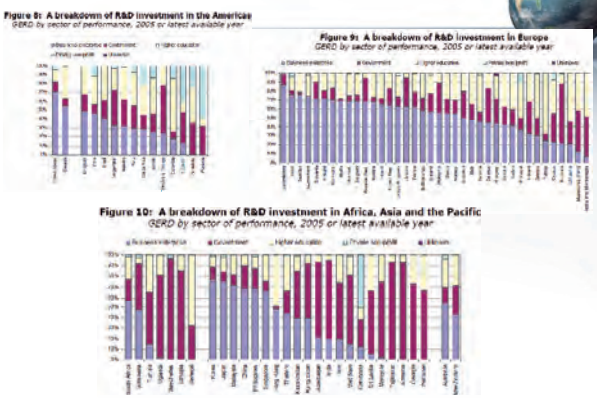
% of emigrants who completed tertiary education as a percentage of the total emigrants



(Source) Adams, 2003

Especially, Asian and African countries experience severe Brain-Drain.

Which sectors receive the most investment



Key challenges

- Enabling flow from research to implementation
- Enhancing capacity of higher education sector supporting climate change adaptation

UNU example project

- A number of catastrophic floods or near misses highlighted the danger of catastrophic disasters striking a major urban center.
- UNU convened an expert meeting in 2003 from 15 countries
  - Bangladesh, Cambodia, China, Fiji, India, Indonesia, Lao PDR, Malaysia, Nepal, Pakistan, Philippines, Singapore, Sri Lanka, Thailand and Vietnam
- which recommended a joint action programme, focusing on assessing extreme flood risks and developing response plans
- Building on case studies a training program comprising of the modules rainfall downscaling, GIS and inundation modeling have been developed.
- Training trainers –> Country training –> M.Eng. Program

26

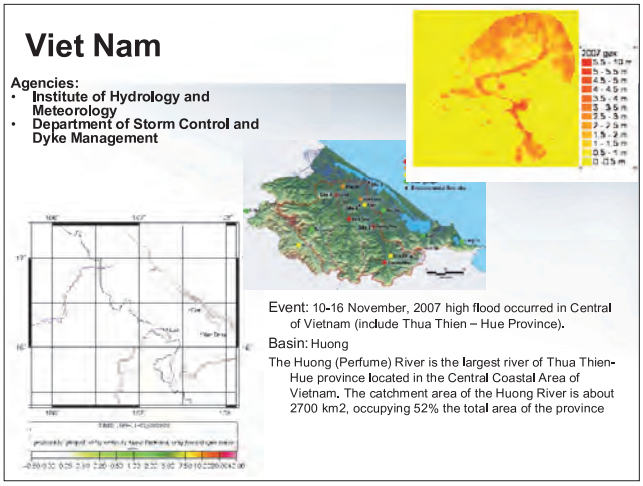
First session 5 countries - 2007

- Organized by UNU (1.5 months in two sessions)
  - Resources from: UNESCO-IHE, Monash University, Australia, Nippon Koei Co., Ltd., AIT, Thailand
- Participants - Faculty from a **University** and professionals from the **organization responsible** for flood control - ***training of trainers***

– China: Tsinhua University, Beijing Municipality
– Nepal: Institute of Engineering, Department of Hydrology and Meteorology
– Philippines: University of Philippines, PAGASA (Hydro meteorological Agency)
– Sri Lanka: University of Peradeniya, Irrigation Department
– Viet Nam: Institute of Hydrology and Meteorology, Department of Storm Control and Dyke Management

Viet Nam

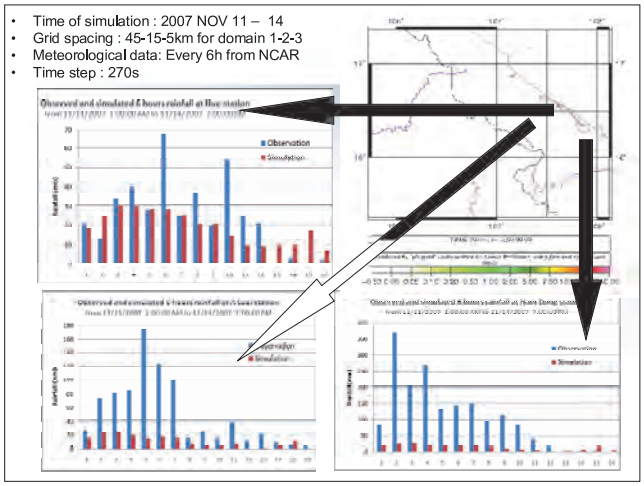
Agencies:
- Institute of Hydrology and Meteorology
- Department of Storm Control and Dyke Management

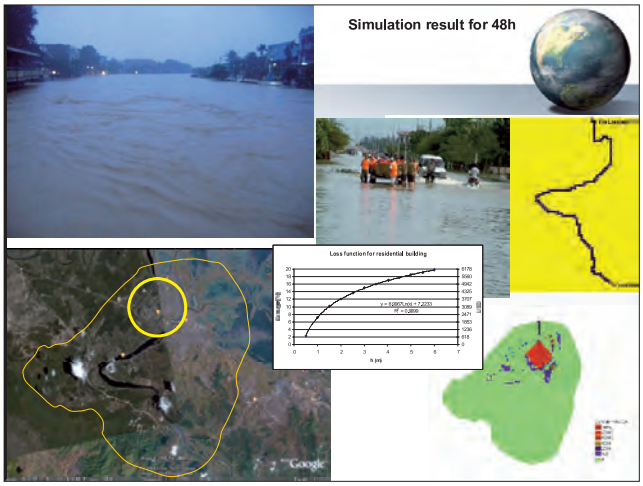


Event: 10-16 November, 2007 high flood occurred in Central of Vietnam (include Thua Thien – Hue Province).

Basin: Huong

The Huong (Perfume) River is the largest river of Thua Thien-Hue province located in the Central Coastal Area of Vietnam. The catchment area of the Huong River is about 2700 km2, occupying 52% the total area of the province





Setting up a national Capacity Development training program on extreme floods

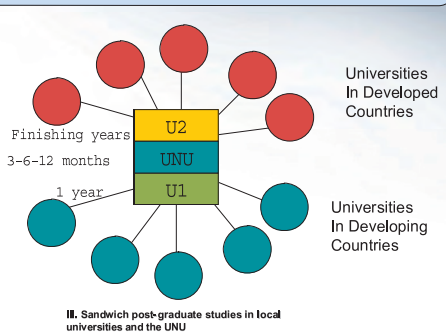
- Intensive traning program for professionals to rapidly develop local capacity
- Organized jointly with the university and relevant government agency
- Supported with HIGHER EDUCATION programs
- **A NEW TYPE OF HIGHER EDUCATION PROGRAM IS NEEDED**

Meeting In Colombo, Sri Lanka On Program

May, 2008

36 senior officials

A UNU proposal for new type of graduate programs to support global needs



II. Sandwich post-graduate studies in local universities and the UNU

Characteristics of Post Graduate Research on adaptation

- **Research Topics:** Specific research topics are developed in consultation with national universities, implementation agencies and international organizations.
- **Multi-disciplinary teamwork:** The research programs utilize existing linkages and contacts with government and national organizations of UNU and partner organizations to promote holistic research programs covering a wide range of diciplines, from natural, social and economic standpoints.
- **Multi-stakeholder involvement:** Establish strong linkages between global and local issues, technical solutions and policies, and academia and UN system through the joint supervision of graduate students.

Summarizing: Issues for developing countries

- It is necessary to create new opportunities and provide an enabling environment in which the communities affected by climate change can define their own programs based on traditional knowledge or social harmony
- Ability to understand future changes, potential impacts is very important to design appropriate adaptation strategies.

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Role of Universities in advanced countries

- Help developing counties to customize global knowledge
  - Modifying and calibrating models
  - Setting up observations and verification methodologies
- Jointly develop "Adaptation Science" : what are the principles?
  - Target to preserve: output, jobs, ecological services
  - Prioritizing
  - Impacts of adaptation

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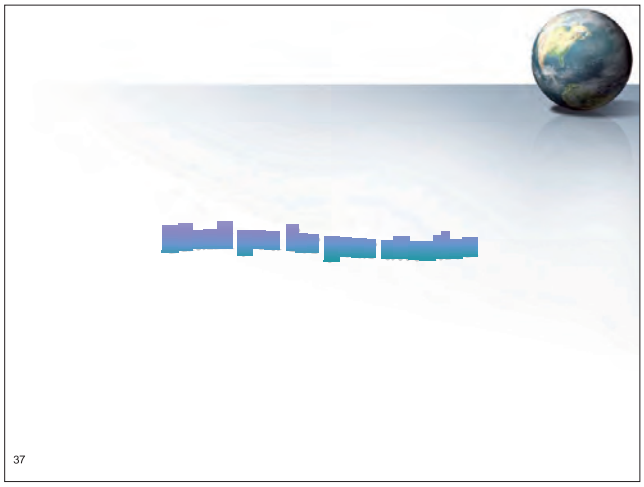
Concluding Remarks

- Enhancing capacity of higher education sector in the developing countries offer best hope to successfully address climate change challenges
- The support of developed country is extremely important to rapidly develop the higher education sector in developing countries and also develop capacity of professionals through joint training programs
- Joint degree programs can harness best of human resources, facilities and existing knowledge to address pressing global problems related to climate change and adaptation.



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3. まとめ

気候変動を抑制するためには、エネルギーの効率向上や代替等の技術の開発とその普及が不可欠である。そのためには、産業界と大学が相互に協力・連携し、研究開発とその成果の応用を推進しなければならない。また、気候変動への適応は途上国にとって経済・社会の持続的発展を左右する大きな課題となっている。各国・地域の特性に応じて、最適な環境技術を広く普及するための方策を迅速に立案し実行することが必須である。

ワークショップでの話題提供と議論を通じて、気候変動の抑制とそれへの適応に必要な 5 つのキーワード「IIIEE」が得られた。

Integrate
　産学官それぞれの主体が培った知識や技術を統合すること
Interact
　異なる研究分野、主体、地域、国家の間の交流・連携を促進すること
Innovate
　統合と交流・連携を通じて、新たな知識から新たな価値を創出すること
Ensure
　気候変動の抑制と適応に向けた具体的な行動を確実に推進すること
Enjoy
　気候変動の抑制と適応に向けた試みや努力を楽しむこと

また、気候変動問題の解決に向けて全世界で共有すべき 4 つの重要な指針「CRDS」が明らかになった。

Cooperation for adaptation to climate change
　気候変動への適応のための協力連携
Relations among developed and developing countries
　先進国と途上国との関係
Demand for a new type of civilization
　これまでとは異なる新たな文明・生活の要求
Strategy for global and local environments
　全地球的環境と地域環境に対する戦略

付録 1. プログラム

Role of Technologies and Universities in Mitigating Climate Change

- A joint symposium between the Centre for Research and Development Strategies, Japan Science and Technology Agency and the International Institute for Industrial Environmental Economics at Lund University -

2 December 2008, 08h45-17h00

Aula, International Institute for Industrial Environmental Economics (IIIEE) at Lund University

Tegnérsplatsen 4, Lund, Sweden

Chair person: Håkan Rodhe, Assoc. Prof, IIIEE

08.45 Registration and coffee

09.00 Welcome & Introduction of the Theme: Prof. Lena Neij, IIIEE

09.20 “Climate Change Initiative” at Lund University: Prof. Per Warfvinge, Lund University of Technology

09.40 Long Term Prospects of Mitigation Strategies for Global Climate Change : Technology Development and Role of Universities: Prof. Itaru Yasui, Principal Fellow, JST/Center for Research and Development Strategies

10.15 Coffee

10.45 Cost reduction of Energy Efficiency Technologies and Challenges of Technology Transfer: Prof. Lena Neij, IIIEE

11.10 Industry characteristics and Diffusion of Eco-innovation cases of Nordic Countries: Assoc. Prof. Naoko Tojo, IIIEE

11.30 Q&A and discussion

12.00 Lunch

13.30 Economic growth, energy consumption and CO2 emissions in Sweden 1800-2000: Assoc. Prof. Astrid Kander, Department of Economic History

13.50 Cases of Clean Technology Transfer and Roles of Education: researchers at IIIEE

14.25 GIES-Global Innovation EcoSystem: A Proposal of A Framework for Technology Transfer: Dr. Kayano Fukuda, Fellow, JST/Center for Research and Development Strategies

14.50 Adaptation Strategies for Global Climate Change: Capacity Building and Role of Universities in Advanced Countries: Dr. Srikantha Herath, United Nations University

15.25 Coffee break

15.55 Roundtable discussion: Role of technology and universities in mitigating climate change

16.45 Wrap up and closing remark: Assoc. Prof. Håkan Rodhe, IIIEE

付録 2.　出席者

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Köhler	Andreas	IIIEE, LU
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環境問題に関する国際ワークショップ

「気候変動抑制に対する技術と大学の役割」
報告書

CRDS-FY2008-WR-08

独立行政法人 科学技術振興機構 研究開発戦略センター

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