IGES research on energy and climate scenarios in Japan

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Japan and energy

- Japan relies 96% of its energy supply on imports (as of 2009, incl. nuclear fuels)*
- Japan was the 3rd largest user of nuclear power after US and France**, relying more than a quarter of its power generation on nuclear

*IEA (2011) Energy Balances of OECD Countries, 2011 Edition.
** Based on 2009 December figure. IEA (2011) Electricity Information, 2011 Edition.

Post-Kyoto climate targets

No (unconditional) GHG reduction target for post-2012 enshrined in the national legislation

- 2009 Copenhagen Pledge: -25% vs 1990 level in 2020 (conditional)
- 2010 Basic Energy Plan (energy related CO_2): -30% vs 1990 level in 2030

Whatever the targets may be, the increased nuclear power generation was considered to be the key to achieve climate targets

Innovative Strategy for Energy and the Environment*

- To be formulated under the National Policy Unit in August 2012
- Three basic philosophies*
  - Realization of new best-mix of energy sources
    - Draw up a scenario of **reduced dependence on nuclear energy**
    - Utilize a clear and strategic schedule to avoid energy shortfalls and price rises
    - Thorough review of nuclear power policies and operate under a new framework
  - Realization of new energy systems
    - **Distributed energy system**
    - Seek to make an international contribution as advanced problem-solving nation
  - Formation of national consensus
    - **Stimulate national discussions overcoming the confrontation between nuclear proponents and opponents**
    - **Verify objective data**
    - Formulate innovative energy and environmental strategies while maintaining dialogue with a broad range of national people

* National Policy Unit (2011) Interim Compilation of Discussion Points for the Formulation of "Innovative Strategy for Energy and the Environment", http://www.npu.go.jp/policy/policy09/pdf/20110908/20110908_02_en.pdf, accessed on November 29, 2011.

Innovative Strategy for Energy and the Environment*

- Three scenarios proposed for 2030
- Various indicators presented (e.g. electricity generation cost, impact on GDP, etc)

	2010 Historic	2030 Zero scenario	2030 15% scenario	2030 20-25% scenario
Electricity mix				
Nuclear	26%	0%	15%	20-25%
Renewables	10%	35%	30%	25-30%
Fossil fuel	63%	65%	55%	50%
GHG reduction vs. 1990 levels	0.3%	23% (0-7% in 2020)	23% (9% in 2020)	25% (10-11% in 2020)

* National Policy Unit (2011), http://www.npu.go.jp/policy/policy09/pdf/20120629/20120629_1.pdf (in Japanese), accessed on 17 July, 2012.

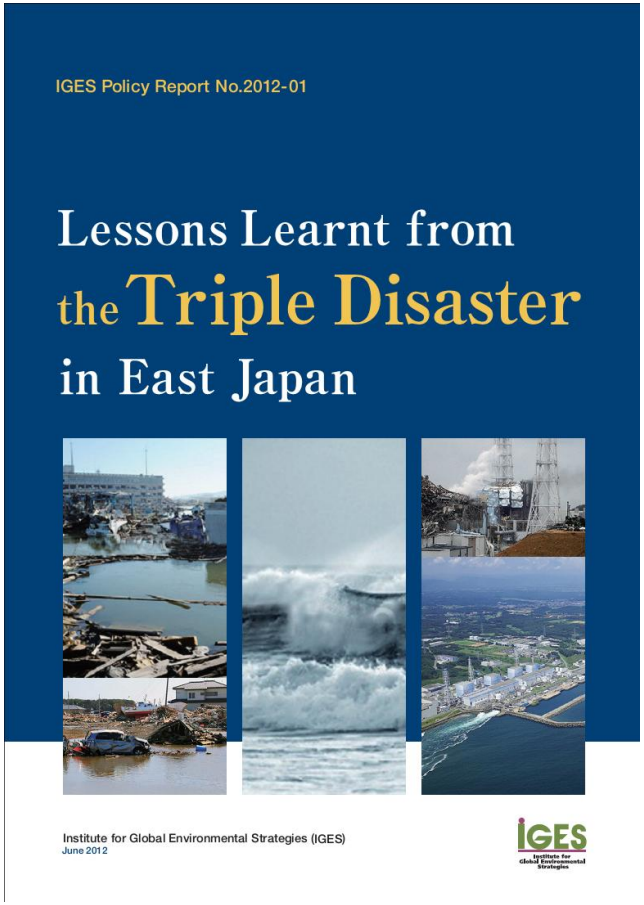
Long-term energy and climate scenarios: A modeling study

IGES research on energy and climate scenarios

- Since 2010, IGES has been performing energy-CO_2 scenario analyses using energy techno-economic model
- Assessment on the possible long-term consequences of reduced nuclear power on Japan's energy system and CO_2 emissions (up to 2050)
- Aim to contribute to the discussion on the Innovative Strategy

Balancing Energy and Climate Goals of Japan: Exploring Post-Fukushima Energy Supply Options

- Research report by A.Bhattacharya, N.K.Janardhanan and T.Kuramochi
- Chapter 2 of the IGES Triple Disaster Study
- Published in June 2012 (before three policy scenarios were announced)
- Downloadable from www.iges.or.jp



Key questions addressed

- Is 80% reduction of CO_2 emissions by 2050 compared to 1990 levels feasible without relying on nuclear?
- How will the nuclear phase-out affect Japan's energy system?
- How much renewables and CCS required by 2050?
- How will nuclear phase-out affect fossil fuel imports?

Modeling approach

- TIMES Integrated Assessment Model (developed originally by the IEA Energy Technology Systems Analysis Programme)
- Long-term CO_2 emissions reduction pathway: two scenarios compared

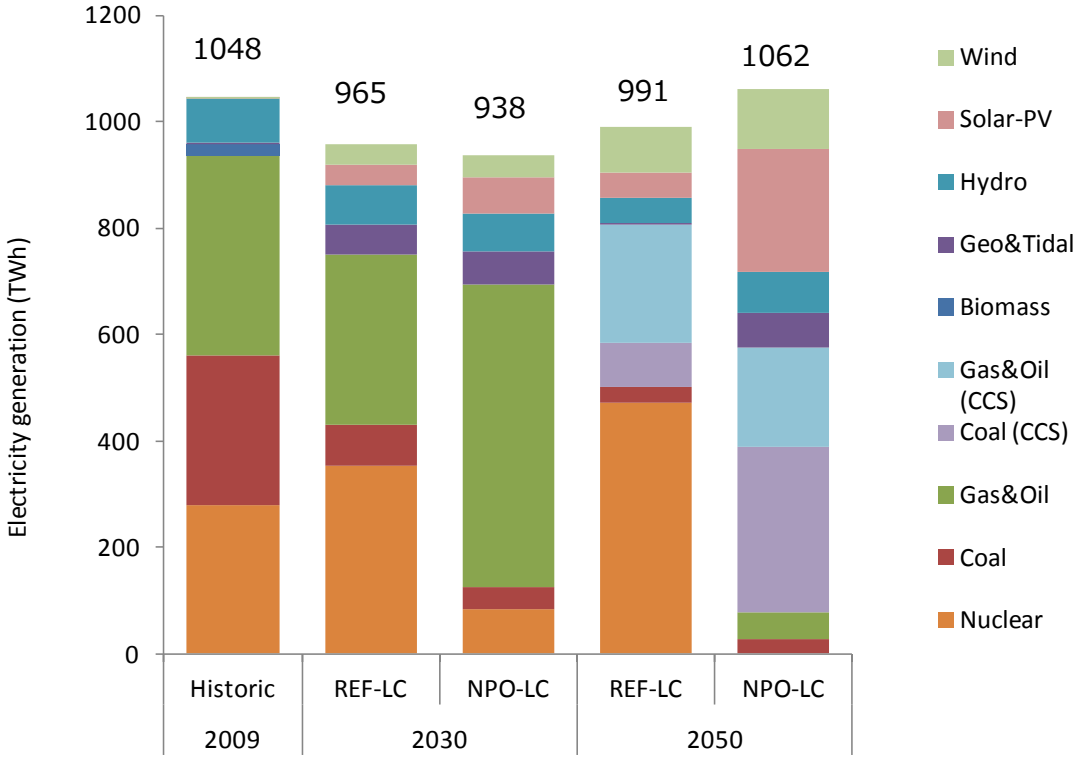
	Reference (REF-LC)	**Nuclear phase-out (NPO-LC)**
Share of nuclear power in electricity mix	2030: ~50% 2050: ~60%	-Decommissioning of Fukushima Daiichi -No restart of Fukushima Daini -Shutdown after 40 years operation -No new nuclear power plant -60-70% of the remaining capacity operating at 70% capacity factor -Complete phase-out in 2050
CO_2 emissions reduction vs. 1990 levels	2020: 17%, 2030: 40%, 2050: 80%	

Modeling approach

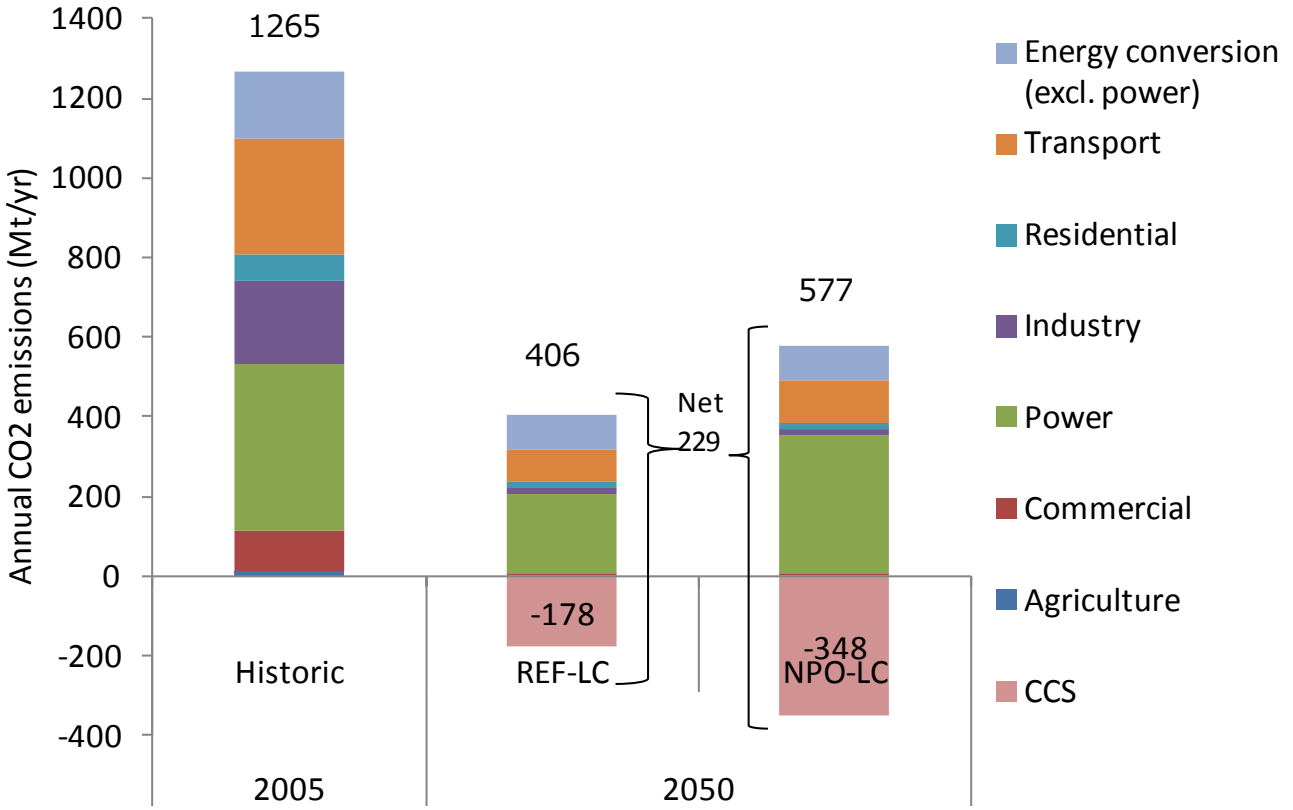
- **Activity drivers (population, GDP, etc)** taken from the dataset prepared by the National Institute of Environmental Studies (NIES)
- **Updated technology data** based on the discussions in the National Policy Unit (verified objective data)
- **Renewable energy potential**: upper limits for installed capacity based on the expert assessments in, e.g., government committees

CO_2 reduction + nuclear reduction: Electricity mix

- Stringent CO_2 target with reduced nuclear result in very large increase of natural gas use in the mid-term (~2030)
- In 2050, nearly all fossil fuel power plants are equipped with Carbon Capture and Storage (CCS) with or without nuclear
- In Nuclear Phase-Out scenario, wind and solar power is installed to the upper limit

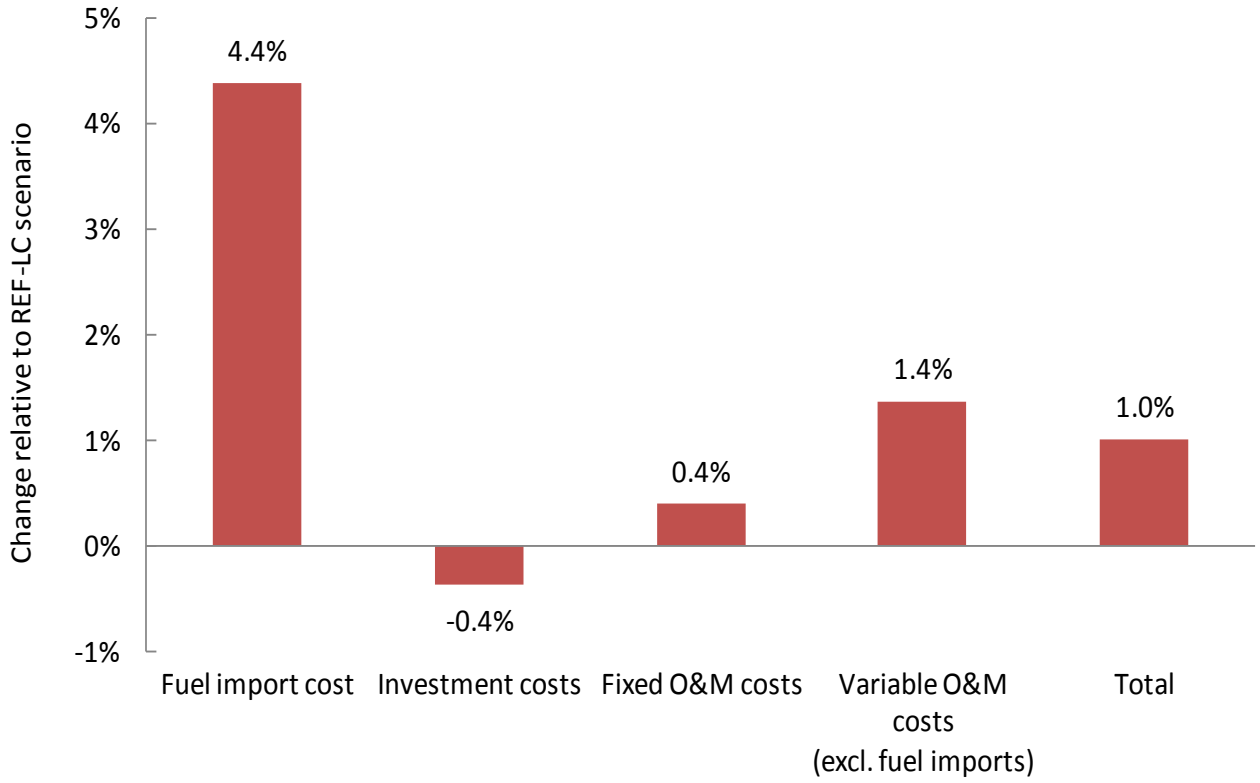


80% reduction of CO_2 without nuclear in 2050: Breakdown by emission source



- Larger role of CCS (mainly in energy conversion sectors)
- Indicates the need for further reduction in energy demand

80% reduction of CO_2 in 2050: Discounted total energy system cost 2010-2050



- 1% increase in total cost
- Average annual cost increase is in average about 0.13% of GDP

Discussion

- Modeling results can change largely, even when parameter values are defined within the reasonable range
- Feasibility of large-scale deployment and renewables and CCS as projected by the model
- Feasibility of large increase in natural gas imports in the mid term (~2030)
- Further investigation of the potential for renewable technologies other than wind and PV
- Did the model fully take into account the energy demand reduction potential through changes in lifestyle and economic structure?

Conclusions and recommendations

- Achieving 80% reduction of CO_2 emissions by 2050 without nuclear is economically feasible
- Major actions must be taken ASAP to realize the projected deployment of low-carbon technologies by 2050
  - Need for regulatory and institutional reform in the power sector to promote renewable energy
  - Need to promote investment for RD&D of CCS and alternative/advanced energy technologies
- Ensure adequate supply of natural gas
- Need for changes in lifestyle and economic structure
- Need for appropriate policy measures to direct consumer behavior toward saving energy

Thank you for your attention!

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