# Current Status and Issues of Nuclear Power Generation in the World

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Japan Atomic Energy Commission

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# March 11 Event

- The Great East Japan Earthquake and the resulting tsunamis struck the Fukushima Dai-ichi Nuclear Power Stations of Tokyo Electric Power Co. on March 11, 2011. This caused a nuclear accident that was unprecedented with regard to three points: the nuclear accident compounded by natural hazards; the simultaneous progression of accidents at multiple units; and the continuation of accident over an extended period of time.
- The fact that this accident has raised concerns around the world about the safety of nuclear power generation is a matter which Japan takes with the utmost seriousness and remorse. Above all, Japan sincerely regrets causing anxiety for people all over the world about the release of radioactive materials.

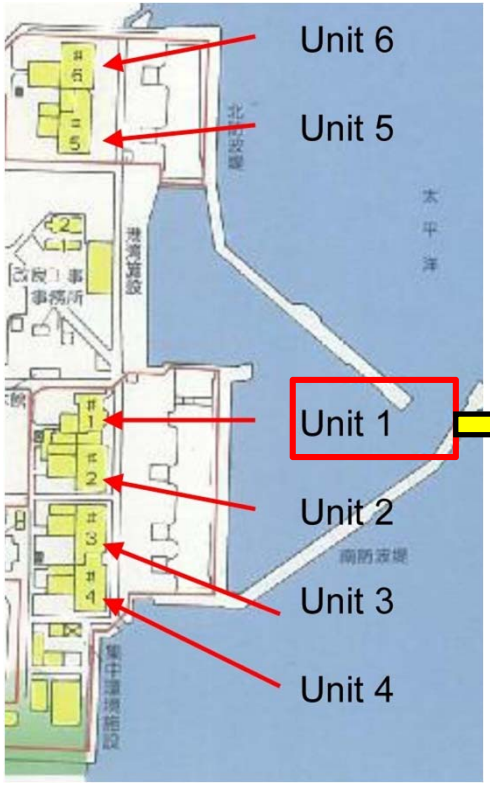
- In the face of this hardship, Japan has received support and expressions of solidarity from around the world.
- I would like to express Japan's sincere gratitude to you all.

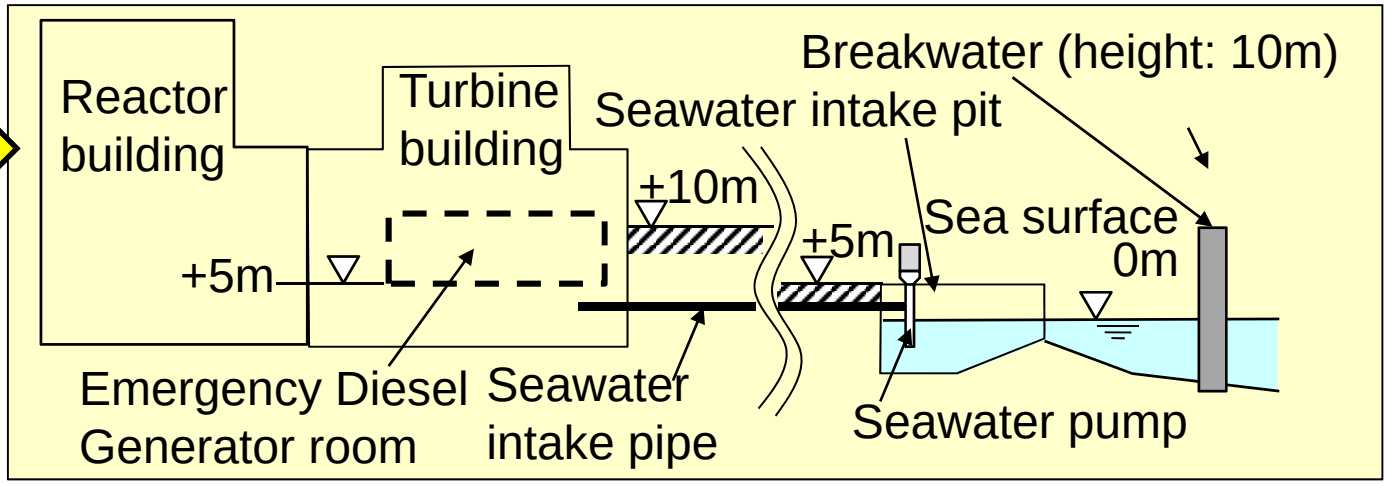
# Content

- Summary of the accident
- Nuclear power generation in the world before March 11.
- Response to the accident in the world
- Future prospect

# Overview of Fukushima-Dai-ichi NPS

| | Unit 1 | Unit 2 | Unit 3 | Unit 4 | Unit 5 | Unit 6 |
|---|---|---|---|---|---|---|
| | BWR-3 | BWR-4 | BWR-4 | BWR-4 | BWR-4 | BWR-5 |
| PCV Model | Mark-1 | Mark-1 | Mark-1 | Mark-1 | Mark-1 | Mark-2 |
| Electric Output (MWe) | 460 | 784 | 784 | 784 | 784 | 1100 |
| Commercial Operation | 1971,3 | 1974,7 | 1976,3 | 1978,10 | 1978,4 | 1979,10 |
| Plant Status on Mar. 11 | In Operation | In Operation | In Operation | Refueling Outage | Refueling Outage | Refueling Outage |

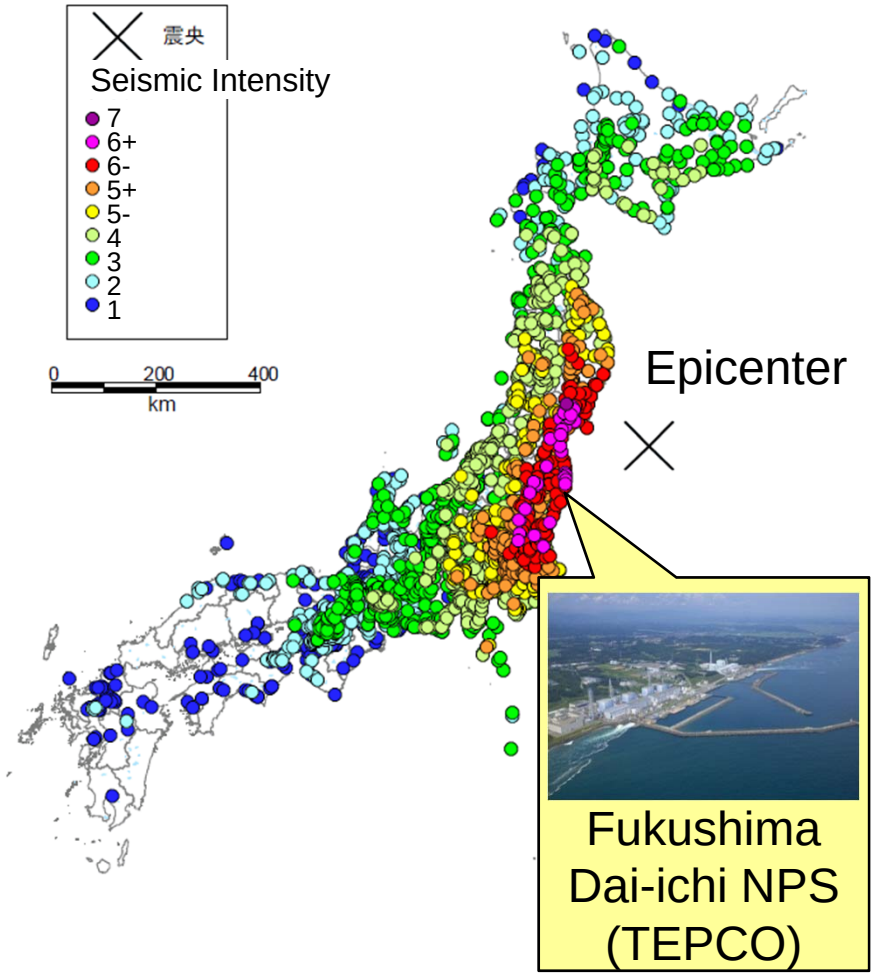



(Source)Report of Japanese Government to the IAEA Ministerial Conference on Nuclear Safety

# Tohoku District – off the Pacific Ocean Earthquake

- Occurrence: 14:46 March 11, 2011
- Moment magnitude: 9.0Mw




Map of Seismic Intensity

(Source) Ministry of Education, Culture, Sports, Science & Technology)

Source area of
the Tohoku district
- off the Pacific Ocean
Earthquake

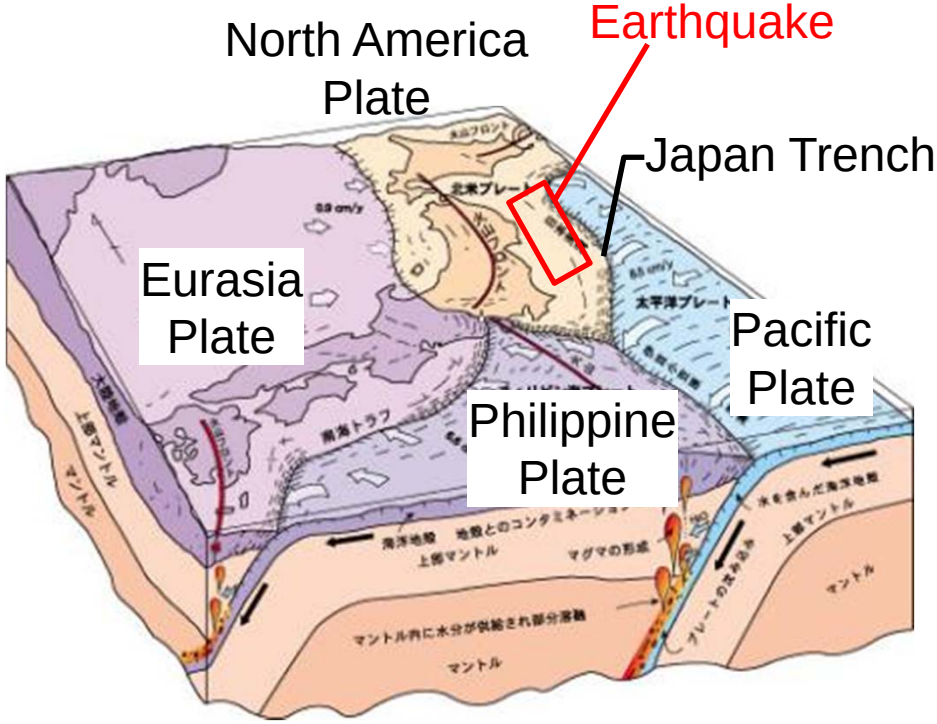



Plate tectonics around Japan

(Source) JGCA HP http://www.zenchiren.or.jp/tikei/index.htm
Partially modified by JNES

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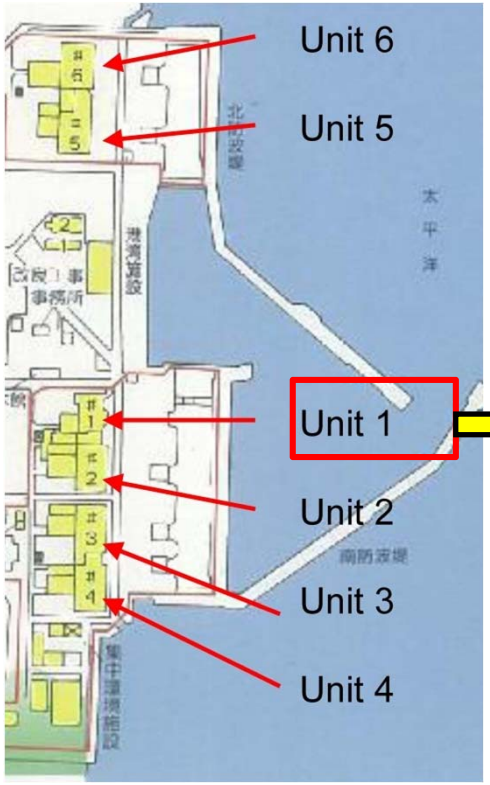
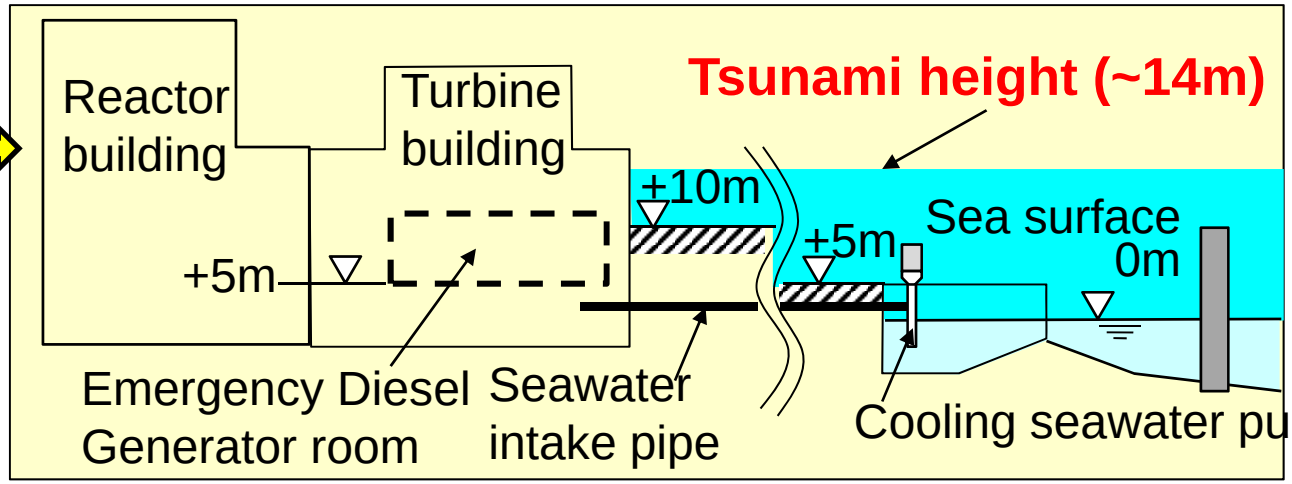
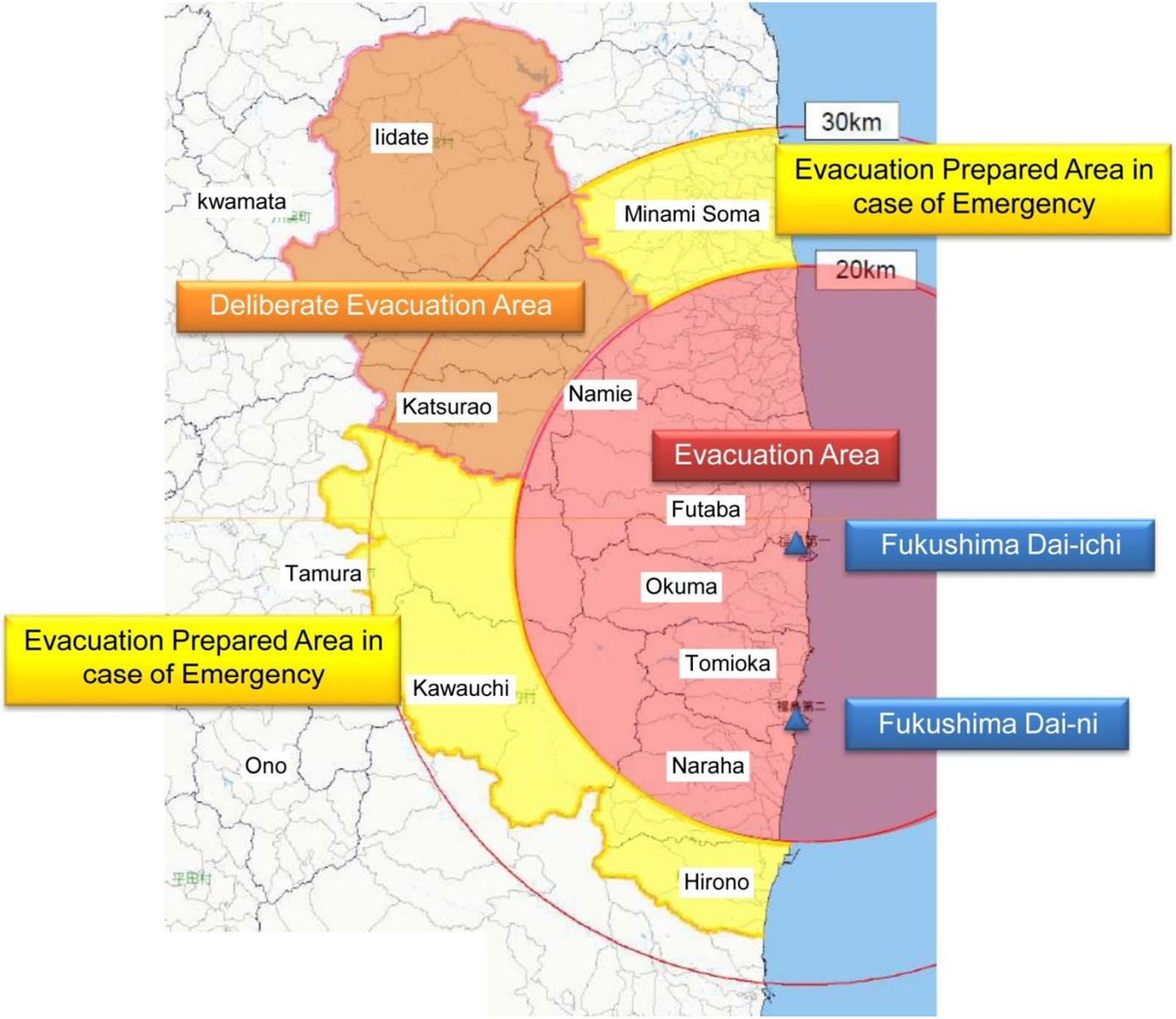



(Source)Report of Japanese Government to the IAEA Ministerial Conference on Nuclear Safety

# Present Protected Areas




(Source)Report of Japanese Government to the IAEA Ministerial Conference on Nuclear Safety

# Major Tasks Being Pursed

## Offsite management

- Monitor environmental radiation and assess radiation dose residents have received and will receive and implement measures for residents' healthcare.
- Decontaminate residential area, facilities, environment of schools for education and agricultural area, treat and dispose radioactive waste.
- Reconstruct agricultural and livestock industries, decontaminating forests and wildlife and assuring safe marine products.

## Onsite management

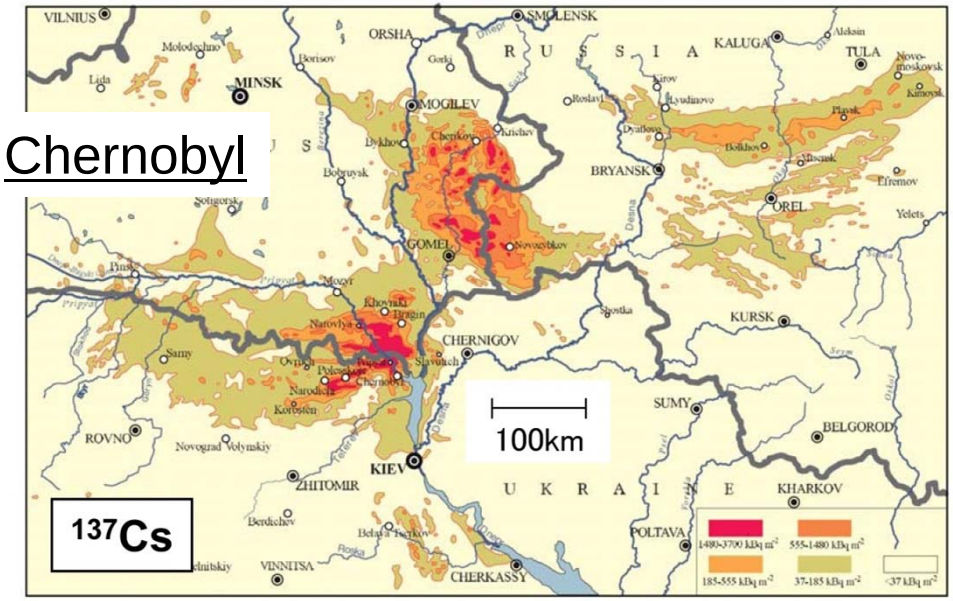
- Bring every units to stable safe shutdown state as soon as practicable.
- Prepare a roadmap to complete the decommissioning of the units, starting from managing a large amount of radioactive material, the contaminated buildings, water and wastes within the site, to carrying spent fuel out of every units , and taking out damaged fuel.

**Though the restoration will be a great challenge for Japan, we have firmly determined to accomplish it.**

# INES preliminary evaluation: **Level 7**

## Comparison of contamination area

<u>Chernobyl</u>




<u>Fukushima</u>

nearly
same scale

| | |
|---|---|
| Total | 14 x $10^{18}$ Bq |
| I-131: | 1.8 x $10^{18}$ Bq |
| Cs-137: | 85 x $10^{15}$ Bq |
| Sr-90: | 10 x $10^{15}$ Bq |
| All Pu: | 3 x $10^{15}$ Bq |

<u>To the air</u>

| | |
|---|---|
| I-131: | 0.16 x $10^{18}$ Bq |
| Cs-137: | 15 x $10^{15}$ Bq |

<u>To the sea</u>

| | |
|---|---|
| I-131: | 2.8 x $10^{15}$ Bq |
| Cs-134: | 0.94 x $10^{15}$ Bq |
| Cs-137: | 0.94 x $10^{15}$ Bq |

(source) IAEA report “STI/PUB/1239” (2006)

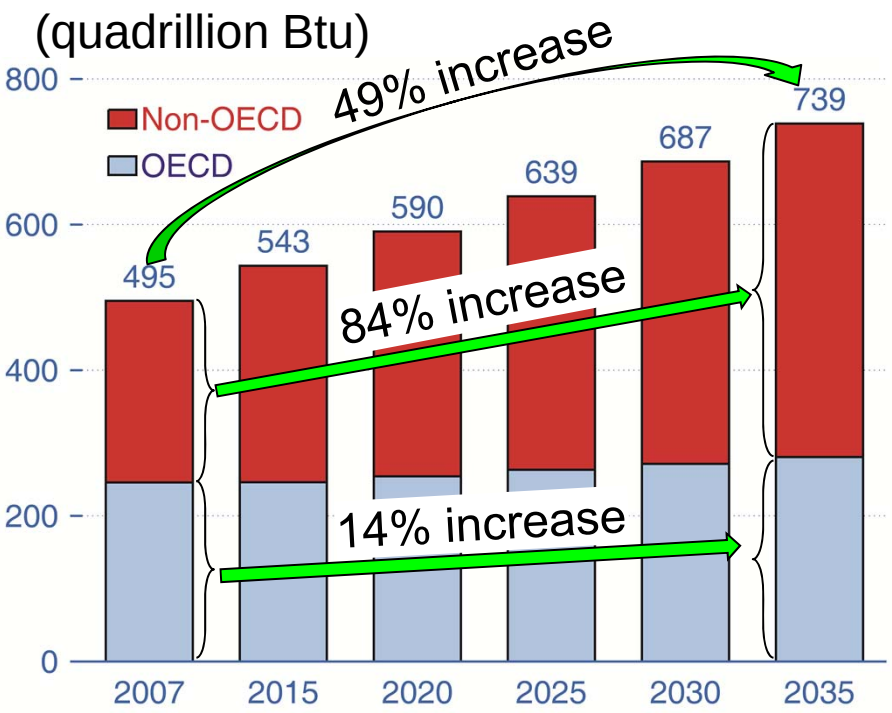
(Source)Report of Japanese Government to the IAEA Ministerial Conference on Nuclear Safety

# Dissemination of Information

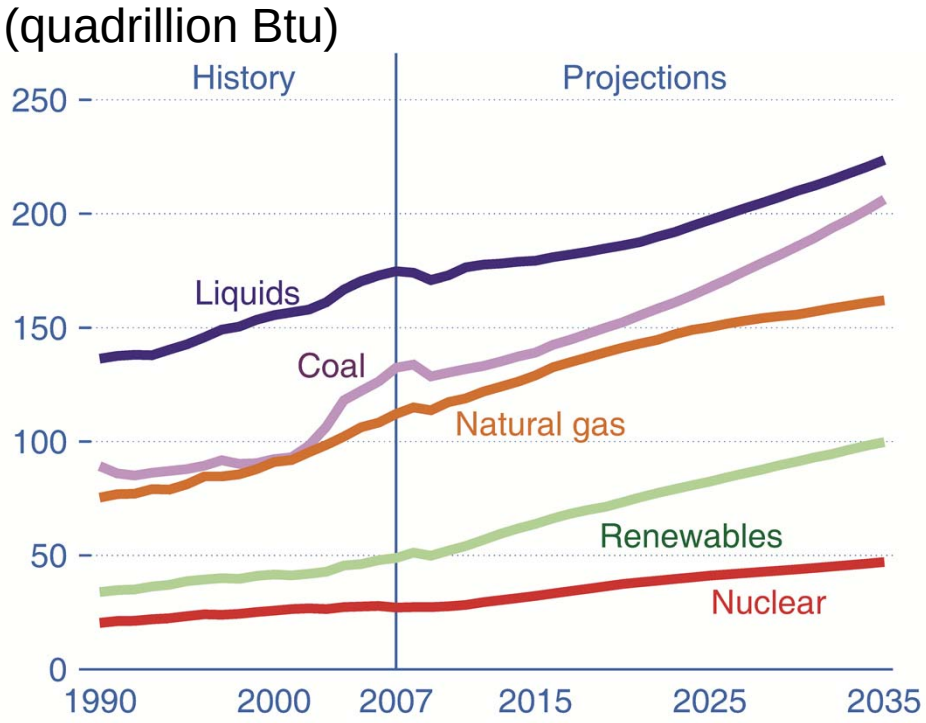
- Daily press conference by Government and TEPCO
- Acceptance of IAEA's International Fact-Finding Expert Mission, which delivered several preliminary findings and lessons learned to the IAEA Ministerial Conference in June 2011.
- Submission to this Conference a report outlining Japan's preliminary assessment of the situation and lessons learned thus far.

Japanese Government will continue to communicate the status of the accident to the international community in an accurate and timely manner ant share the lessons learned with international community.

# Projection of World Energy Consumption




World marketed energy consumption, 2007-2035

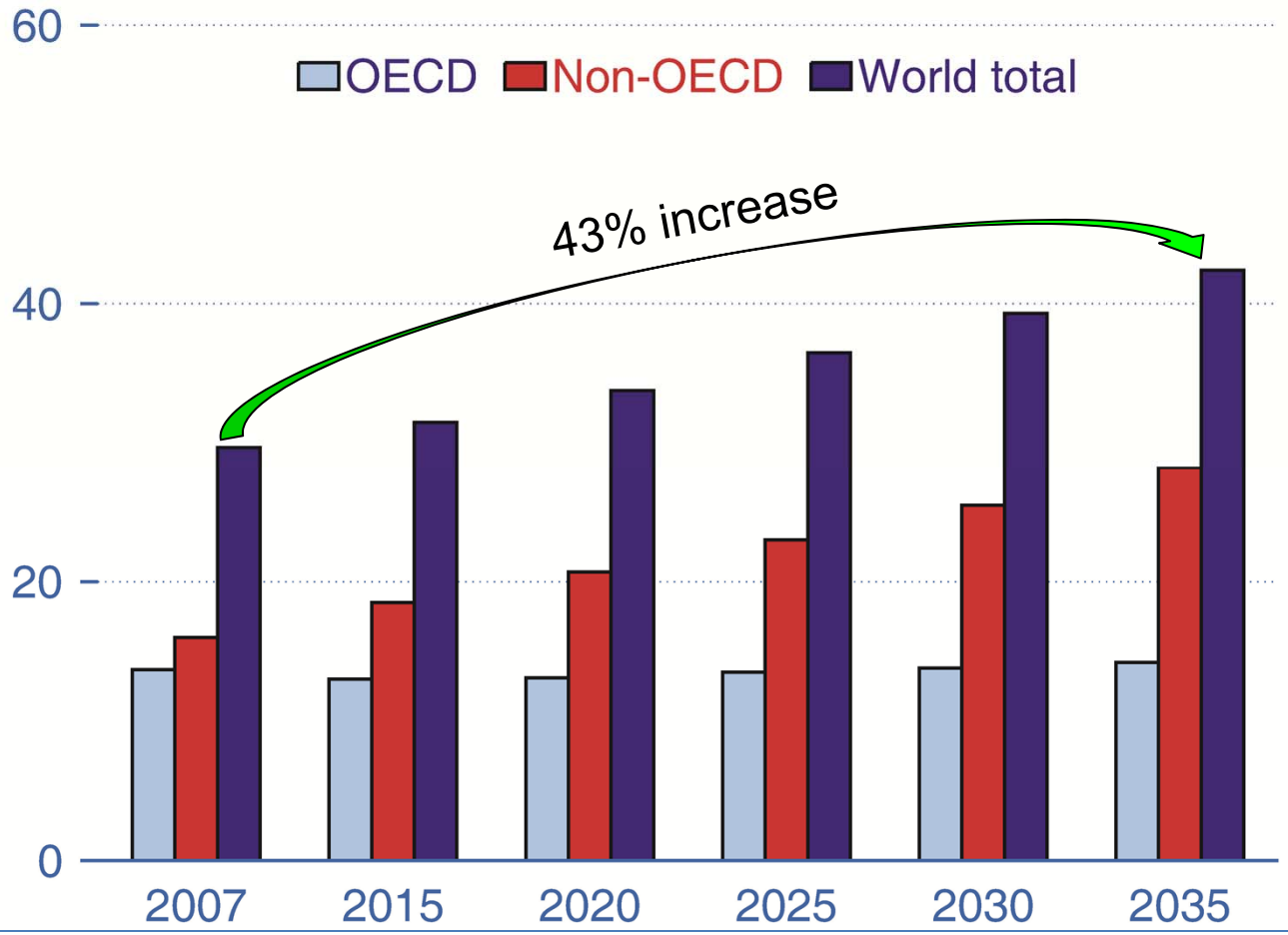



World marketed energy use by fuel type, 1990-2035

(Source) DOE/EIA, International Energy Outlook 2010

# Projection of Carbon Dioxide Emission

(billion metric tons)

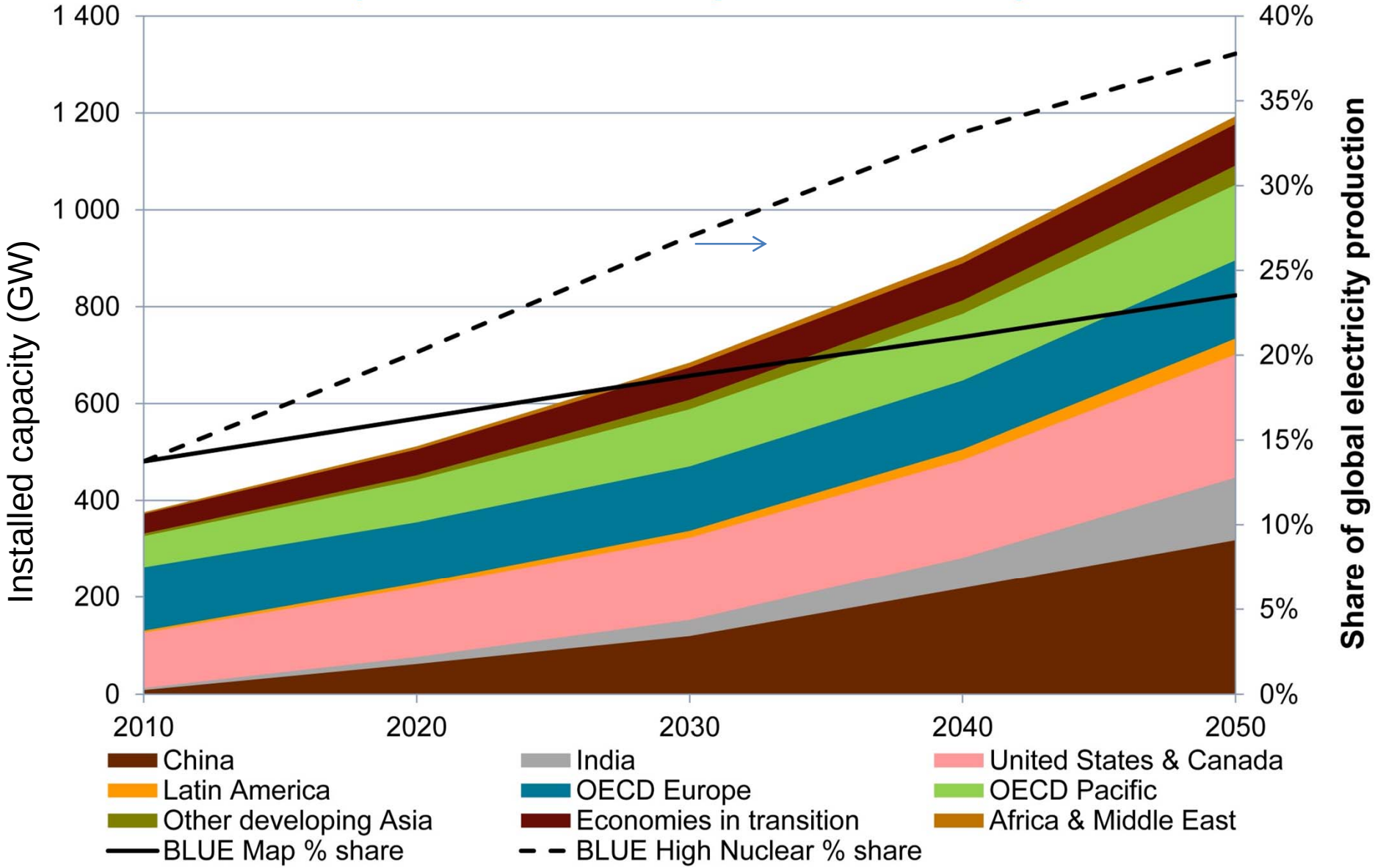



| | 2007 | 2015 | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|---|---|
| (Non-OECD)/(OECD)= | 1.17 | 1.43 | 1.57 | 1.71 | 1.85 | 1.99 |

World energy-related carbon dioxide emission, 2007-2035

(Source) DOE/EIA, International Energy Outlook 2010

# Growth in Nuclear Capacity to 2050 (IEA Blue Map Scenario)




(source: The IEA/NEA Nuclear Energy Technology Roadmap)

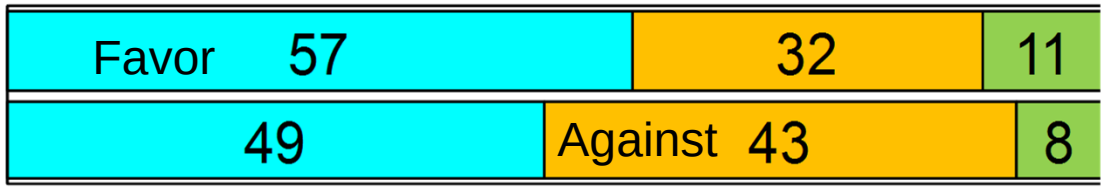
# Nuclear Safety, Security and Safeguards to Assure Nuclear Nonproliferation

- Safety
  - Convention on Nuclear Safety
    - Define basic principles for siting, design, construction, operation, the availability of adequate financial and human resources the assessment and verification of safety, quality assurance and emergency preparedness.
    - Hold a meeting every two years to review the observance of the principles specified in the Convention based on country reports.
  - IAEA's international nuclear safety regime:
    - Prepare safety standards.
    - Appraise the application of and compliance with the IAEA standards.

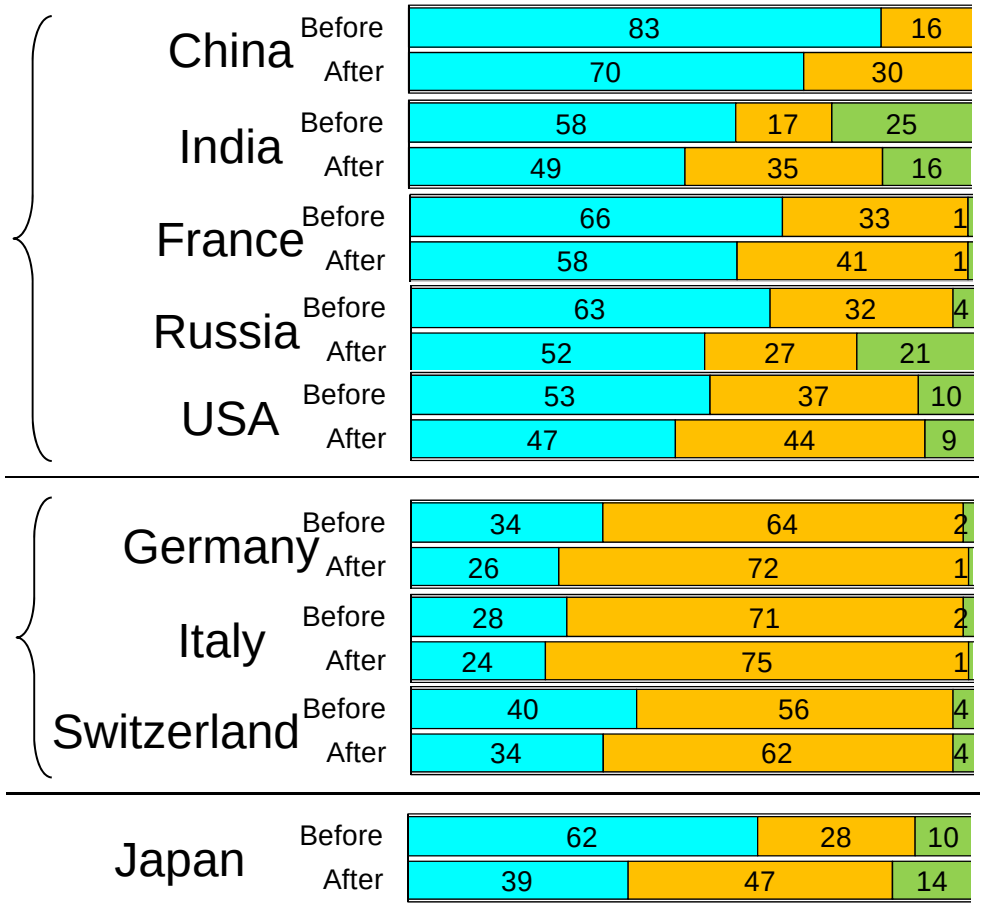
# Nuclear Safety, Security and Safeguards to Assure Nuclear Nonproliferation (2)

- Security
  - Convention on the Physical Protection of Nuclear Material
  - IAEA activities to prepare guidance and recommendations
  - International agreements and resolutions ( UN SC, Summits  etc.) to implement the IAEA guidance and recommendations
- Nuclear Non-Proliferation
  - NPT, Comprehensive Safeguards Agreements with the IAEA and Additional Protocols (AP)
  - Three states problem, violation, AP+, and multilateral approaches for fuel cycle activities

# Public opinions for nuclear energy before and after Fukushima ( March 21-April 10, 2011)




- Net favor globally falls from 25% to a mere 6%, though supporters continue to outnumber opponents by 49% : 43%.
- Majority keeps “Favor" in China, India, France, Russia and USA.
- Majority keeps “Against” as before in Germany, Italy and Switzerland.
- In Japan majority changes from “Favor” to “Against”.




(Source) Impact of Japan Earthquake on Views about Nuclear Energy
Finding from a Global Snap Poll in 47 countries by WIN-Gallup International

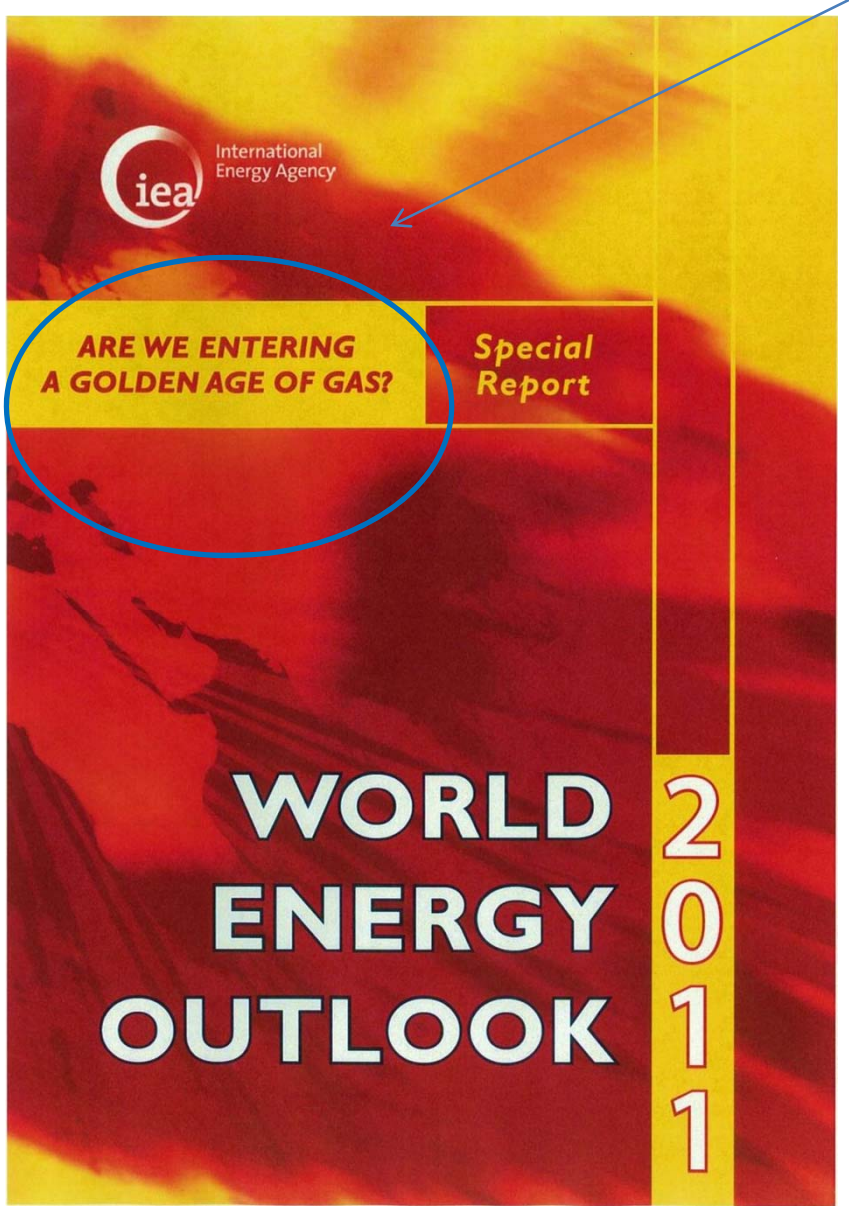
# Nuclear Energy Policy After Fukushima

- USA
  - Speech on U.S. energy security by President Obama (March 30), including the continuous use of nuclear energy and direction to NRC to review the safety of NPPs in the US.
  - NRC's Japan task force judged that continued operation do not pose an immediate risk to public health and safety. At the same time, though it recommended changes to defense-in-depth measures at nuclear plants; cites station blackout, seismic, flooding and spent fuel pools as areas for improvement.
- EU
  - Implementation of "Stress tests" that review the margin against beyond design basis events or unexpectedness.
  - Announcement to continue the use of nuclear energy: UK, France, Northern and Eastern parts of Europe
  - Decision to change the nuclear energy policy in Germany, Austria, Italy and Switzerland
- Russia
  - Pursue "Stress tests" and propose strengthening of the International standards for reactor safety

# Nuclear Energy Policy After Fukushima (2)

- China
  - Stop licensing activities for new plants, while performing safety review of existing plants. Will improve safety standards.
- G8
  - The events in Japan confirm that there is a continuing need to re-evaluate safety and we recognize the importance of learning from the Fukushima accident and its aftermath.
  - Encourage countries to make use of the relevant IAEA capabilities to help enhance the safety of their nuclear installations.
- IAEA
  - Has the important role for the enhancement of nuclear safety world wide.
  - Plans to improve its safety standards, strengthen the review process by international specialists on nuclear power plants
  - Urges the assurance of effectiveness and independency of nuclear regulatory agency
  - Support emergency response in countries and accept and transmit information

# Future Prospect: An Example




- Global uncertainties afflicting the energy sector can be seen as opportunities for natural gas. All regions have the potential to increase gas production and enhance overall energy security. Based on the assumptions of the GAS scenario, from 2010 gas use will rise by more than 50% and account for over 25% of world energy demand in 2035.
- Natural gas will displace coal and to a lessor extent oil, driven down emissions, but it will also displace some nuclear power, pushing up emissions: global energy related $CO_2$ emissions will be only slightly lower than those in the New Policies Scenario.
- To limit the increase in global temperature to 2 ℃ requires a greater shift to low-carbon energy sources, increased efficiency in energy usage and new technologies, including carbon capture and storage.

# AEC today

We are promoting to

- identify all of the effects of radioactive material dispersion and plan to make utmost effort to reduce them as soon as practicable.
- Make sure the safety of other nuclear power plants for the public to allow them continue the operation.

As for Japan's future nuclear energy policy, we will

- Rectify the defects in our present system
- Pursue the establishment of new policy that reflects the voice of the nation about the role of nuclear energy in our energy supply mix and the Japan's roles in international nuclear regime.