

Presentation at session8-2 “Fukushima-Daiichi lessons learned” WECC2015, Kyoto, December 1, 2015

Utilization of Nuclear Power in Japan

Yoshiaki Oka

Chairman, Japan Atomic Energy Commission

Emeritus professor, the University of Tokyo

The views expressed here are of my own and do not necessarily reflect those of JAEC nor the government

contents

1. Japan Atomic Energy Commission
2. Energy demand and energy security
3. Nuclear power plants
4. Strategic energy plan
5. Mitigation of mental and social impact of big nuclear accidents

Administrative Organizations for Nuclear Energy Policy

Cabinet Office

Atomic Energy Commission (AEC)

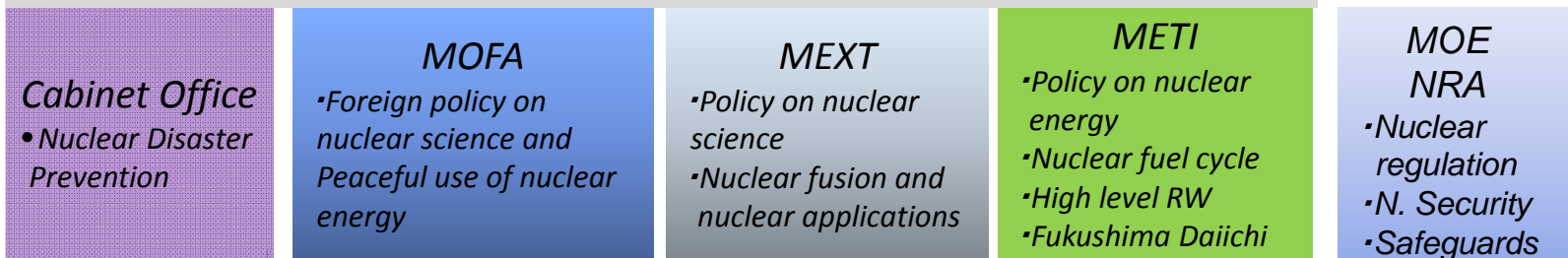
Discuss and form a plan on:

- **Policy on nuclear energy research, development and utilization**
 - General Idea
 - Lessons learned from Fukushima Dai-Ichi accident
 - Approach to utilization of nuclear power generation
 - Research and development
 - Utilization of nuclear resources under a volatile international environment
 - Public understanding, education & development of human resources
- **Important policy matters on nuclear energy utilization e.g., coordination among relevant ministries on nuclear energy research, development and utilization**

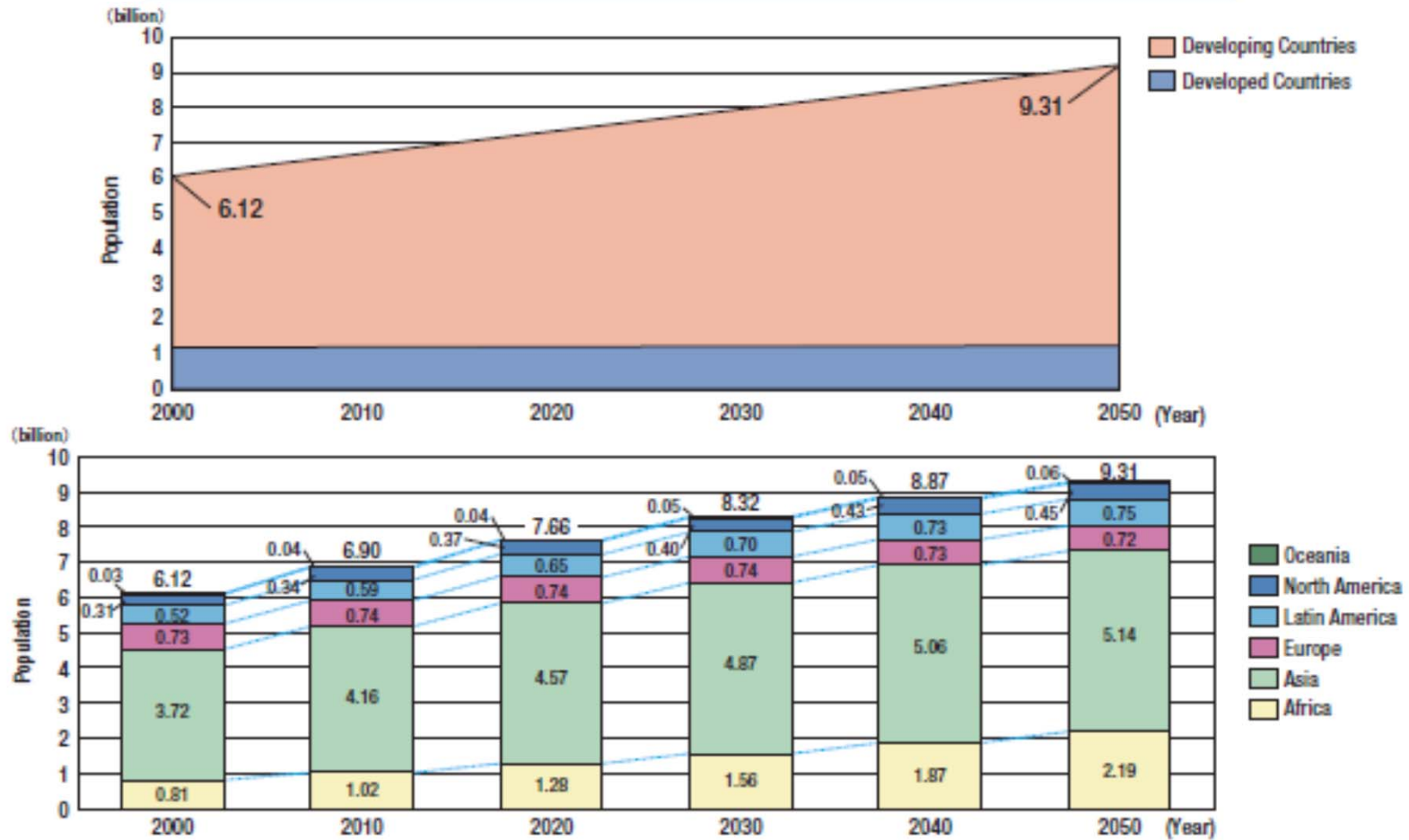
Basic Guidelines



Ministries that own individual policy matters



World Population Projections

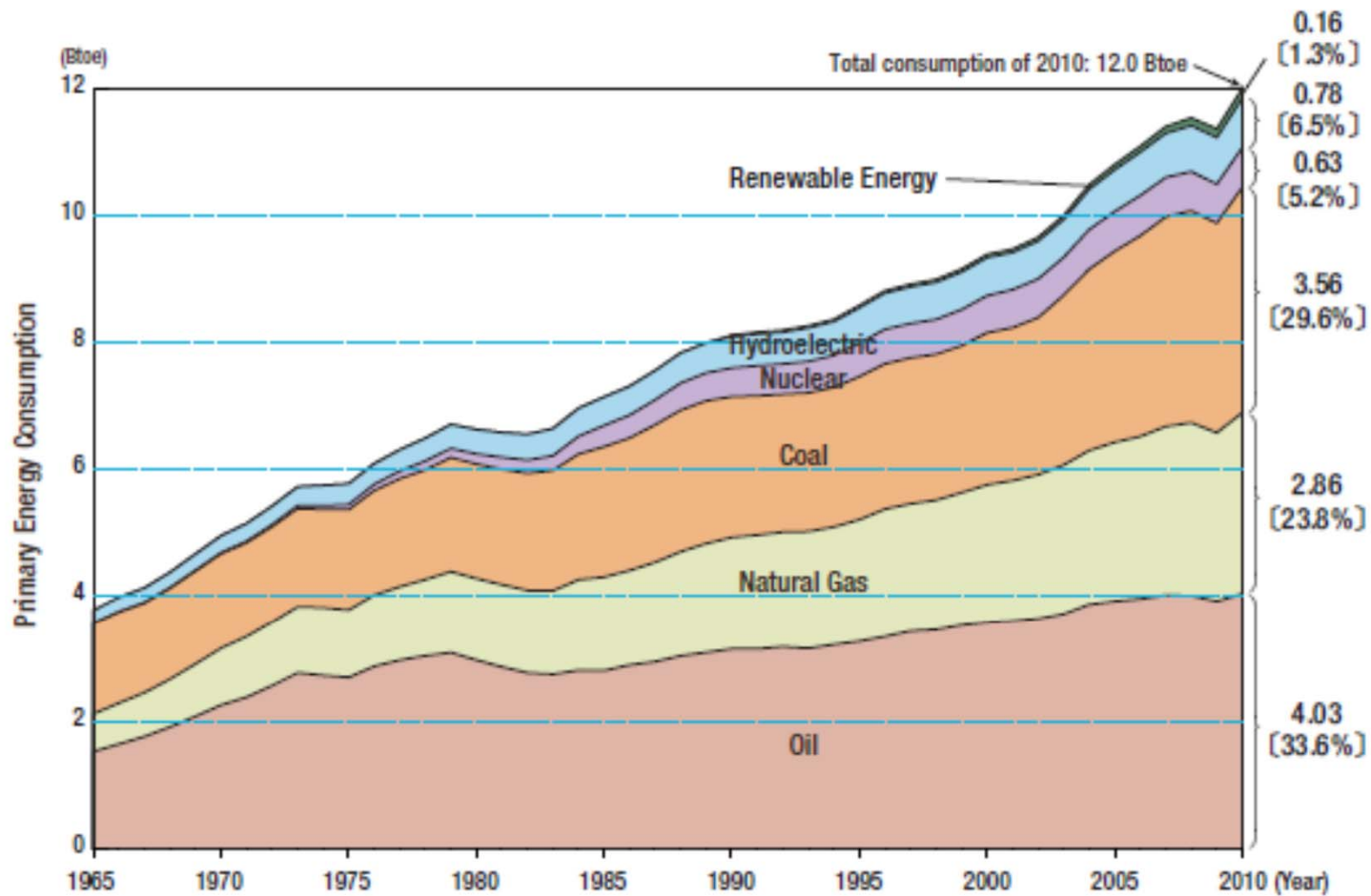


(Note) Figures may not add up to the totals due to rounding.

Source: World Population Prospects: The 2012 Revision (October 2013 release)

Source: http://www.fepec.or.jp/library/pamphlet/zumenshu/pdf/all_english.pdf

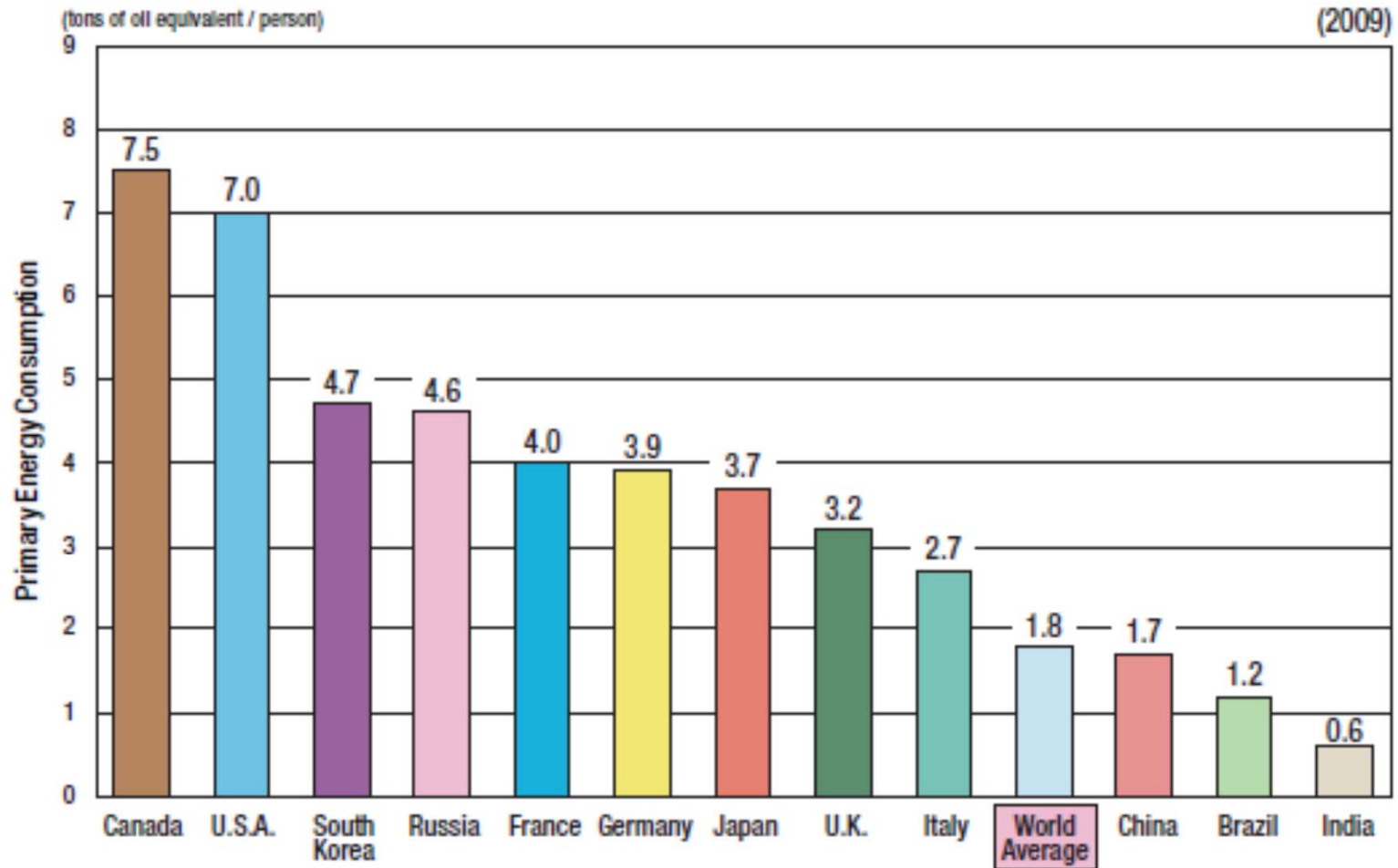
The World's Primary Energy Consumption



(Note) Figures may not add up to the totals due to rounding.
 The figures in parentheses are share of total.
 Btoe: billion tons of oil equivalent

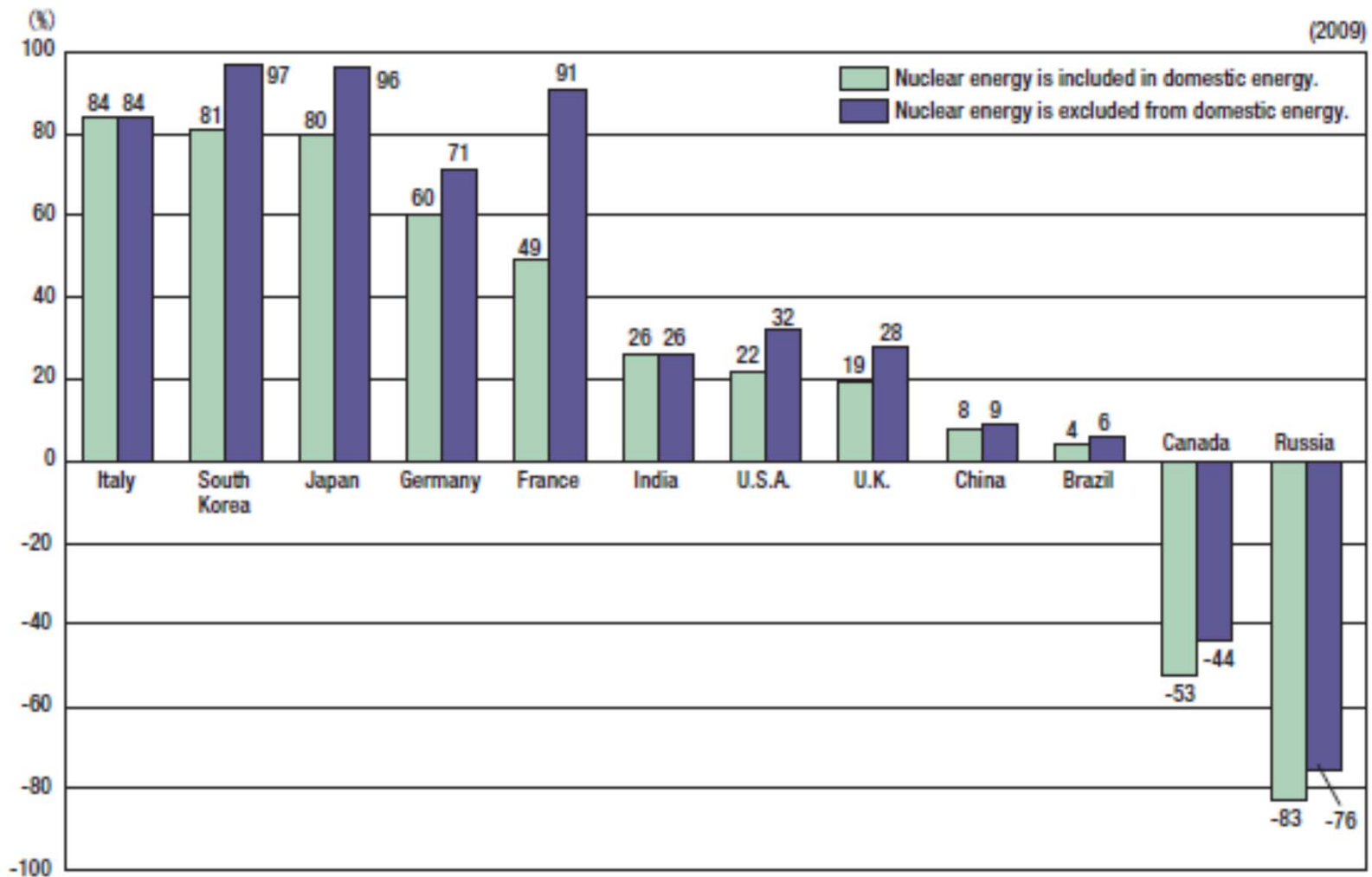
Source: http://www.fepec.or.jp/library/pamphlet/zumenshu/pdf/all_english.pdf

Primary Energy Consumption per Capita



Source: http://www.fepec.or.jp/library/pamphlet/zumenshu/pdf/all_english.pdf

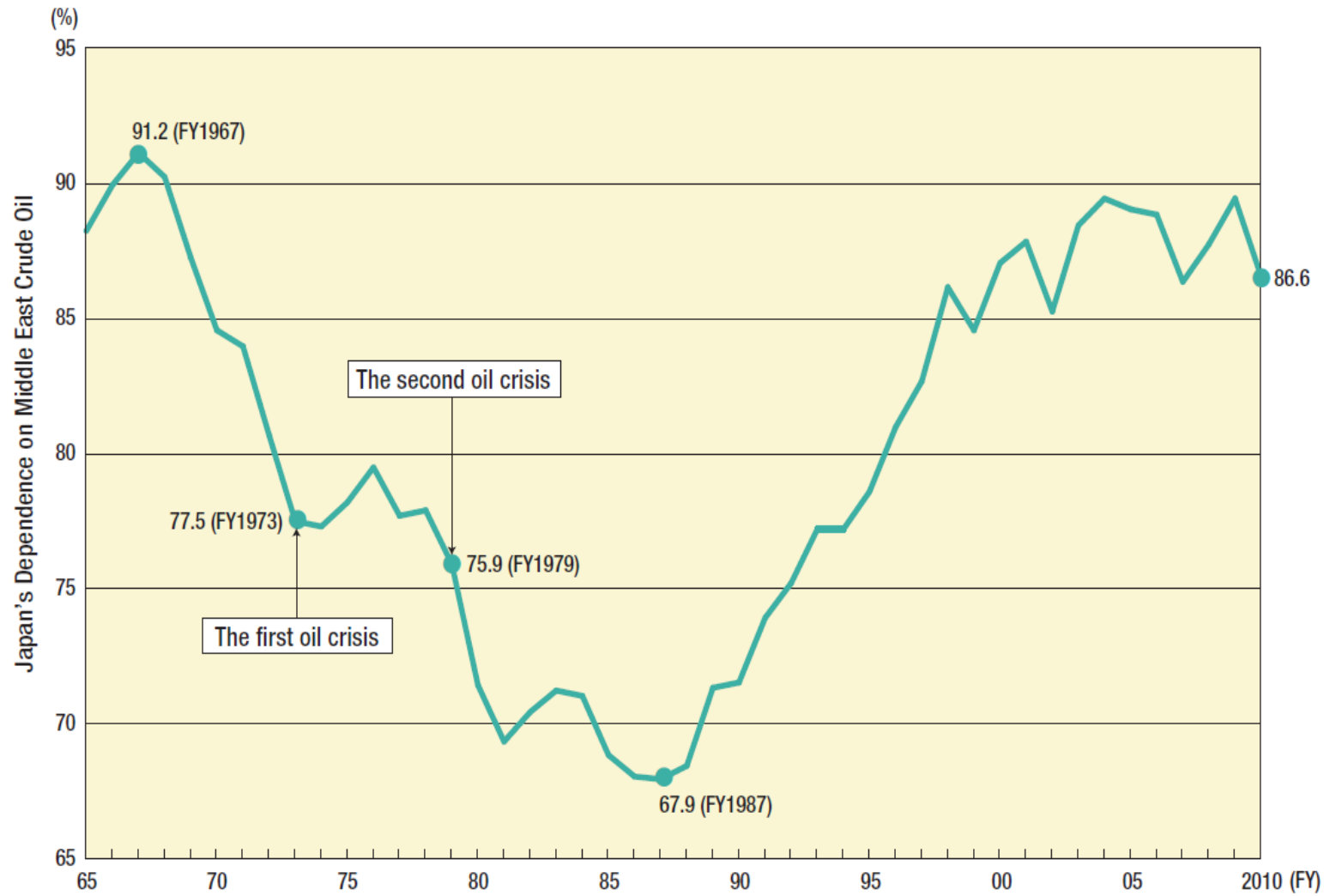
Dependence on Imported Energy Sources in Major Countries



(Note) Canada and Russia are net-exporting countries.

Source: http://www.fepc.or.jp/library/pamphlet/zumenshu/pdf/all_english.pdf

Japan's Dependence on Middle East Crude Oil of Total Imports



Energy Security

- Developed countries have only 20% of the global population. Emerging countries will need huge energy resources for their development.
- Japan's self-sufficiency rate of primary energy excluding nuclear energy is only 6%. Japan largely depends on the Middle East for crude oil and LNG supply.
- Fossil fuel resources are unevenly distributed around the world. Most of the wars and disputes around the world are conflicts over energy resources.
- High dependency on imported energy resources is a high risk.
- Due to the suspension of operation of nuclear power plants, Japan has to buy expensive LNG. Electricity tariff rose about 30%. Approx. 4 Trillion Yen of national wealth is lost a year.

Nuclear Power Utilization in Japan

43 LWR plants; BWR and PWR

9 utilities (TEPCO, Kansai, Chubu etc.) by region and
JAPC and J-Power(EPDC)

First LWR demo (JPDR, 12MWe BWR) in 1959

First commercial plant (GCR) in 1965, LWR in 1970

3 Manufacturers; Toshiba, Hitachi and MHI

3 nuclear fuel manufacturers; GNF, Mitsubishi NF, NFI

Commercial nuclear fuel cycle program by JNFL
(enrichment, spent fuel reprocessing and low level
radioactive waste disposal) in Rokkasho-mura

Only for peaceful use, no nuclear weapon by law

Uniqueness of Nuclear Energy

Nuclear energy can serve all of the needs,

- ① Energy security
- ② Economic efficiency
- ③ Mitigation of global warming

It is economical electricity source if used long and stably.

Strategic Energy Plan (METI, April 2014)

Chapter 2: Basic Policy – Nuclear Power

Position:

- Quasi-domestic energy source with superiority in stability of energy supply and efficiency, low and stable operational cost and free from GHG emissions.
- An important base-loaded power source contributing to stability of energy supply-demand structure.

Policy Direction

- On the premise that safety comes before everything else, proceed with the restart of the nuclear power plants in case the NRA confirms conformity with the regulations.
- Dependency on nuclear power generation will be lowered to the extent possible by energy saving and introducing renewable energy as well as improving efficiency of thermal power generation, etc. Will carefully examine a volume of electricity by nuclear power generation.
- Steadily make efforts to deal with spent fuel problem as a responsibility of the current generation.

Strategic Energy Plan

Chapter 3 – Section 4 Re-establishment of the nuclear energy policy

1. Sincere reflection on the TEPCO's Fukushima nuclear accident
2. Efforts towards restoration and reconstruction of Fukushima
3. Untiring pursuit of safety and establishment of stable environment for nuclear operation
4. Steady approach without putting off implementing measures into the future
 - (1) Solutions of spent fuel management
 - Final disposal of high-level radioactive waste
 - Expanding storage capacity of spent fuel
 - (2) Promotion of the nuclear fuel cycle
 - Reprocessing and plutonium use in LWRs
 - Flexibility of mid- to long-term approaches
 - Technology development on volume reduction and mitigation of harmfulness of radioactive waste
5. Establishment of confidential relationship with people, nuclear host municipalities and international community

Electricity demand and supply in 2030

Electricity demand

Economic growth
1.7%/y



2013

Saving
(-17%)



980.8
Billion
kWh

2030

Power sources

Total generation
1065
Billion kWh

Renewables
22-24%

Nuclear
20-22%

LNG
27%

Coal
26%

Oil
3%

Blomass
3.7-4.6%

Solar
7.0%

Hydro
8.8-9.2%

Geothermal
1.0-1.1%

Wind
1.7%

Loss

2030

Source; Long-term energy supply and demand outlook, July 2015 METI

Challenges for the Government and the Nuclear Industry after Fukushima Accident

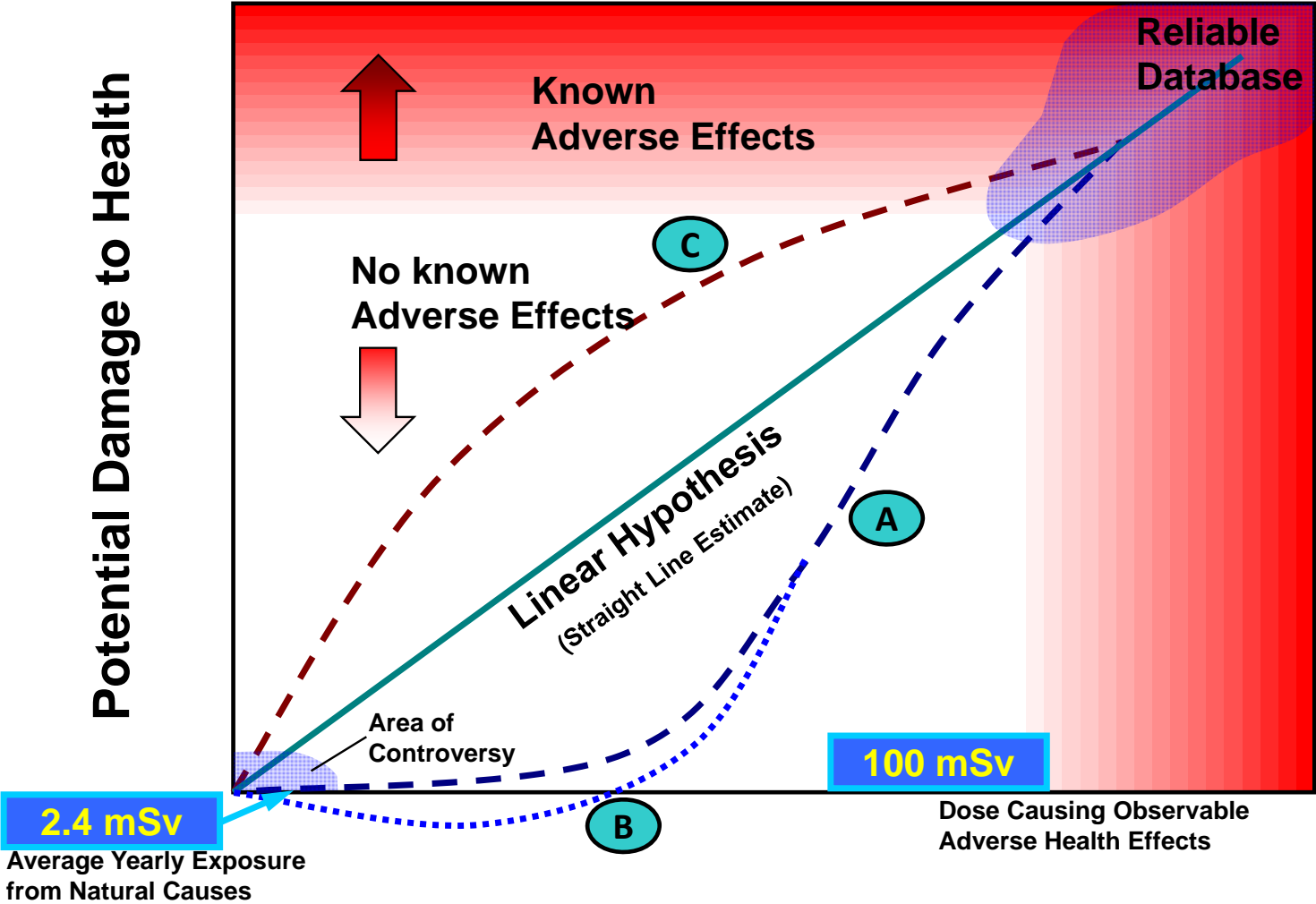
- (1) TEPCO and the Government need to complete decommissioning of Fukushima Daiichi NPPs and restoration of the area affected by the accidents.
- (2) Nuclear Regulatory Agency (NRA) needs to establish independent, open, efficient, clear and reliable regulation.
- (3) The nuclear industry must pursue the world's highest level of safety through continuous safety improvement.
- (4) It is our responsibilities to share the lessons learnt from the Fukushima Accident with the international communities and to contribute to peaceful use of nuclear energy and nuclear nonproliferation while many developing countries are introducing/expanding nuclear power generation.
- (5) The nuclear industry as well as the Government must maintain nuclear technologies and human resources in order to contribute to peaceful use of nuclear energy, decommissioning, and nuclear safety.

Source: METI

Mitigation of mental and social impact of big nuclear accidents

Health effect of low level radiation

- Acute health effect occurs above threshold (high) dose.
- Linear non-threshold model (linear hypothesis) is used for estimating latent health effect (cancer) at low dose



Source: A.E.Waltar

Radiation Dose [mSv]

Health implications of radiation exposure of the public resulting from Fukushima Daiichi NPS accident (UNSCEAR 2013 Report, Appendix E)

- “No discernible risk”: An increased incidence of effects is unlikely. Consequences are small relative to the baseline risk and uncertainties.
- The most important health effects would appear to be on mental and social well-being as a consequence of the evacuation and their displacement to unfamiliar surroundings, and the fear and stigma related to radiation exposure. For example more than 50 hospitalized patients died either during or soon after the evacuation, probably because of hyperthermia, dehydration or deterioration of underlying medical problems. Upward of 100 elderly people may have died in subsequent months.
- Understanding full health impact of accident forms an important context for the Committee’s commentary.

“Maintaining health” should be the goal

- Order of “sheltering” made most people escape from their homes, but those weak in disaster (single elderly people, patients etc.) were left and separated from outside area.
- Displacement worsen health of the evacuees. No working (farming) increases instability of legs, sugar disease, fatness, osteoporosis
- Displacement for avoiding low level of radiation exposure increased other health risks. It is effective, only when other risks do not increase.
- Lack of exercise and fatness increase cancer risk 1.2 times, equivalent to 100-200mSv of exposure.
- Telling only “radiation” risk increased fear of “radiation”. Radiation risk is a part of cancer risk. It is a part of health risk.
- “Maintaining health” should be the goal for avoiding mental and social health effects of nuclear accidents.

Source: Sae Ochi, Energy review pp7-10, April 2015,(in Japanese)

Lessons of risk communication and management of nuclear accidents

- LNT model is a hypothesis, not a scientific fact. But it assumes that risk is NOT zero. Start to tell “no risk” was a wrong way, failed and increased fear of radiation in Fukushima. It is logically impossible to prove “zero risk”. Start to tell “Cancer risk of radiation exposure is NOT zero” looks a good way of risk communication.
- Telling various cancer risks in human life and its uncertainty at low exposure is the way. Cancer risk of low radiation exposure is within the uncertainty.
- Comparing various cancer risks such as radiation, chemicals, etc. is necessary, but will be not enough to manage mental and social effects.
- “Maintaining health” is good goal for managing the problems and taking actions at severe nuclear accidents.