

The 3/11 Fukushima Nuclear Accident: Current Status, Lessons Learned and Possible Implications for Future Energy Policy

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



Summary (1)

- The 3/11 Fukushima nuclear accident triggered by the East Japan Great Earthquake and Tsunami has become one of the worst nuclear accidents (3 core meltdown) not only in Japan but also in the world, and not yet under control.
 - INES level 7, radioactivity discharge(air and the sea) & contaminated land area : 1/5~1/10 of the Chernobyl,
 - It will take at least 6-9 months to stabilize the situation
- Securing safety and welfare of local public is the first priority. At the same time, assuring safety of existing nuclear power plants, including spent fuel storage, is also critically important.
 - Some hot spot area exists beyond evacuation area and careful monitoring is needed. Evacuee is unlikely to be able to return by the end of the Year.
 - Hamaoka nuclear plant has been shutdown by PM request. 35 units out of 54 units are now shutdown, and more could be shutdown.



Summary (2)

- It is Japan's responsibility to disclose and share the information as much as possible with the public and the rest of the world.
 - IAEA fact-finding team has published preliminary findings, suggesting improvement in regulatory and emergency preparedness
 - The gov't has established independent accident investigation committee
 - The gov't issued report to the IAEA, summarizing 28 lessons learned
- Future nuclear and energy policy will need to be thoroughly discussed with all stakeholders and nationwide public debate.
 - Current energy policy (build 14 more reactors, 50% nuclear share by 2030) will be scrapped.
 - More emphasis on new energy sources and conservation is expected, but role of nuclear power has not been denied.
 - Public opinion is gradually shifting towards “reducing dependency on nuclear energy”
 - We need a nationwide public debate for future energy policy



Loss of all power sources due to the Earthquake and Tsunami

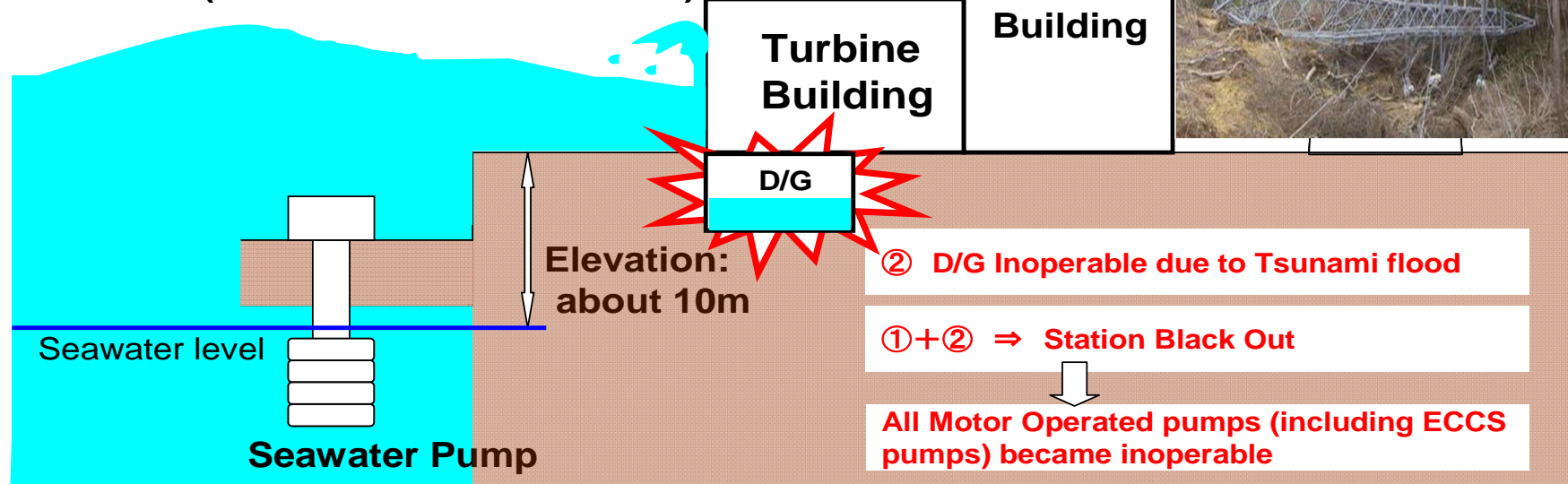


Note:

- All operating units when earthquake occurred were automatically shut down.
- Emergency D/Gs have worked properly until the Tsunami attack.

① **Loss of offsite power due to the earthquake**

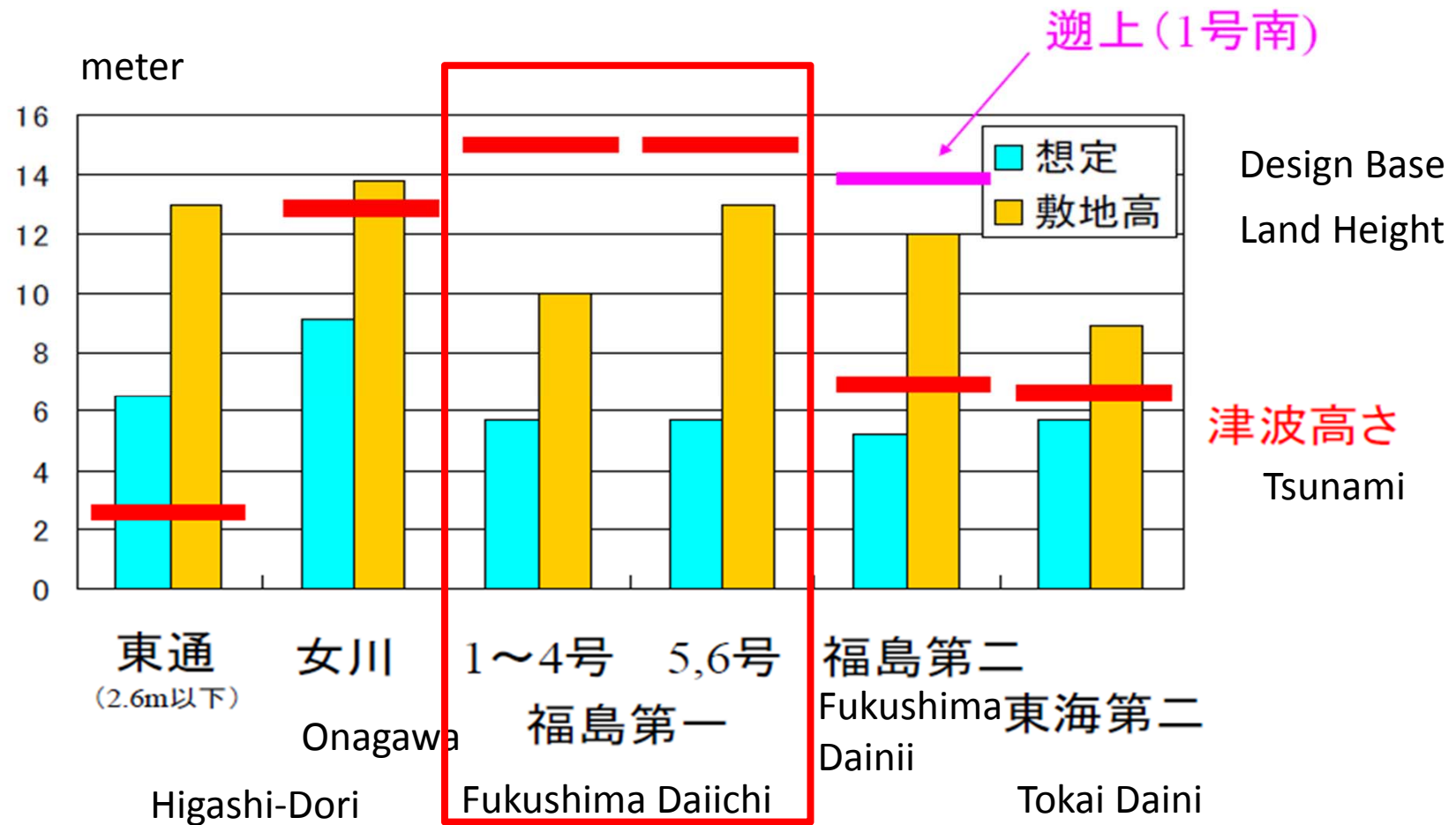
Tsunami (estimated more than 10m)



Source: Nuclear and Industry Safety Agency(NISA), April 4, 2011, at IAEA

<http://www.nisa.meti.go.jp/english/files/en20110406-1-1.pdf>

Tsunami, Design Base and Land height



Source: Takashi Okamoto, "Current Status and Lessons learned from the Accident", May 21, 2011
http://www.aesj.or.jp/aesj-symp/presentations/01-01_okamoto.pdf (in Japanese)

Timeline of event: No. 1 unit

- Delay in cooling and venting? -

11th

14:46 *Earthquake hit the NPP*

15:37 *Tsunami hit, all AV power lost*

16:36 *All cooling capability lost (nuclear emergency declared by TEPCo)*

~17:00 *core exposed, possible meltdown start*

23:00 *Radiation level at control room is reported to be high (0.5~1.2mSV/h)*

12th

3:15 *METI/TEPCo announced the decision to vent*

5:46 *Started pumping water to the reactor core*

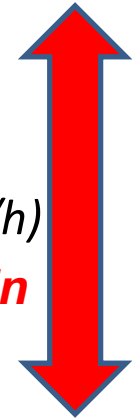
6:50 *METI/NISA ordered TEPCo to vent*

9:04 *TEPCo started venting operation (after confirmation of evacuation)*

14:30 *Confirmed venting*

15:36 *Hydrogen explosion*

14hrs9min



Safety Regulation on Sever Accident

- The Regulatory Guide for Reviewing Safety Design *does not take total AC power loss as a design basis event.*
 - *No particular considerations are necessary against a long-term total AC power loss*
 - the assumption of a total AC power loss is not necessary if the emergency AC power system is reliable enough
 - Loss of all seawater cooling system functions is not taken as a design basis event.
- Flammability Control System (FCS) is not aimed at preventing hydrogen combustion *inside the reactor building*
- In Japan, a civil standard on seismic PSA is also established, *while study of PSA related to other external events such as flooding has only started.*
- (Based on NSC decision in 1992).. licensees have taken *voluntary actions (not included in regulatory requirements)*, such as measures to prevent accidents from becoming severe accidents



INES Level is now 7

Discharge quantity is roughly 1/5~1/10 of Chernobyl

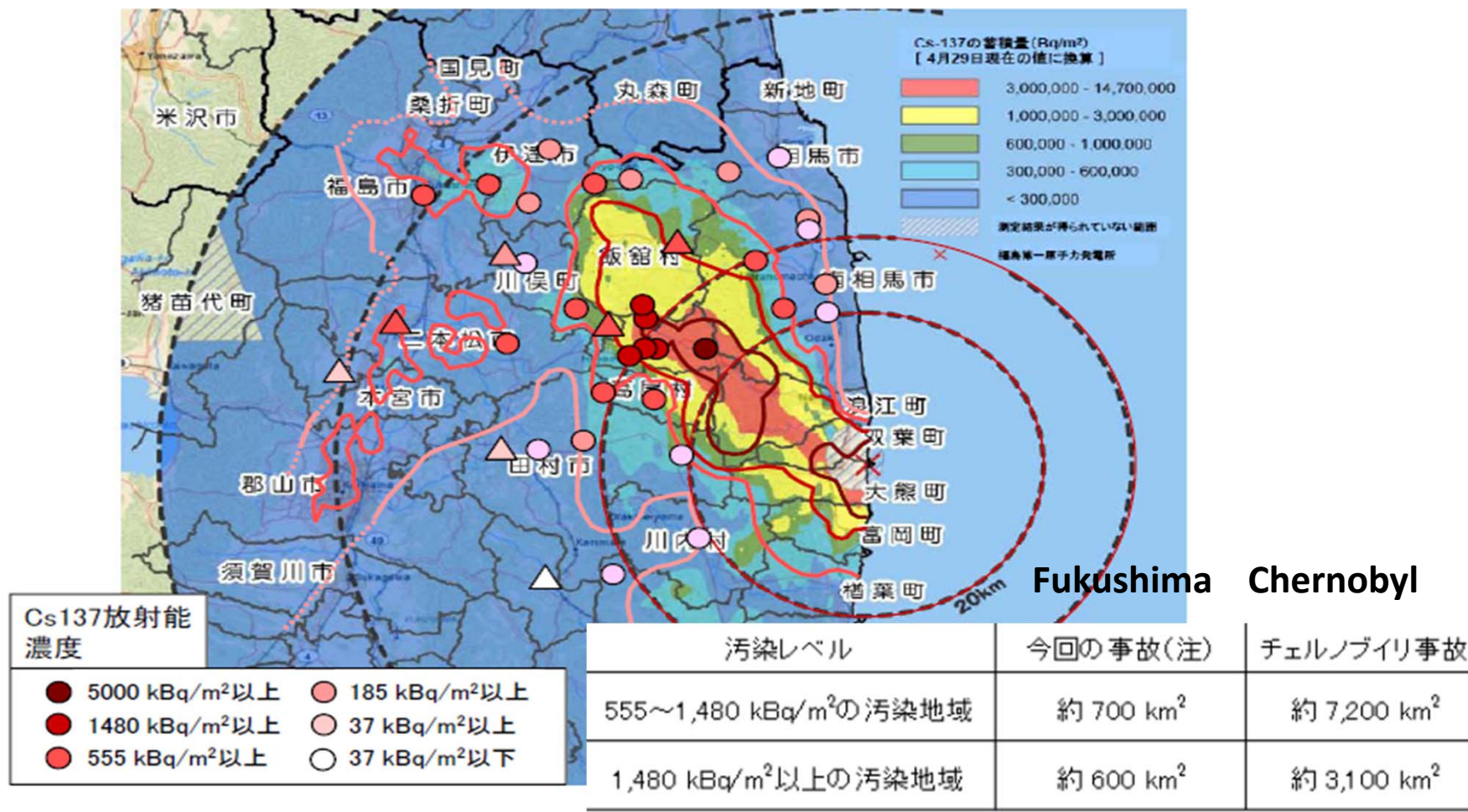
	Assumed amount of the discharge from Fukushima Dai-ichi NPS		(Reference) Amount of the discharge from the Chernobyl accident
	Estimated by NISA	Announced by NSC	
^{131}I ... (a)	$1.3 \times 10^{17} \text{ Bq}$	$1.5 \times 10^{17} \text{ Bq}$	$1.8 \times 10^{18} \text{ Bq}$
^{137}Cs	$6.1 \times 10^{15} \text{ Bq}$	$1.2 \times 10^{16} \text{ Bq}$	$8.5 \times 10^{16} \text{ Bq}$
(Converted value to ^{131}I) ... (b)	$2.4 \times 10^{17} \text{ Bq}$	$4.8 \times 10^{17} \text{ Bq}$	$3.4 \times 10^{18} \text{ Bq}$
(a) + (b)	$3.7 \times 10^{17} \text{ Bq}$	$6.3 \times 10^{17} \text{ Bq}$	$5.2 \times 10^{18} \text{ Bq}$

Source: NISA, April 12, 2011 <http://www.nisa.meti.go.jp/english/files/en20110412-4.pdf>



Contamination Map by MEXT and DOE (as of May 6, 2011)

5月6日公表文科省・米国DOE航空機モニタリング結果との重ね合わせ



Source: T. Kawada, "Current Status of Soil Contamination and how to respond,"
Presentation at Japan Atomic Energy Commission Meeting, May 24, 2011
<http://www.aec.go.jp/jicst/NC/iinkai/teirei/siryo2011/siryo16/siryo2.pdf>



Statement by JAEC (2011/04/05)

- “We are gravely concerned about this accident which can fundamentally undermine public trust in safety measures, not only in Japan but also in other countries”
- “...we have decided to suspend this (deliberation) process (of new Framework for Nuclear Energy Policy) for the foreseeable future.”
- “It is our intention to take appropriate measures when all safety measures necessary are identified comprehensively, based on thorough investigation of the causes of the accident, as well as on the results of a nationwide public debate on overall energy policy.”



JAEC's Statement (2011/05/10)

- “If they (the regulatory authorities) judge that the measures are insufficient, they should take strict steps, including shutdown, in accordance with laws and regulations”
- “Moreover, on the recognition that the social environment surrounding nuclear power generation has dramatically changed as a result of the accident at the Fukushima Dai-ichi Nuclear Power Plant, JAEC will start sorting out the important issues to be considered when making decisions on nuclear policy in the future”



Source: http://www.aec.go.jp/jicst/NC/about/kettei/seimei/110510_e.pdf

Report of Japanese Government to the IAEA Ministerial Conference on Nuclear Safety (06/07/2011)

- 5 Categories 28 list of Lessons learned
 1. Strengthen preventive measures against a severe accident
 2. Enhancement of Responsive measures against a severe accident
 3. Emergency responses to nuclear disaster accident
 4. Robustness of the safety infrastructure established at the nuclear power station
 5. Thoroughness in safety culture while summing up all the lessons.

Source: Nuclear Emergency Response Headquarters, Government of Japan,
""Report of Japanese Government to the IAEA Ministerial Conference on Nuclear Safety

-The Accident at TEPCO's Fukushima Nuclear Power Stations -", June 2011.

http://www.kantei.go.jp/foreign/kan/topics/201106/iaea_houkokusho_e.html



Summary of Preliminary Findings by the IAEA Fact Finding Team (11/06/01)

- The response on the site by dedicated, determined and expert staff, under extremely arduous conditions has been exemplary and resulted in the best approach to securing safety given the exceptional circumstances.
- The Japanese Government's longer term response to protect the public, including evacuation, has been impressive and extremely well organized.
- The tsunami hazard for several sites was underestimated. Nuclear designers and operators should appropriately evaluate and provide protection against the risks of all natural hazards, and should periodically update these assessments.
- Defence in depth, physical separation, diversity and redundancy requirements should be applied for extreme external events, particularly those with common mode implications such as extreme floods.

Source: IAEA International Fact Finding Expert Mission of the Nuclear Accident Following the Great East Japan Earthquake and Tsunami, Preliminary Summary, 24 May -1 June, 2011.

<http://www.iaea.org/newscenter/focus/fukushima/missionsummary010611.pdf>



Summary of Preliminary Findings by the IAEA Fact Finding Team (11/06/01)

- Nuclear regulatory systems should address extreme external events adequately, including their periodic review, and **should ensure that regulatory independence and clarity of roles are preserved in all circumstances** in line with IAEA Safety Standards.
- Severe long term combinations of external events should be adequately covered in design, operations, resourcing and emergency arrangements.
- Emergency arrangements, especially for the early phases, should be designed to be robust in responding to severe accidents.

Source: IAEA International Fact Finding Expert Mission of the Nuclear Accident Following the Great East Japan Earthquake and Tsunami, Preliminary Summary, 24 May -1 June, 2011.

 <http://www.iaea.org/newscenter/focus/fukushima/missionsummary010611.pdf>

Investigation Commission of Fukushima Nuclear Accident

- “Independence, transparency, and comprehensiveness: these are the three principles around which we are preparing the formulation of the Nuclear Incident Investigation Commission.” (PM Kan, Press Conference, 2011/05/10)
- Prof. Yotaro Hatamura, expert on human error, is chosen as a head of Gov’t investigation commission. (2011/05/24)
 - 1st meeting was held on June 7, 2011
- Diet is also planning to establish independent commission within the Diet



PM Kan's request to shutdown all Hamaoka NPPs (May 6, 2011)

- “Today, in my capacity as Prime Minister, I requested that Chubu Electric Power Company suspend the operation of all nuclear reactors at Hamaoka Nuclear Power Station. I made this decision, first and foremost, in consideration of the safety and well-being of the public..” (May 6,2011)
 - METI Minister confirms that all other units can operate assuming they satisfy safety requirements issued by METI Nuclear and Industry Safety Agency (NISA)
 - NISA approved short-term measures taken by the all utilities (May 6, 2011)



More nuclear plants may face shutdown

- Out of all 54 units:
 - 14 units are shutdown due to the Earthquake
 - 21 units are shutdown due to maintenance etc.
 - 19 units are now operating, but 9 more units will be shutdown due to maintenance by early next year.
- The governor of Fukui said it will not approve the re-startup of nuclear reactors without new safety requirements. (May 20, 2011, Asahi)



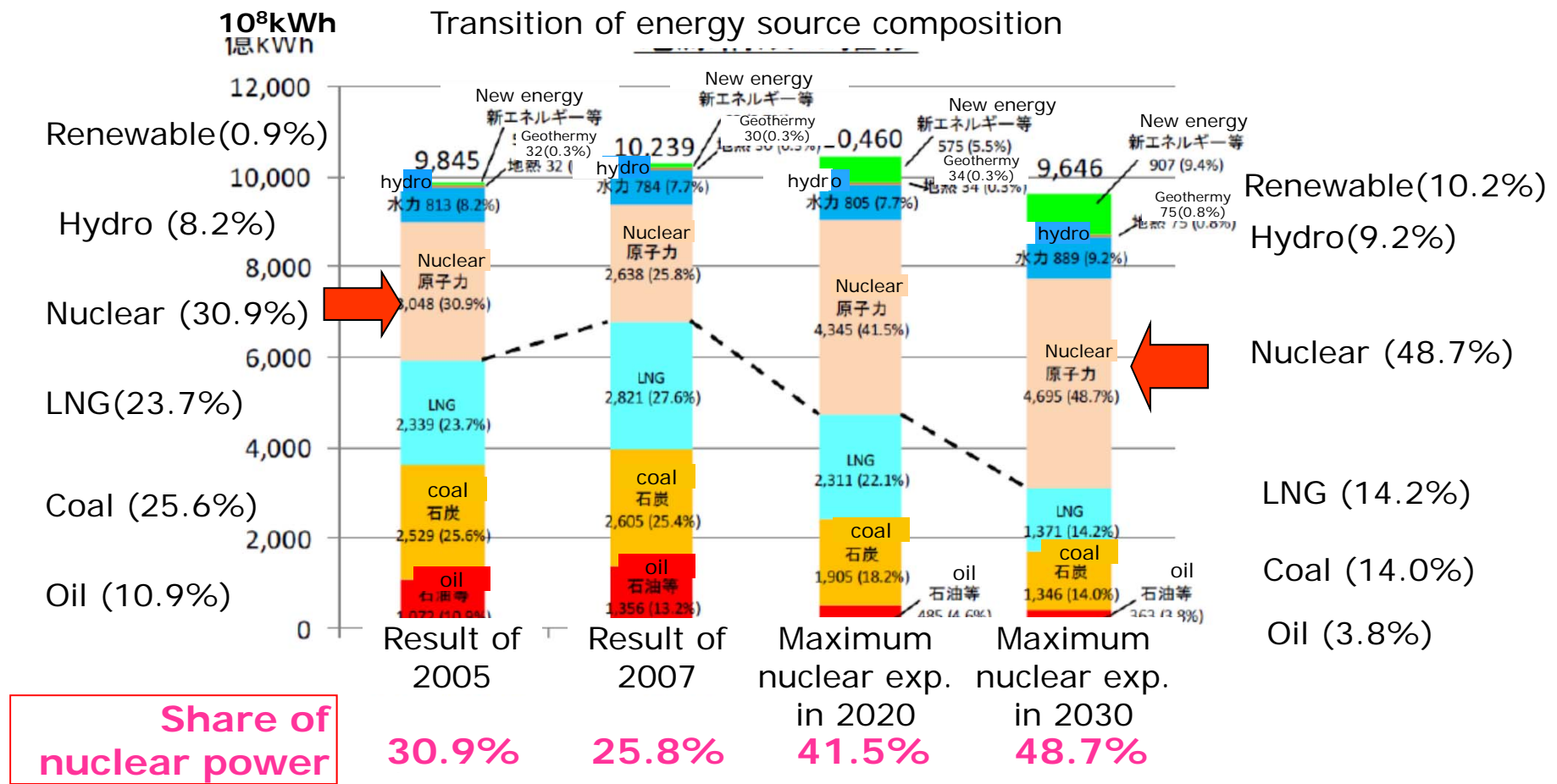
Statement by PM Kan on Future Energy Policy : Four Pillars (May 24, 2011@OECD)

1. Safety of nuclear energy. ...we will achieve the highest standard of nuclear safety.
2. Efficient use of fossil fuel minimizing CO2 emission with advanced technologies
3. Increase the share of renewable energy in total electric power supply to at least go beyond 20 percent by the earliest possible in the 2020s
 - Reduce solar power cost by 1/3 by 2020, 1/6 by 2030
 - Install 10 million solar panels by 2020
4. Achieve energy efficiency without compromising the comfort of life in households and communities.



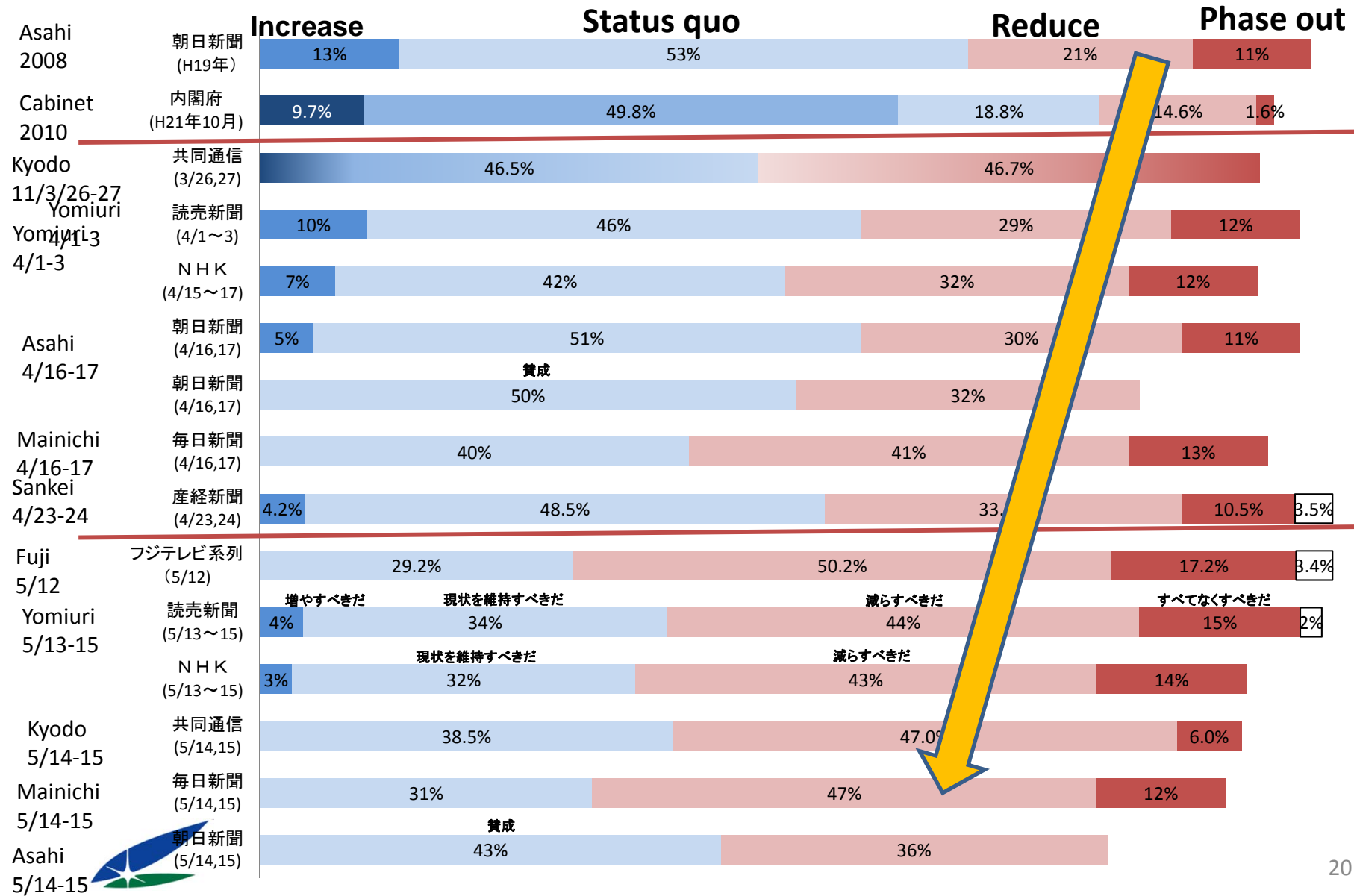
http://www.kantei.go.jp/foreign/kan/statement/201105/25oecd_e.html

Goal of Power Production Mix in 2030



Source: Institute of Energy Economics, March 2010

Public Opinion Shifting to “reduce” and “phase out”



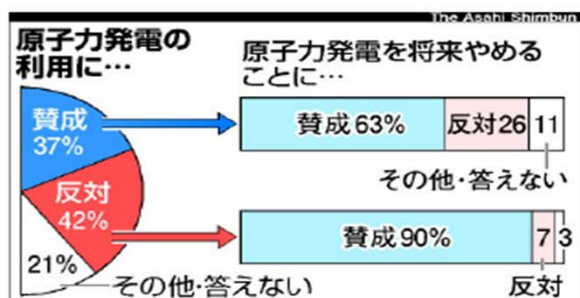
Asahi Poll, 74% says “agree to phase out nuclear power in the future” (06/13/11)

朝日新聞

THE ASAHI SHIMBUN DIGITAL

将来的に「脱原発」賛成74% 朝日新聞世論調査

2011年6月13日23時46分



原発に関する意識

朝日新聞社が11、12の両日実施した定例の全国世論調査（電話）によると、「原子力発電を段階的に減らして将来はやめる」ことに74%が賛成と答えた。反対は14%だった。東日本大震災の後、「脱原発」にかかわる意識をこうした形で聞いたのは初めて。

原子力発電の利用に賛成という人（全体の37%）でも、そのうち6割あまりが「段階的に減らして将来はやめる」ことに賛成と答えた。



朝日新聞:<http://digital.asahi.com/articles/TKY201106130401.html>

World Public Opinion Poll (2011)

Global Views before the Japan Earthquake:

	Globally	Japan
Favorable:	57%	62%
Unfavorable	32%	28%
Net Favor	25%	34%
No Response	11%	10%

Global Views after the Japan Earthquake:

	Globally	Japan
Favorable	49%	39%
Unfavorable	43%	47%
Net Favor	6%	-7%
No Response	8%	14%
Total	100%	100%

Source: WIN/Gallop poll, "JAPAN EARTHQUAKE JOLTS GLOBAL VIEWS ON NUCLEAR ENERGY"
April, 19, 2011

