Impact of Fukushima accident on Nuclear and Energy Policy

New Factors Determining Changes in Energy Policies in the World

February 11, 2014

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Vice Chairman, Japan Atomic Energy Commission

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

Issues and Challenges

- Fukushima Daiichi Decommissioning and Restoring life in Fukushima area
- Restoring Public Trust in Nuclear Safety and Energy Policy
- Impact on Global Nuclear Energy Development

Fukushima Daiichi Decommissioning and Restoring life in Fukushima area

PM Abe's assuring speech on Fukushima at the International Olympic Committee (Sept. 7, 2013)

- *" Let me assure you the situation is under control… It has never done and will never do any damage to Tokyo. There are no health-related problems until now, and nor will there be in the future."*

-From Reuter, "Abe helps secure 2020 Games for Tokyo," Sept. 7, 2013

http://uk.reuters.com/article/2013/09/07/uk-olympics-idUKBRE9860BO20130907

http://www.kantei.go.jp/jp/96_abe/actions/201309/07ioc_day2.html

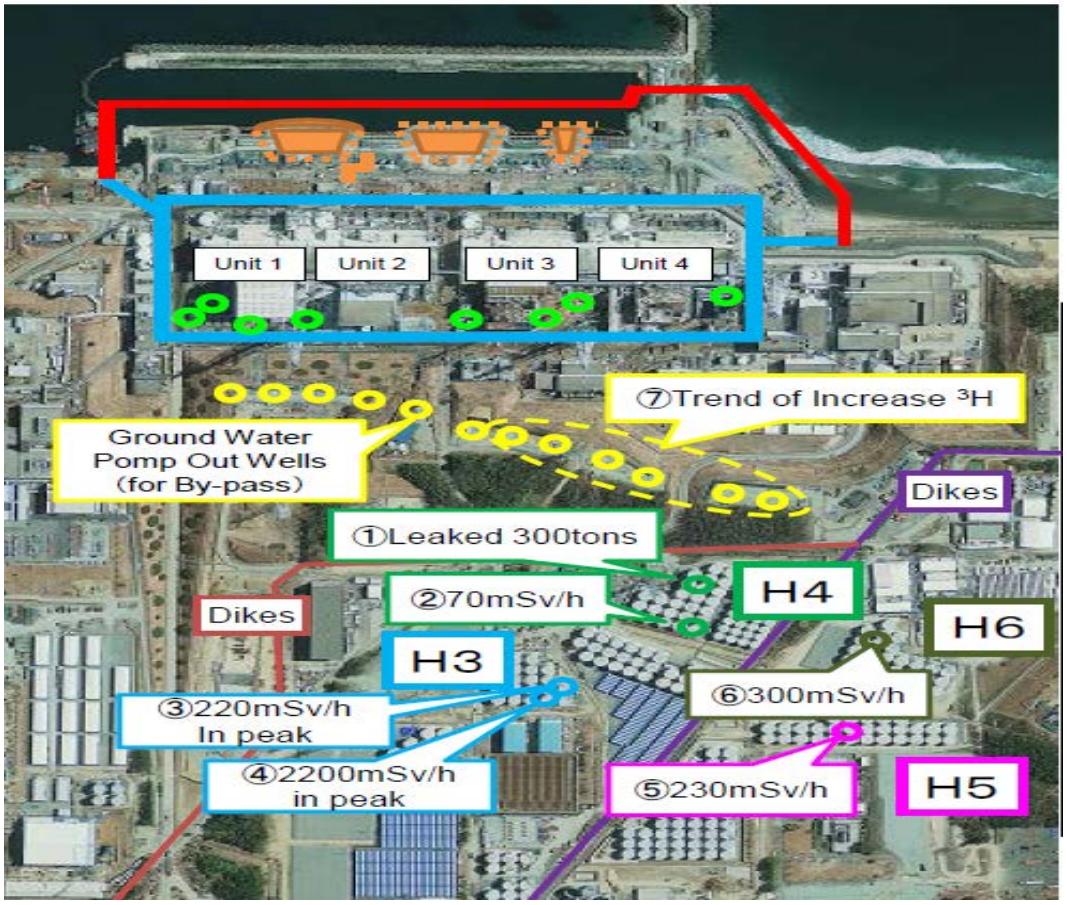
Struggling with contaminated water…during the recent typhoon (Sept. 15, 2013)

http://www.tepco.co.jp/nu/fukushima-np/handouts/2013/images/handouts_130917_01-j.pdf

"I think the current situation is that it is not under control," by a TEPCO official.

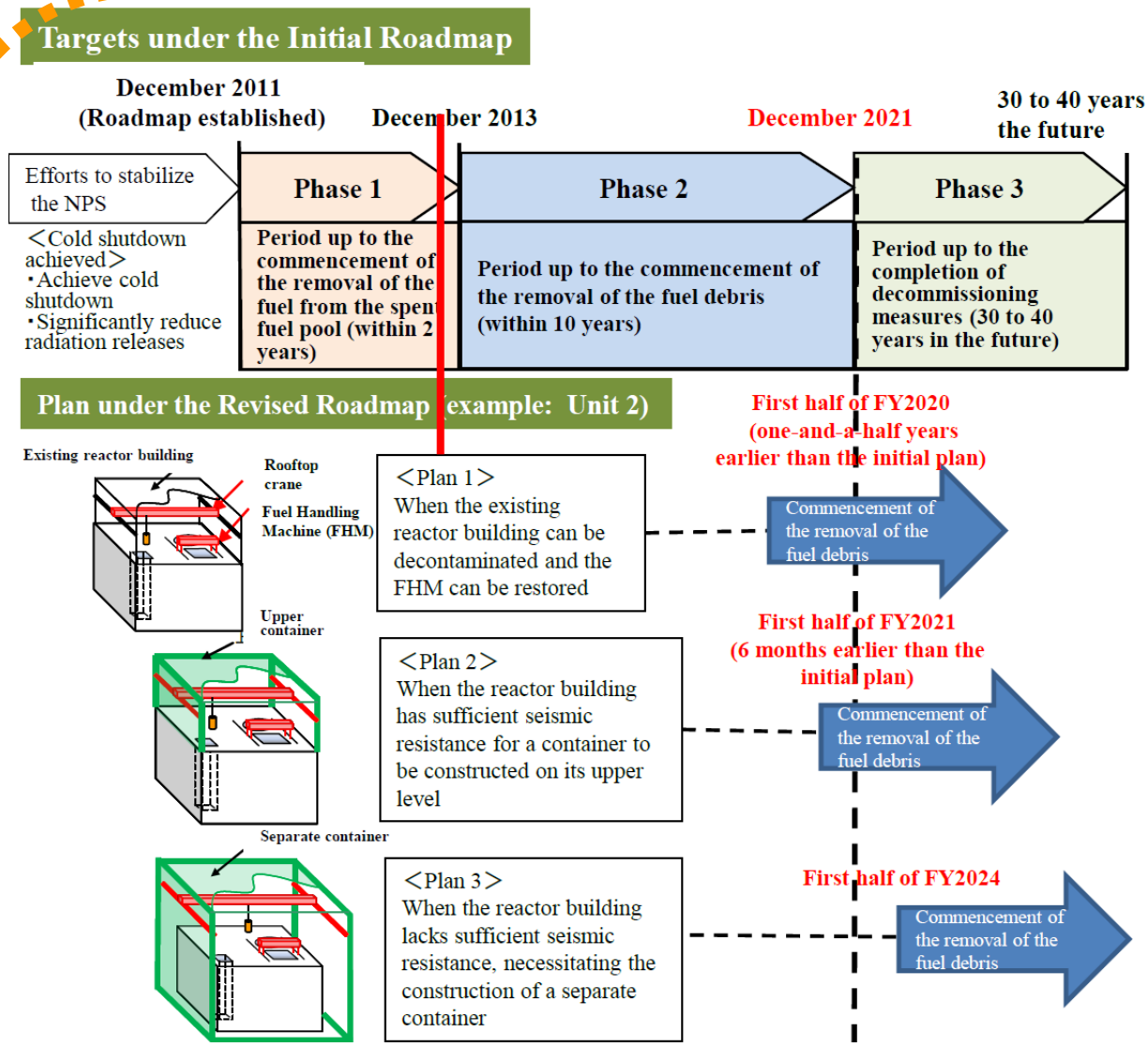
-Fukushima 'not under control' – TEPCO official refutes PM's assurances, Reuter, Sept. 13, 2013

http://rt.com/news/fukushima-under-control-tepco-819/



http://www.meti.go.jp/english/earthquake/nuclear/decommissioning/pdf/20130903_01a.pdf

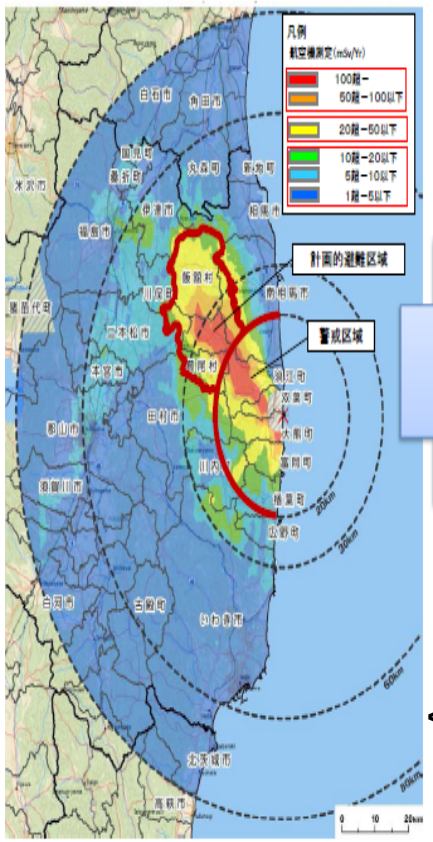
Mid-Long Term Roadmap for Fukushima Dai-ichi



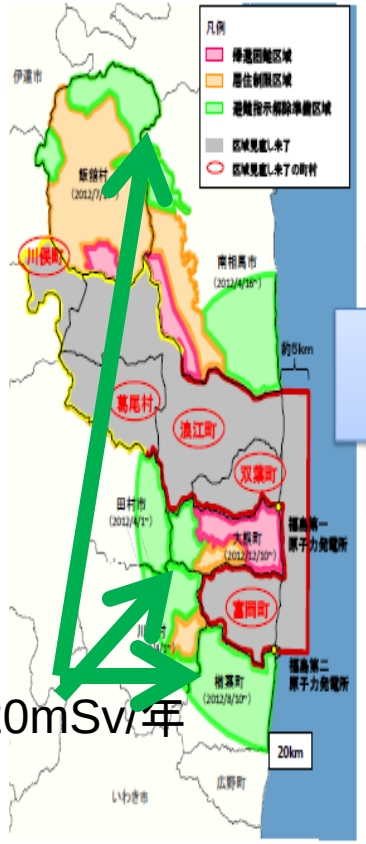
Source: Agency for Natural Resources and Energy, Announcement of the Revised Version of the Mid-and-Long-Term Roadmap towards the Decommissioning of TEPCO's Fukushima Daiichi Nuclear Power Station Units 1-4, June 2013,
http://www.meti.go.jp/english/press/2013/0627_01.html

Evacuation Area Amended (13/08/08)

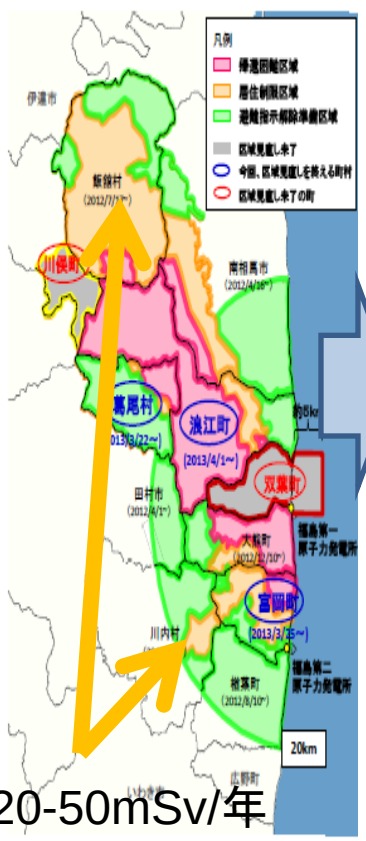
(2012/04/29)



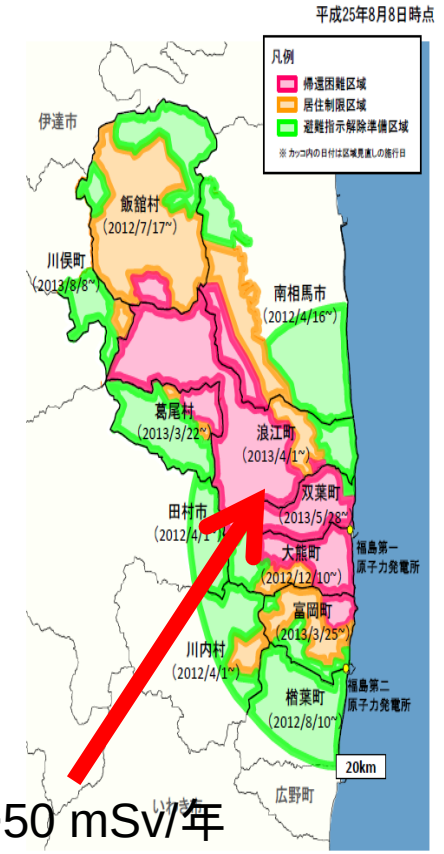
(12/12/10)



(13/04/01)



(13/08/08)



<20mSv/年

20-50mSv/年

>50 mSv/年

Tomioka

http://www.kantei.go.jp/saigai/pdf/20130307gainenzu.pdf

http://www.kantei.go.jp/saigai/pdf/20130808gainenzu.pdf

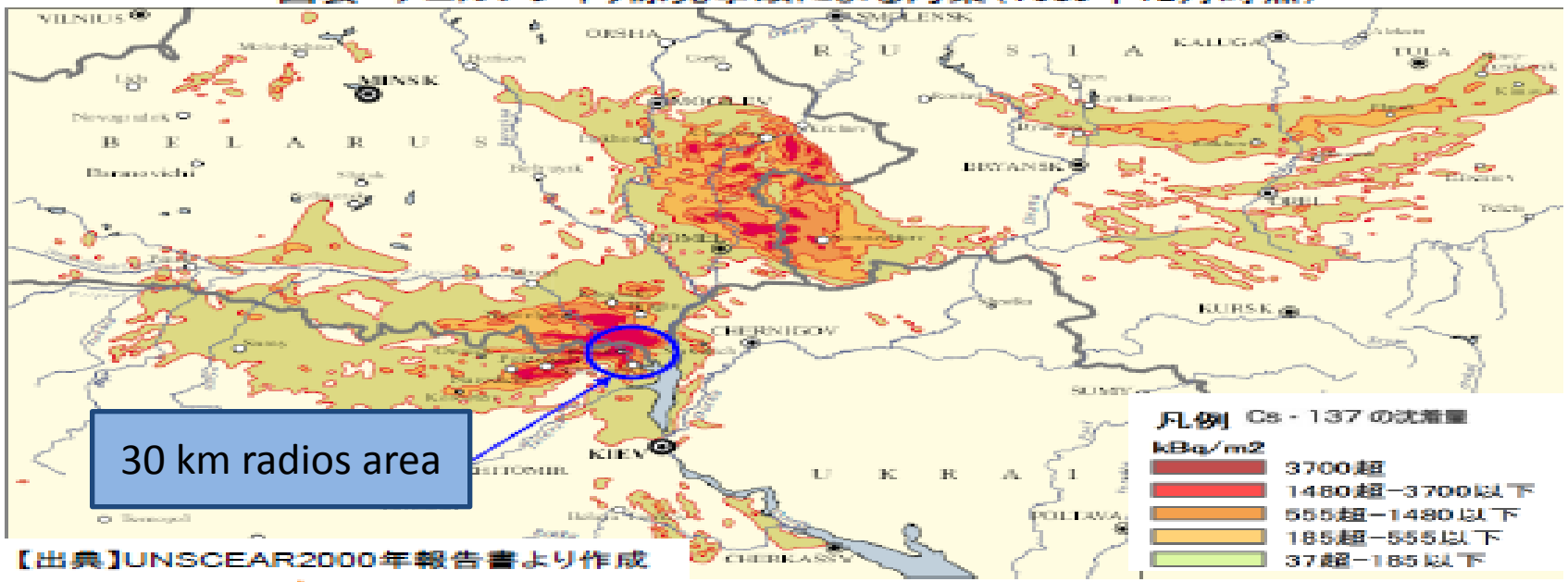
Cherry blossom in Tomioka Town (10 km from Fukushima Daiichi)

http://www.asahi.com/special/10005/images/TKY201204190192.jpg

http://img.47news.jp/PN/201204/PN20120419010011 25.-.-.CI0003.jpg

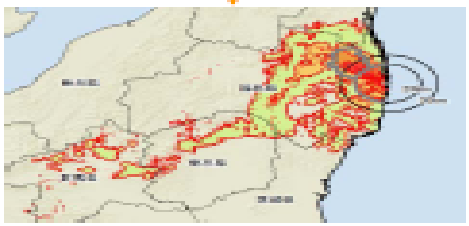
Compared with the Chernobyl accident

図表　チェルノブイリ原発事故による汚染（1989年12月時点）



【出典】UNSCEAR2000年報告書より作成

両図を同縮尺で記載



図表　東電福島第一原発事故による汚染（2011年11月時点）

【出典】文部科学省発表資料（2011年11月）より作成

図表　汚染地域の面積

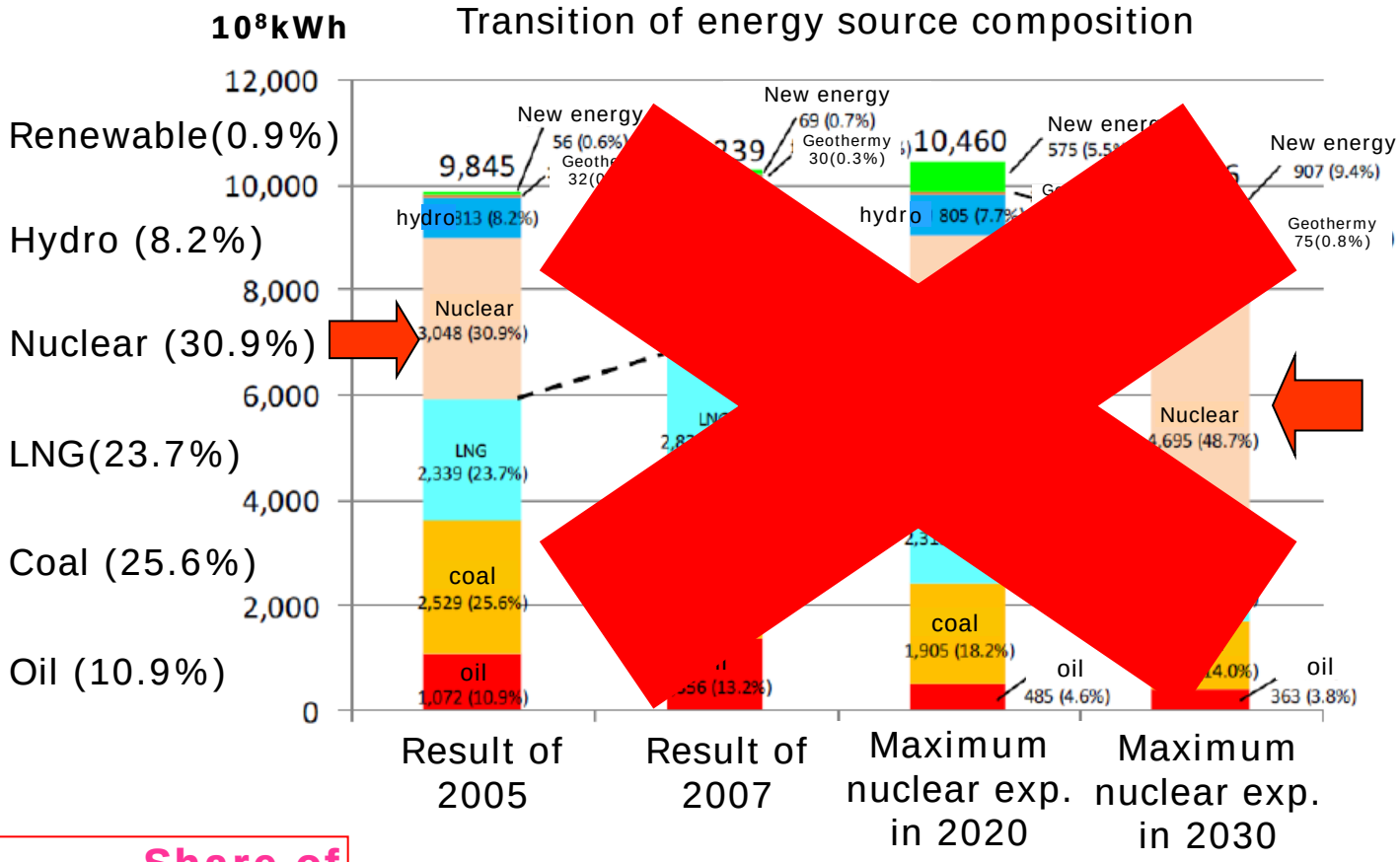
汚染濃度（kBq/㎡）	汚染地域の面積（km²）		
	Chernobyl	Fukushima	F/C
＞ 1,480	3,100	200	6 %
555 － 1,480	7,200	400	6 %
185 － 555	18,900	1,400	7 %
37 －185	116,900	6,900	6 %
合計面積	146,100	8,900	6 %

3

http://www.meti.go.jp/earthquake/nuclear/pdf/130314_01a.pdf

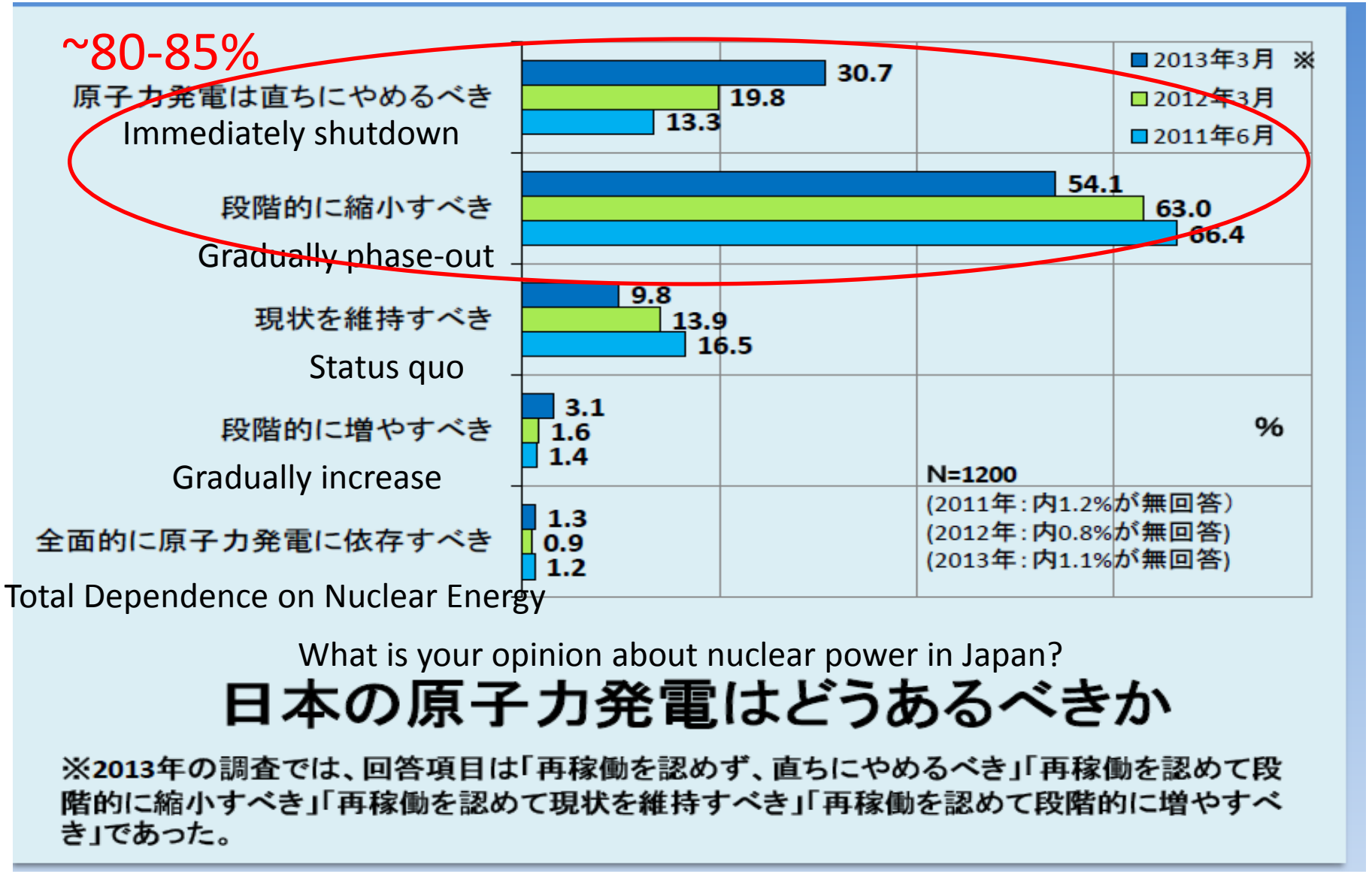
Restoring Public Trust in Nuclear Safety and Energy Policy

Goal of Power Production Mix in 2030 Before 2011/3/11

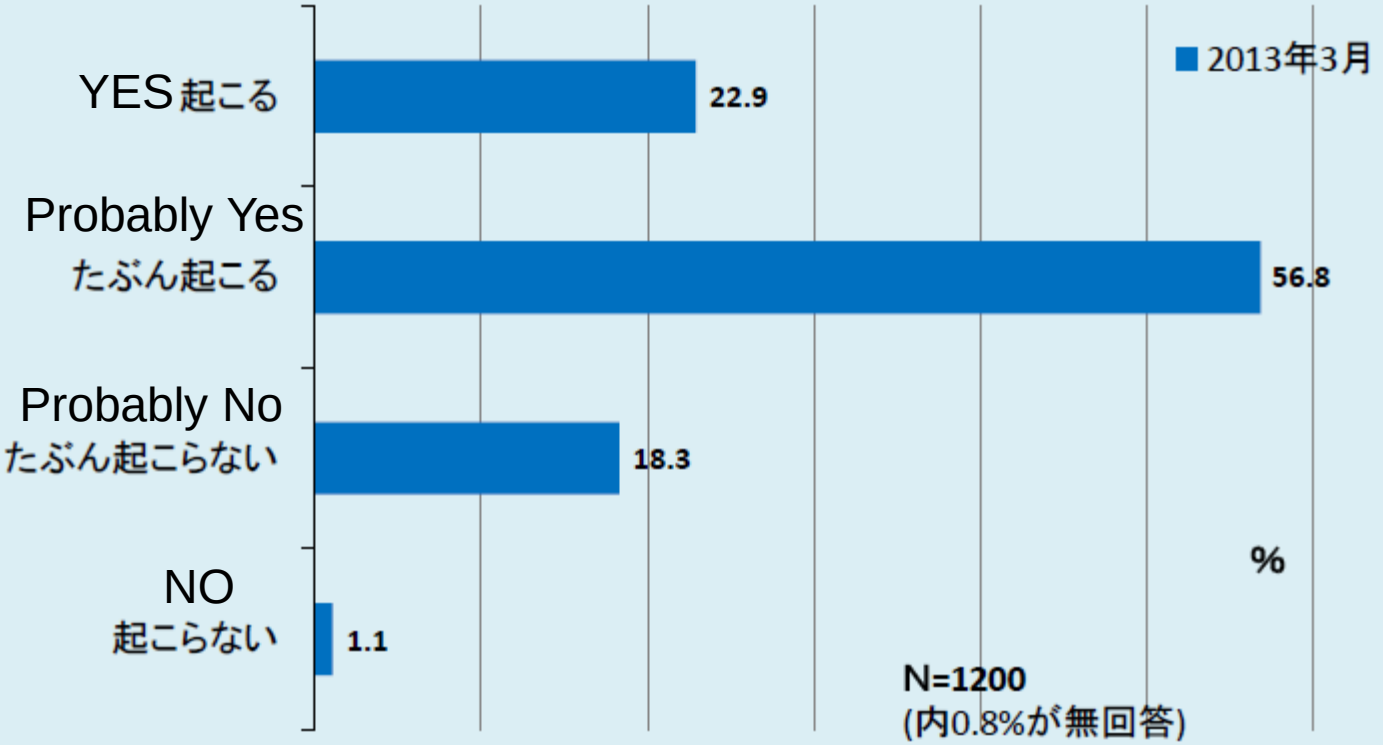


Share of nuclear power	30.9%	25.8%	41.5%	48.7%

Source: Institute of Energy Economics, March 2010



Source: Prof. Hirotada Hirose, "Changes of Public Opinion about Nuclear Power," Presented at Japan Atomic Energy Commission, July 17, 2013
http://www.aec.go.jp/jicst/NC/iinkai/teirei/siryo2013/siryo27/siryo2.pdf

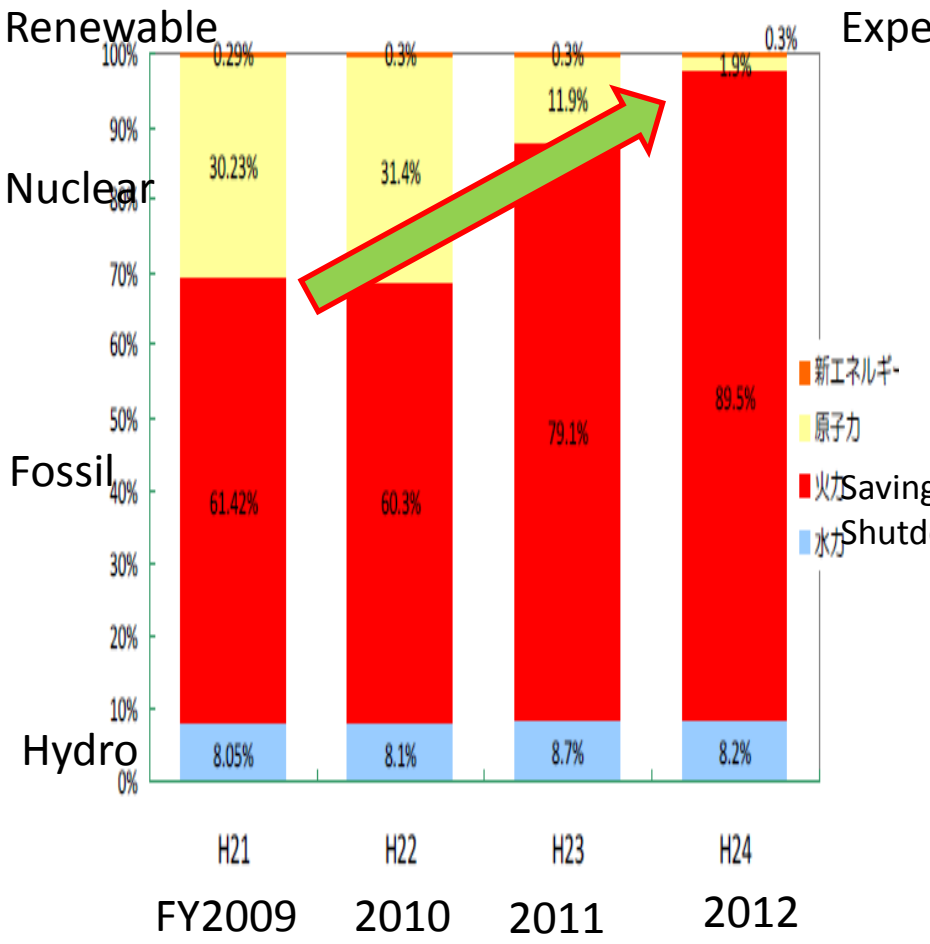


Do you think a similar scale of nuclear accident will happen again?

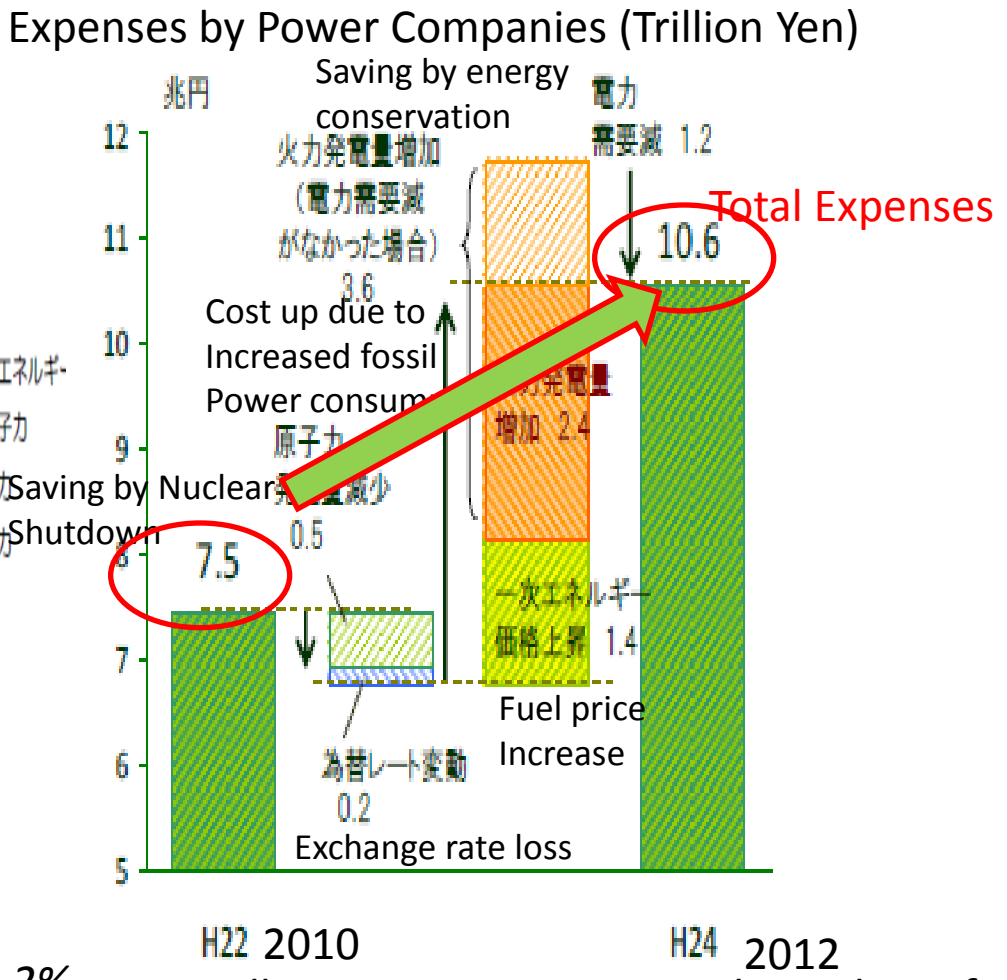
各地の原発再稼働で
福島第一原発と同程度の事故が起きる可能性

Source: Prof. Hirotada Hirose, “Changes of Public Opinion about Nuclear Power,” Presented at Japan Atomic Energy Commission, July 17, 2013
http://www.aec.go.jp/jicst/NC/iinkai/teirei/siryo2013/siryo27/siryo2.pdf

Impact of Shutdown of Nuclear Power from FY 2010 to FY 2012



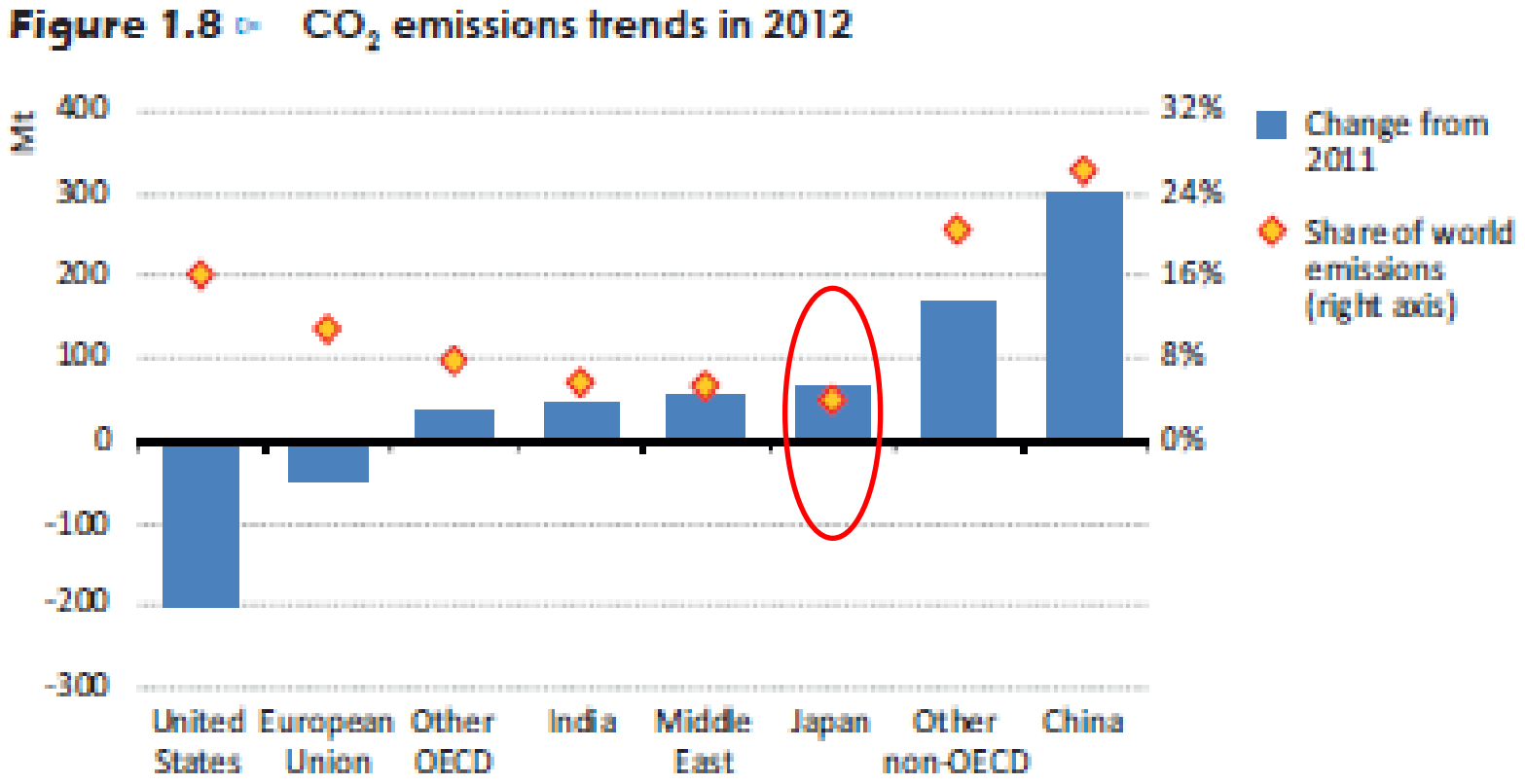
Share of nuclear power down from 31% to 2%



3.1 trillion yen extra expenses due to loss of nuclear power

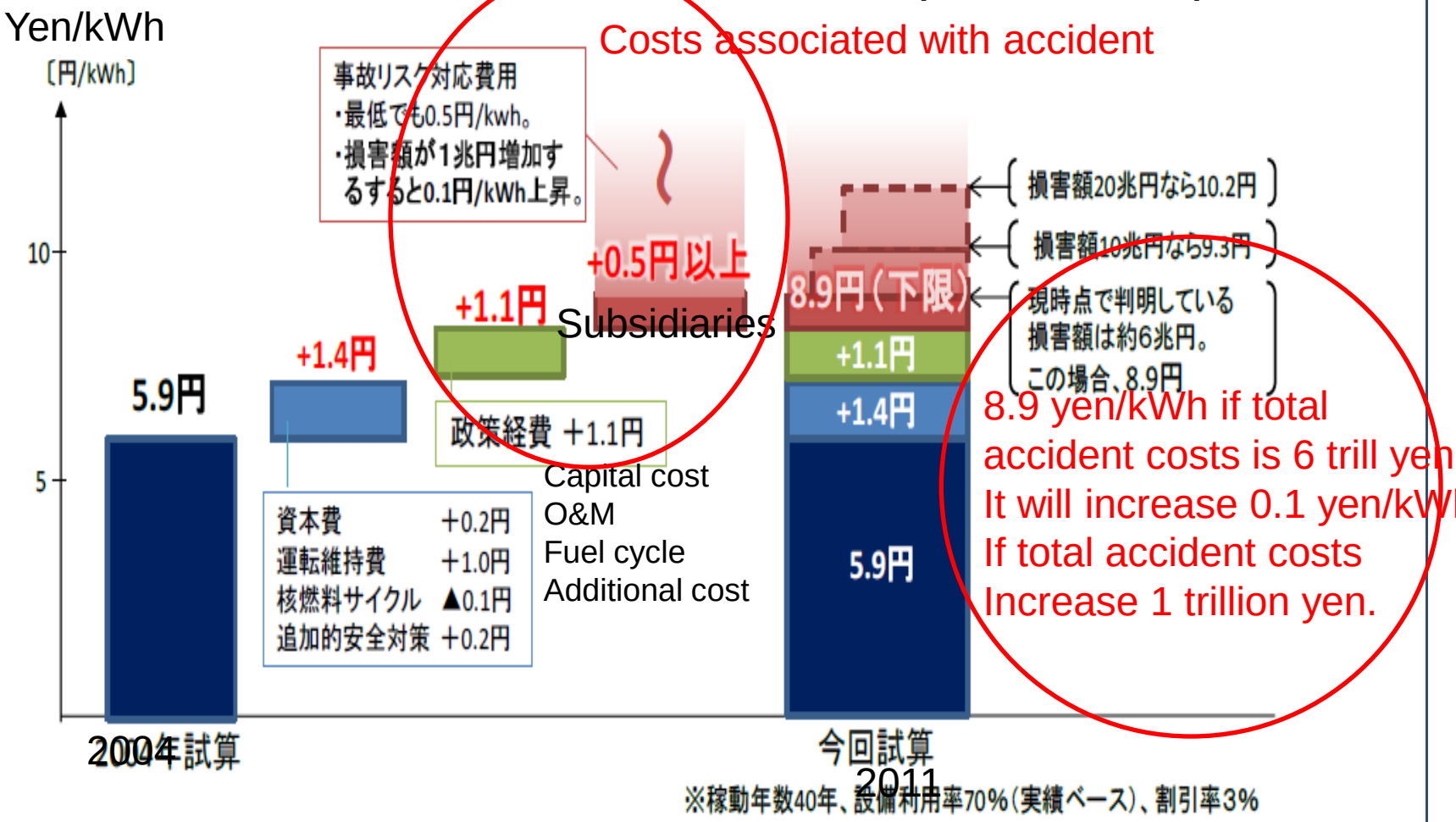
Source: Yuji Yamaguchi, The Institute of Energy Economics, Japan, 2013.
http://www.aec.go.jp/jicst/NC/iinkai/teirei/siryo2013/siryo31/siryo3.pdf

Japan's CO2 emission increased by 70 MT or 5.8% from 2011



Source: International Energy Agency (IEA), "Redrawing Energy Climate Map," 10 June 2013, http://www.worldenergyoutlook.org/media/weowebsite/2013/energyclimatemap/RedrawingEnergyClimateMap.pdf

Nuclear Power Generation Costs (2004, 2011)

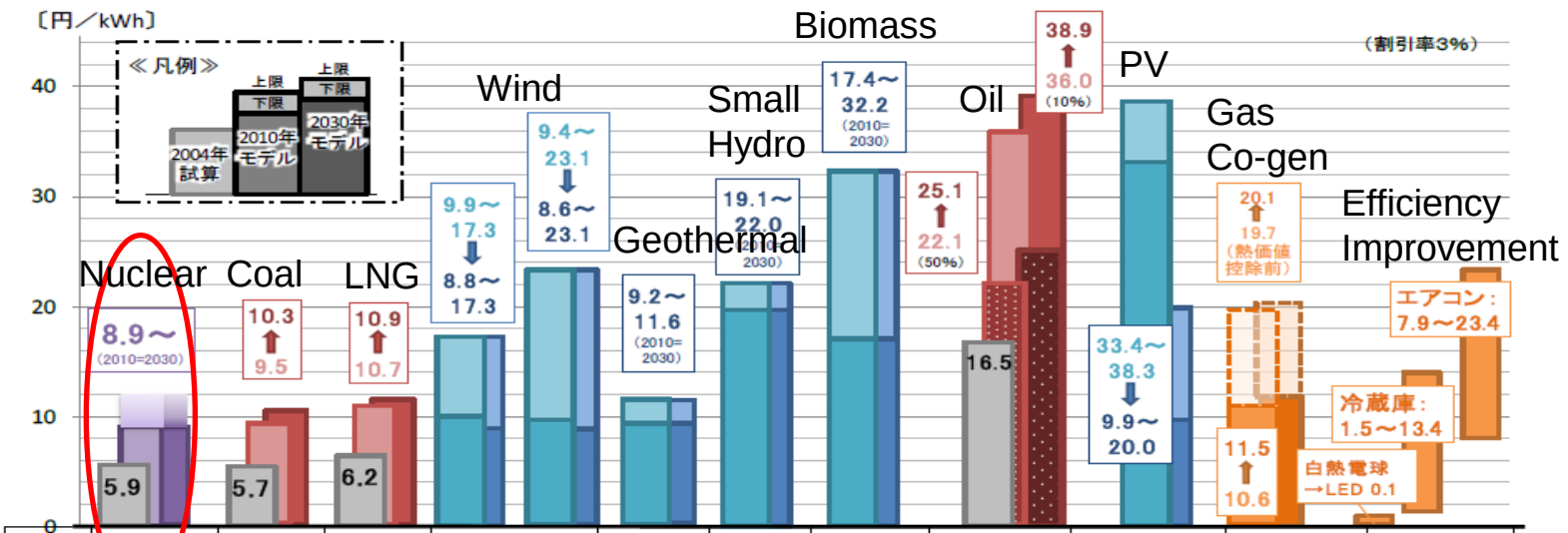


（図 ２０）原子力の発電コスト（2004 年試算と今回試算）

出所：コスト等検証委員会報告書、2011年12月19日
http://www.npu.go.jp/policy/policy09/pdf/20111221/siryo3.pdf

Nuclear power can be competitive, but social costs can be high…

【コスト試算のポイント】
○モデルプラント形式（最近7年間の稼働開始プラント、最近3年間の補助実績等を基に設定）
○CO2対策費用、原子力の事故リスク対応費用、政策経費等の社会的費用も加算。
○2020年、2030年モデルは燃料費・CO2対策費の上昇、技術革新等による価格低減を見込んで試算。



	原子力	石炭火力	LNG火力	風力 陸上	風力 洋上着床式	地熱	小水力	バイオマス（木質専焼）	石油火力	太陽光（住宅用）	ガスコジェネ	省エネ
シナリオ等	核燃料サイクル現状モデル	新政策シナリオ	新政策シナリオ	横ばい～低減	横ばい～低減	－	－	－	新政策シナリオ	参照～パラダイムシフト	新政策シナリオ	－
設備利用率	70%	80%	80%	20%	30%	80%	60%	80%	50%・10%	12%	70%	－
稼働年数（2030年モデル）	40年	40年	40年	20年	20年	40年	40年	40年	40年	20年（35年）	30年	－
留意点・ポイント 赤：増加要因 青：低減要因 黒：その他（導入ポテンシャルに関する記述を含む。）	8.9円は下限。事故の損害額が5.8兆円から1兆円増えるごとに0.1円増。次世代軽水炉による合理化は、定量的には見込まず。	燃料費・CO2対策費用上昇。発電効率向上。	燃料費のウェイト大。発電効率向上。シェールガスのメリットは資源戦略が鍵。	量産効果でコスト低減の可能性あり。立地の拡大には、規制・制度改革、系統強化等が必要。		安定電源として有望。電源線のコストの問題がある。導入可能量拡大には、立地に係る課題の解決などが必要。	安定的な発電が可能。多くの場所で可能性あり。	未利用間伐材の収集・運搬距離等により燃料費が変動。	主に燃料費が上昇	量産効果でコスト半減の可能性あり。次世代太陽電池が実現すれば、コストはさらに下がる可能性あり。大量導入には、系統対策が必要。	熱の利用を勘案すると大規模集中電源並み。電気代（業務・産業：13.7円）の節約を考慮すると需要家のメリット大。	機器によって幅あり電気代（家庭：20.4円）の節約を考慮するとメリット大。
今後の対応	○原子力の事故費用：最新の情報が得られ次第、数字を見直し。 ○技術革新や量産効果によるコスト低下：技術革新の進歩や普及の動向に応じて、試算結果の見直しや試算への組込み。 ○系統安定化対策：エネルギーミックスのシナリオが固まった段階でシナリオ毎に試算。 ○経済効果：エネルギーミックスのシナリオが決まった段階でマクロ的な効果として分析・試算。											

（図　３６）主な電源の発電コスト（2004 年試算／2010 年・2030 年モデルプラント）

出所：コスト等検証委員会報告書、2011年12月19日
http://www.npu.go.jp/policy/policy09/pdf/20111221/siryo3.pdf

PM Abe's Statement at Diet on Energy Policy (2013/02/28)

- Reflecting on the accident at Tokyo Electric Power Company's Fukushima Daiichi Nuclear Power Station, under the Nuclear Regulation Authority, we will foster a new culture of safety that will uncompromisingly enhance the degree of safety. After doing so we will restart nuclear power plants where safety has been confirmed.
- We will promote the introduction of energy conservation and renewable energies to the greatest possible extent to reduce our degree of dependency on nuclear power as much as possible. At the same time, we will begin a fundamental reform of the electric system.

http://www.kantei.go.jp/foreign/96_abe/statement/201302/28siseuhousin_e.html

Recommendations to the Energy Basic Plan (Draft) by METI's Advisory Council on Energy - For Nuclear Energy Policy（2013/12/06）

- We continue to use nuclear energy as an important base-load energy source to support stable energy supply
- We reduce dependence on nuclear energy as much as possible by expanding renewable energy, energy efficiency and more efficient fossil power plants.
- Under this basic policy, considering the constraints of energy resource situations, we maintain the necessary level of nuclear power from the viewpoints of energy supply stability, cost reduction, climate change, human resources to maintain the safety.

http://www.enecho.meti.go.jp/info/committee/kihonseisaku/12th/12th1-2.pdf

Recommendations to the Energy Basic Plan (Draft) by METI's Advisory Council on Energy - For Nuclear Energy Policy（2013/12/06）

(1) Measures to recover and revitalize Fukushima

(2)Enhance safety constantly and establish environment for stable nuclear business operations

(3) Steady progress in measures without delay

① Comprehensive and enhanced measures to deal with spent nuclear fuel

- Strengthen measures for final disposal of HLW
- Expansion of spent fuel storage capacity
- R&D on reduction of toxicity/volume of radioactive waste

②Steady progress in nuclear fuel cycle

- Important to increase flexibility of nuclear fuel cycle

(4) Building confidence with citizens, local governments and international society

①Public communication after Fukushima accident

②Building confidence with local siting community

③Contribution to peaceful use of nuclear energy in the world and non-proliferation

http://www.enecho.meti.go.jp/info/committee/kihonseisaku/12th/12th1-2.pdf

JAEC's statement on METI's Draft (2014/01/09)

- The government should explain better to the public how it reached the decision (about nuclear power)
- Always keep it in mind that the accident has put constraints on rights of citizens to life
- Increase transparency of (on-site operation) and increase dialogue with local community
- When cooperating with foreign countries in nuclear power development, the government should seek "win-win" relationship, while non-proliferation should be an essential condition.

JAEC's statement on METI's Draft (2014/01/09)

- Institutional scheme (of spent fuel/nuclear waste management) should always reflect changes in circumstances…Operation of Rokkasho reprocessing plant should be flexible considering commitment to local community as well as international concern.
- Governance structure of nuclear power under the liberalized market needs to be discussed.
- Need an independent organization to monitor and facilitate communication with public on HLW disposal program.
- JAEC's four principles for enhancing public confidence, in particular, "transparency, fairness and public participation", should be the basis of government programs for restoring public confidence.

Three types of spent fuel storage capacity

(As of September 2013, total of 17,335 tons are in storage)

At-reactor storage

Storage capacity: 20,640 tU/17 sites (as of Sept. 2013, 14,340tons ~70% full)

On-site dry cask storage is not allowed by local governments (Fukushima-1 & Tokai-2 was allowed).

?

If Rokkasho was cancelled...

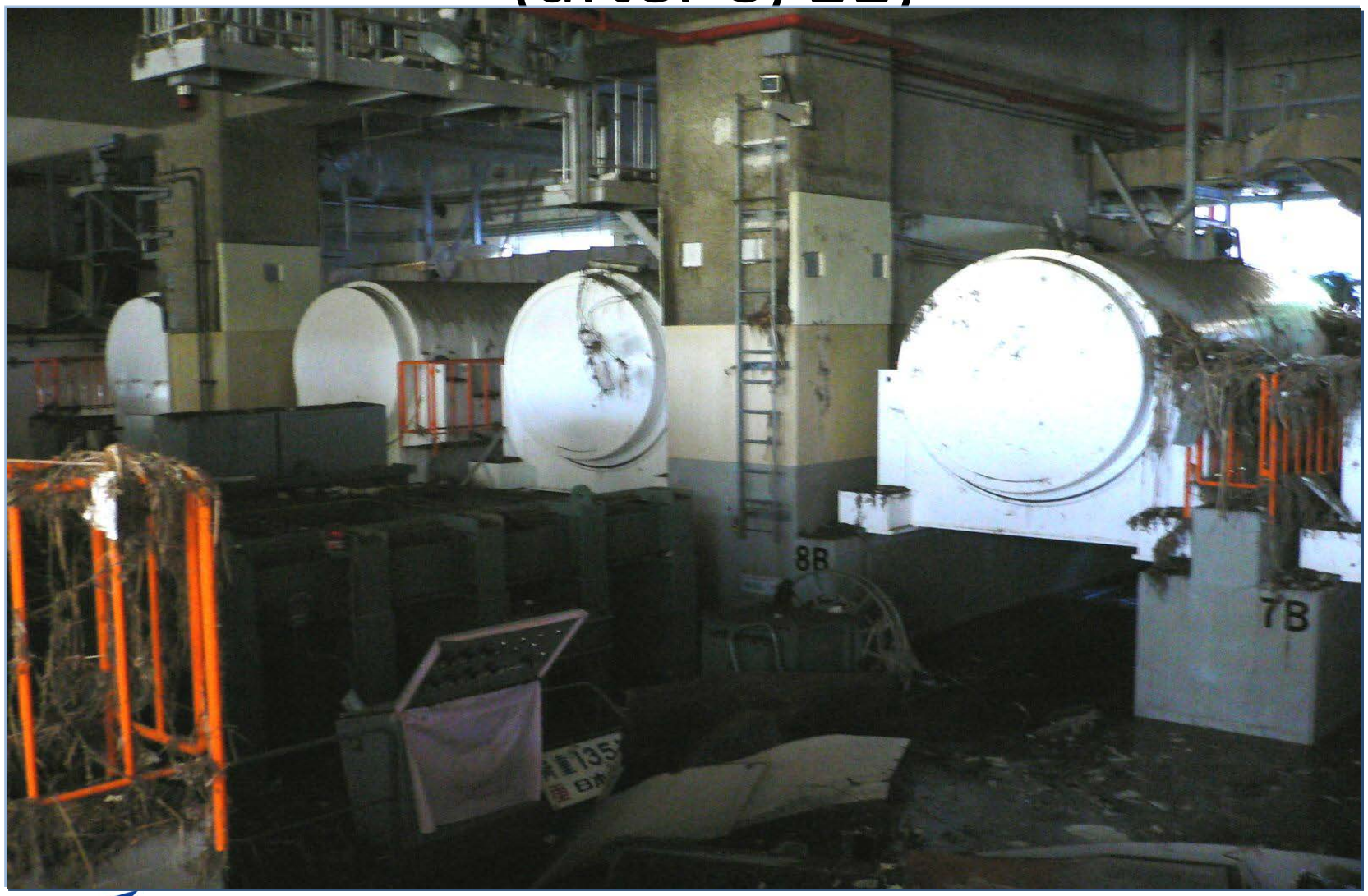
Rokkasho reprocessing plant

Storage capacity:**3,000tU**
(storage **2,945 tU** as of Sept. 2013)
Construction cost: ¥2.14Trillion
Commission date: not known

Mutsu Interim storage site

Dry Cask storage type
Capacity : totally 5,000 tU
1st 3,000 tU, add 2,000tU in future
Operation: October 2013 (postponed)
(Status : under construction)
Construction cost: ¥0.1Trillion
(including dry casks)

Dry Cask Storage at Fukushima Daiichi (after 3/11)



http://photo.tepco.co.jp/library/110909_2/110909_69.jpg

Global Civilian Plutonium Stockpile (2010)
- Reprocessing has international security implications -

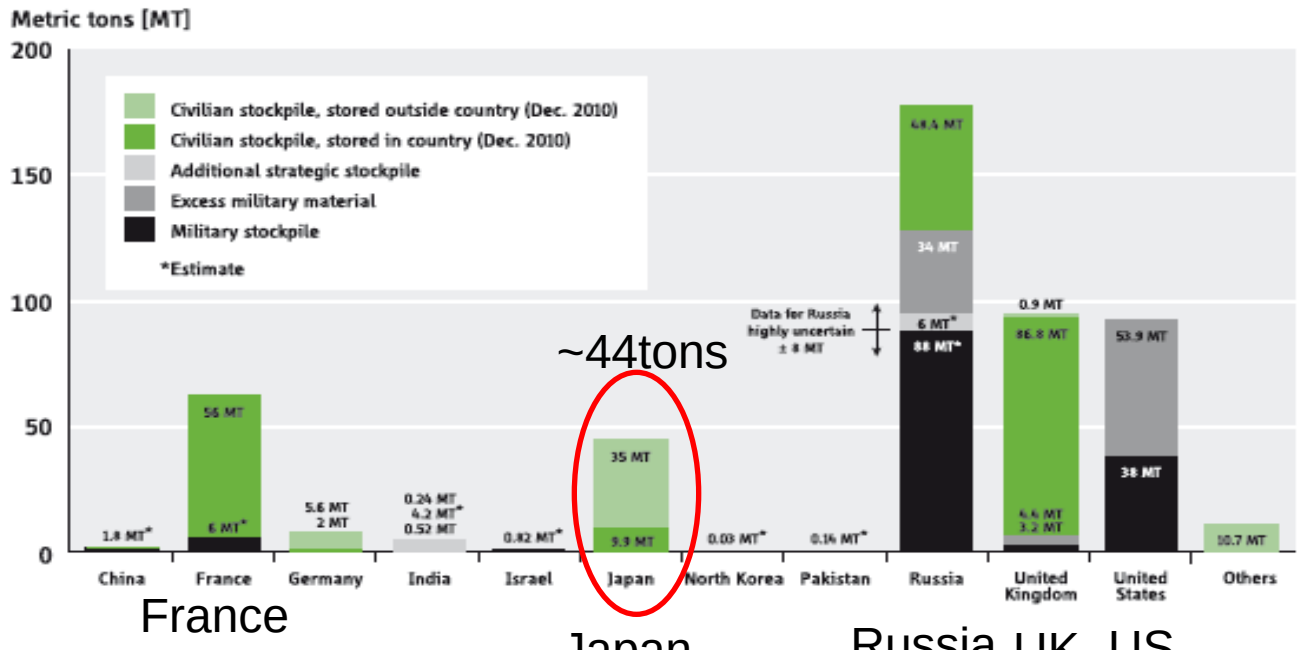


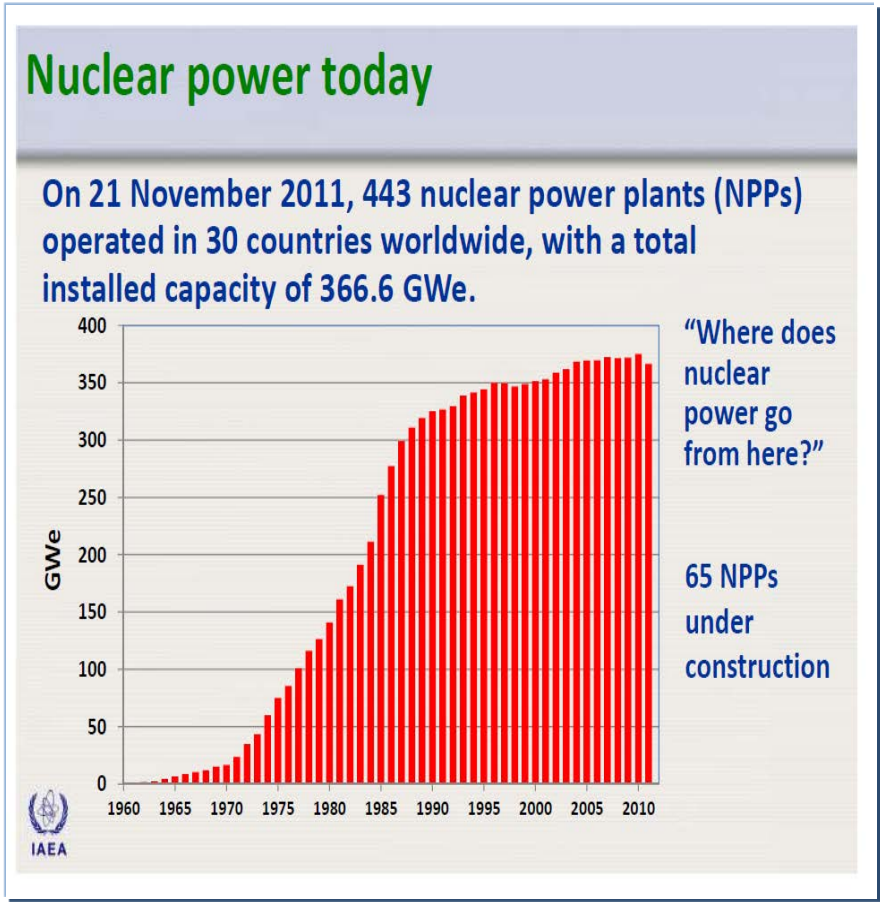
Figure 4. National stocks of separated plutonium. Civilian stocks are based on the most recent INFCIRC/549 declarations for December 2010 and are listed by ownership, not by current location. Weapon stocks are based on non-governmental estimates except for the United States and United Kingdom whose governments have made declarations. Uncertainties of the military stockpiles for China, France, India, Israel, Pakistan, and Russia are on the order of 10–30 %. The plutonium India separated from spent heavy-water power-reactor fuel has been categorized by India as "strategic," and not to be placed under IAEA safeguards. Russia has 6 tons of weapon-grade plutonium that it has agreed to not use for weapons but not declared excess.

Source: International Panel on Fissile Material (IPFM), Global Fissile Material Report 2012, http://fissilematerials.org/library/gfmr11.pdf

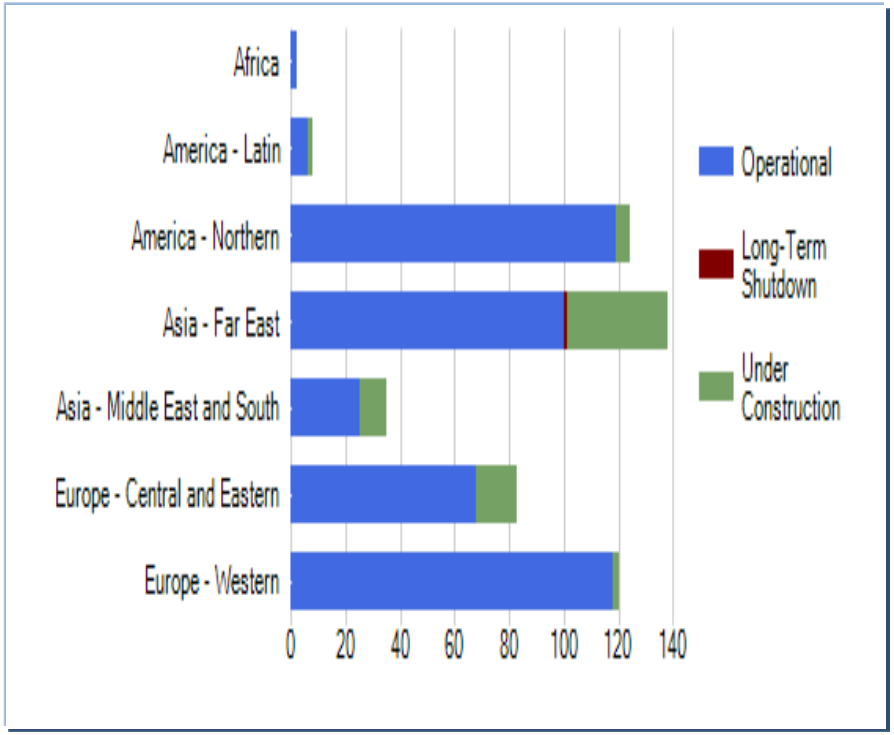
Impact on Global Nuclear Energy Development

Global Nuclear Power Development
Current Status (IAEA)

As of Jan.31, 2014, 438 nuclear power plants (374.3GWe) are operating and 71 units are under construction, one unit in long term shutdown. http://www.iaea.org/pris/

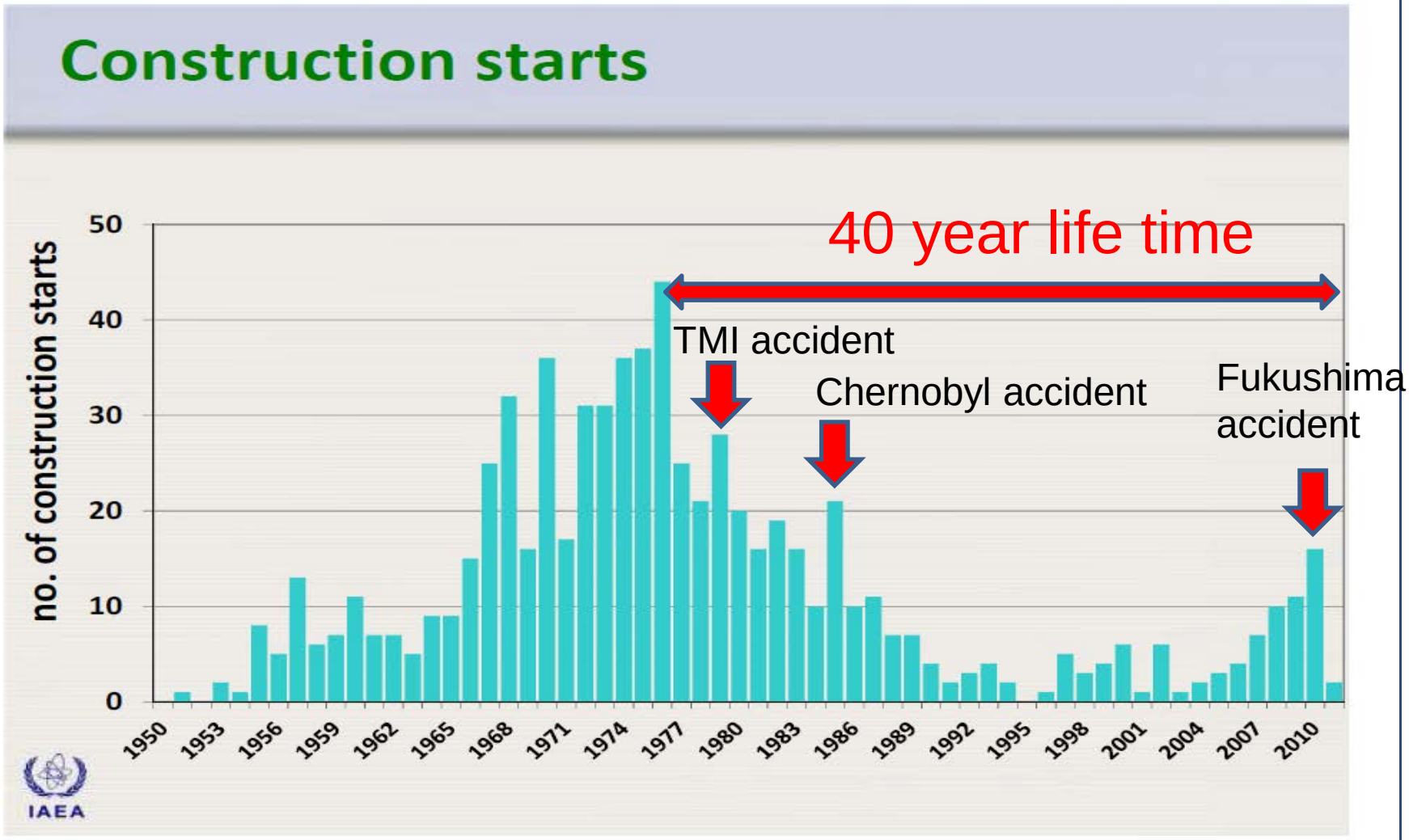


Total Number of Reactors



Source: H-HolgerRogner, Head, Planning & Economic Studies Section (PESS)Department of Nuclear Energy, International Atomic Energy Agency, "Energy, Electricity and Nuclear Power Estimates for the Period up to 2030," November 2011.

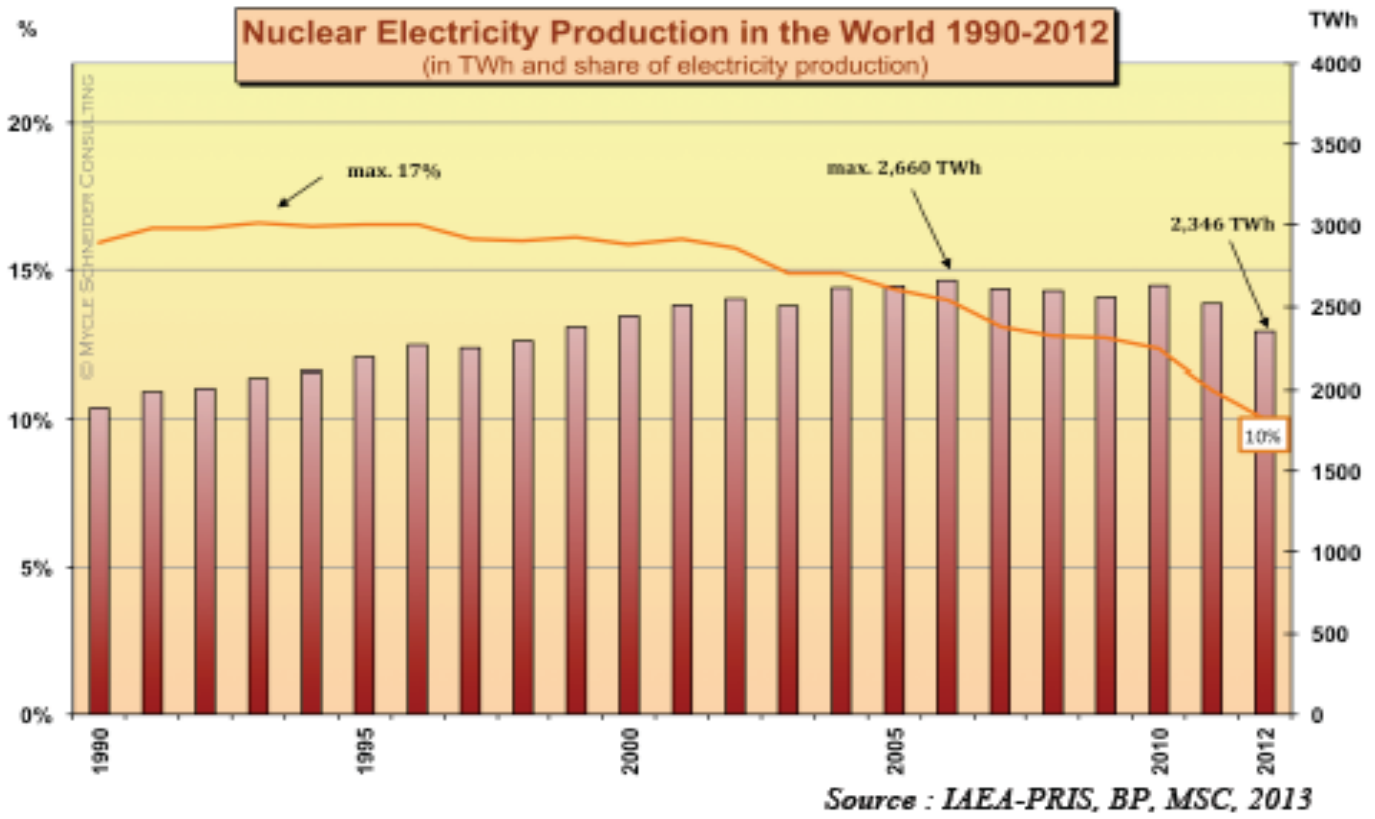
Global Nuclear Power Plant Construction (IAEA) : Replacement of old reactors are coming….



Source: H-HolgerRogner, Head, Planning & Economic Studies Section (PESS)Department of Nuclear Energy, International Atomic Energy Agency, "Energy, Electricity and Nuclear Power Estimates for the Period up to 2030," November 2011.

Global Nuclear power production is in decline

Figure 1: Nuclear Electricity Generation in the World



http://www.worldnuclearreport.org/

Estimates of Nuclear Electrical Generating Capacity : Comparison of estimates in 2013 and 2011

	Actual in 2011	Estimates for 2030 Estimated in 2011	Estimates for 2030 Estimated in 2013	Estimates for 2050 Estimated in 2011	Estimates for 2050 Estimated in 2013
World Total					
Nucl. Capacity (GWe)			-13%		-21%
Low Estimate	368.8	501	435	560	440
High Estimate		746	722	1228	1113
			-3%		-9%
Share (%)					
Low Estimate	7.1	5.2	4.5	2.7	2.2
High Estimate		6.2	6.2	6.0	5.6
Far East					
Nucl. Capacity (GWe)			-18%		-14%
Low Estimate	79.8	180	147	220	189
High Estimate		255	268	450	412
			+5%		-8%
Share (%)					
Low Estimate	5.0	6.4	5.3	4.2	3.7
High Estimate		7.5	8.1	8.6	8.0

Source: International Atomic Energy Agency, "Energy, Electricity and Nuclear Power Estimates for the Period up to 2050,"
2011 Edition http://www-pub.iaea.org/MTCD/Publications/PDF/RDS1_31.pdf
2013 Edition http://www-pub.iaea.org/MTCD/publications/PDF/RDS-1-33_web.pdf