

After Fukushima: Rethinking the Case for Nuclear Power's Expansion

By

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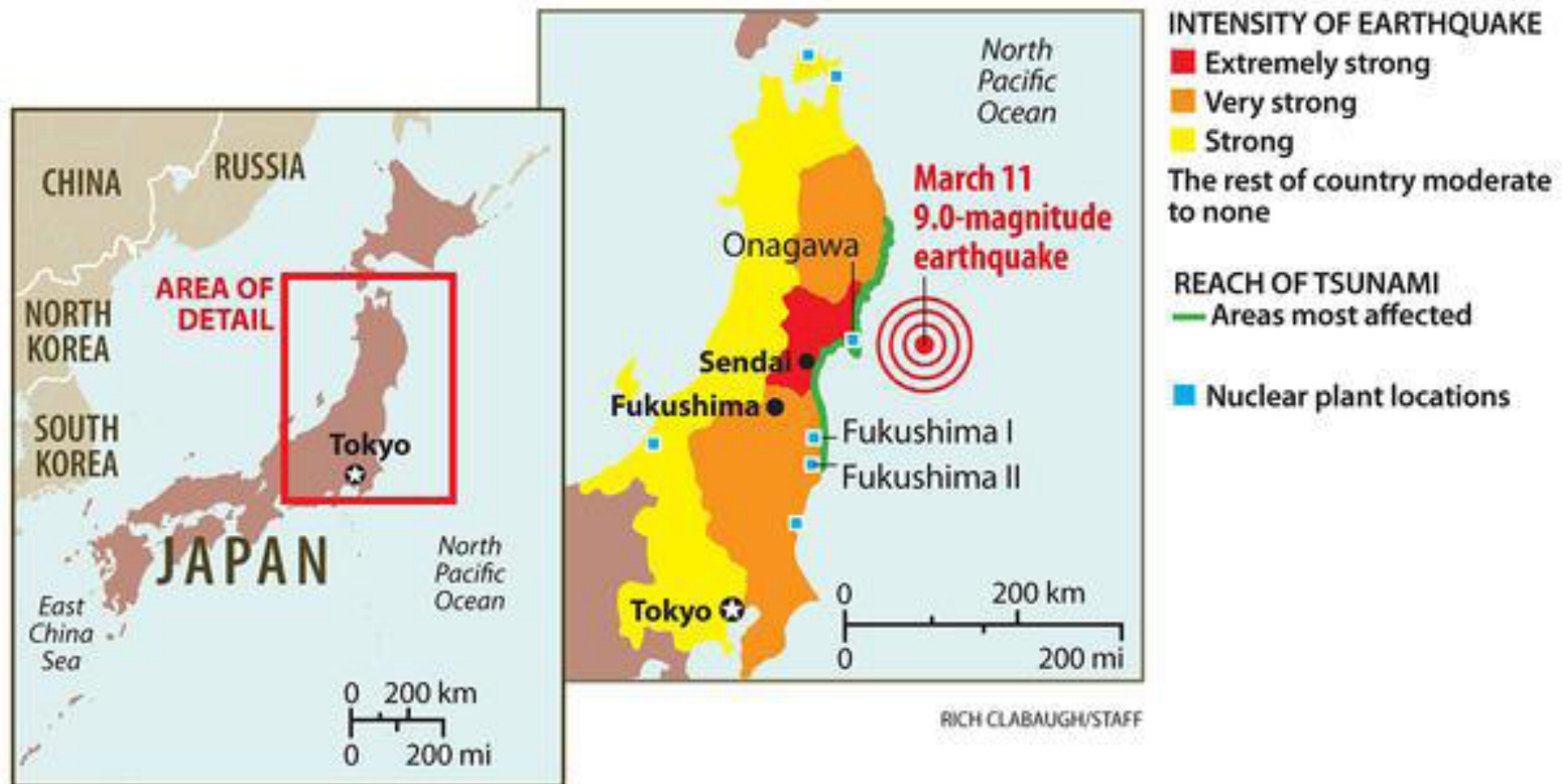
Nonproliferation Policy Education Center

www.npolicy.org

Japan

Aftershock: Effected Japanese Areas & Nuclear Plants

chart courtesy Nautilus



Nonnuclear Plants Damaged Too

Haramachi, in South-Soma (photo courtesy Nautilus)



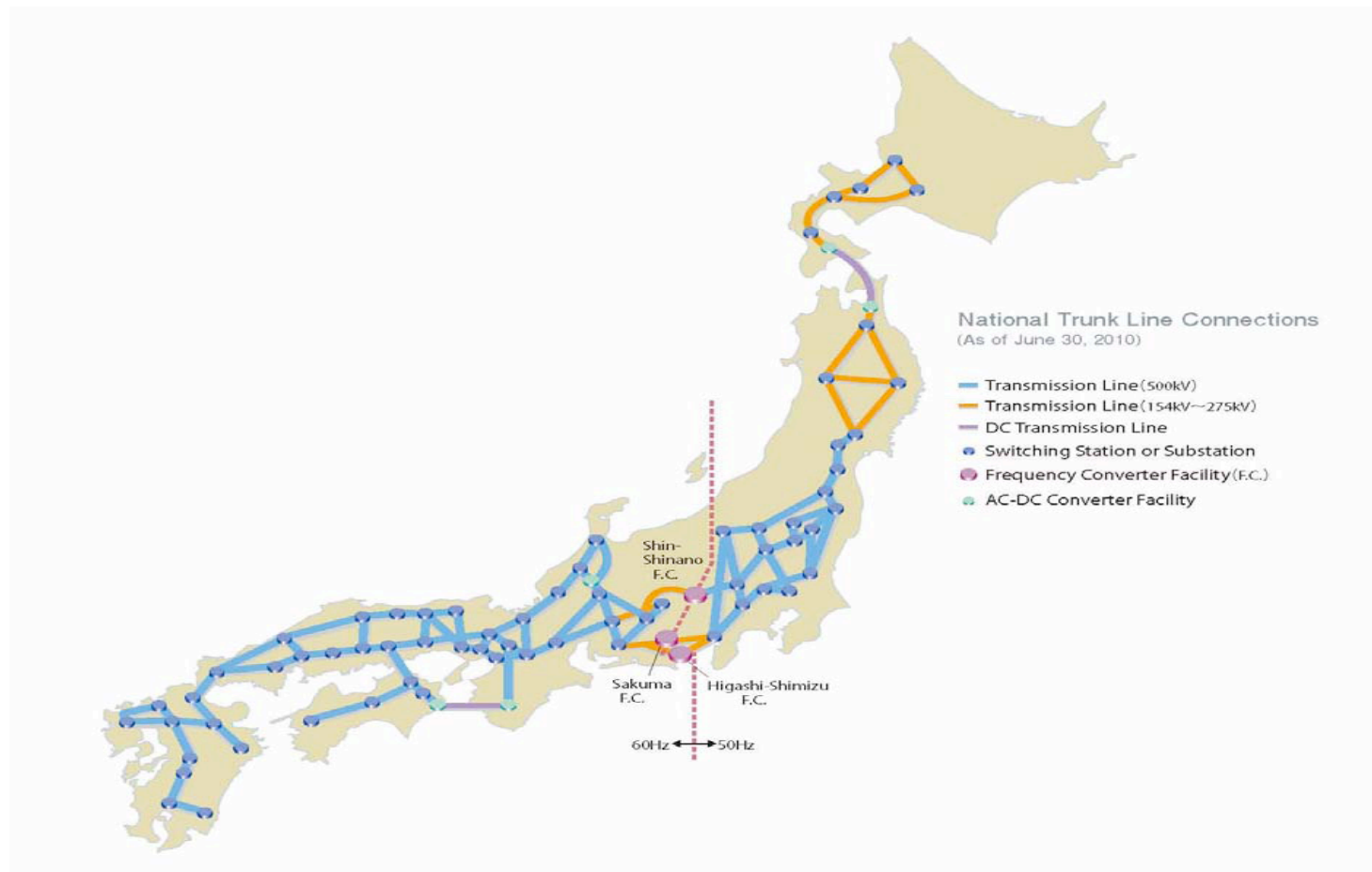
Some Grid Investments Will Be Unavoidable

photo courtesy Nautilus



Japan's Divided Grid

chart courtesy Nautilus



After Fukushima: How Smart, How Green?

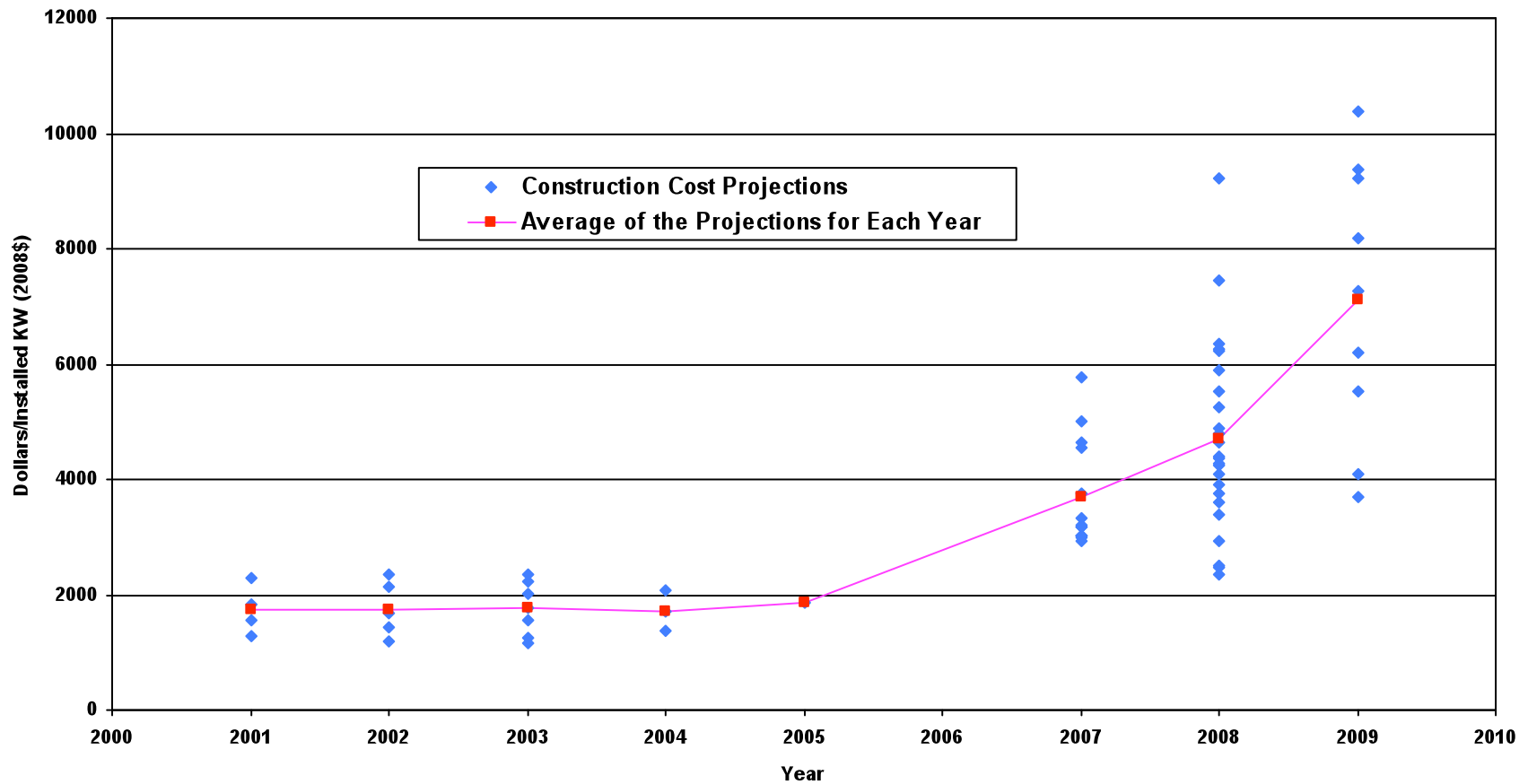
- How much nuclear – 20%, 30%, or 40%?
- How much LNG?
- An integrated, smarter grid?
- How much distributed local power generation?
- “Path from Fukushima” a global example?

TEPCO: A Financial Disaster

- **World's largest private electrical utility**
- **\$91 billion in debt before crisis**
- **Now a Financial “Zombie”** – insolvent, with negative net worth, propped up with government financing?
- Facing 12 to over 130 billion in claims
- **Stock lost nearly 80% of its value**
- **Moody's downgraded TEPCO debt from A1 to Baa1**

US and EU

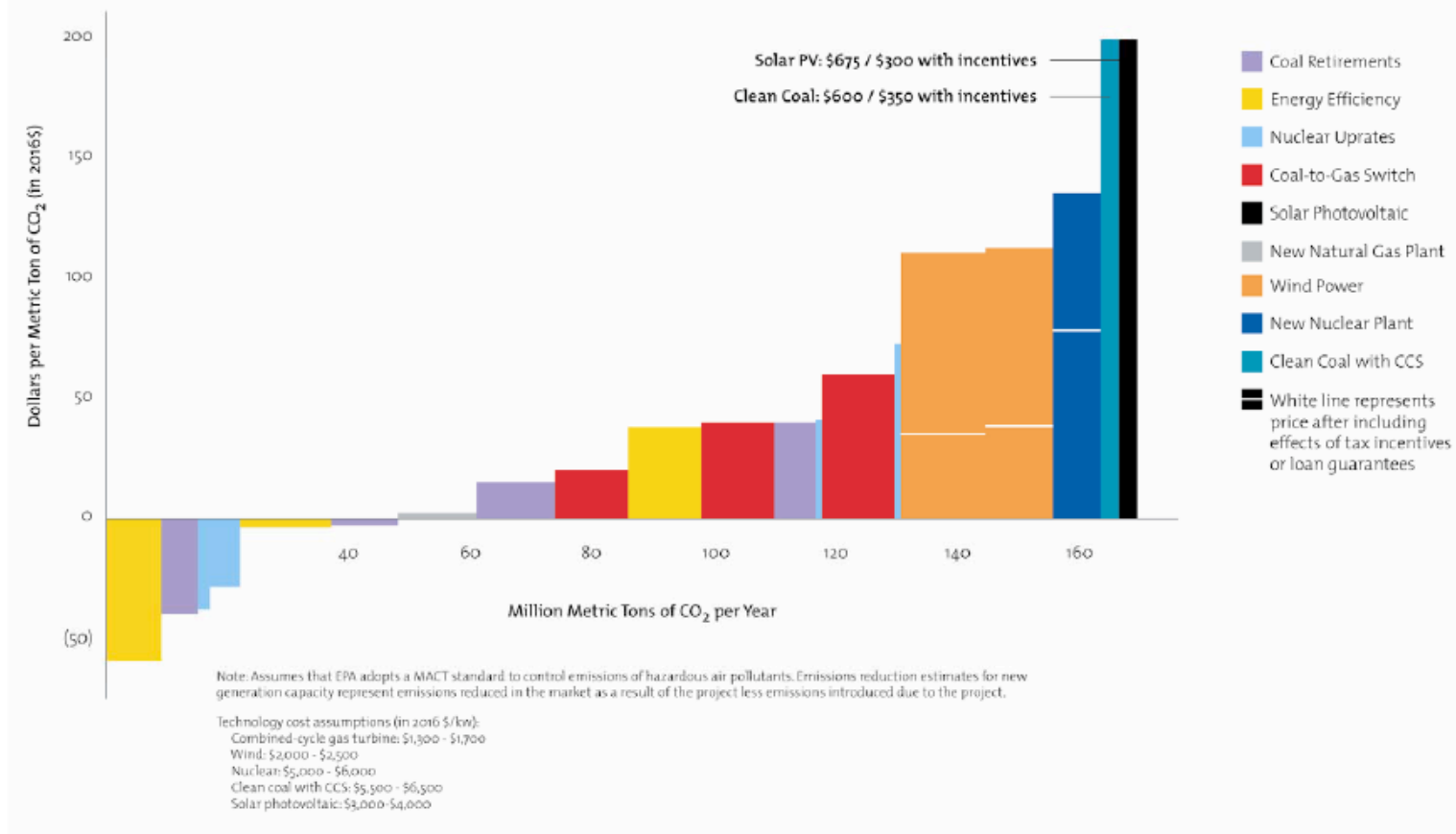
Projected US Reactor Costs Before Fukushima



US Merchant Utility Takeaways

chart courtesy Excelon

Cost Per Avoided Ton of CO₂ of Clean Energy Options in PJM



Current US Plants after Fukushima: Limited Issues

- How many more 20 year extensions?
- Any plant closures?
- How many upgrades?
 - Emergency safety systems
 - Evacuation plans
- Spent fuel management?

Future US Builds: Different Issues

- New safety license requirements?
- Increased construction license scrutiny leading to longer construction times?
- Who will pick up 20 percent after loan guarantees – Not TEPCO, probably not as many private investors -- EdF, AREVA, Russia?

EU: No Net Nuclear Growth?

- German early shutdown of 7 plants
- Italian, Polish plans likely to slide
- Finnish, Slovakian, Bulgarian, Romanian plans likely to go forward
- decommissionings

Developing States

Reactor Exports and Liability

- New reactors: Safe enough for US vendors to assume liability?
- CSC: more, or less, popular after Fukushima?
- TEPCO, KEPCO, AREVA/EdF – up to providing sufficient export financing?
- Wither Russian exports?
- Given safety & cost issues, how will nuclear in new states be viewed?

Nuclear Power's Emerging Markets: Cause for Concern

- Saudi Arabia
 - Turkey
 - Jordan
 - Vietnam
 - UAE
 - Yemen
 - Algeria
 - Pakistan
- Iran
 - North Korea
 - Malaysia
 - Venezuela
 - Egypt
 - Libya
 - Syria

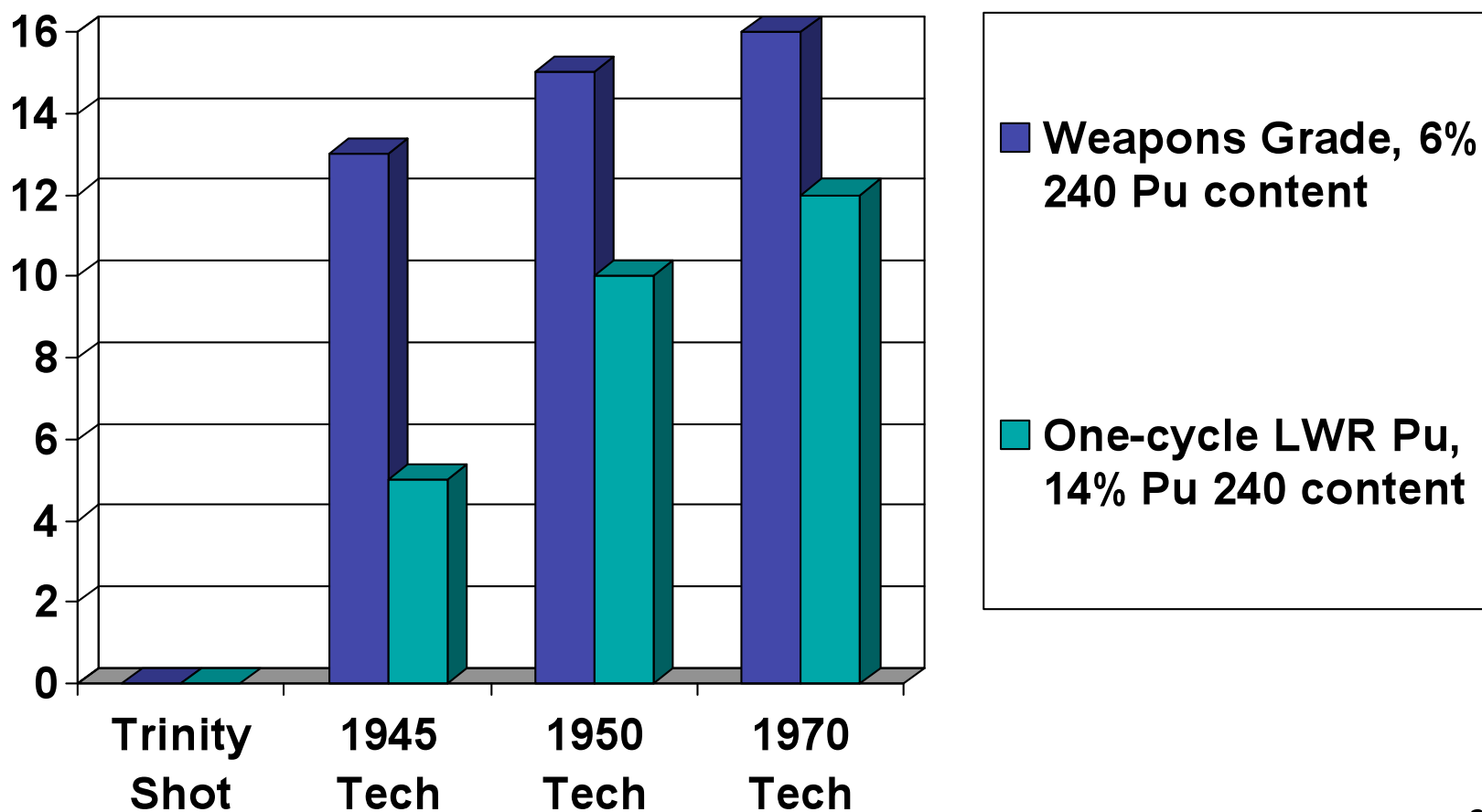
Current Narrative on Power-Weapons Link: Don't Worry

- Problem is not reactors but fuel making
- Fuel banks and access will convince others not to make fuel
- The IAEA can be strengthened
- Counterproliferation fueled by actionable intelligence for the rest
- In the end nuclear weapons not militarily usable and can be deterred easily.

Power Reactors Are a Weapons Worry

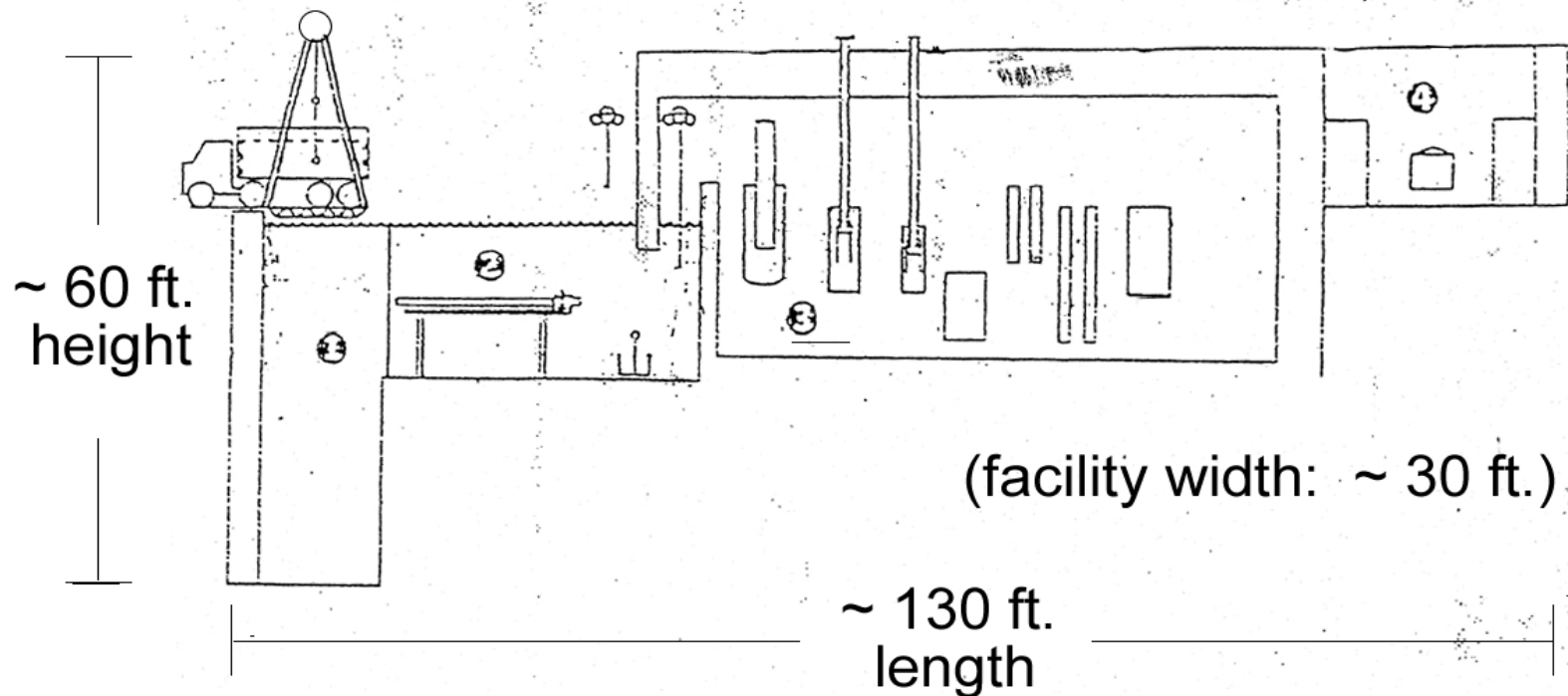
- US, Russia, UK, India, DPRK, France, Pakistan all used plutonium from reactors connected to the grid
- US tested reactor grade pu device in early 60s
- India made a point of claiming it tested power reactor grade plutonium device
- Turks did research to demonstrate LWR pu could be used to make bombs
- LWRs in the US used to produce tritium

Hardly Proliferation Resistant Enough: Estimated Yields for Different Bomb Technologies Using LWR Pu (Hubbard)



Small, Covert Reprocessing Plant Can Make 20 or More Bombs/Month (e.g., Ferguson- Culler) from Spent Fuel

<10-day startup, 1 bomb's-worth-a-day production rate



Sources: Adapted from D.E. Ferguson, "Simple, Quick [Re]Processing Plant," Memorandum to F.L. Culler, Oak Ridge National Laboratory, August 30, 1977; and J.A. Hassberger, "Light-Water Reactor Fueling Handling and Spent Fuel Characteristics," Fission Energy and Systems Safety Program, Lawrence Livermore National Laboratory, circa February 26, 1999.

Peaceful Reactors As Weapons Cover: The Case of Bushehr

- Oct 10, 2008 NYT reported a Russian implosion expert “visited” Iran. Bushehr to have hundreds of Russian technicians.
- Dr. Prasad feared to have transferred tritium extraction tech useful for weapons “boosting” on “safety” assistance visits to Bushehr
- Hundreds of Iranians trained in Russia and elsewhere on the entire fuel cycle
- Russian fuel assistance suspected to Arak, ISIS

Persuading Nonweapons States to Forego Fuel Making: The Record So Far

- Germany
- Netherlands
- Japan
- India
- Brazil
- Argentina
- Iran
- South Africa

Some Safeguards, Counterproliferation Limits

- Strengthening the IAEA and *Normal Accidents*
- Actionable Intelligence vs. the Laffer Curve of Proliferation Intelligence Demand
 - The Israel case ('69,'79)
 - Others

How the Mid-East Nexus Between Reactors and Bombs Has Been Handled

13 Military Strikes against IAEA member states' large reactors since 1980

11 against safeguarded reactors since 1980

1980 Iran against Osirak

1981 Israel against Osirak

1980-1985 Seven Iraqi strikes against Bushehr

1990 US against Osirak

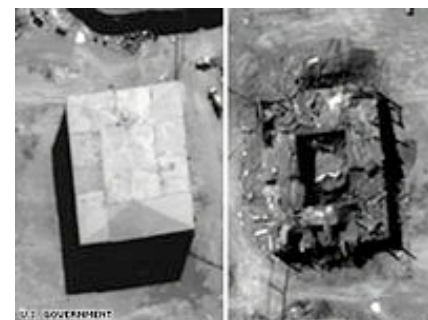
2003 US against Osirak

2 against IAEA member states reactors

1991 1 Iraqi Scud attack attempted against Dimona

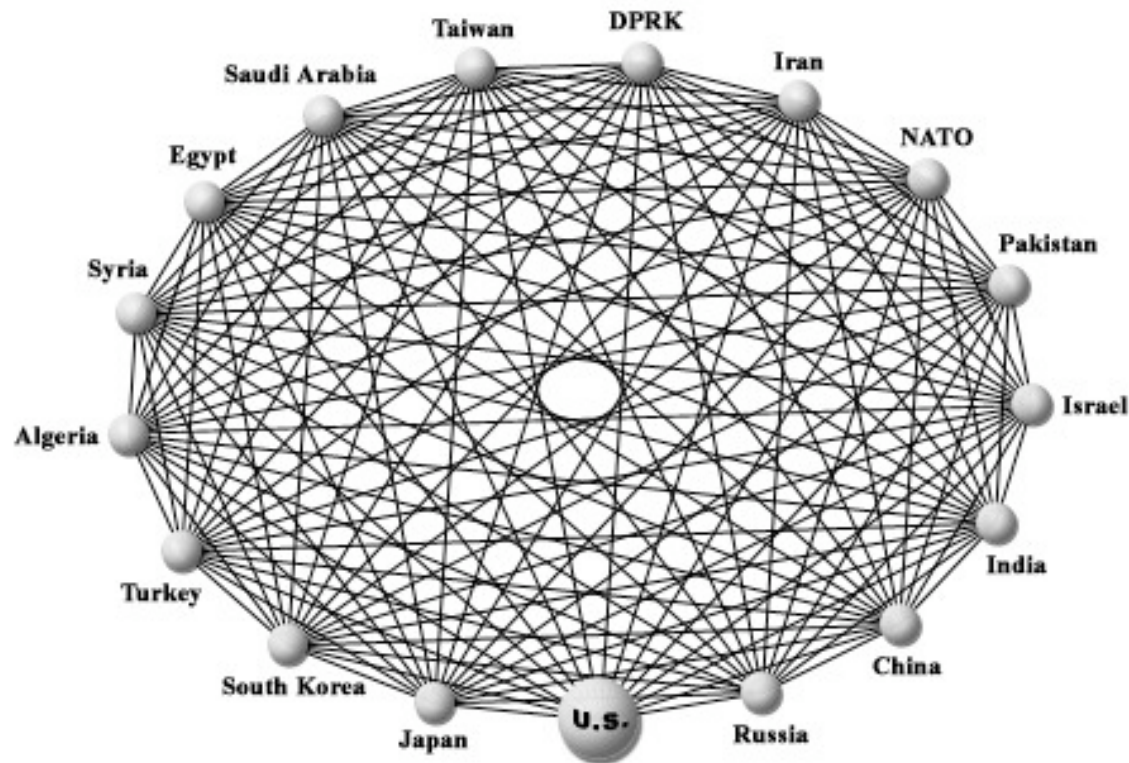
2007 Israeli strike against Syria's Reactor

Israeli 67 war, a Russian provocation aimed at Dimona



With More Nuclear-Ready States: Ramp Up to a Nuclear 1914?

Possible Proliferated Future



(136 chances for strategic miscalculation)

Today, plus

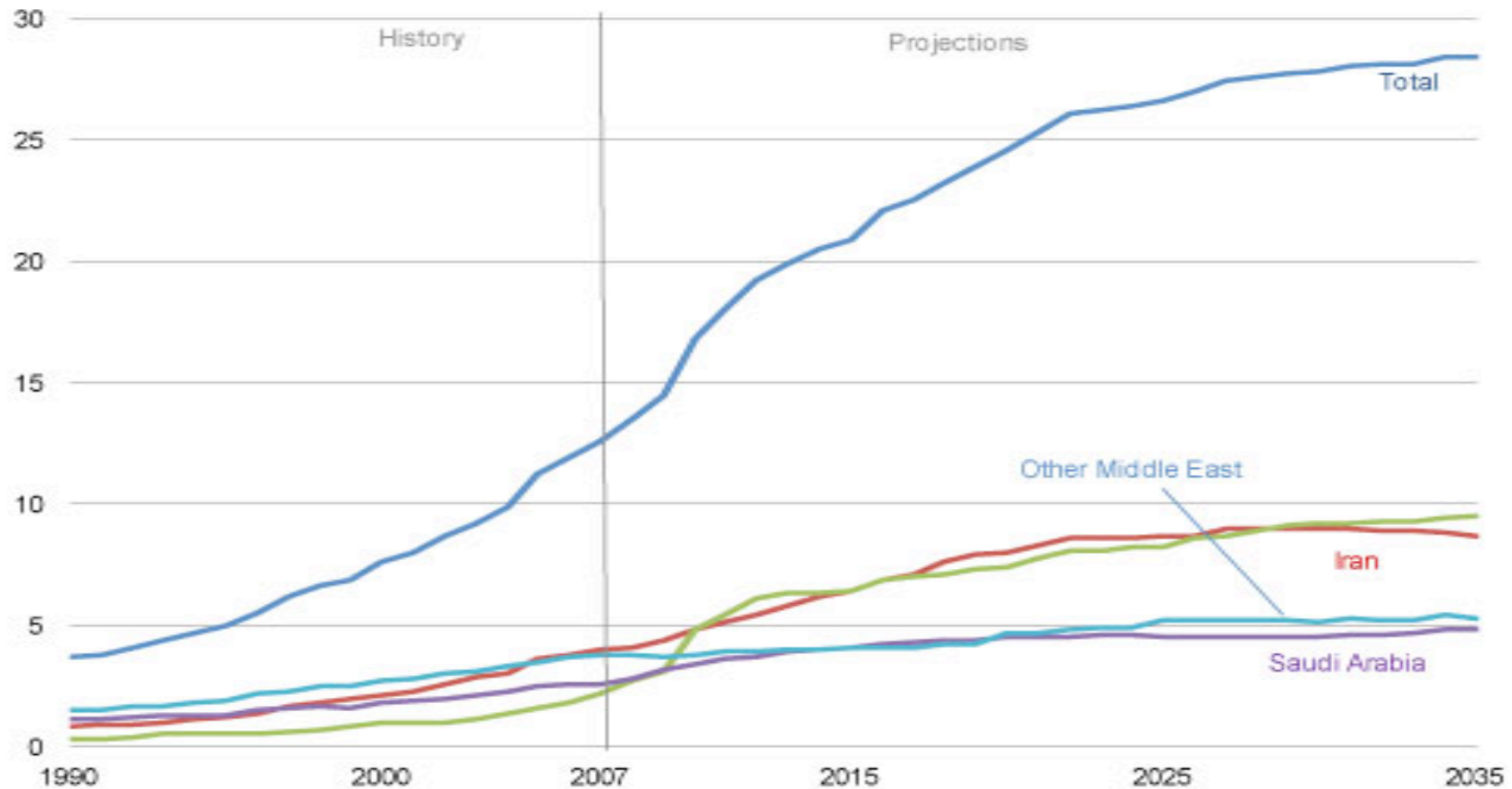
Iran DPRK Taiwan Saudi Arabia Egypt
Syria Algeria Turkey South Korea Japan

Takeaways

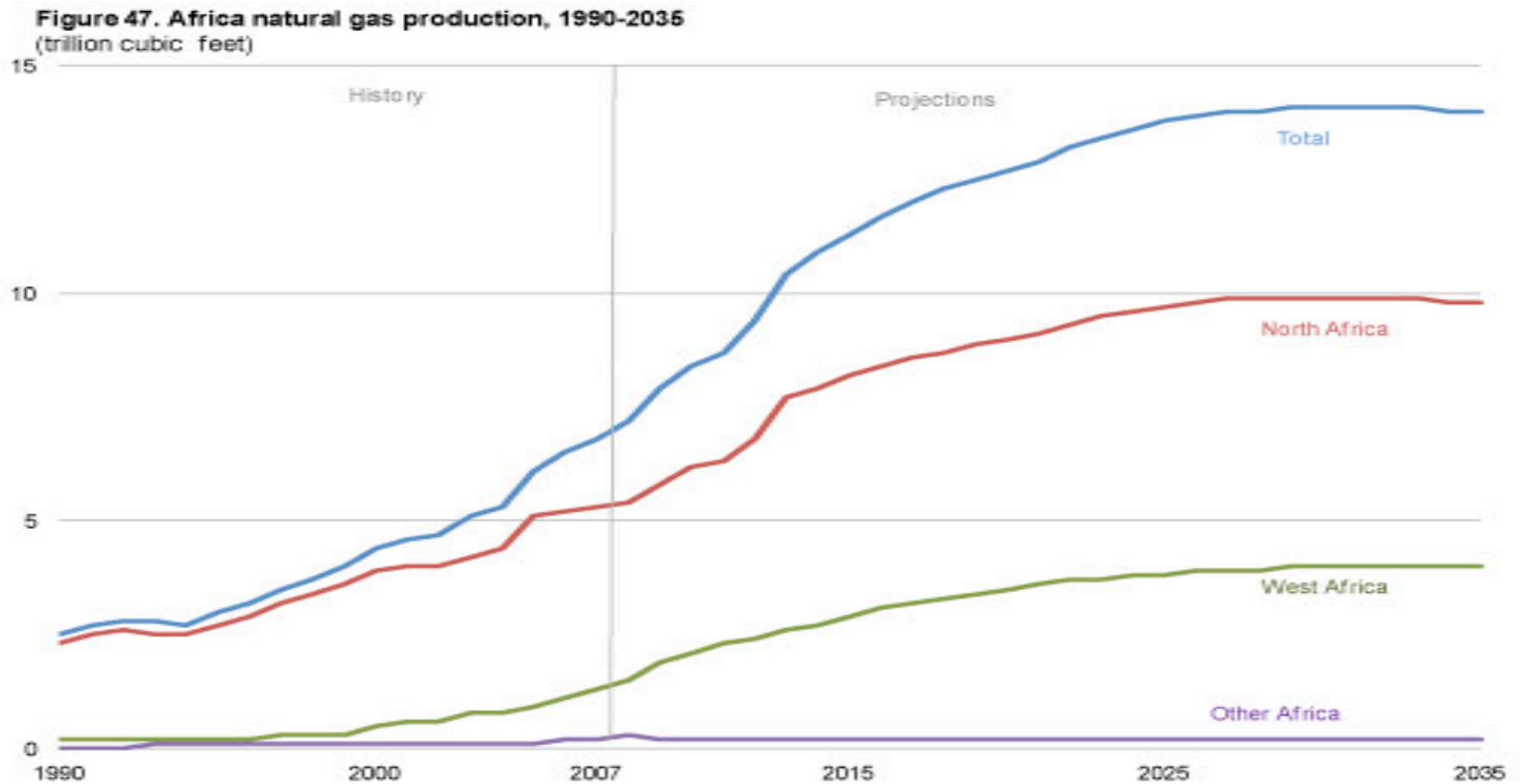
- **safety first**
- **Start counting energy costs, comparing nuclear with nonnuclear alternatives**
- **Clarify where & how the IAEA can safeguard against diversions & where and why it cannot**
- **Reward acting on first indications of proliferation**
- **Stop paying extra to run security risks with nuclear power's expansion or rewarding others to do so**
- **Tighten the rules using the Gold Standard as a start**

Middle East: Growing Natural Gas Production

Figure 45. Middle East natural gas production, 1990-2035
(trillion cubic feet)

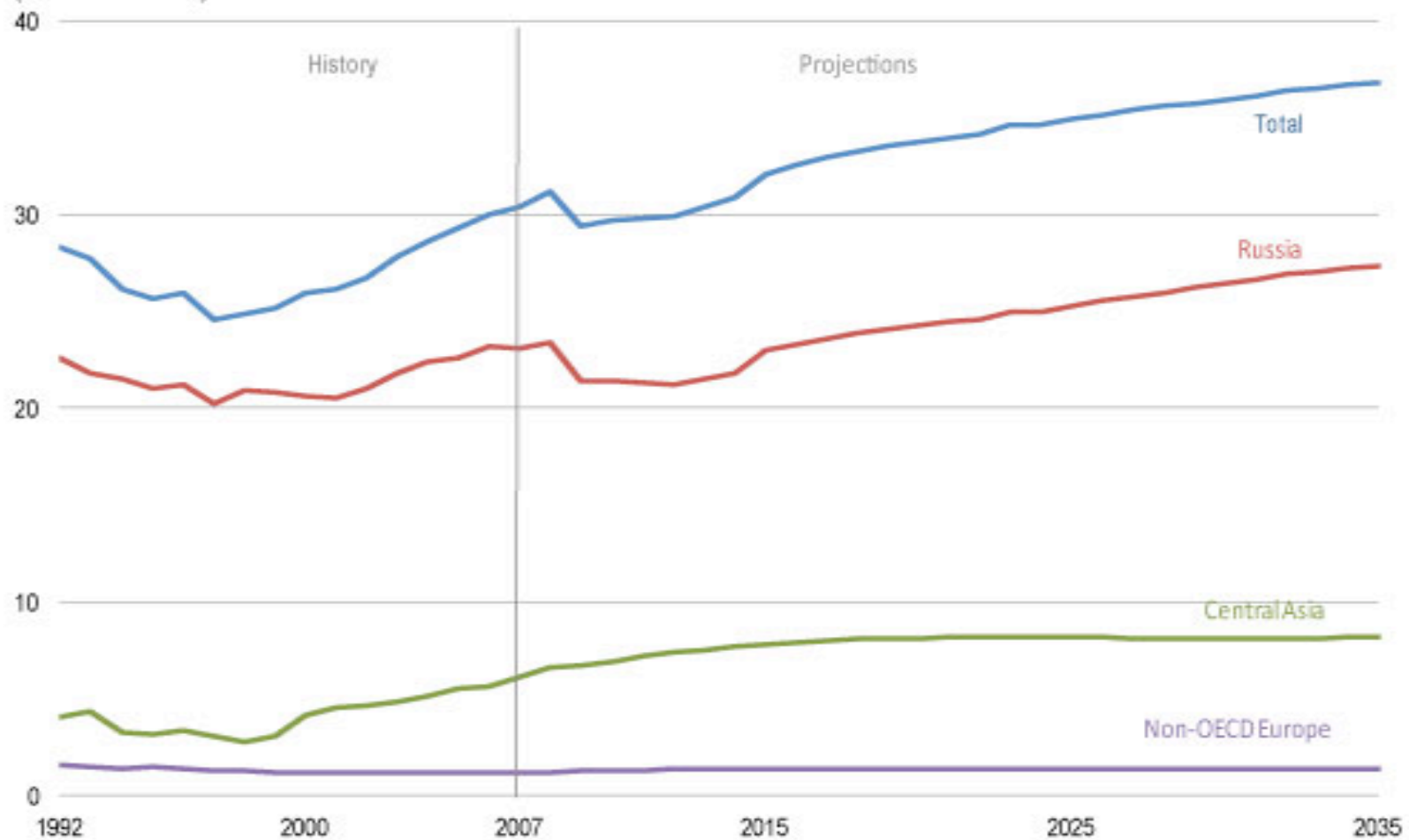


North Africa and the Continent



Eurasia

Figure 46. Non-OECD Europe and Eurasia natural gas production, 1992-2035
(trillion cubic feet)



OECD

Figure 43. OECD natural gas production by country, 1990-2035
(trillion cubic feet)

