After Fukushima: Does the Nuclear Industry Have a Future?

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Nuclear Intelligence Weekly

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Japan Pre-Fukushima

- 54 “operating” reactors (48.9 MW gross)
- 38 reactors online (as of March 10, 2011)
- 5 of 7 Kashiwazaki-Kariwa (Tepco) units down from 2007 quake, including 2 since restarted and down for technical problems
- Average capacity factor (2010) = 68%

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Fukushima Daiichi

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Unit 1 Explosion

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Sequence of Unit 3 Explosion

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After the Tsunami

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Damages …

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Human Toll

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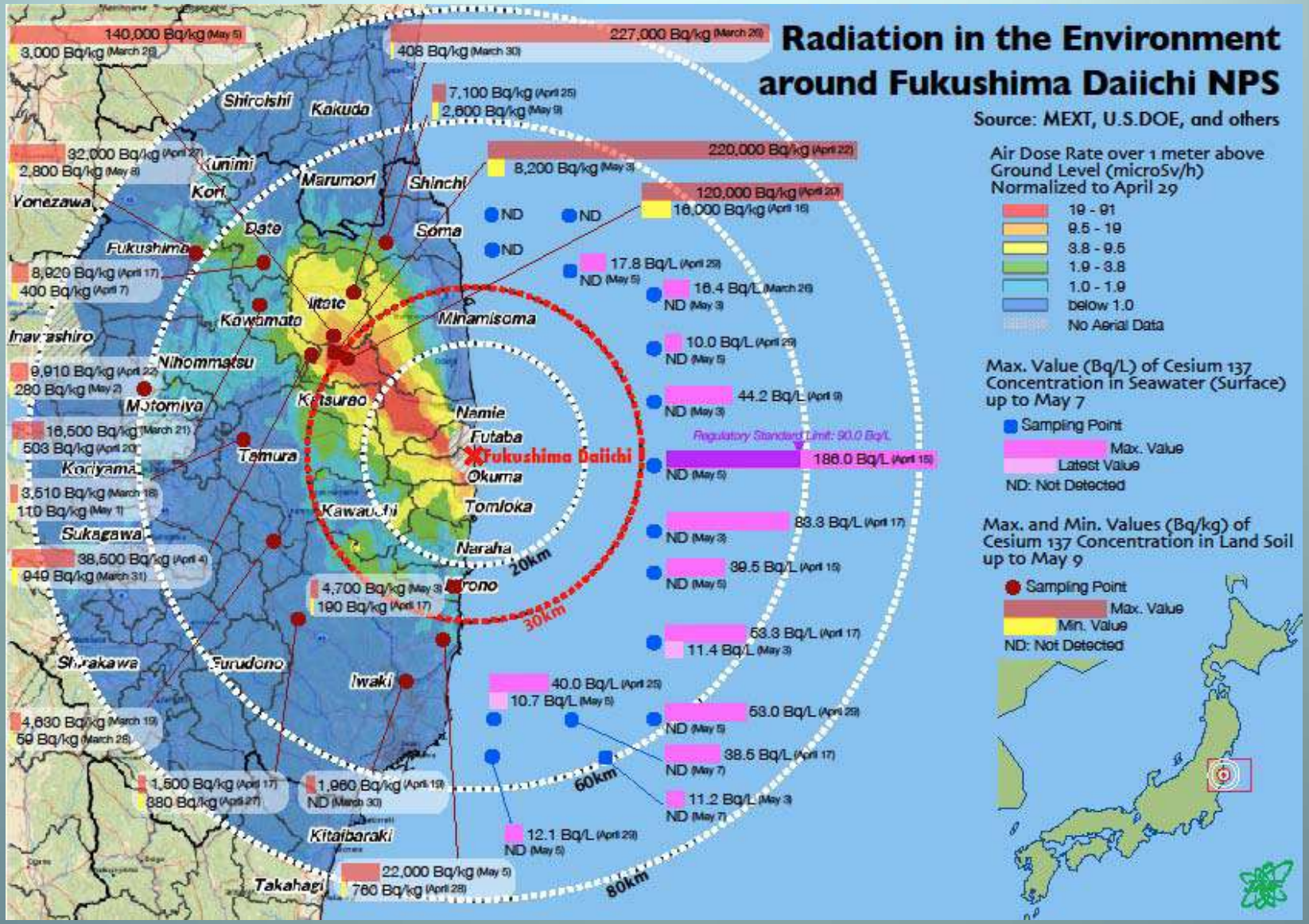
Radiation Exposures



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Japan Post-Fukushima

- March 11th: 14 reactors (12 GW) knocked out by quake (including 1 already down)
- 3 units at Hamaoka shut at government request (including 1 already down)
- Others subsequently shut for inspection & refueling

Six Months Later

- Shutdown: 43 reactors (39 GW)
- Operating: 11 reactors (10 GW)
- Zero operating by September 2012?

* 13-month maintenance/refueling cycle

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The Response – Low Key…or Not?

Zero Nukes

$54. 5 billion in nuclear subsidies

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Others responses

Benjamin Netanyahu:

"I think we'll go for the gas. I think we'll skip nuclear."

Luigi De Paoli

"I think there is now less than 0.01 percent chance for nuclear in Italy."

- German phase-out (17 reactors with 8 shut down immediately)
- Swiss phase-out (5 reactors, 2 planned)
- Italy, Venezuela, Israel, Kuwait abandon newbuild programs
- Taiwan phase-out? (4 units, with 5th about to start)

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The German Response: Part I

- 7 oldest reactors shut down (7 GW)

Replacement power

50% imported electricity

25% domestic gas

25% domestic coal

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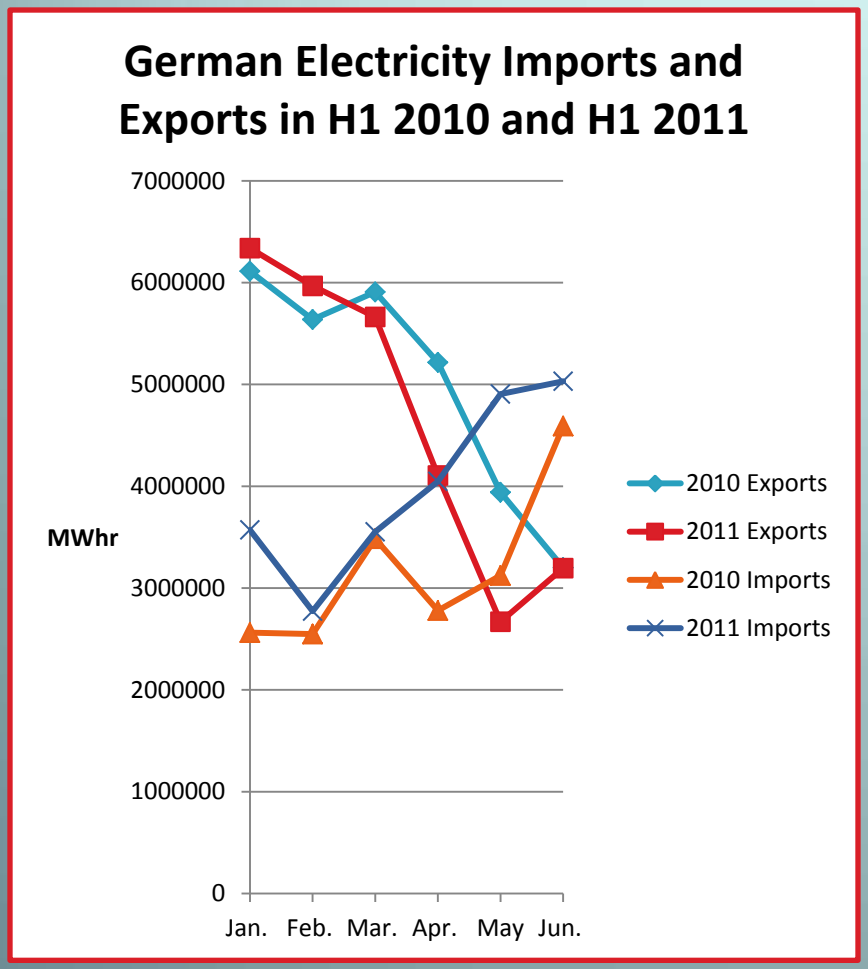
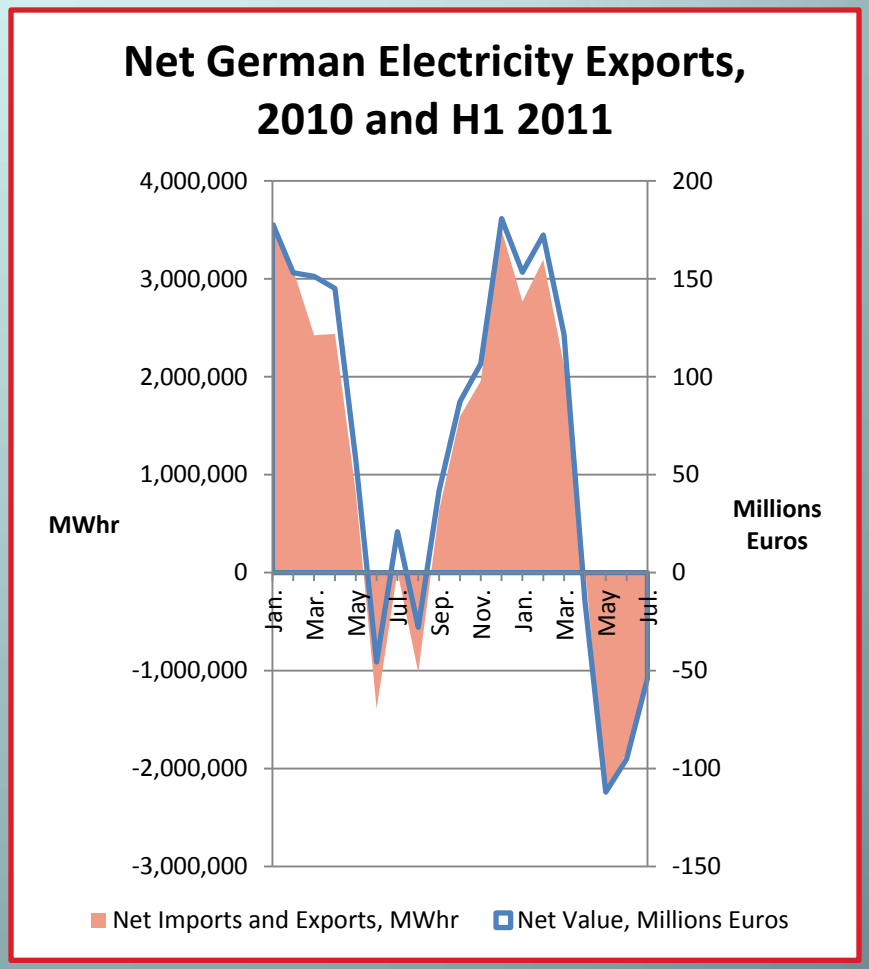
The Short-Term Impact





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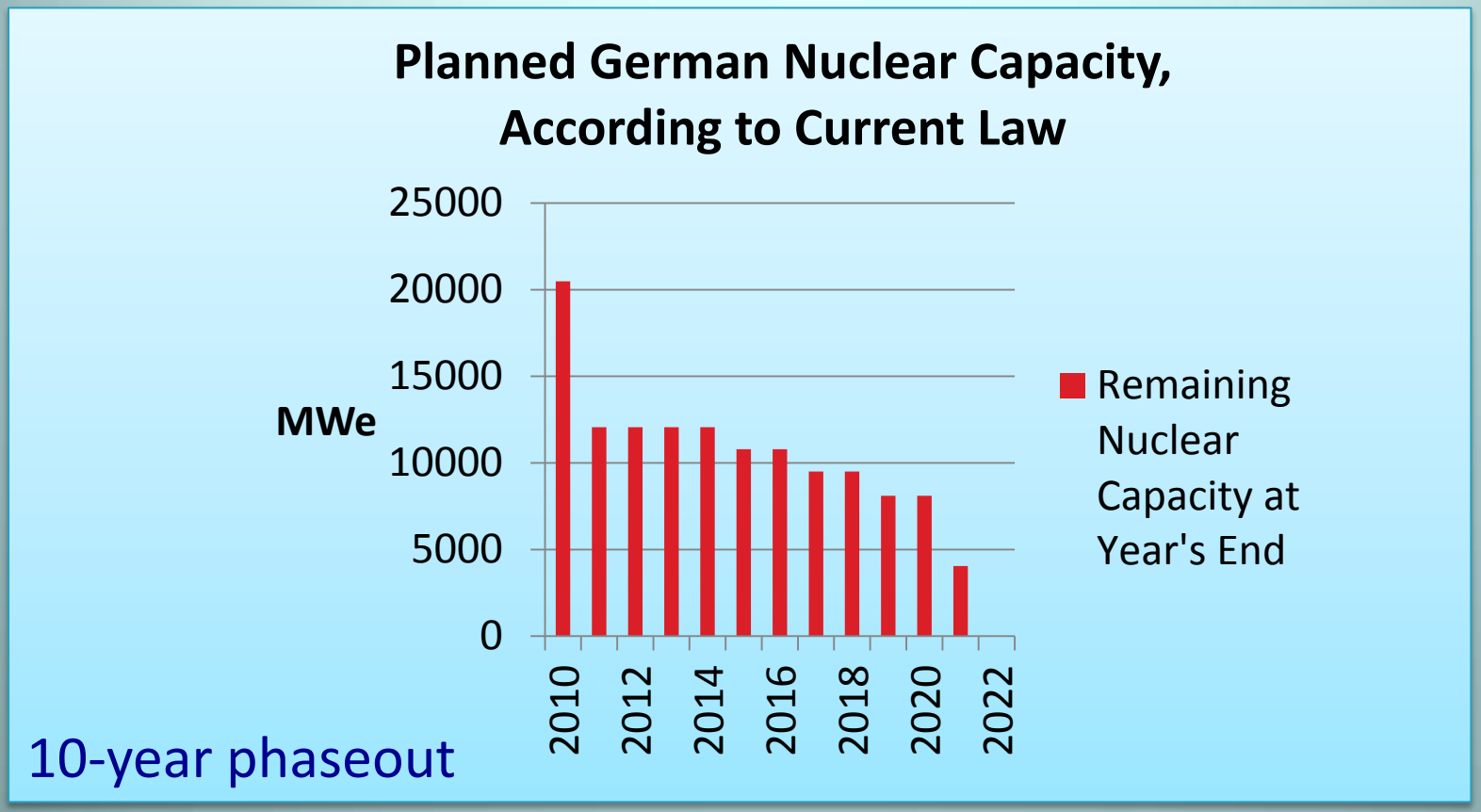

THE GERMAN RESPONSE: PART II

China's Response

- Suspends all new reactor approvals pending safety review
- Debate breaks out over whether to stop Gen-II projects and move to Gen-III (adding to uncertainty over timing of future newbuild)
- Construction continues on 27 reactors

China's Nuclear Situation So Far

14 operating (11.6 GW)

27 under construction (30.9 GW)

71 approved under National Plan (80.8 GW)

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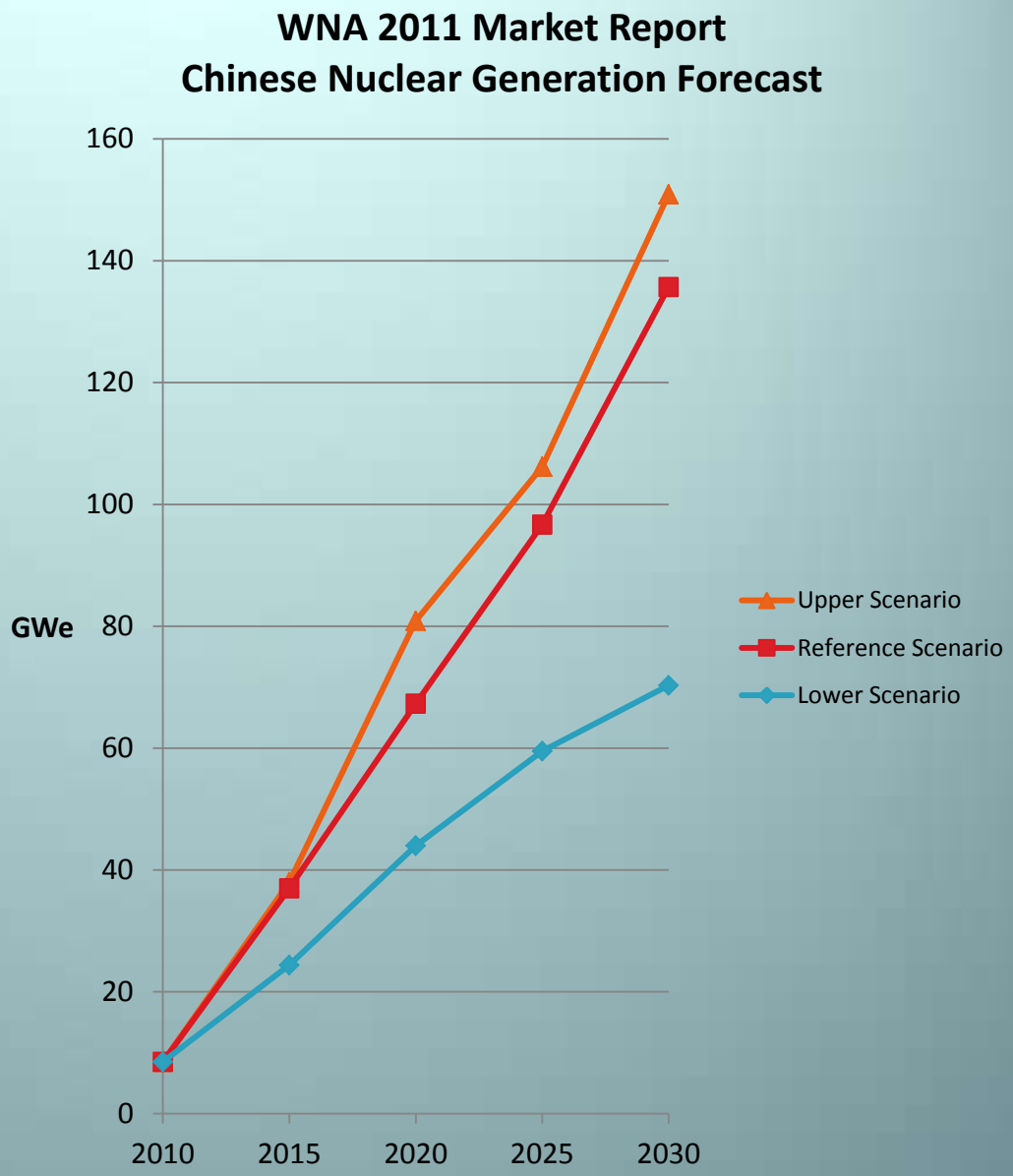
China's Nuclear Growth

67 GW by 2020

- 12 GW operating
- 30 GW under construction
- 25 GW more need

<u>Over the Next 8 Years</u>

A lot depends on when government lifts suspension on new project approvals.



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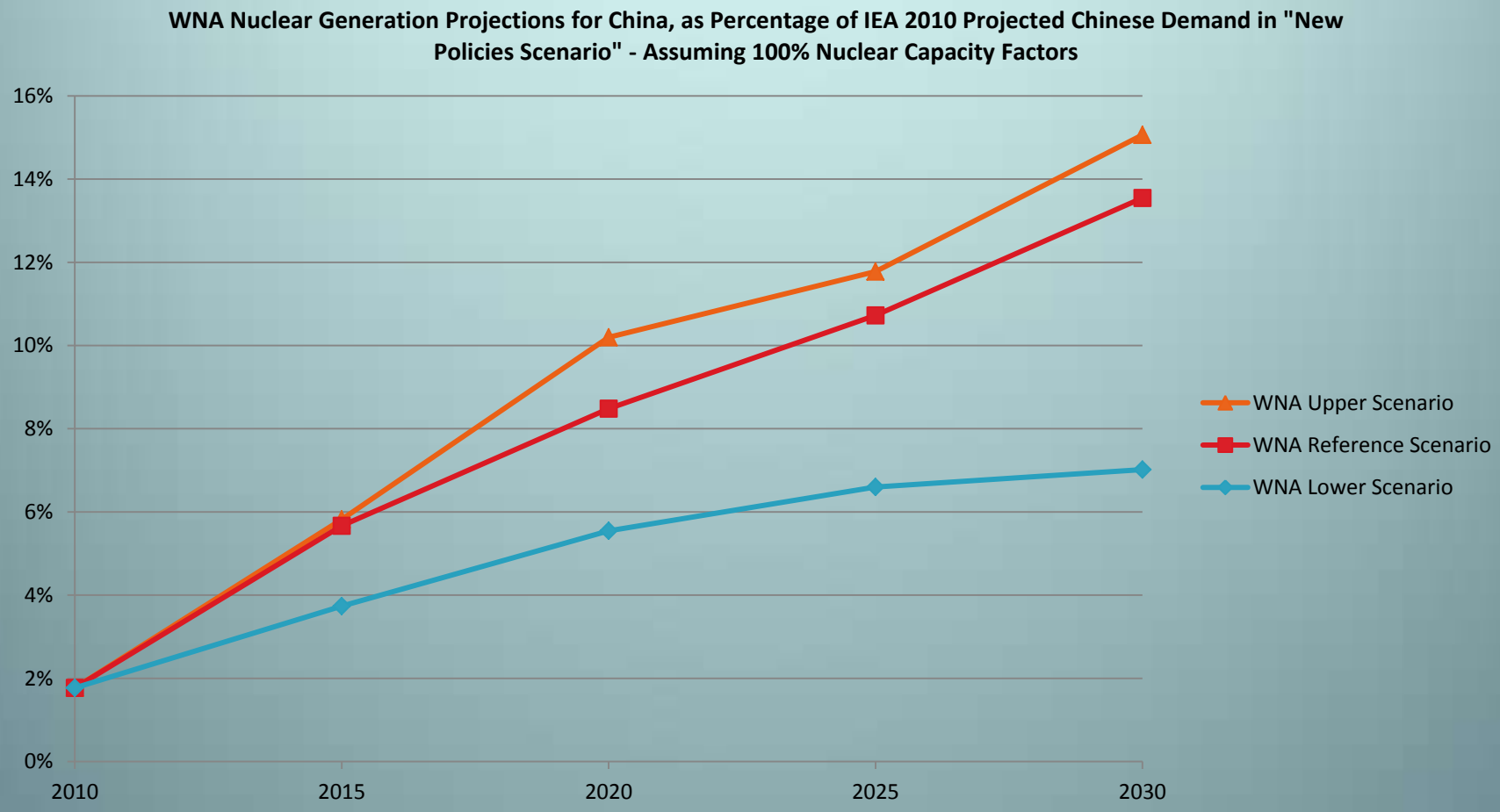
Nuclear Contributes Under 15% of Total Chinese Demand in 2030



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UNITED STATES

"U.S. electric power companies do not have the size, financing capability or financial strength to finance new nuclear power projects on balance sheet, on their own. To do so could place the entire company at risk – if the project could receive Board approval in the first place. These first projects require credit support – either loan guarantees from the federal government or assurance of investment recovery from state governments, or both."

Frank L. Bowman, President, Nuclear Energy Institute, May 6, 2008

Energy Policy Act 2005

- Authorized $4 billion; increased to $18.5 billion for new reactors ($38.5 billion total, including $2 billion for nuclear fuel cycle facilities)
- 1.8 cent per kilowatt-hour tax credit for 6,000 MW of new nuclear capacity ($125 million annual limit)
- Guarantees loans for 80% of project cost
- Federal Financing Bank must provide loan

DOE Estimate

- $9 billion per reactor
- $188 billion in loan guarantee requests
- based on submitted requests for 21 reactors, with installed capacity of 28,000 MW – 2% of electrical capacity (as of October 2008).

The Situation So Far

2002

- Bush announces Nuclear Power 2010
- First reactor online in 2010 “timeframe”
- Easier NRC licensing
- 30 projects subsequently proposed

Now

- Plant Vogtle (Georgia) 2016-2017

  Provisional $8.3 loan guarantee
- VC Summer (South Carolina) 2016-2019
- 2-unit Westinghouse AP1000s

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The US

2004

DOE/Industry overnight cost estimates (1,100 MW – 1,600 MW)

$1,500-$1,800/kW

$2-$4 billion/reactor

2007-2008

- FP&L ($6-$9 billion/plant)*
- Progress Energy ($7 billion)*
- Duke Energy ($5.5 billion)
- TVA ($7.5 billion)*

*financing included

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Nuclear Energy's Rising Costs - Europe

Olkiluoto-3 (Finland)
1600-MW EPR

- 2004 - €3 billion ($2250-$2475/kW)*
- 2010 - €5.7 billion ($4800/kW)*
- Project started in 2005; completion delayed to 2013.

* Includes 2.6% finance costs

Flamanville (France)
1630-MW EPR

- 2006 – €3.3 billion ($2590/kW)*
- 2010 - €5 billion
- At least 2 year delay

*overnight

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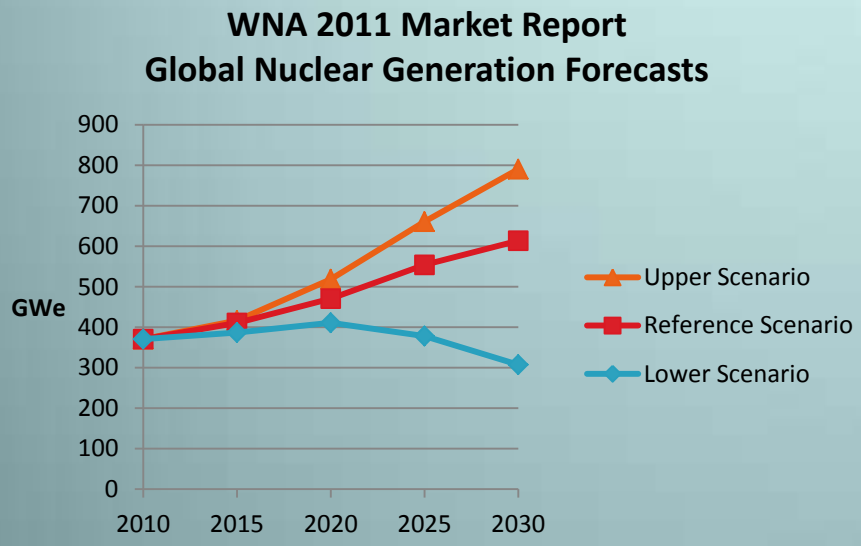
World Nuclear Association Forecast

- 30% increase by 2020 (514 reactors)
- 66% increase by 2030 (577 reactors)
- Additions in China India, South Korea and Russia outnumber declines in Germany, France, the UK (US has fewer reactors, a bit more capacity)
- Watch French elections (against background of unfavorable nuclear sentiment)

Global Nuclear Forecasts



A Bullish View

- 66% increase to 2030
- 577 reactors vs 435
- 136 GW in China

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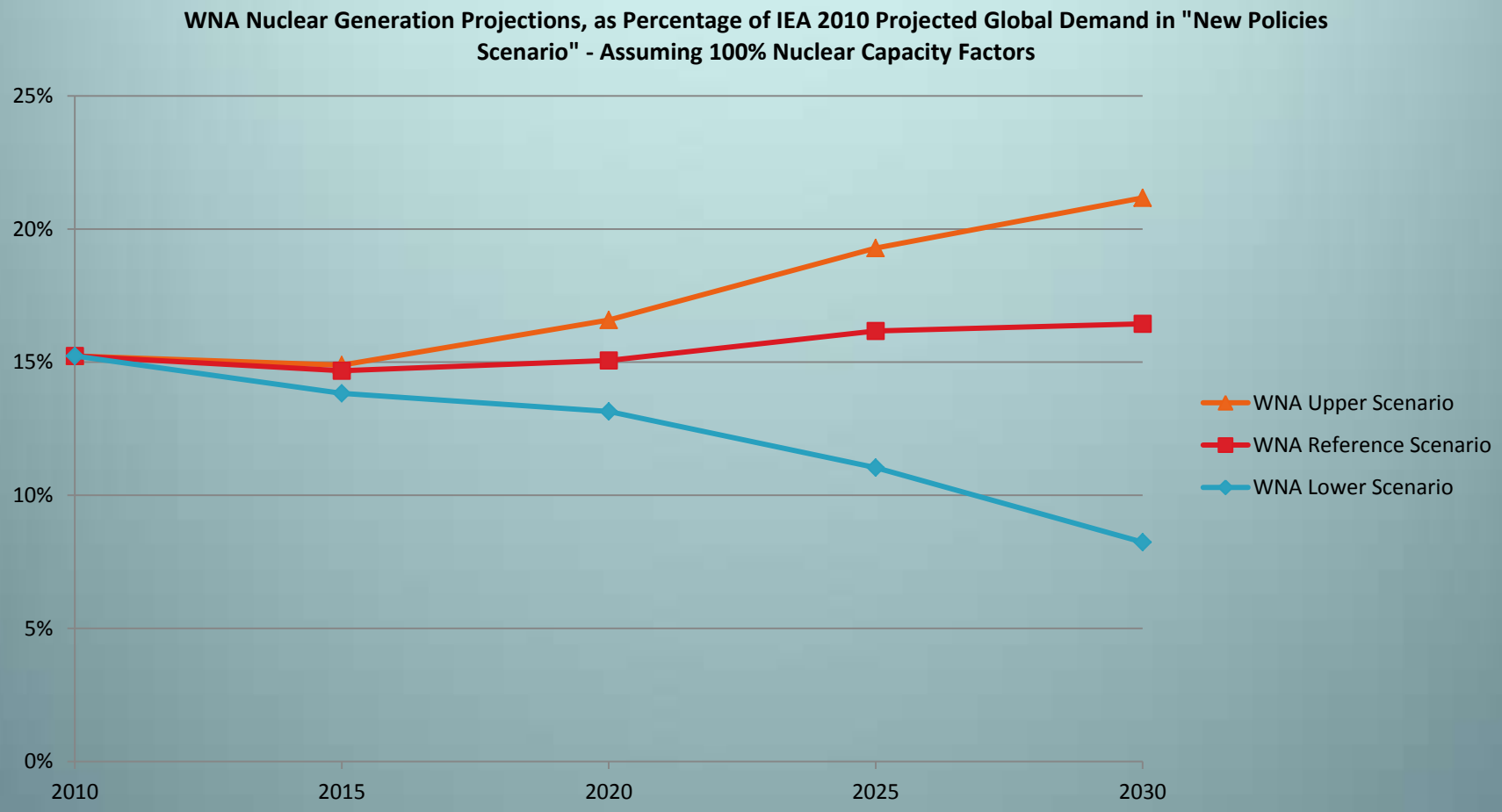
Treading Water – 13-15%



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