

# NARUC WEBINAR

7 DECEMBER 2012



# ABOUT BLOOMBERG NEW ENERGY FINANCE

200 staff in 12 offices worldwide

**Objective:** serve clients with the best intelligence on finance, technology and policy developments in clean energy, energy efficiency and carbon markets



# BLOOMBERG NEW ENERGY FINANCE

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## MARKETS

- Renewable energy
- Carbon markets
- Smart technologies
- Renewable energy certificates
- Carbon capture and storage
- Power
- Water
- Nuclear

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- **Knowledge Services:** Summit, Leadership Forums, Executive Briefings & workshops

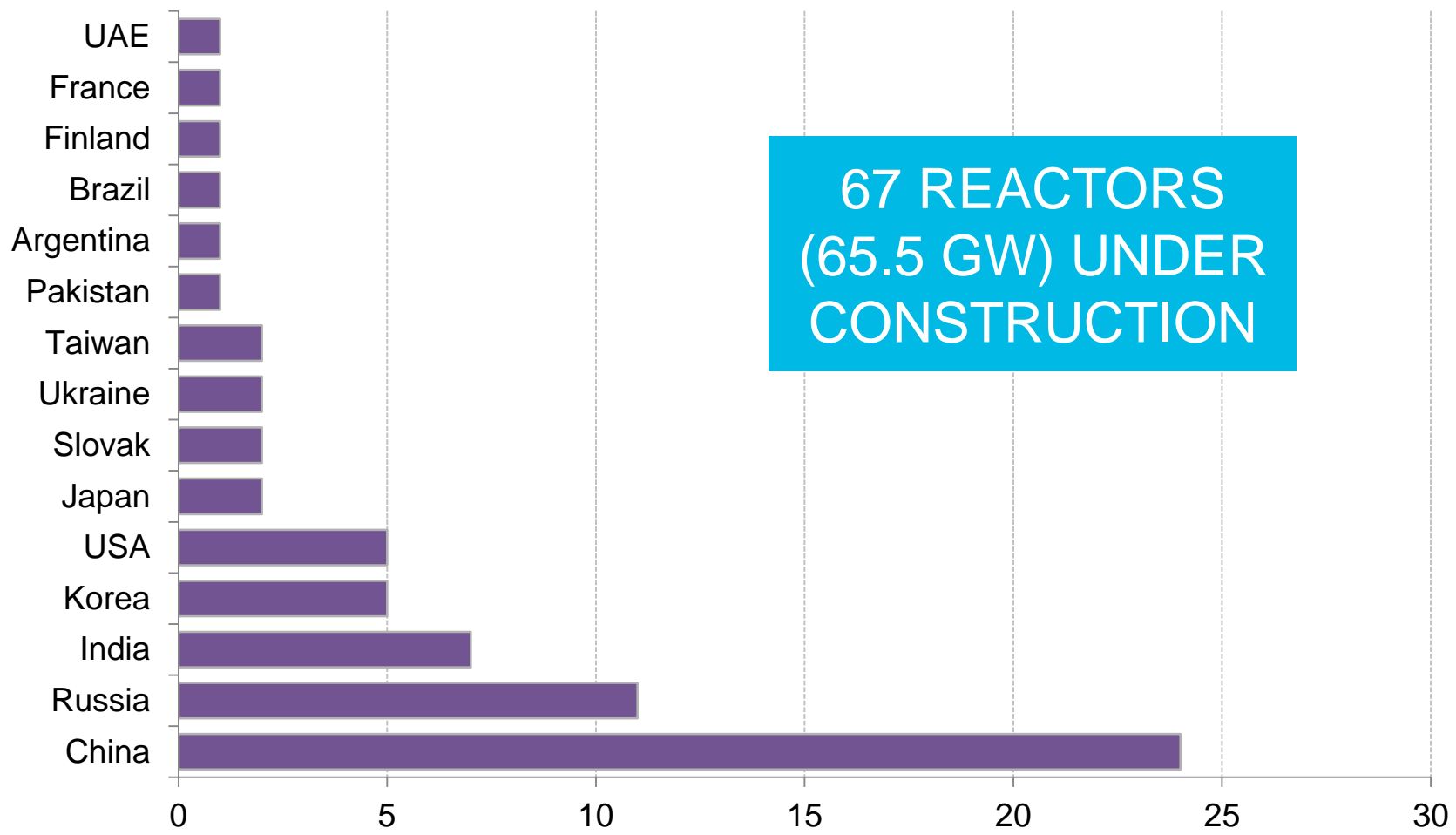
# CONTENTS

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1. Global nuclear energy status in Q4 2012
2. Major challenges to nuclear
3. Nuclear risk
4. New nuclear paradigm

# GLOBAL NEW CONSTRUCTION

Q4 2012 (GW)

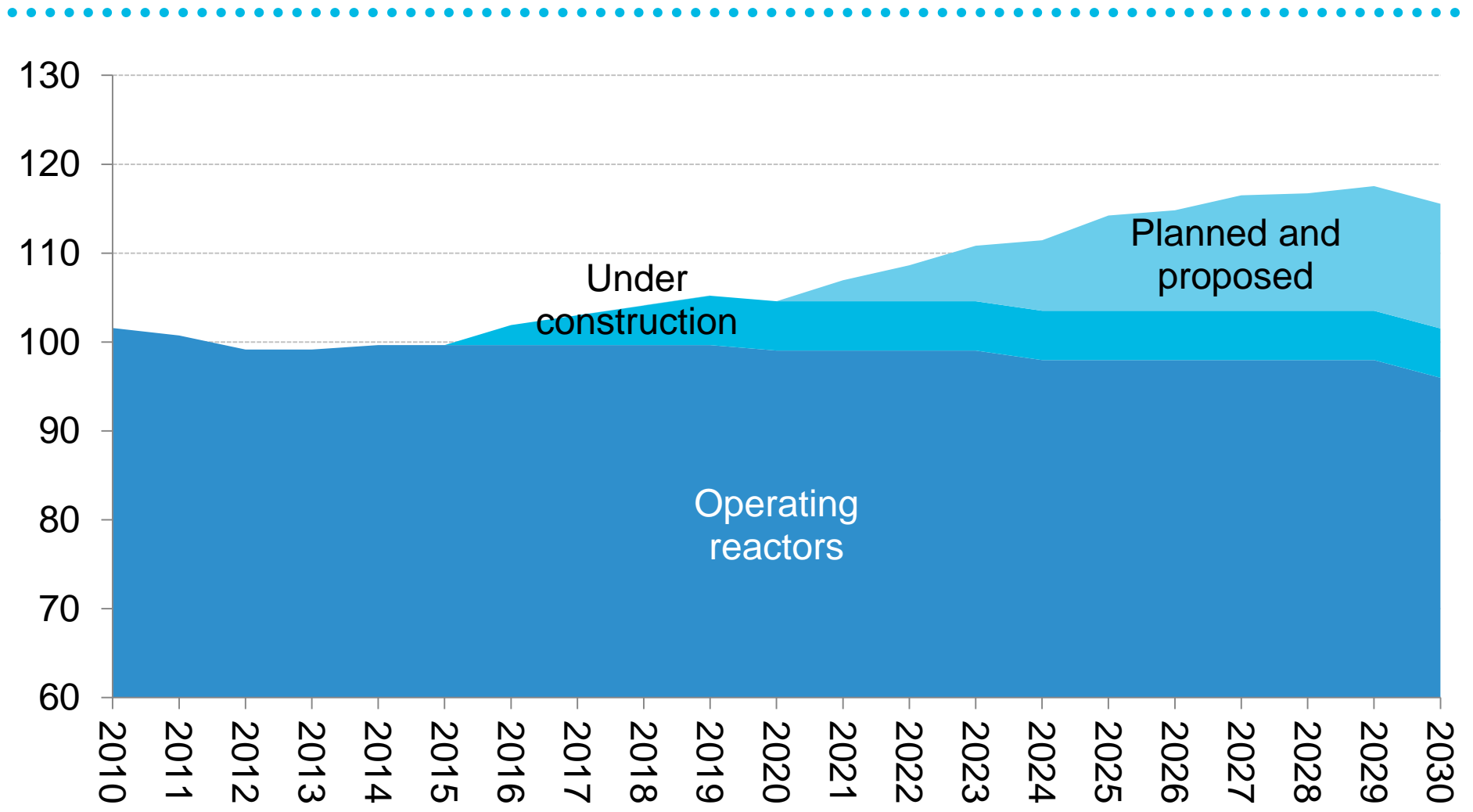


Note: Atucha in Argentina started in 1981, Flamanville, Olkiluoto, and Lunmenn in Taiwan ~10 years.

Source: Power Reactor Information System, IAEA, Bloomberg New Energy Finance

# POSSIBLE US NUCLEAR CAPACITY THROUGH 2030

(GW)



Note: 104 of the world's 437 nuclear reactors are in the US.

Source: Bloomberg New Energy Finance, NRC

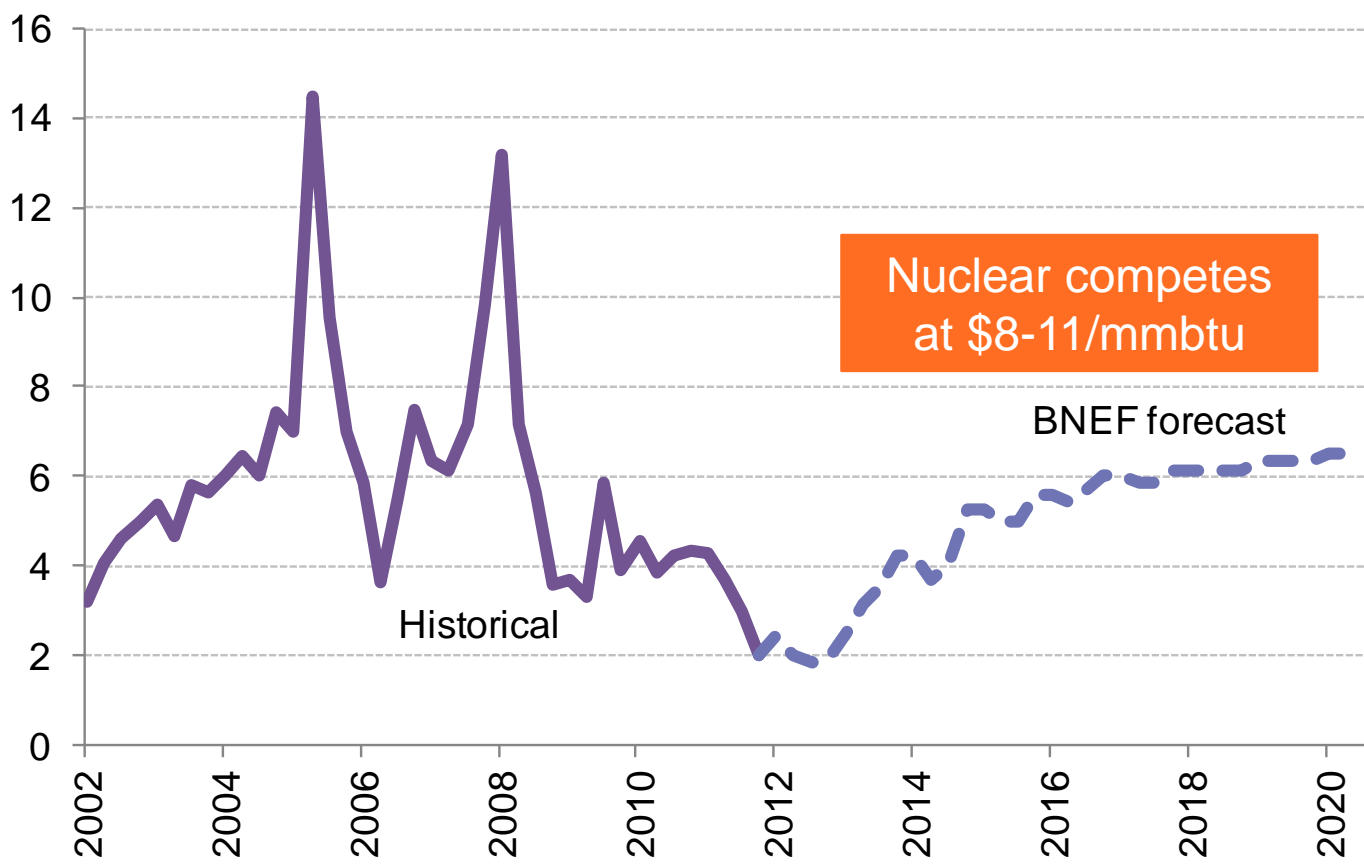
# MAJOR CHALLENGES FACING NUCLEAR IN US

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1. Cheap and abundant natural gas
2. Post-Fukushima reassessment
3. Carbon capture and sequestration
4. General preference for renewables

# HISTORICAL AND PROJECTED GAS PRICE FORECASTS

(\$/MMBTU)

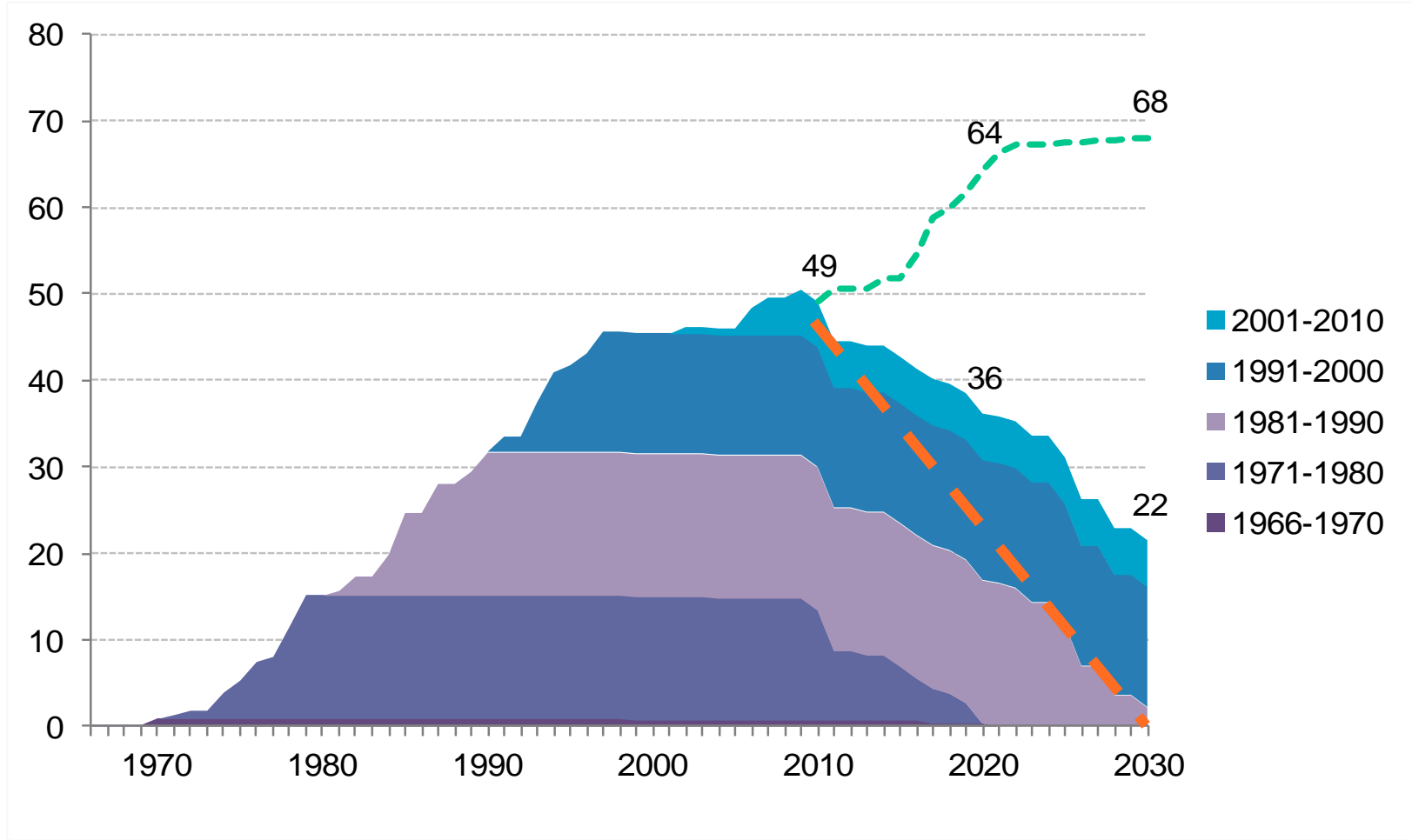


Source: Bloomberg New Energy Finance



# JAPAN NUCLEAR CAPACITY

## 2010 AND PROJECTED GROWTH VS. NO NEW BUILD (GW)



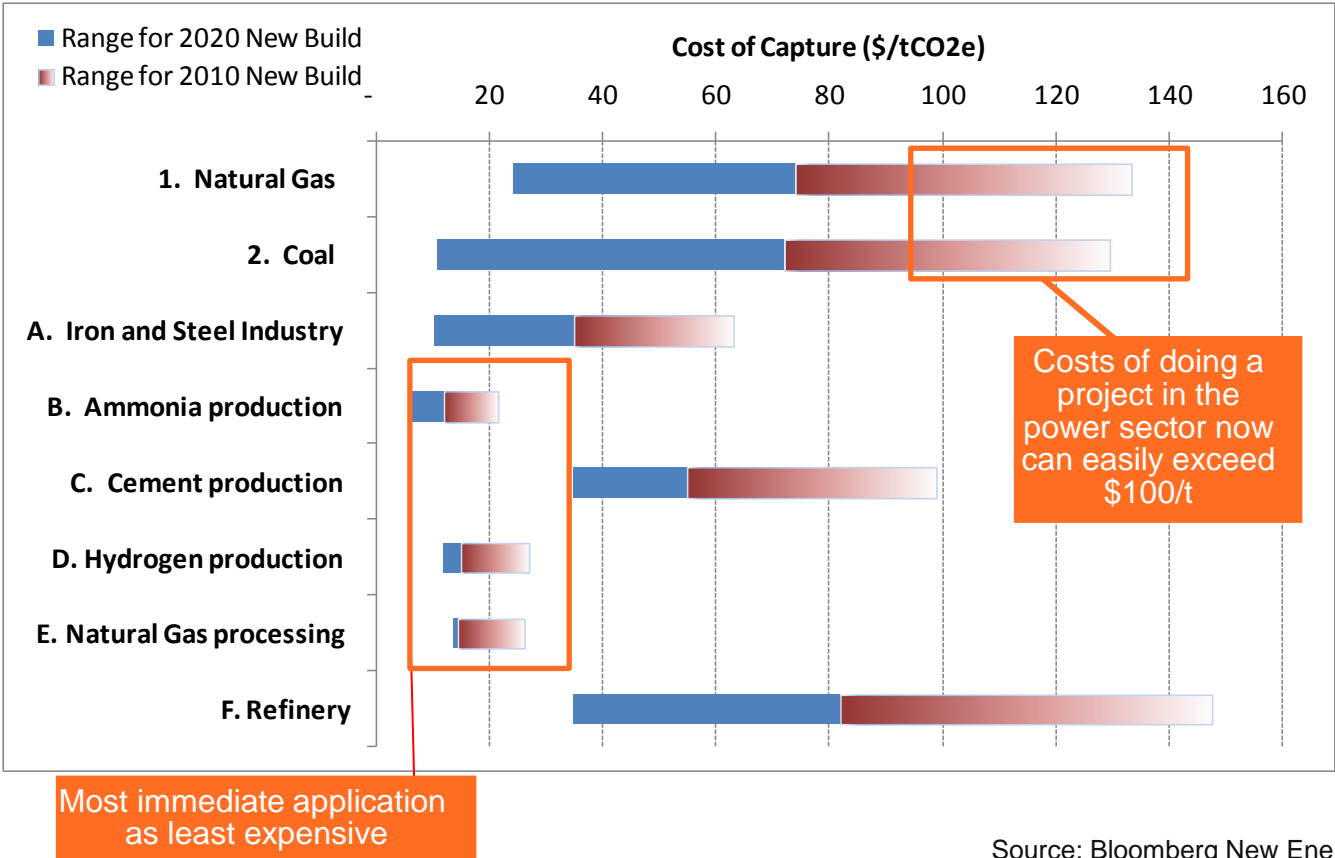
Note: Assuming 40-year operating life.

Source: Bloomberg New Energy Finance, METI

# CCS-CAPTURE COST ESTIMATES FOR NEW BUILD

(\$/tCO<sub>2</sub>e)

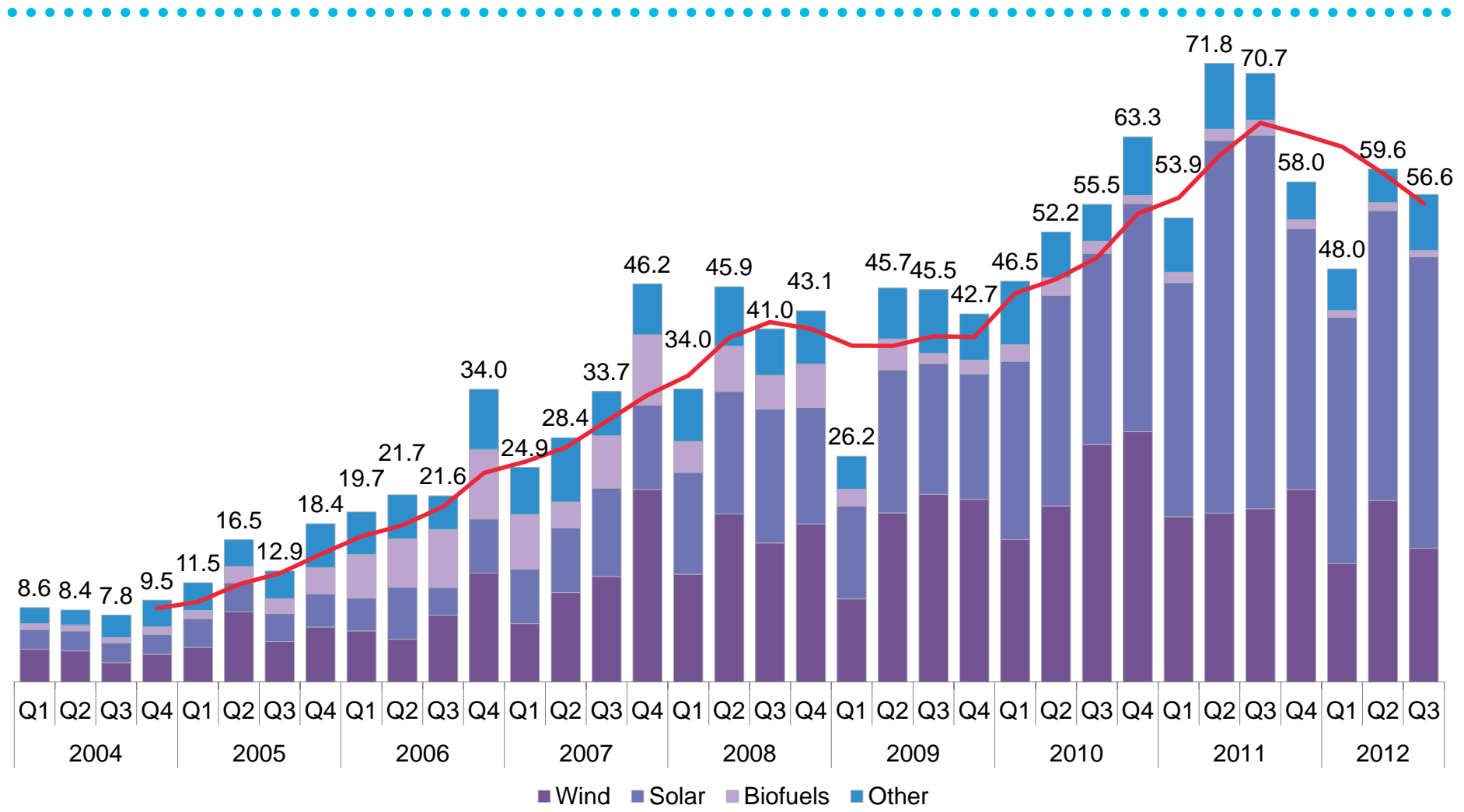
- Ranges below are for all capture technology families and show low-high ranges for newly built facilities in both 2020 (low end of range) and 2010 (high end of range)
- Costs are shown by sector rather than by technology family given importance of CO<sub>2</sub> purity in flue gas and approximate size of application



Source: Bloomberg New Energy Finance (2009)

# NEW INVESTMENT IN CLEAN ENERGY BY SECTOR

Q1 2004–Q3 2012 (\$BN)



Note: Total values include estimates for undisclosed deals. Excludes corporate and government R&D. Includes small distributed capacity & adjustment for re-invested equity. Source: Bloomberg New Energy Finance

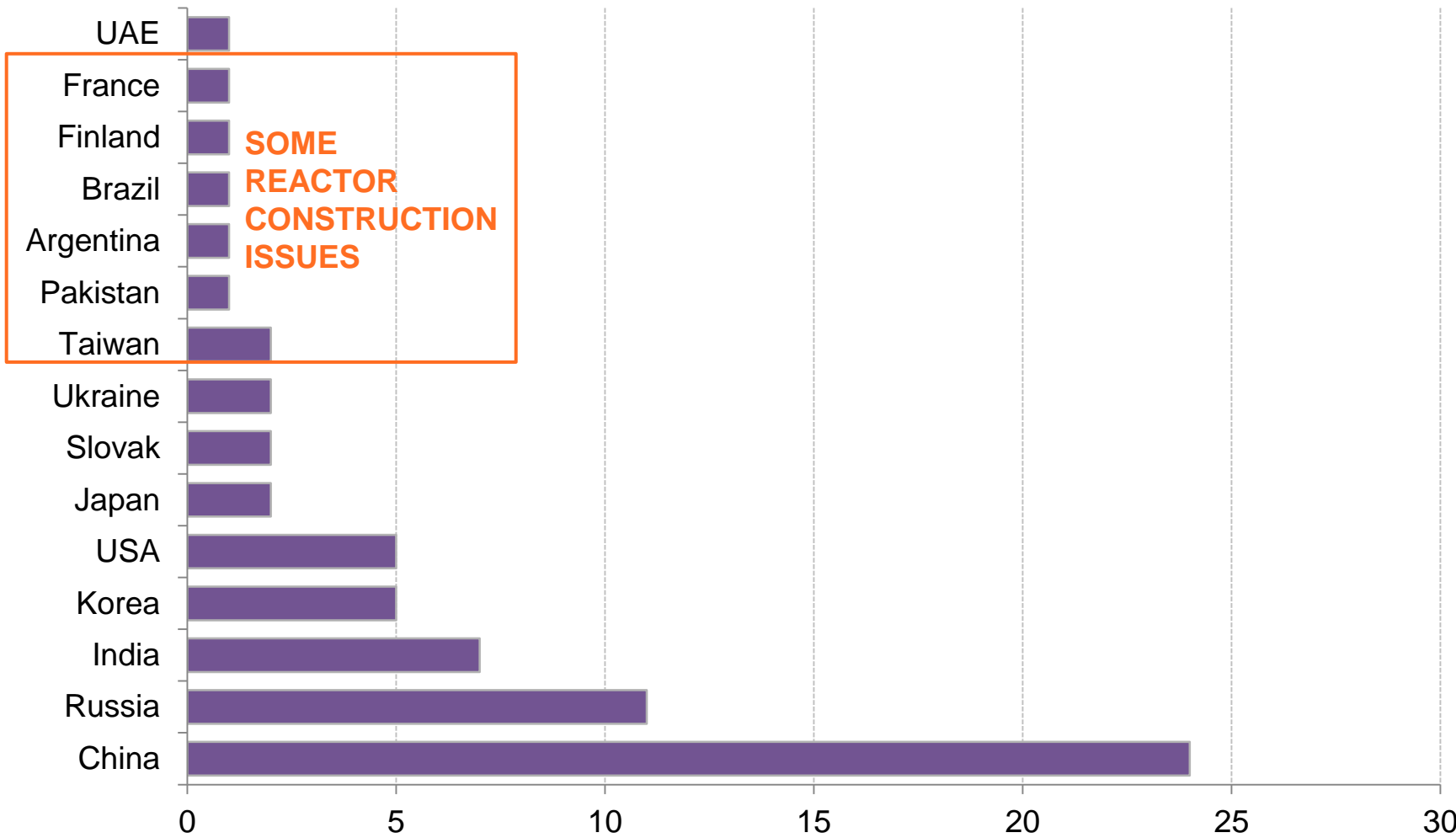
# NUCLEAR RISK

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- Capital seeks opportunities with the best balance of risk to reward
- Power generation portfolio diversification provides value...as one market ebbs, another one may flow...and investing in nuclear is not always just for economic reasons
- Nuclear projects are challenged by:
  - Construction risk
  - Operational risk
  - Single shaft risk
  - Regulatory risk
  - Technology risk
  - Economic risk

# CONSTRUCTION RISK

Q4 2012 (GW)

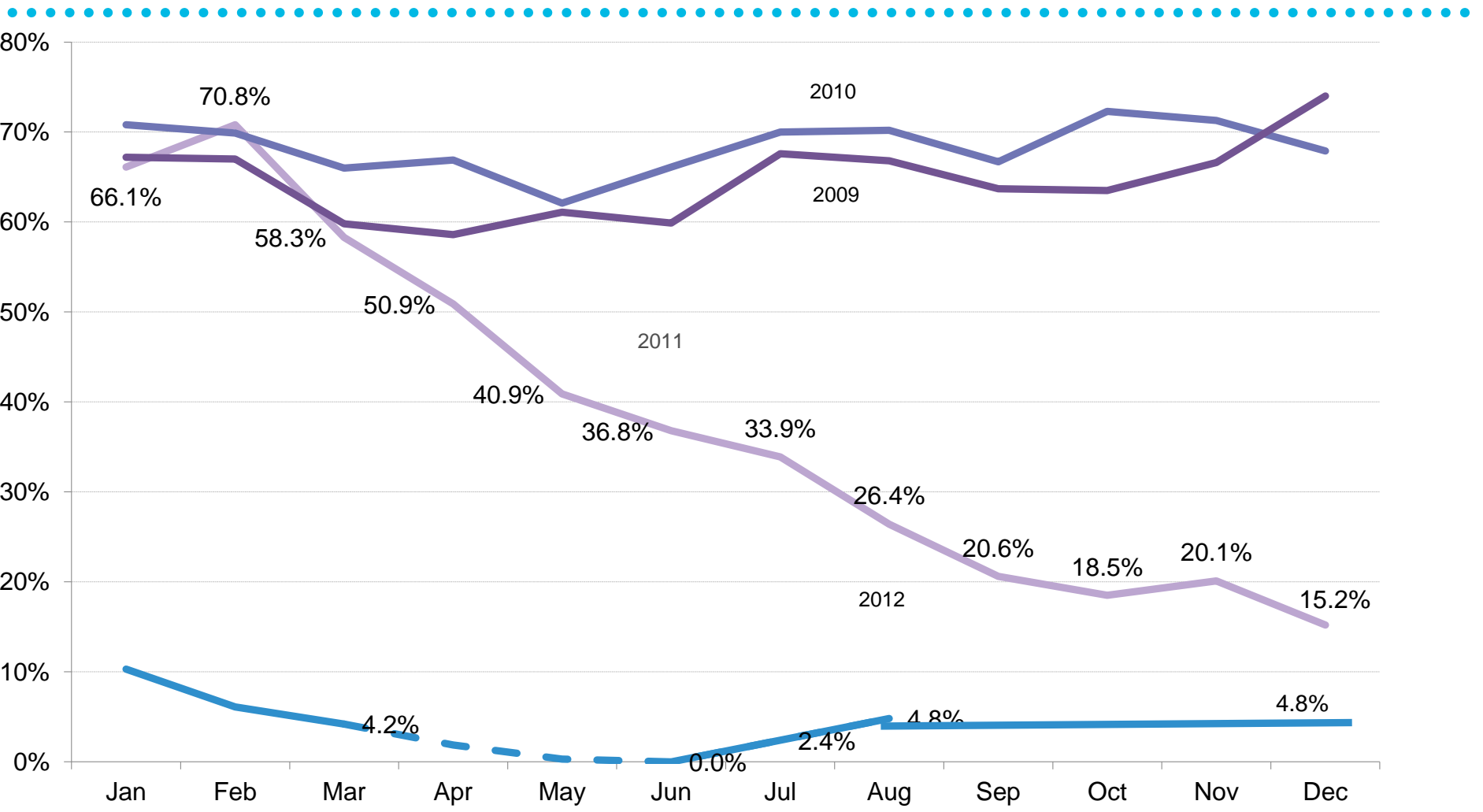


Note: Atucha in Argentina started in 1981, Lunmenn in Taiwan in 1999, Flamanville and Olkiluoto will take ~10 years.

Source: Power Reactor Information System, IAEA, Bloomberg New Energy Finance

# OPERATIONAL RISK

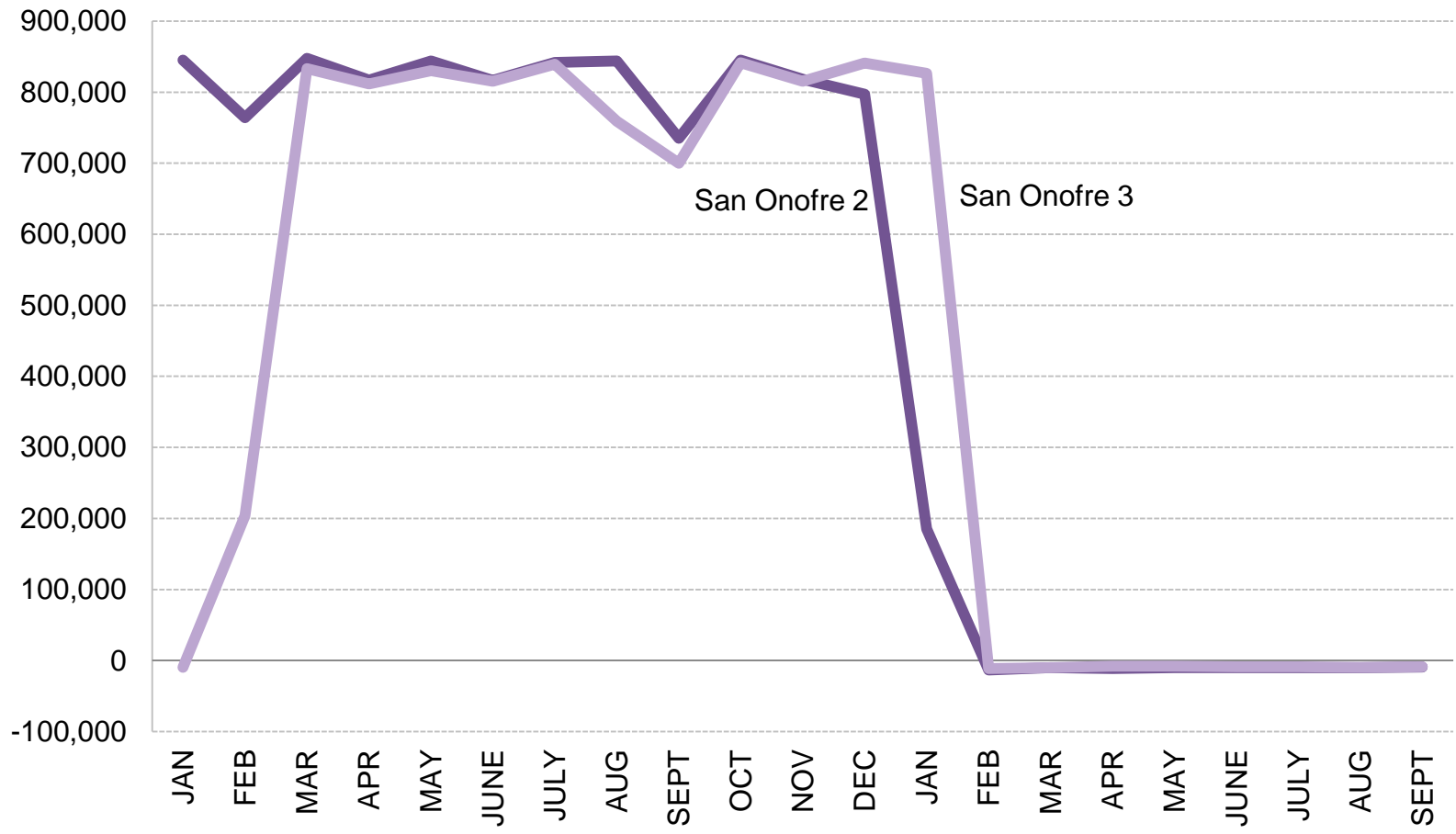
## NUCLEAR CAPACITY FACTOR, JAPAN, 2009–12 (%)



Source: Federation of Electric Power Producers

# SINGLE SHAFT RISK

SONGS 2&3 MWH GENERATED JAN 2011–SEPT 2012 (MWH)

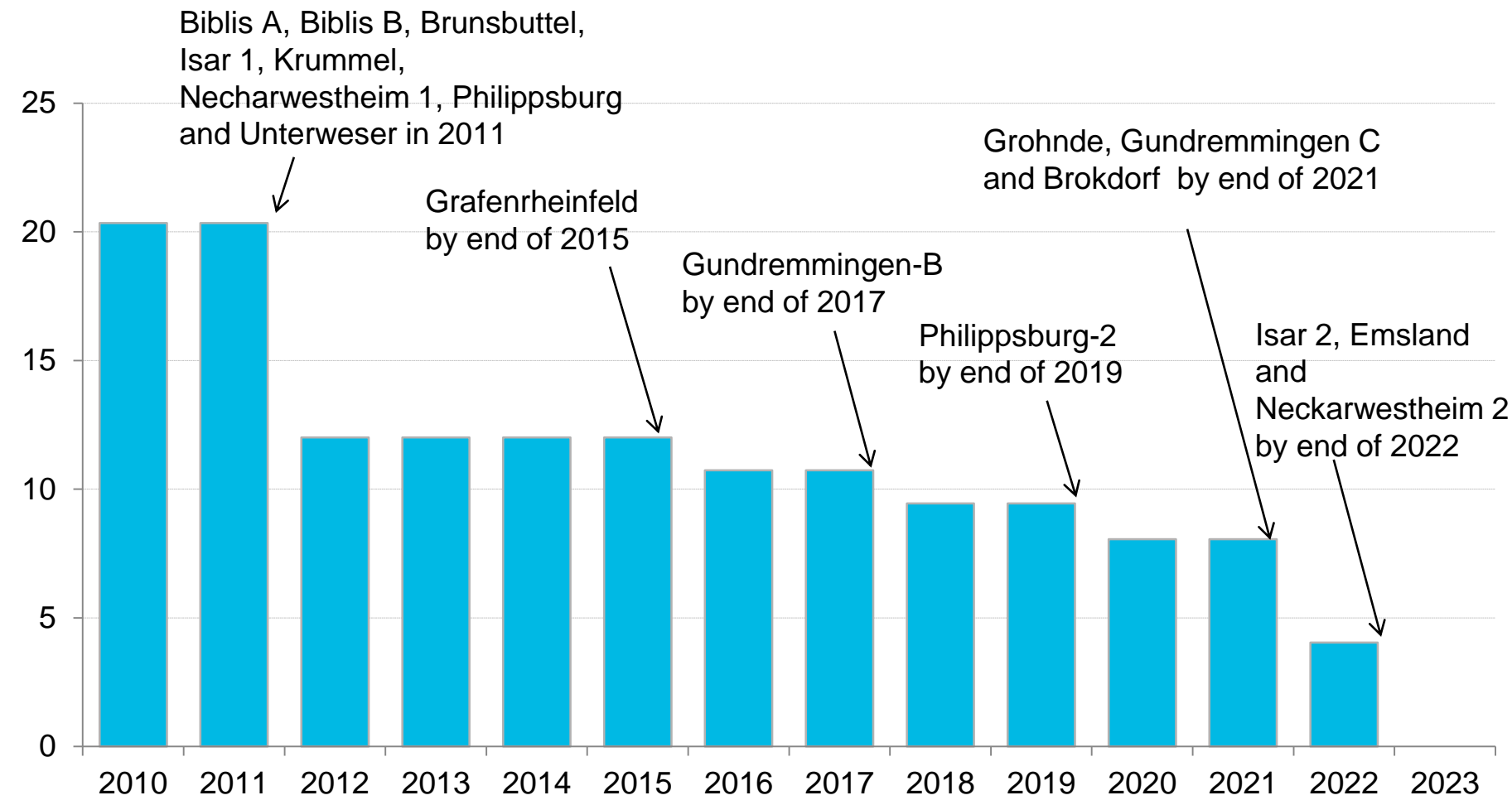


Note: SCE proposing to restart Unit 2 at 70% for five months.

Source EIA

# REGULATORY RISK

## GERMAN NUCLEAR CAPACITY, 2010-23 (GW)

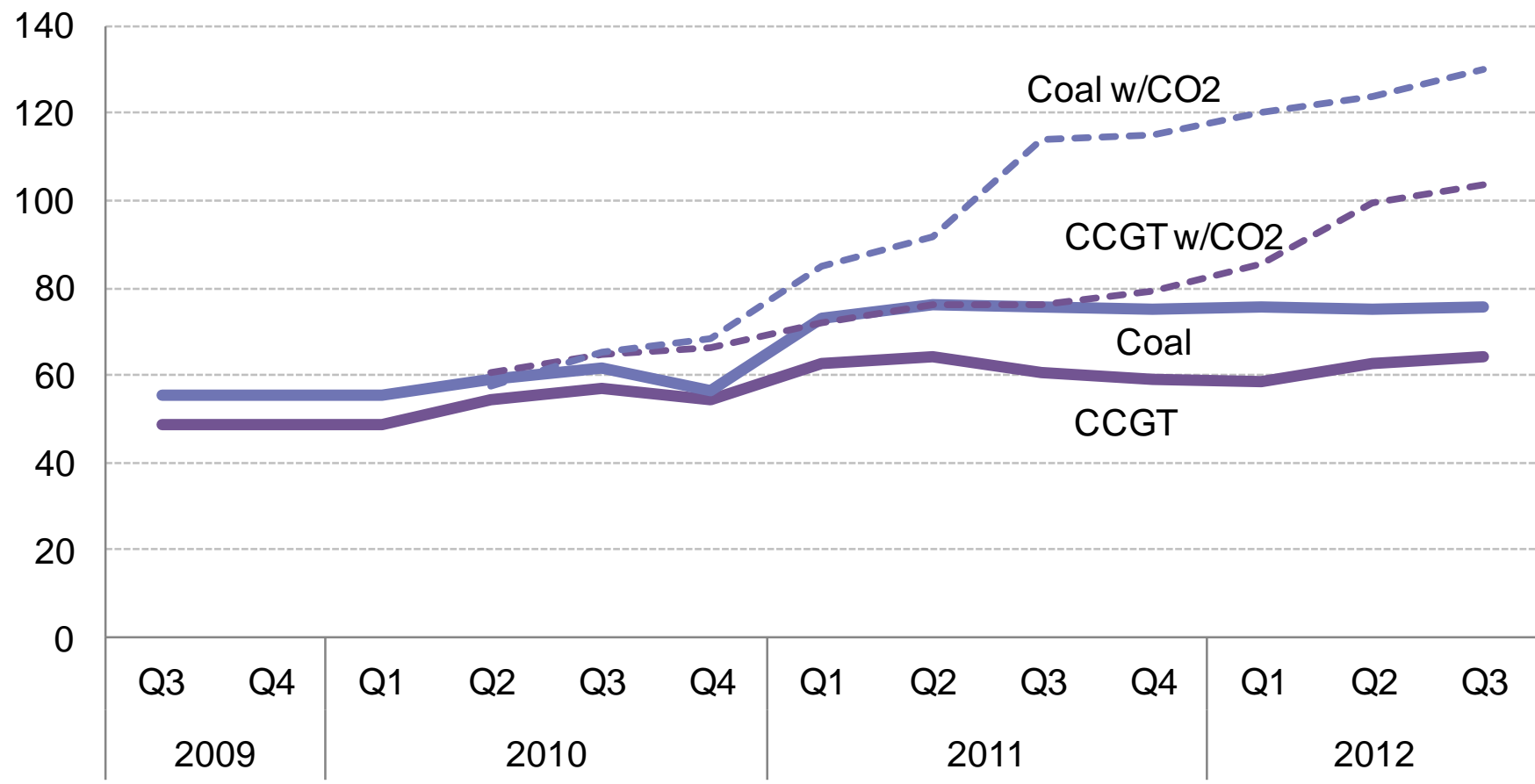


Source: Bloomberg New Energy Finance



# TECHNOLOGY AND ECONOMIC RISK

FOSSIL TECHNOLOGY LCOES, Q3 2009-Q3 2012 (\$/MWH)



Prices are in nominal dollars

Source: Bloomberg New Energy Finance

# NEW NUCLEAR PARADIGM

## EXAMPLES OF NEW REACTORS

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1. Gen4 Energy (25MWe)
2. Holtec SMR (160MWe), Westinghouse SMR (220MWe)
3. NuScale & B&W reactor designs  
(scaleable)
4. Korean, Chinese, Russian and other HTGC reactors

# BABCOCK & WILCOX—GENERATION MPOWER

## B&W MPOWER 180MWE



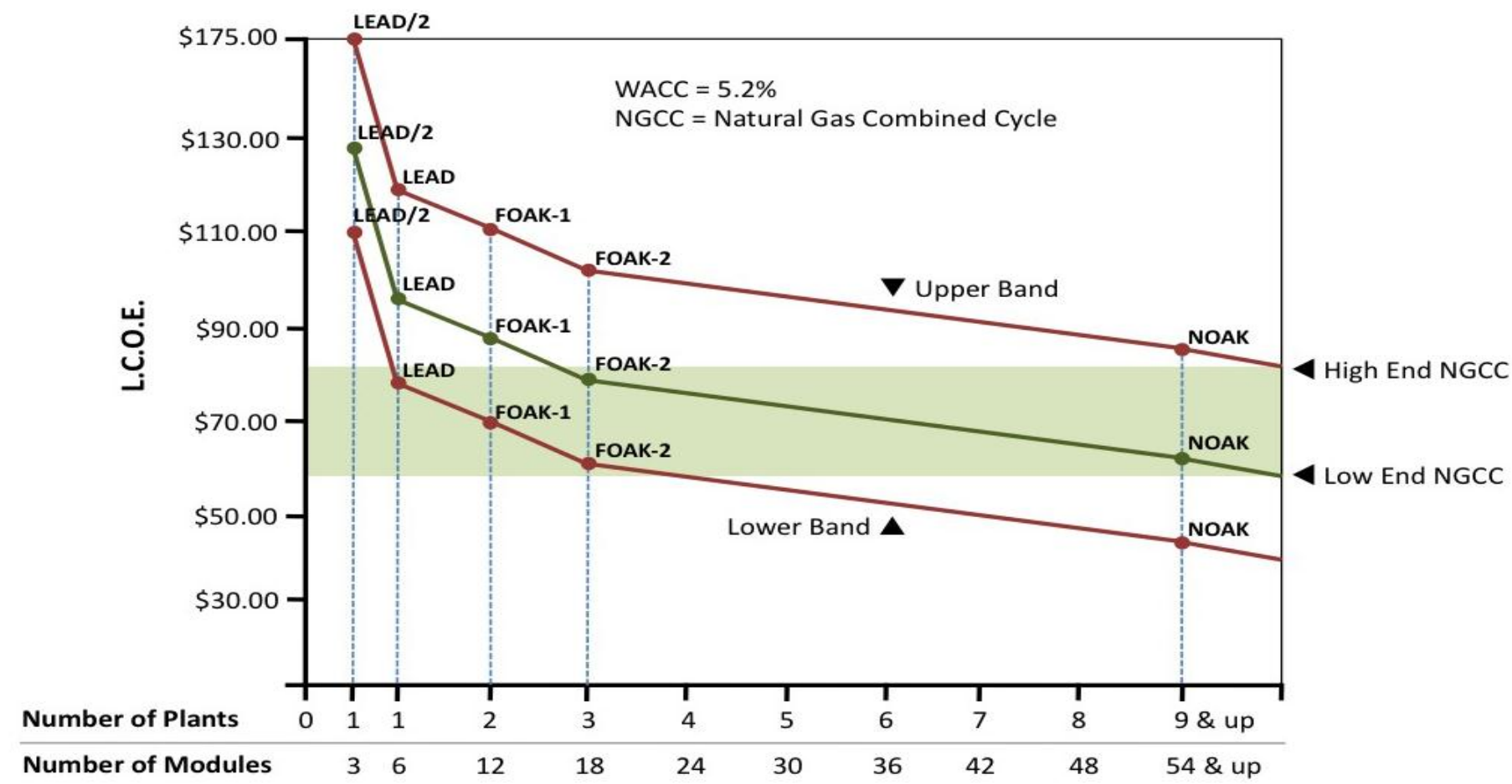
## REACTOR SPECS

- Evolved from military reactors
- Thermal output 530MWt
- Standard LWR fuel <5%
- 4+ year refueling cycle
- Factory sealed, transportable, dry cooling option
- NOAK cost: \$5,000/KW
- LCOE: \$0.082-0.097KW/h
- First install: 2020-22 at TVA, FirstEnergy
- Key features: scalable in 180MW increments, Bechtel a partner, 30 utility member advisory council

Source: Babcock & Wilcox

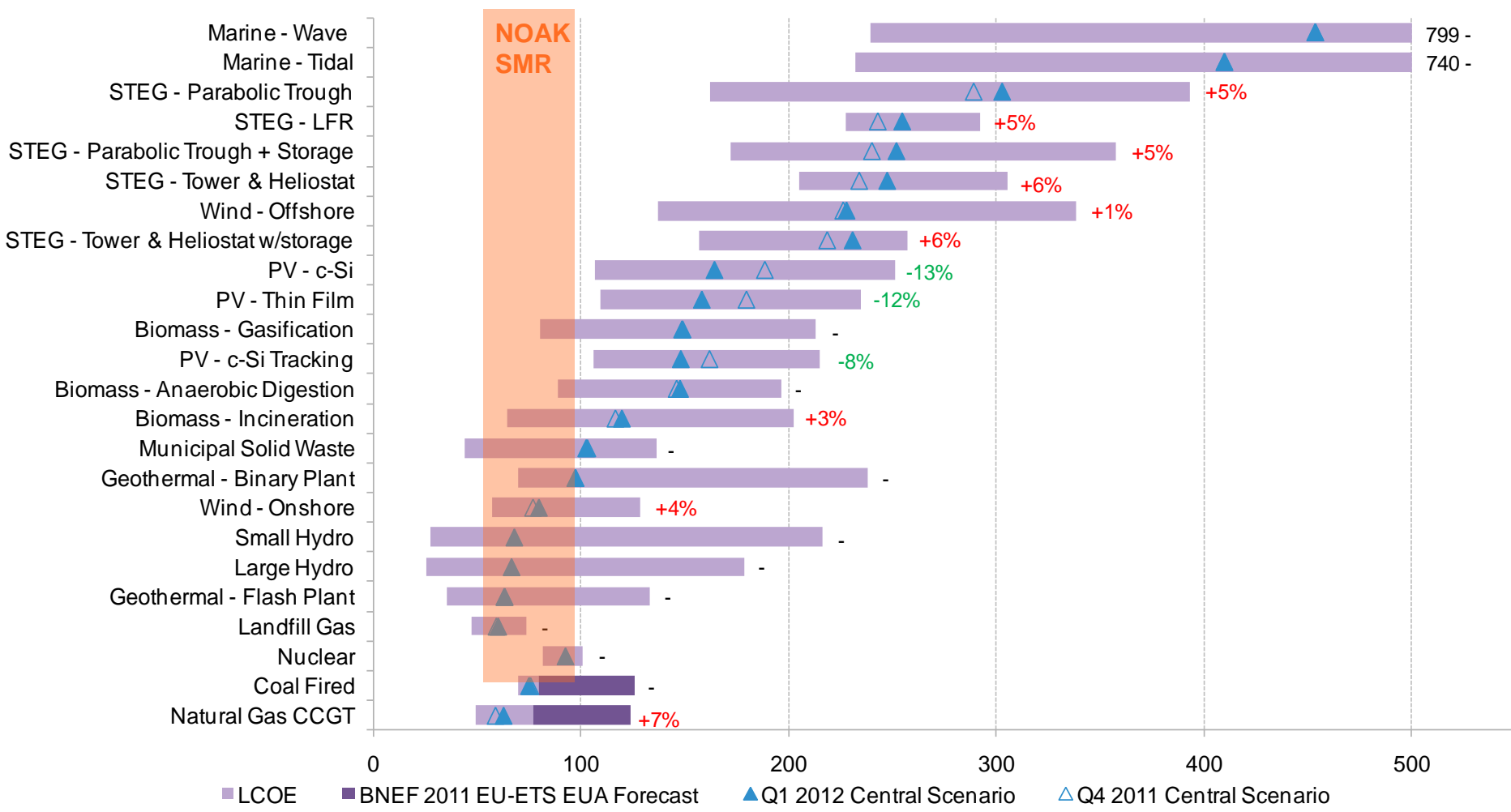
# THE FORECAST MANUFACTURING LEARNING CURVE

LCOE (\$/MWH)



Source: Robert Rosner  
Director, Energy Policy Institute at Chicago (EPIC)Harris  
School of Public Policy , Dec 2011


# SMRS OFFER AN OPPORTUNITY TO COMPETE



Source: Bloomberg New Energy Finance

# NEW NUCLEAR PARADIGM EVOLVING

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Rather than large gigawatt reactors, integrated small modular reactors are less risky to build and can load follow

*“Will SMRs deliver dramatic reduction of business risk?”*



Safety, safety, safety...

*Will regulators, utilities and the general population be comfortable with proclaimed safety of Gen III++ designs?*



Price, performance, operation and reliability to be determined.

*Will LCOE estimates of \$82-97/MWh be met?*

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# FIRST OF A KIND: NEW NUCLEAR REACTOR TECHNOLOGY AND RISK

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## MARKETS

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Carbon Markets  
Energy Smart Technologies  
Renewable Energy Certificates  
Carbon Capture & Storage  
Power  
Water  
Nuclear

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