

# ENERGY TRANSITION IN THE U.S.



**JOHN PARSONS, MIT CEEPR**

July 6-7, 2017

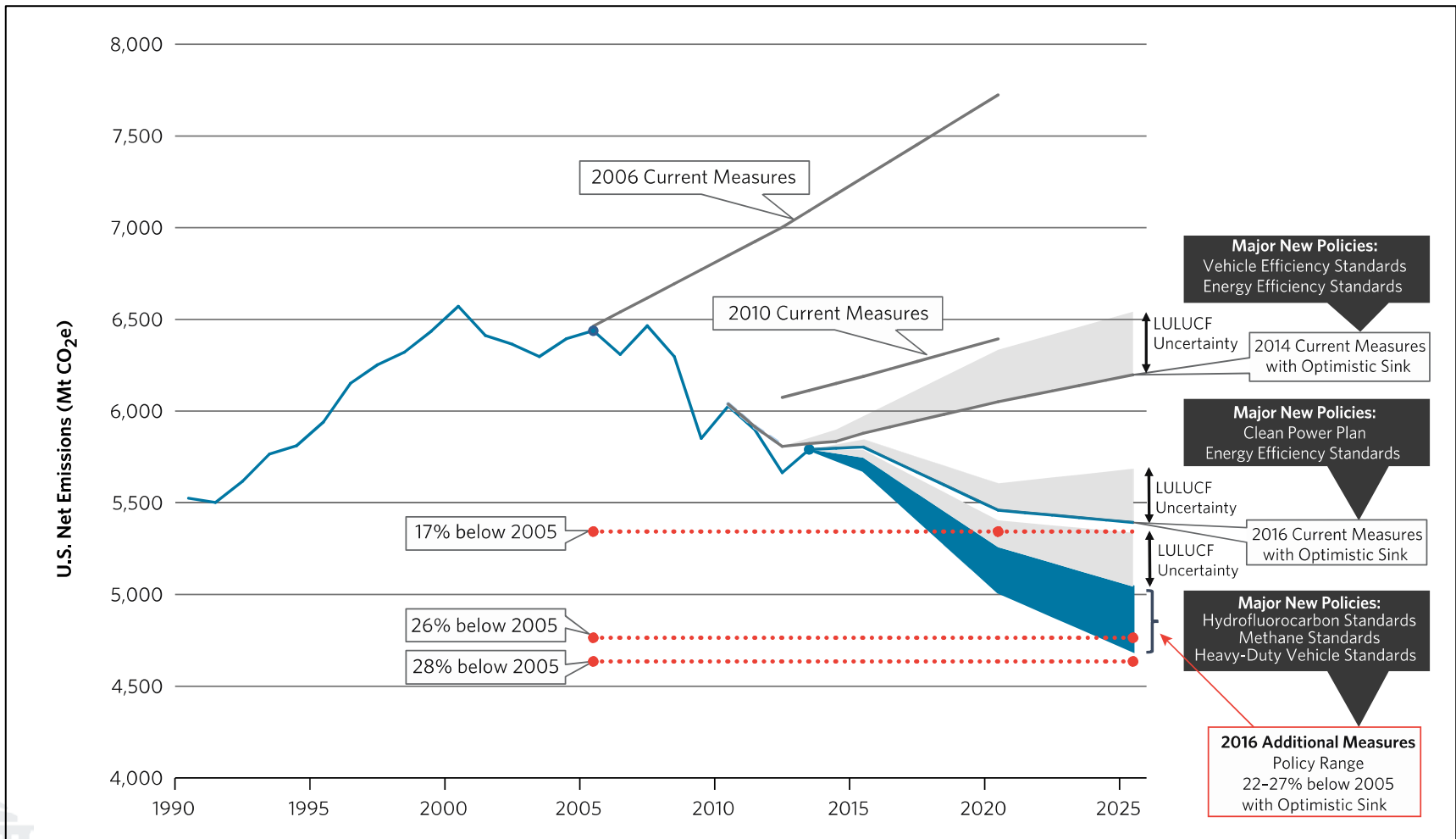
EPRG & CEEPR European Energy Policy Conference

# Outline

- **The Challenge**
- **The Trump Administration's Policy**
- **Nuclear Power in the U.S.**

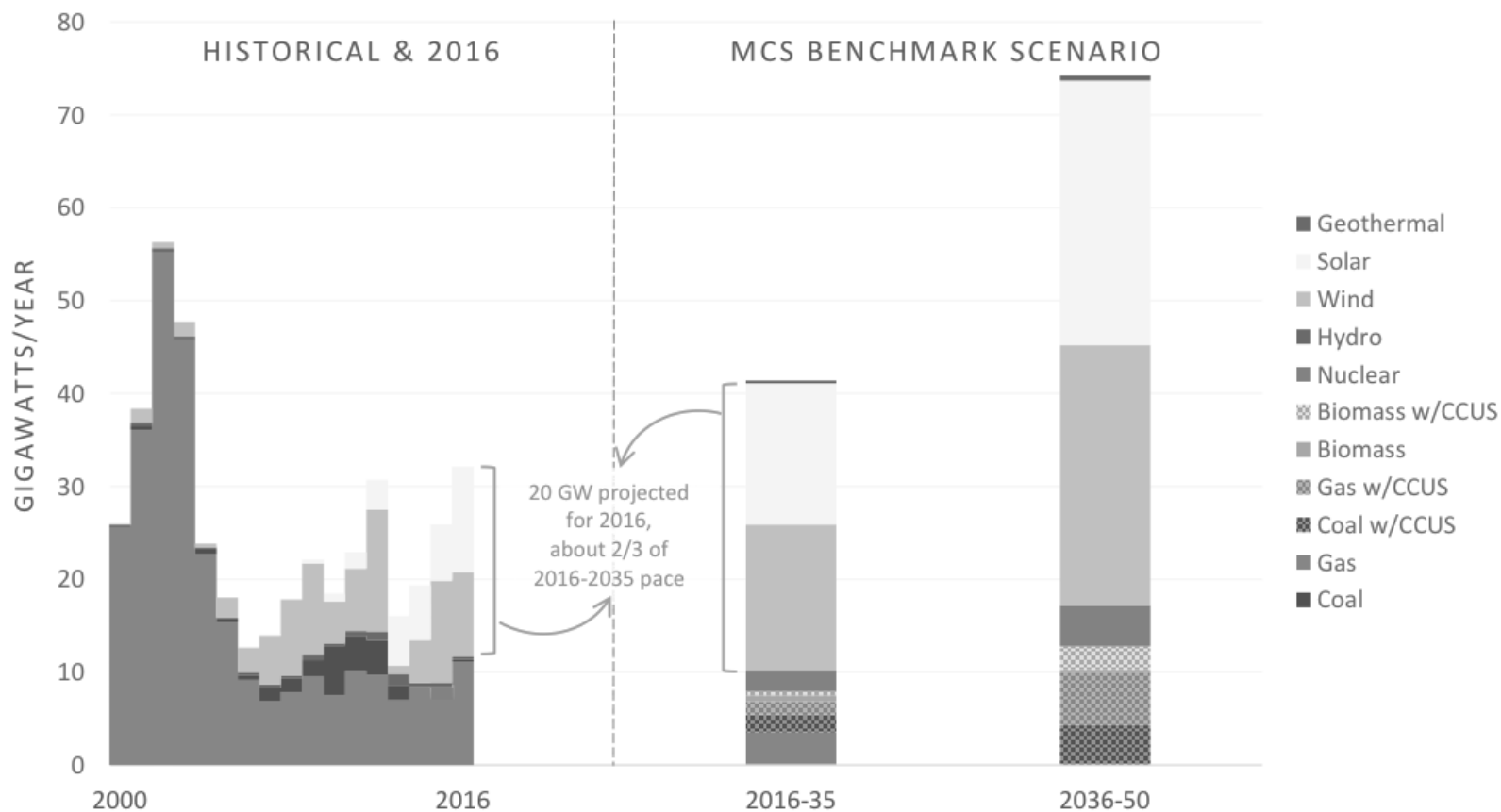


# The Challenge: Forecasted U.S. Emissions Reductions



# The Path to 2050 Requires Deep Decarbonization in Electricity

**FIGURE E2: AVERAGE ANNUAL CAPACITY ADDITIONS BY FUEL, HISTORICAL AND MCS BENCHMARK SCENARIO**



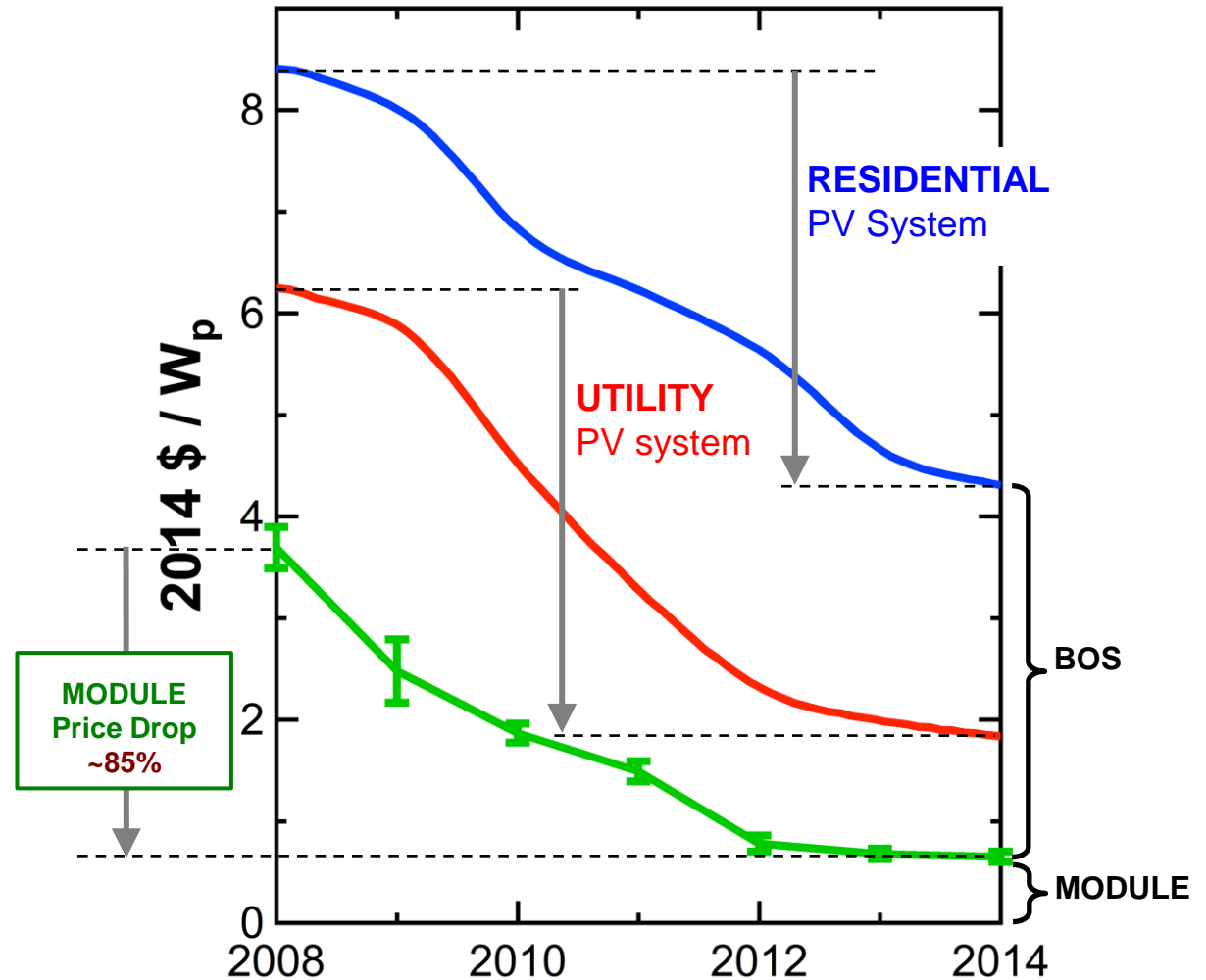
# Short-Term versus Long-Term

- **In the short-term, certain facts are given**
  - e.g., the price of natural gas
- **In the long-term, uncertainty explodes**
  - who knows about the price of natural gas?
  - who knows about technology development
- **In the short-term, we can evade and fool ourselves about eventual trade-offs**
  - e.g., the cost implications of the intermittency of wind & solar
- **In the long-term, these may impose themselves**

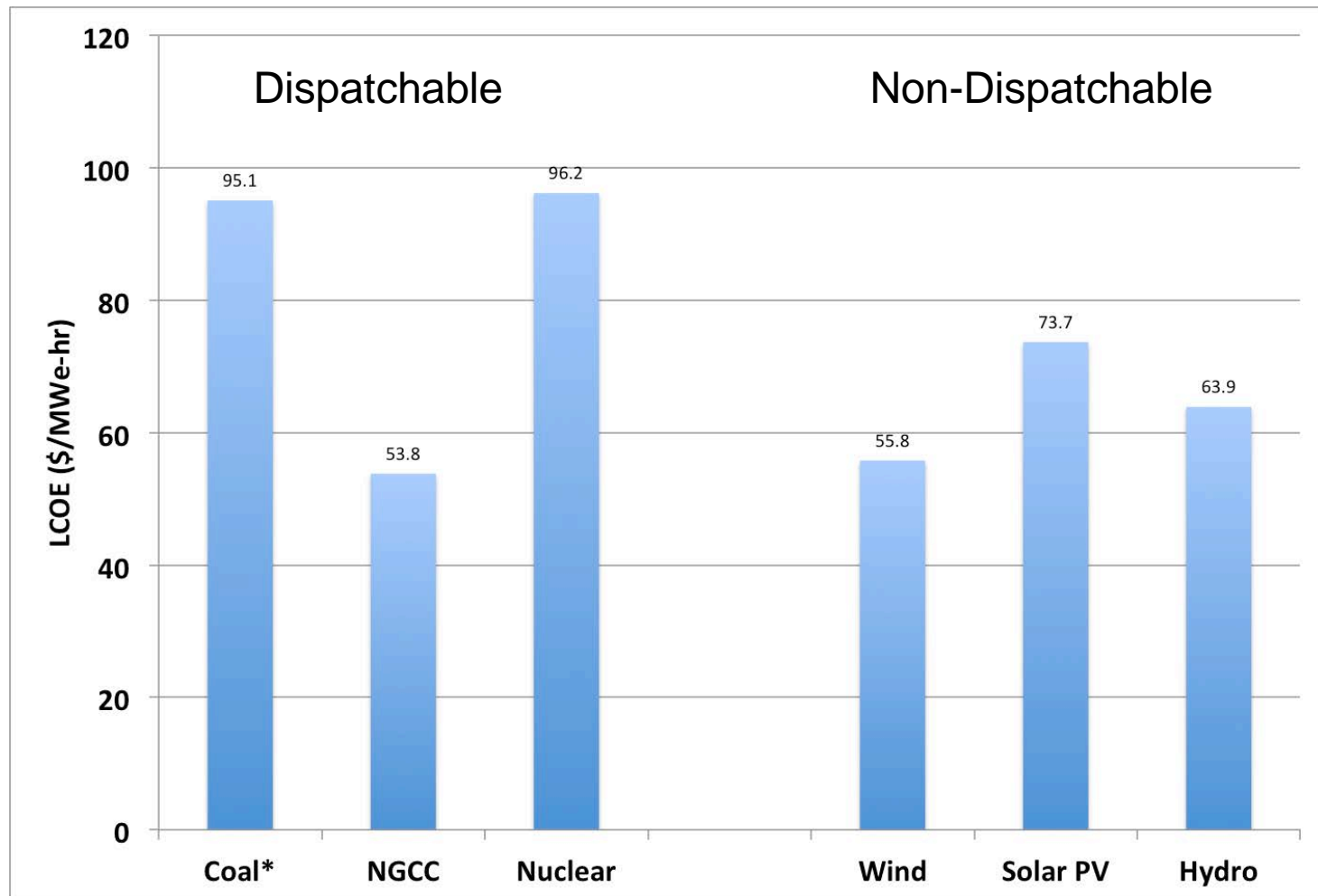


# Declining Cost of Solar and Wind Has Been Great News

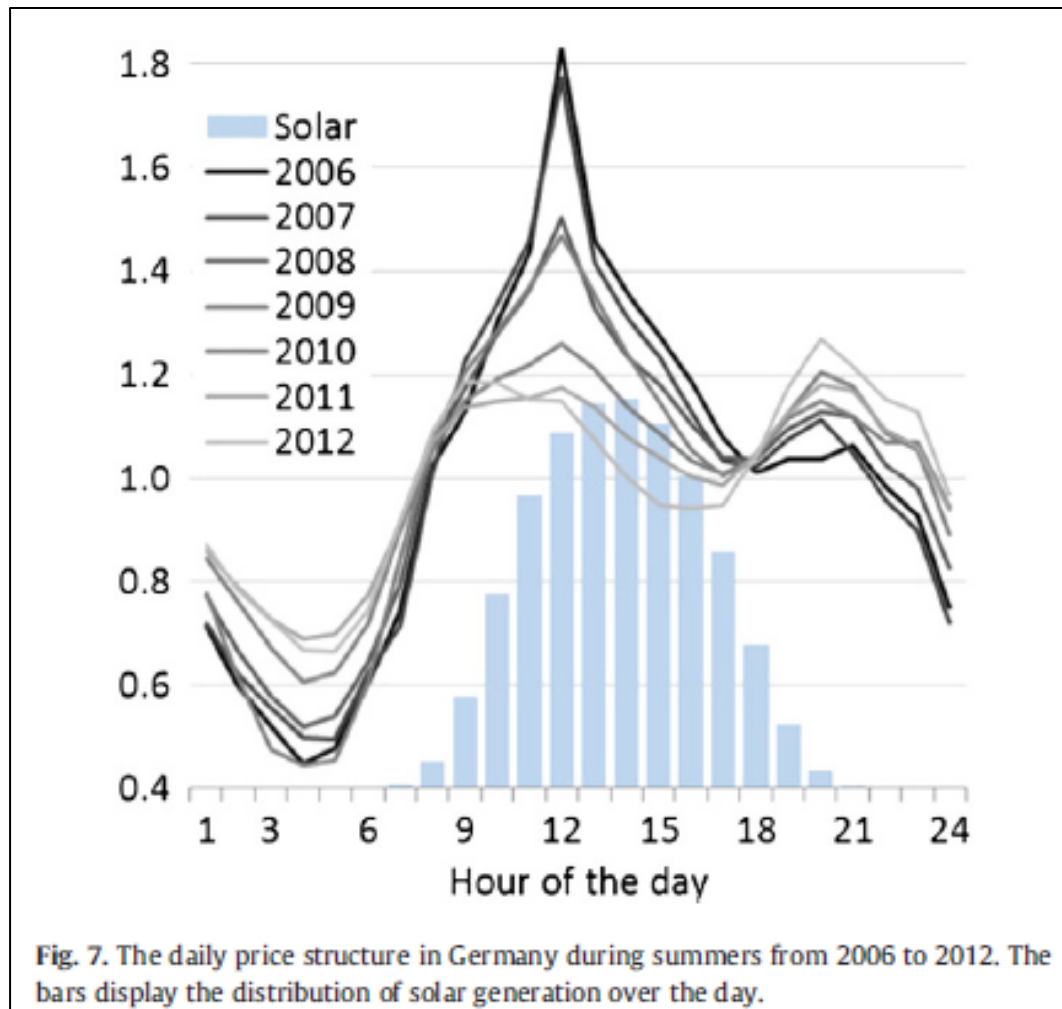
Solar module costs have dropped dramatically. However, cutting BOS costs is now critical.



# LCOE Comparison of Different Energy Technologies (EIA 2017)



# The Declining Contribution of Renewables as Capacity Increases





# TRUMP ADMINISTRATION'S POLICY



# President Trump's Energy Dominance Speech, June 29, 2017

- 1. Revive and expand our nuclear energy sector starting with a complete review of U.S. nuclear energy policy.**
- 2. Treasury address barriers to financing highly efficient overseas coal energy plants ... so we can sell them coal.**
- 3. Oil pipeline to Mexico approved.**
- 4. Negotiate natural gas exports from Sempra to South Korea.**
- 5. Approve 2 long-term applications for export of LNG from Lake Charles.**
- 6. Establishing a new offshore Oil and Gas Leasing program to access the 94% of offshore land closed to development.**



# Trump Policy inferred from Actions

- **Declaration of intent to withdraw from Paris accord.**
- **EPA**
  - Intent to revise or cancel the Clean Power Plan
  - Attempt to delay and undo methane emission rules.
  - Cuts to budgets and scientific work.
- **DOE**
  - a soon to be released Grid Study concerned with troubles of coal and nuclear;
  - massive recommended budget cuts in research in all directions, including clean coal and nuclear;



# Nuclear Power in the U.S.

- **A number of existing reactors have closed before reaching the end of their license terms. Several others are scheduled for closure. Still more are economically precarious.**

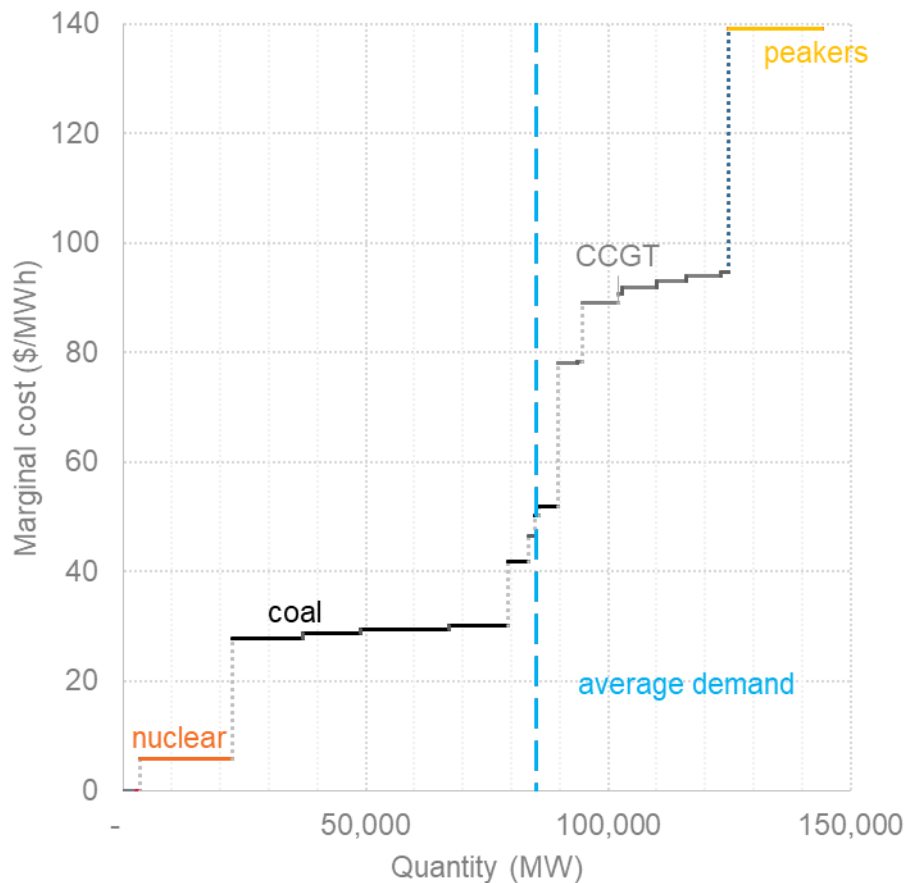


# **Early Nuclear Retirements in Deregulated U.S. Markets: Causes, Implications and Policy Options**

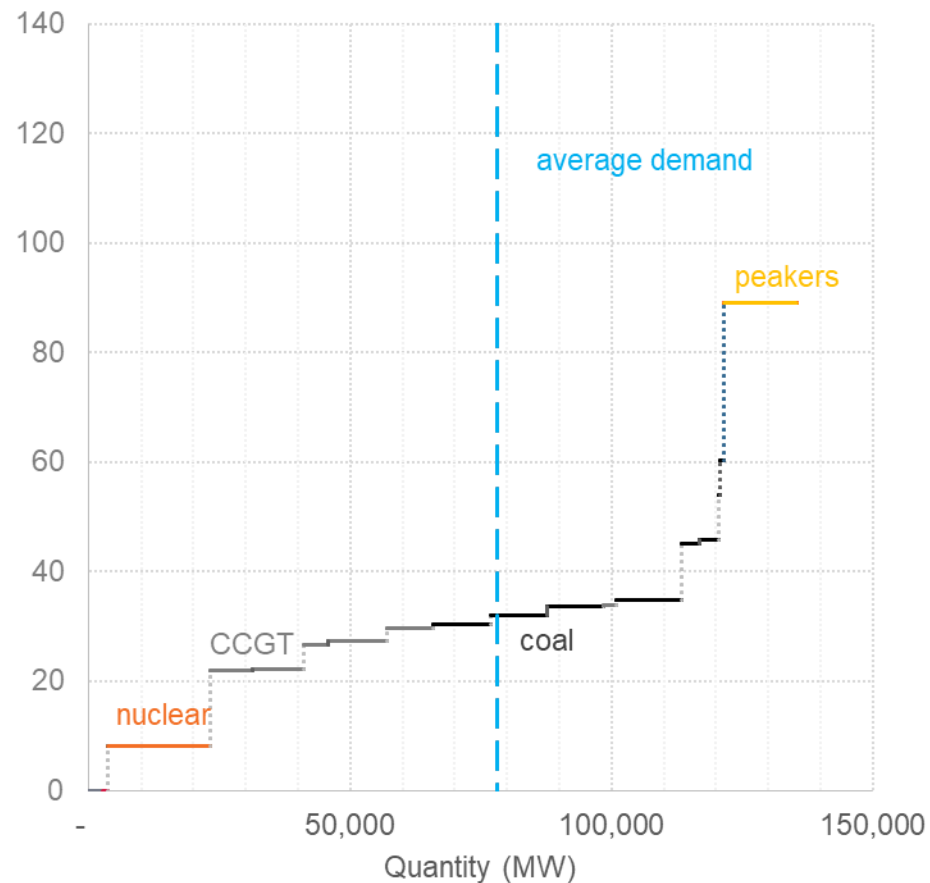
GEOFFREY HARATYK

# Shifting Supply Stack

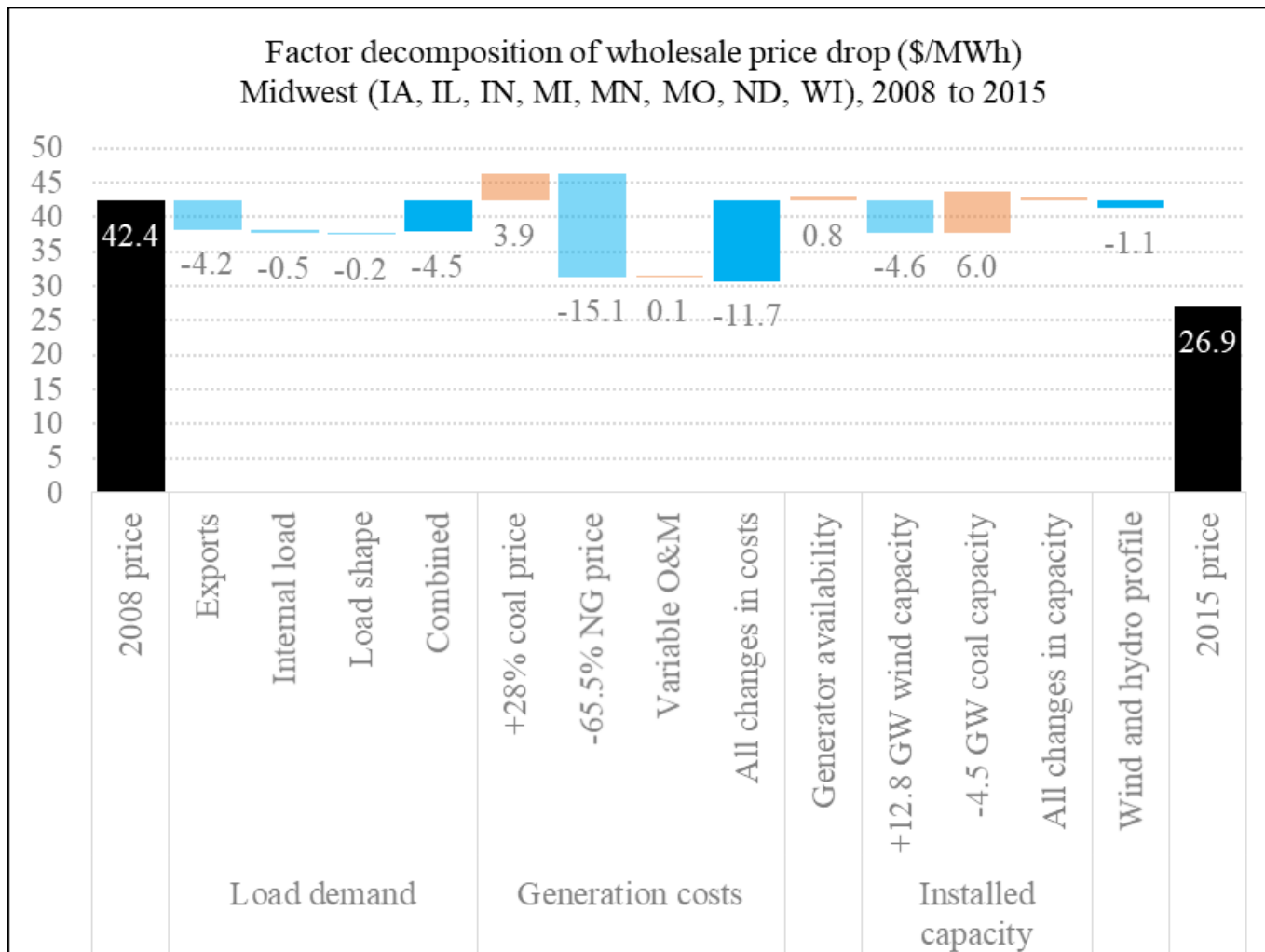
Mid-Atlantic region in 2008



Mid-Atlantic region in 2015



# The drop in the price of natural gas was a primary driver of the drop in the electricity price.



# Some other results

- **About ~20% of the U.S. nuclear capacity is retiring or at risk of retiring in the next 3 years.**
- **Fleet-average revenue shortfall = \$5.5-7.5/ MWh**
- **A moderate carbon price, say \$10/ MT CO<sub>2</sub>, would be enough to bridge this revenue gap.**





# New Reactors

- **Two construction projects of 2 units each are currently under construction. All 4 are Westinghouse AP1000s, so-called Gen III+.**
  - Southern Company's Vogtle plant units 3 & 4 in Georgia.
  - SCANA's Summer plant units 2 & 3 in South Carolina.
- **Both projects are suffering major delays and cost overruns.**
  - Vogtle
  - Summer
- **Toshiba put Westinghouse into Chapter 11 bankruptcy.**
  - outlook for the projects is unclear



# Prospects?

- **MIT Future of Nuclear study in 2003 and again in 2009 expressed the potential for nuclear to contribute to decarbonization.**
- **Economics was key.**
  - Inefficient operation in the U.S. had been resolved.
  - Construction had been a problem. Steps were taken to resolve, both in licensing and in designs.
  - First Gen III+ projects were supposed to be a proof that construction could be on time and on budget, and at a competitive cost.
- **New study conclusion? Inability to execute construction is an existential threat.**



# SMRs – small, modular LWRs

- **NuScale has filed an application for certification with the NRC.**
  - EPZ to site boundary?
- **1<sup>st</sup> build?**
  - On site of Idaho National Laboratory.
  - Power customer: UAMPS.
- **Economic case is unclear.**
  - Don't look to be cheaper than traditional LWRs pretend to be. At least not at first.
  - There is a lot of hype about modularity. I have trouble finding source material that makes a firm case.

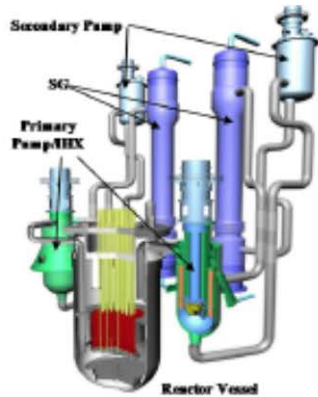


# What About Innovative Nuclear Reactors?

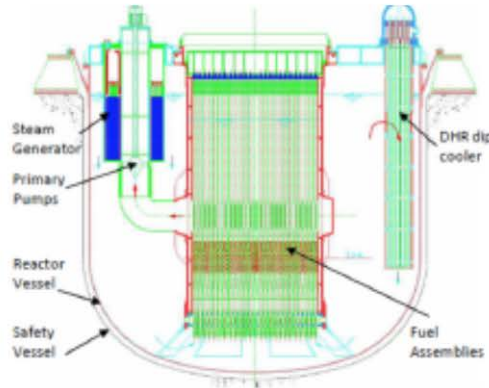
- **One focus of the new MIT Future of Nuclear study.**
- **Several interesting options that offer the prospect of cheaper, safer plants and electricity.**
- A good sign that private capital is being invested.
- Much of the design focus is misplaced.
  - Fuel and waste are red herrings. Yet fuel cycle issues inspire much of the dollars being invested.
- Some of the design focus is on niche markets, temporarily surrendering the big prize of producing commodity electricity cheaply.
  - Mini reactors for off-grid uses.
  - Process heat for industry, with electricity as a by-product.
- A future harvest will require significant effort.



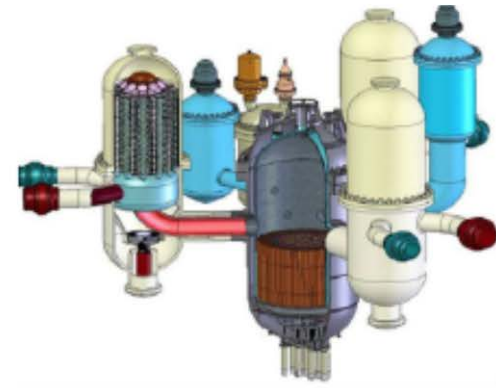
# Innovative Reactors



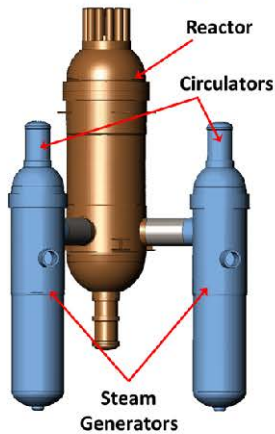
**Sodium Fast Reactor  
(JSFR Loop Configuration)**



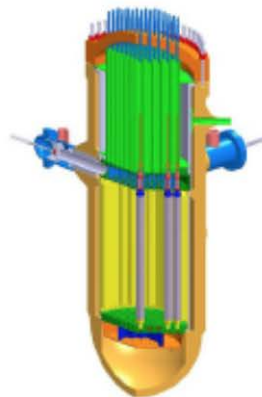
**Lead Fast Reactor**



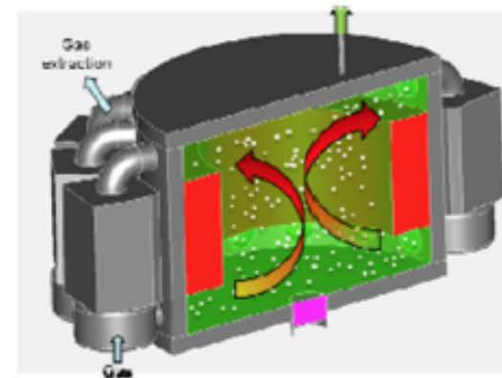
**Gas Cooled Fast Reactor**



**Very High Temperature Reactor**



**Supercritical Water Cooled Reactor**



**Molten Salt Cooled Reactor**



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**THANK YOU**

