

ENERGY TRANSITION IN THE U.S.



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July 6-7, 2017

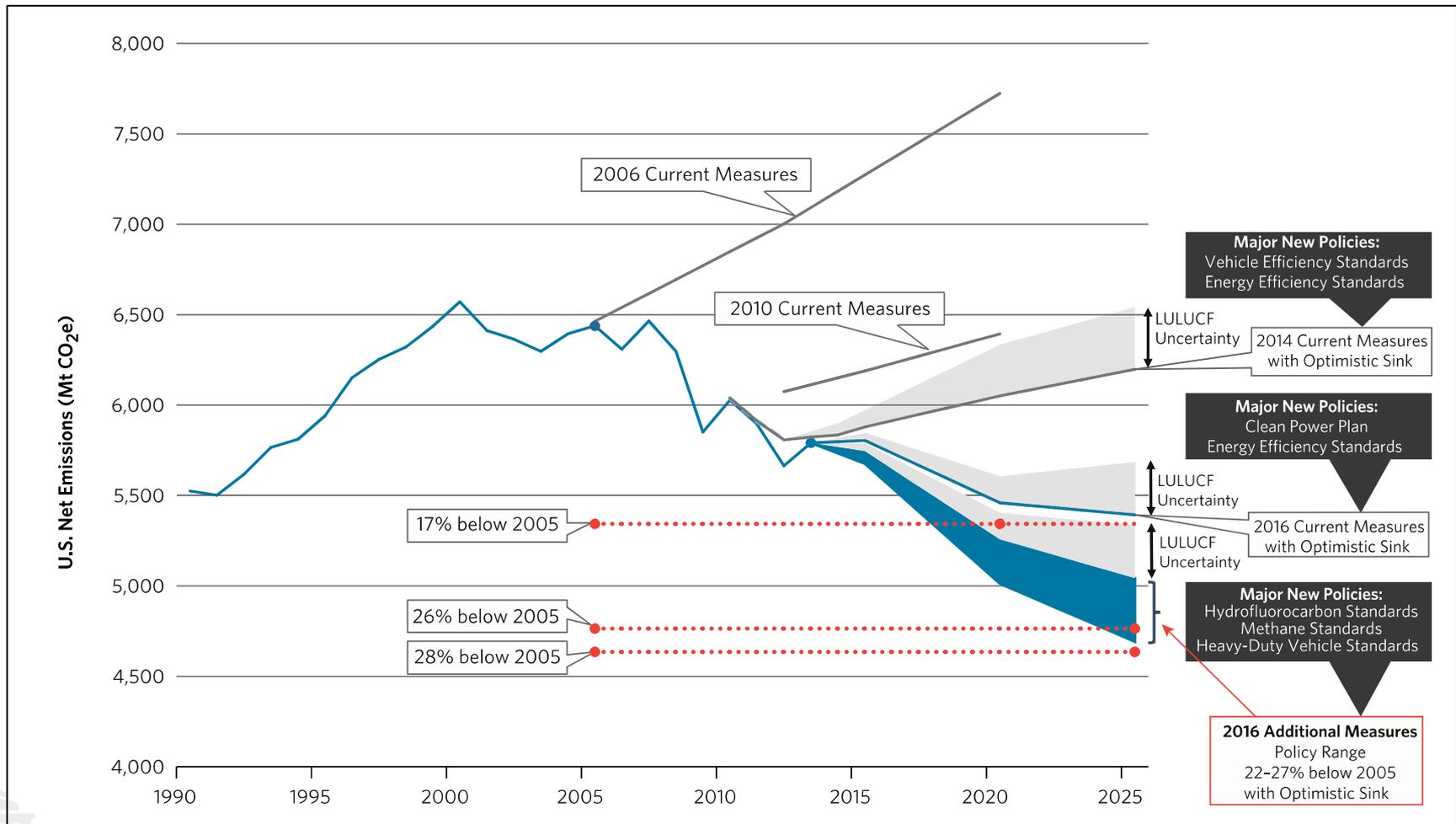
EPRG & CEEPR European Energy Policy Conference

Outline

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

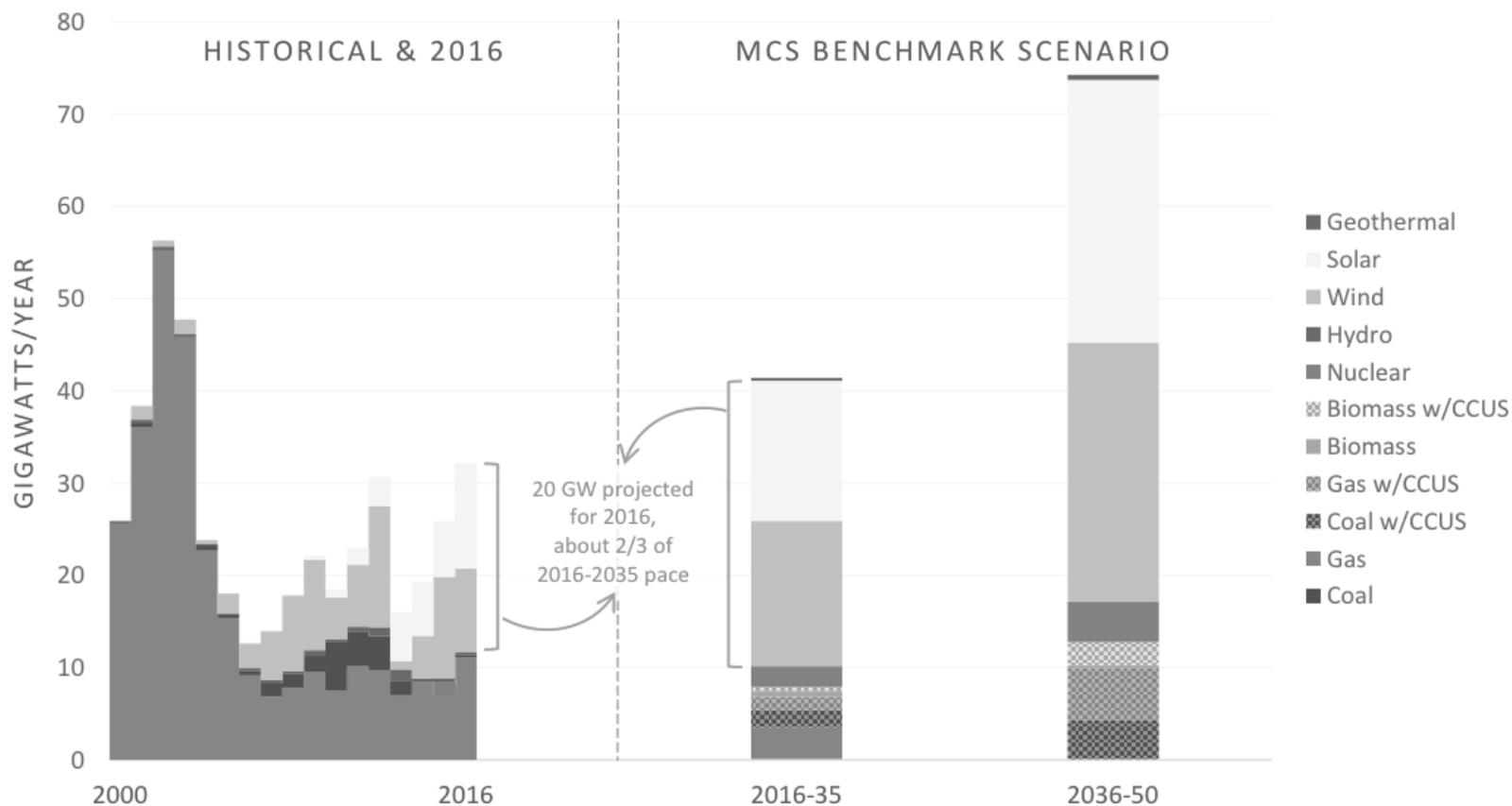


The Challenge: Forecasted U.S. Emissions Reductions



The Path to 2050 Requires Deep Decarbonization in Electricity

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



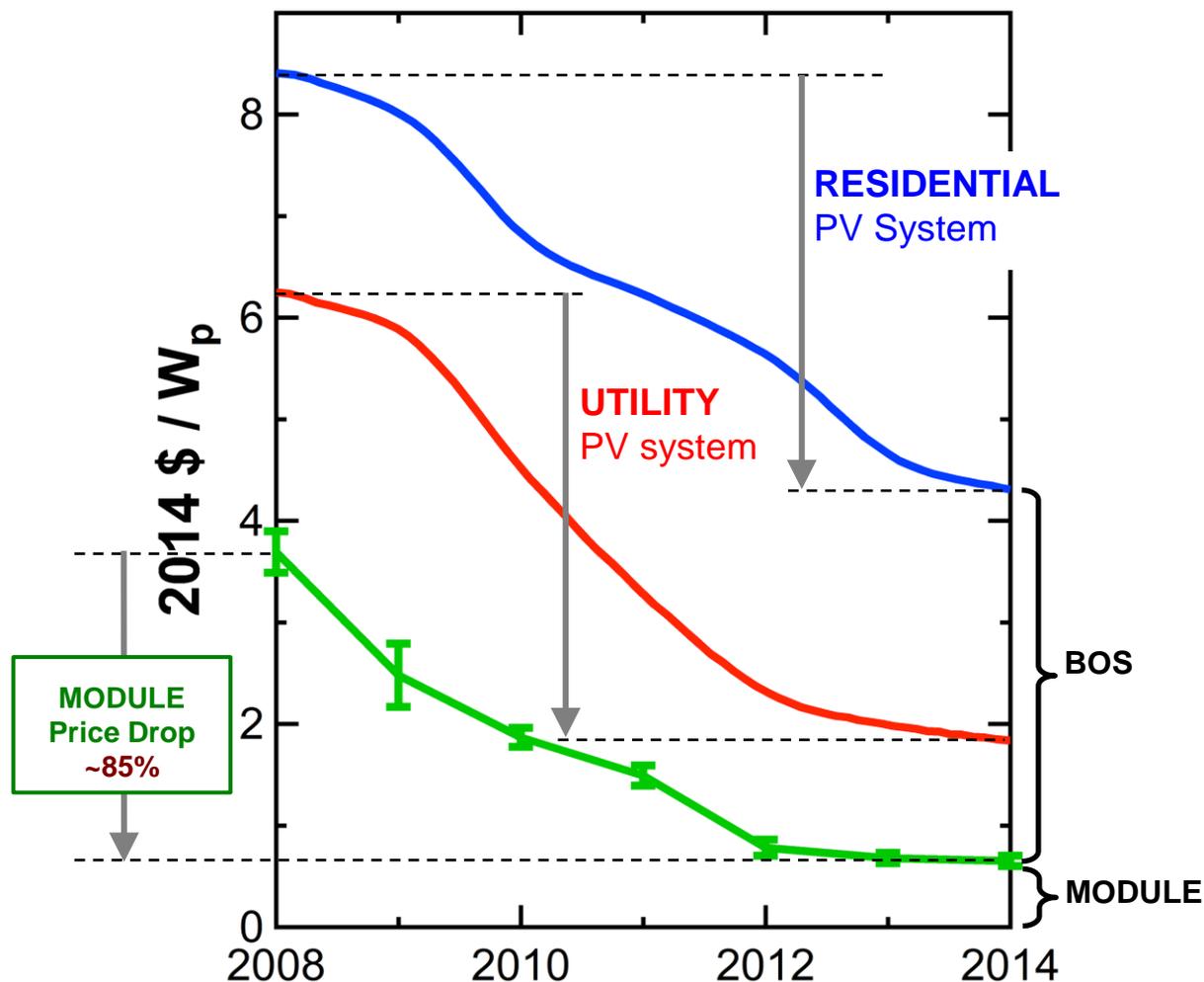
Short-Term versus Long-Term

- **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**

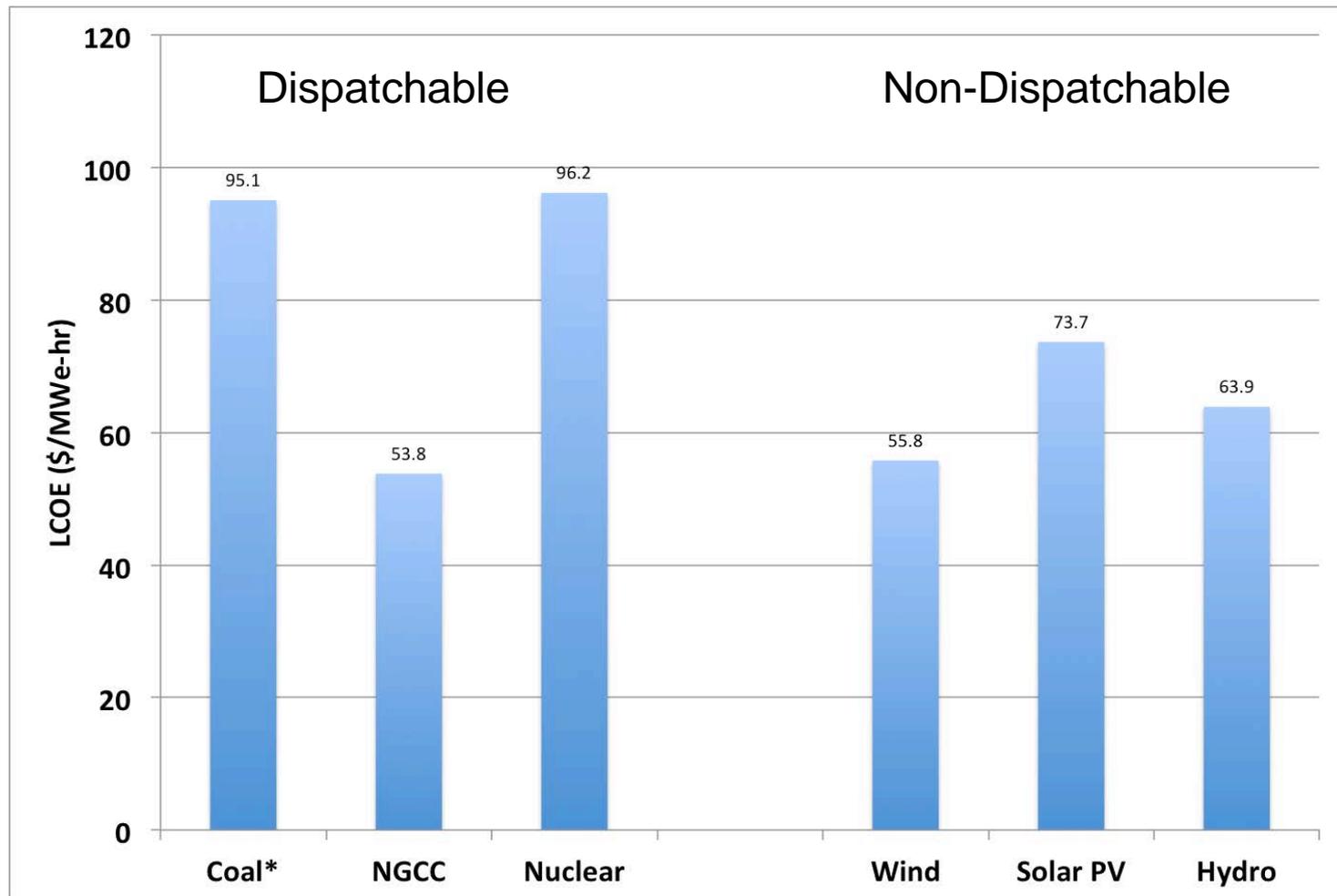


Declining Cost of Solar and Wind Has Been Great News

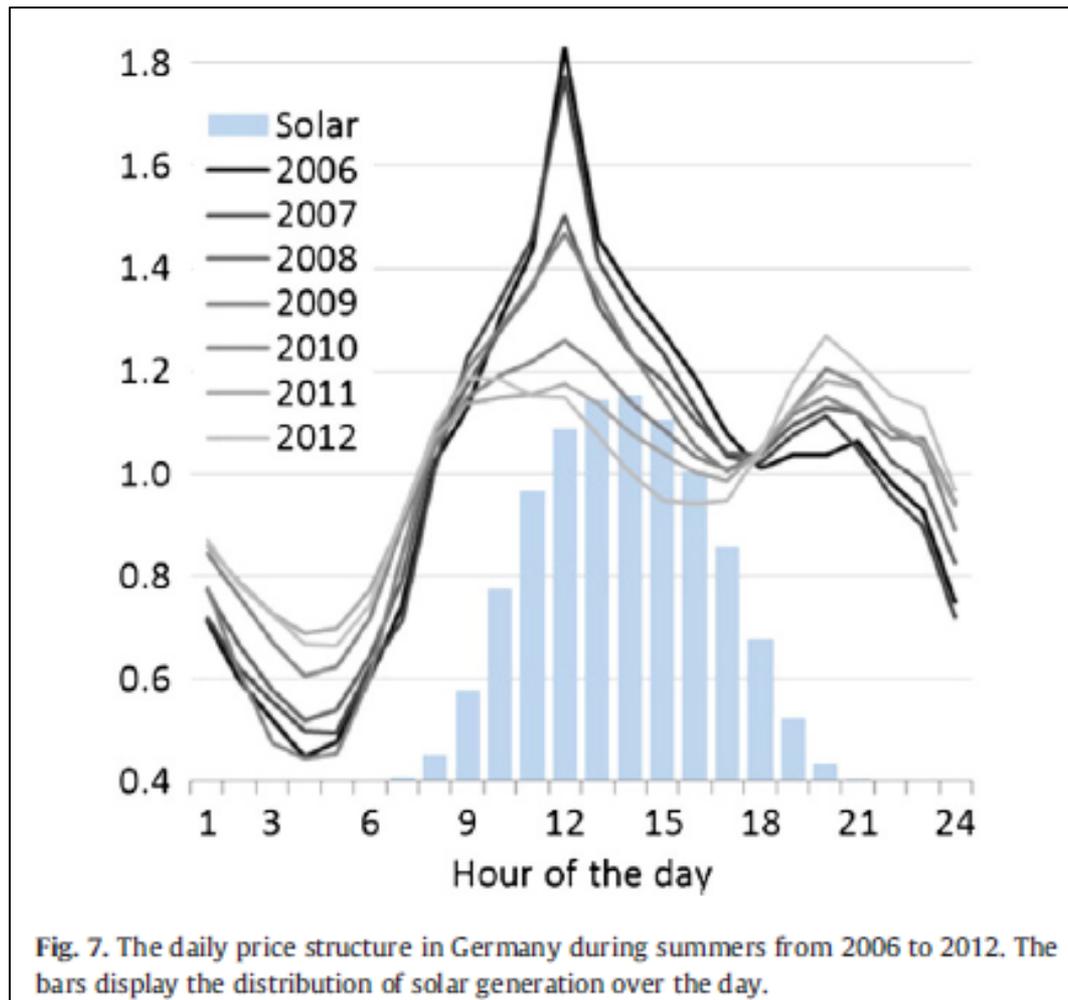
Solar module costs have dropped dramatically. However, cutting BOS costs is now critical.



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.**





MIT Center for Energy and Environmental Policy Research

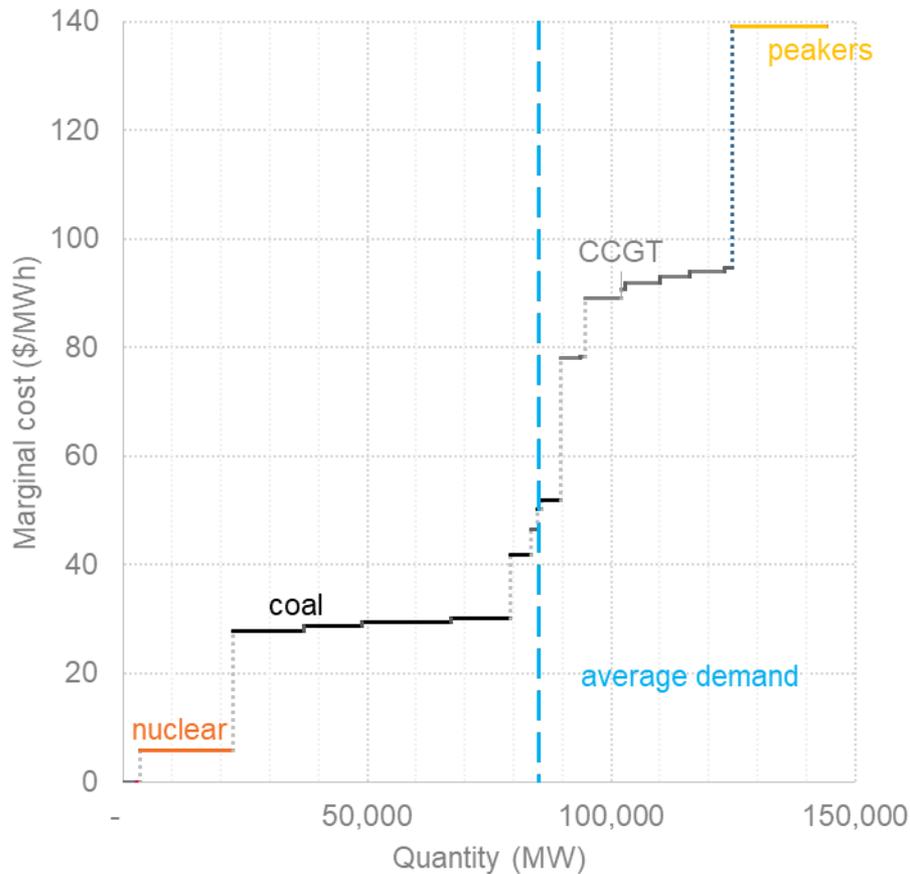
Working Paper Series

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

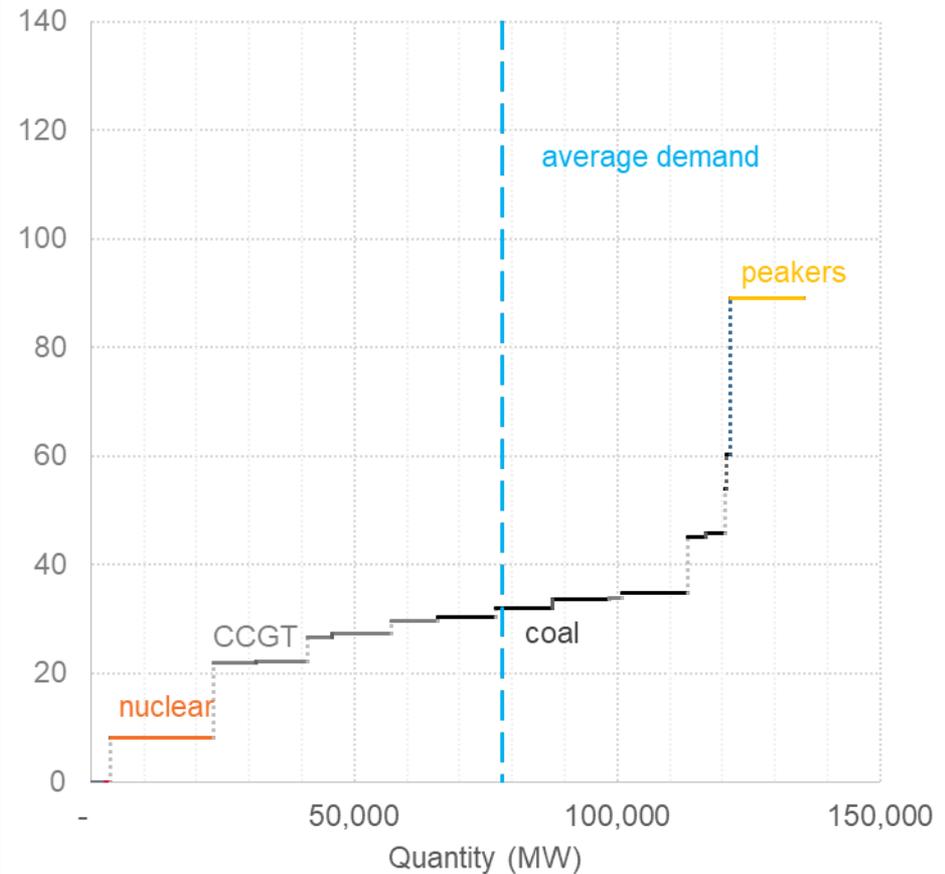
GEOFFREY HARATYK

Shifting Supply Stack

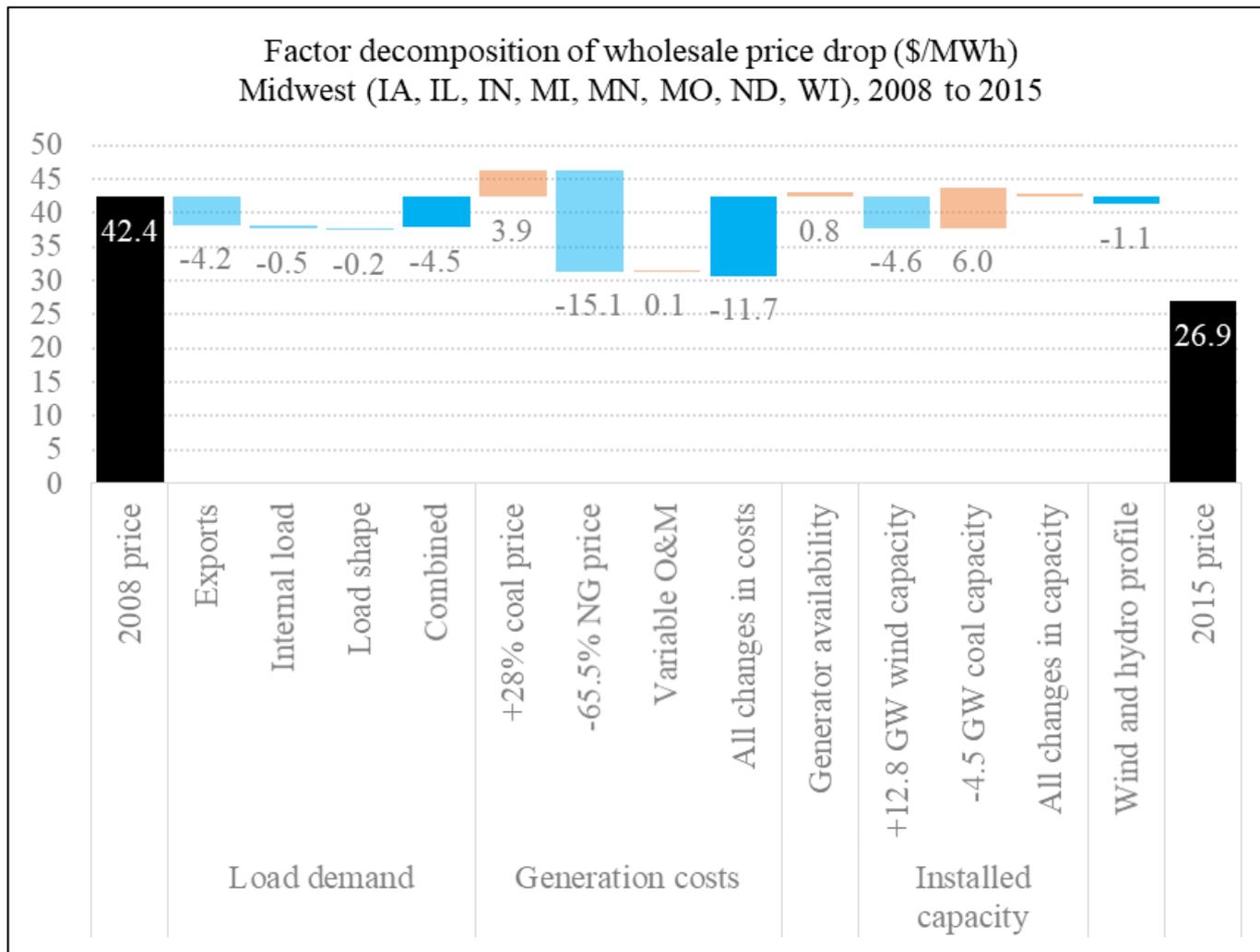
Mid-Atlantic region in 2008



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 CO₂, 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?
- **1st 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.

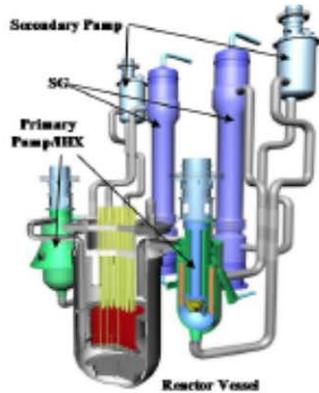


What About Innovative Nuclear Reactors?

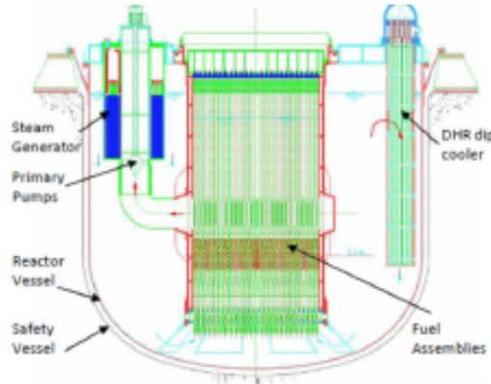
- **One focus of the new MIT Future of Nuclear study.**
- **Several interesting options that offer the prospect of cheaper, safer plants and electricity.**
- A good sign that private capital is being invested.
- Much of the design focus is misplaced.
 - Fuel and waste are red herrings. Yet fuel cycle 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.



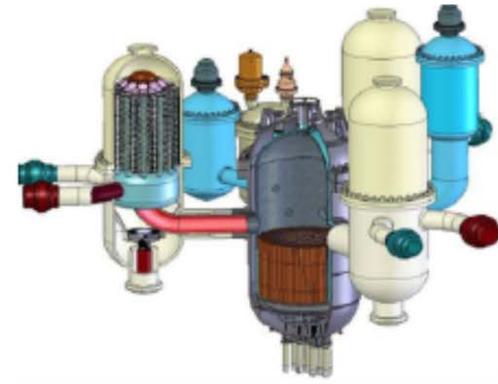
Innovative Reactors



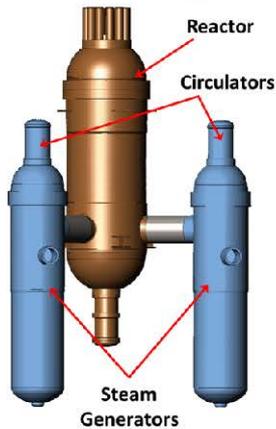
**Sodium Fast Reactor
(JSFR Loop Configuration)**



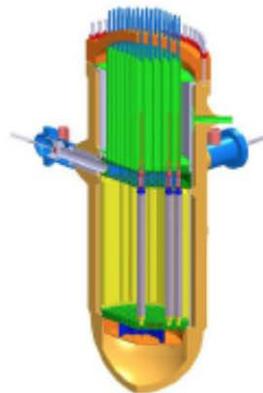
Lead Fast Reactor



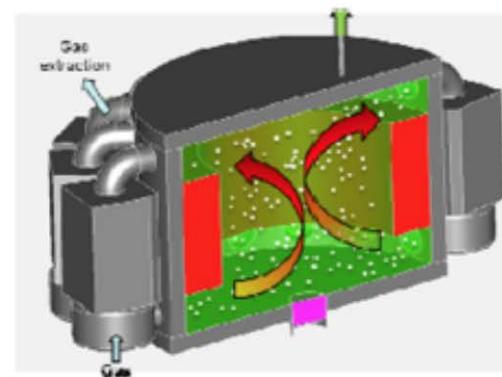
Gas Cooled Fast Reactor



Very High Temperature Reactor



Supercritical Water Cooled Reactor



Molten Salt Cooled Reactor



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THANK YOU

