

# Impacts of a Nuclear Shutdown

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# Impacts of a Nuclear Shutdown

There are two primary impacts of losing a nuclear plant:

## Emissions increase

Lost nuclear output is replaced almost entirely by increased fossil generation

- With attendant increase in emissions

## Electricity prices rise

Law of Supply and Demand: A reduction in supply raises price

- Market's response partially mitigates the price increase

# Nuclear Shutdown causes Increased Emissions

In the short term, lost nuclear generation is replaced by fossil – mostly gas; some coal

- More fossil generation means increased emissions: CO<sub>2</sub>, as well as SO<sub>2</sub>, NO<sub>x</sub>, particulates, etc.

One nuclear unit prevents about 4 million tons CO<sub>2</sub> annually

This is the CO<sub>2</sub> emissions of 900,000 cars

- Equivalent to 20% of the autos in Ohio or Pennsylvania

# Can Nuclear be Replaced by Renewables?

Renewables are unlikely to replace emission-free nuclear generation in the near term

Existing renewables generate the same whether nuclear operates or not

- Similar for new renewables built anyway

To offset lost nuclear, must add still more new renewables

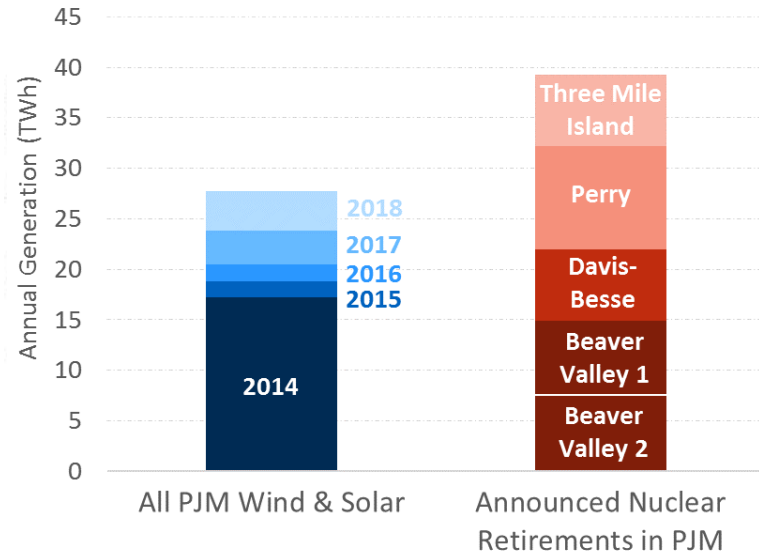
- Even more than would be added otherwise, and much faster

➤ **This raises a question of scale and pace**

# Relative Scale of Nuclear and Renewables

One large nuclear unit generates as much emission-free power as 30% of all existing PJM renewables (wind, solar)

- Accounts for over 3 years of recent PJM renewable growth
  - Ohio renewables provide 1.7 TWh, ~6% of PJM renewables



Source: Generation within PJM footprint via ABB Velocity Suite from EIA Forms 906/923 (2018 estimated; data incomplete).

Substituting renewables for nuclear means falling behind in the growth of emission-free generation

# Nuclear Shutdown Causes Higher Electricity Prices

## **Question: How can closing a relatively costly plant (one having trouble covering its costs in the market) cause power prices to rise?**

Power price is based on generator offers into hourly wholesale markets

- Offers reflect only short-run variable costs (primarily fuel, for most plants)
- Just enough generators are run to meet current-hour load, lowest offers first
- Price is set by the offer of the highest-cost generator needed in that hour

Nuclear's short-run cost is very low

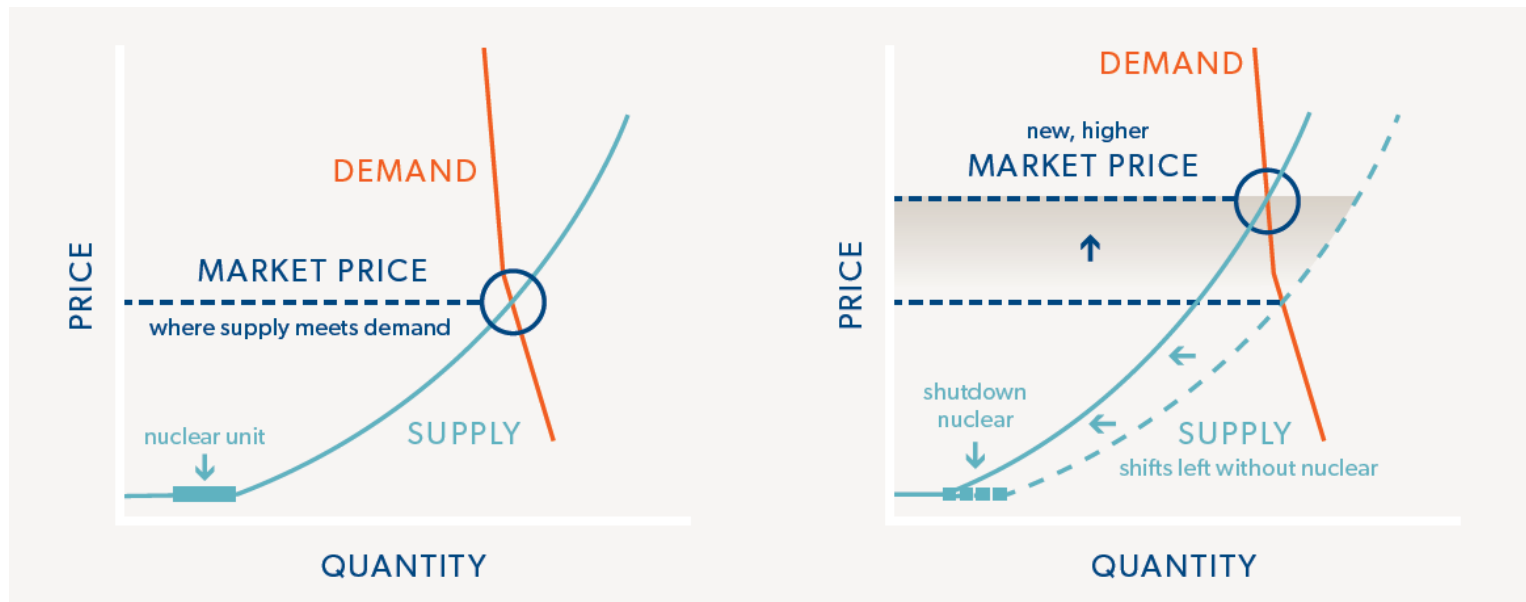
- Nuclear offers \$0/MWh and runs in all hours – as long as it operates
  - Even if price does not cover its ongoing fixed costs (largely labor) on an hourly basis
- Fossil alternatives – existing or new – offer at higher prices reflecting their variable costs (mostly fuel)

Thus short-term market price is higher if more fossil is called on

# Nuclear Shutdown Causes Higher Electricity Prices

## Law of Supply and Demand (short-term effect):

- Reduction in supply causes higher prices – this is widely agreed



**➔ Price suppression (or preventing retirement in order to hold prices down) is not a legitimate policy goal, and can harm markets and customers in the long run**

- However, price impacts may be a side effect of a policy that pursues legitimate goals, such as emission reduction, by addressing gaps in competitive power markets (emissions externality)
- The electricity price effect may help to offset the costs to customers of such a policy



# Presenter Information



## **DEAN MURPHY**

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Dr. Murphy is an economist with a background in engineering. He has expertise in energy economics, competitive and regulatory economics and finance, as well as quantitative modeling and risk analysis. His work centers on the electric industry, encompassing issues such as resource and investment planning (including power and fuel price forecasting), valuation for contract disputes and asset transactions, climate change policy and analysis, competitive industry structure and market behavior, and market rules and mechanics. He has addressed these issues in the context of business planning and strategy, regulatory hearings and compliance filings, litigation and arbitration. Dr. Murphy has examined these matters from the perspectives of investor-owned and public electric utilities, independent producers and investors, industry groups, regulators, system operators, and consumers.

Dr. Murphy holds a Ph.D. in Industrial Engineering and Engineering Management and an M.S. in Engineering-Economic Systems, both from Stanford University, and a B.E.S. in Materials Science and Engineering from the Johns Hopkins University.

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