

ARE “WE” ASKING TOO MUCH OF ELECTRICITY MARKETS?

CEE 4th Mid-Year Meeting, June 28, 2016

Retiring Nuclear Fleet Prematurely

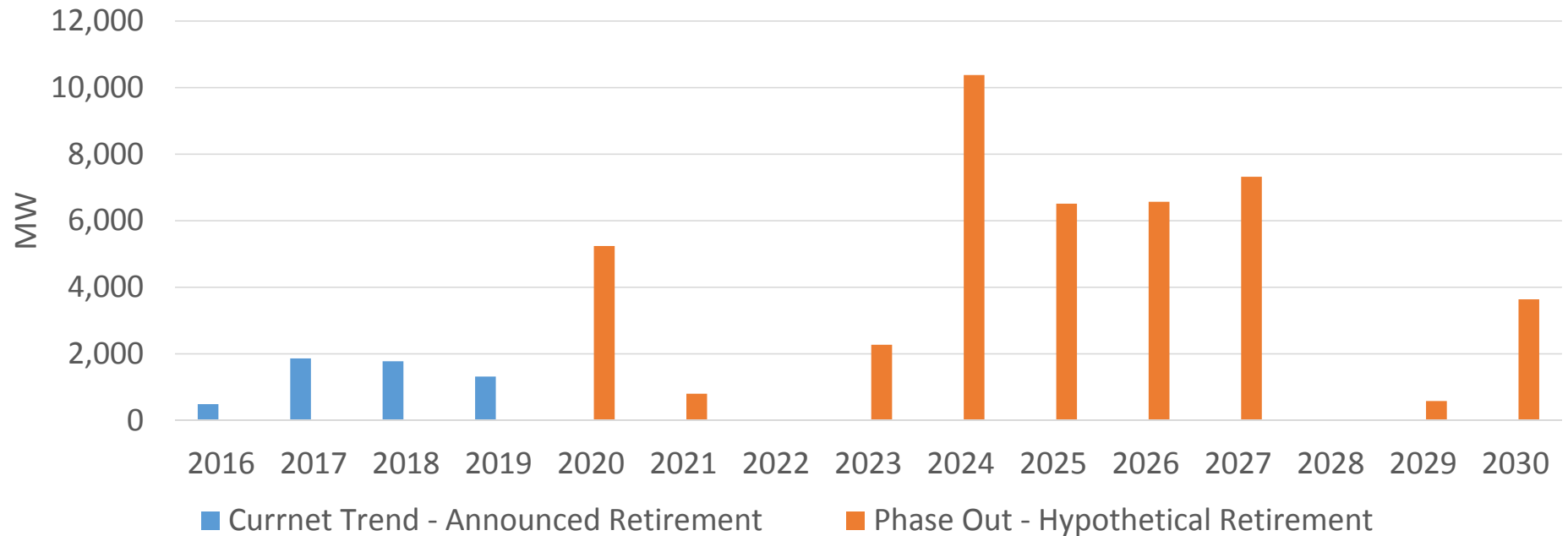
Tsai

Merchant versus IOU Nuclear

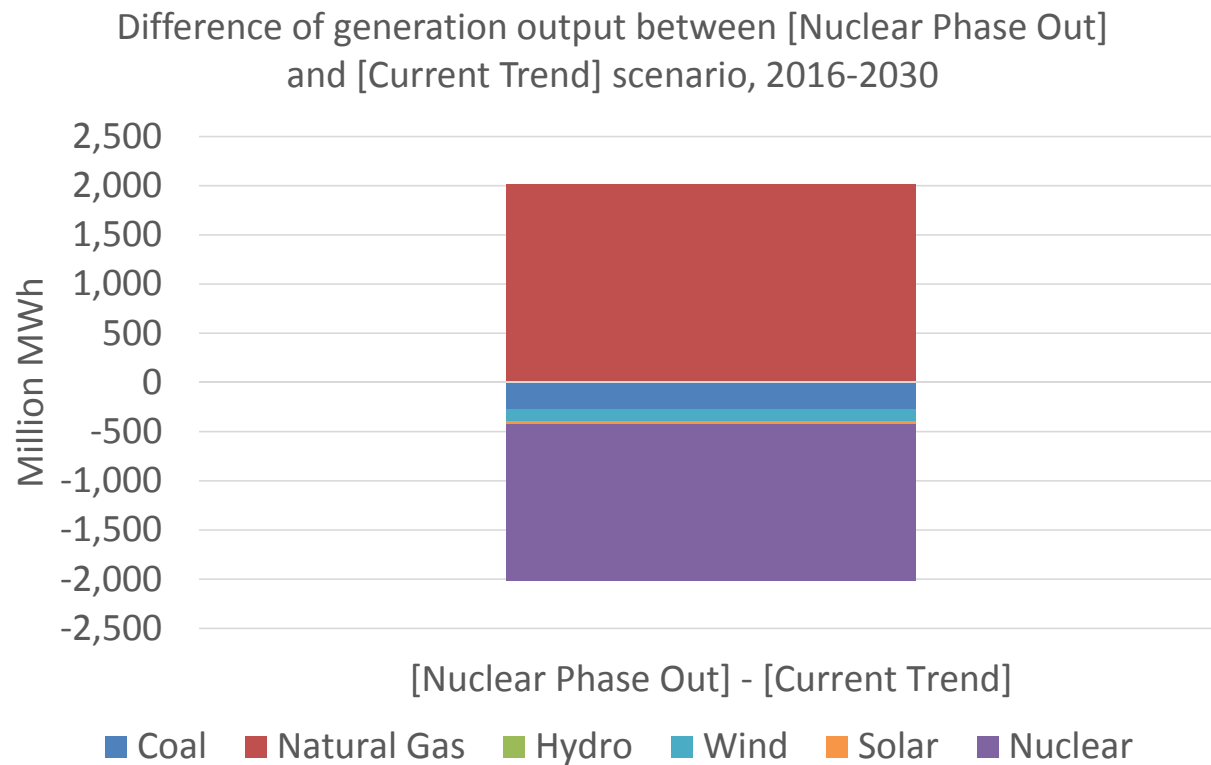
- As of June 15, 2016, 89 reactors in operation; with a total of 86 GW installed capacity
- 5 reactors and 5.5 GW capacity are expected to come online between 2016 and 2020
 - All owned by vertically integrated utilities in regulated markets
- 7 reactors and 5.4 GW capacity are expected to retire (already announced) between 2016 and 2019
 - All owned by merchant generators in competitive wholesale markets

We hypothesize 43.3 GW nuclear capacity in Eastern Interconnection competitive markets will retire by 2030

Eastern Interconnection
Nuclear Capacities Early Retirement Scenario



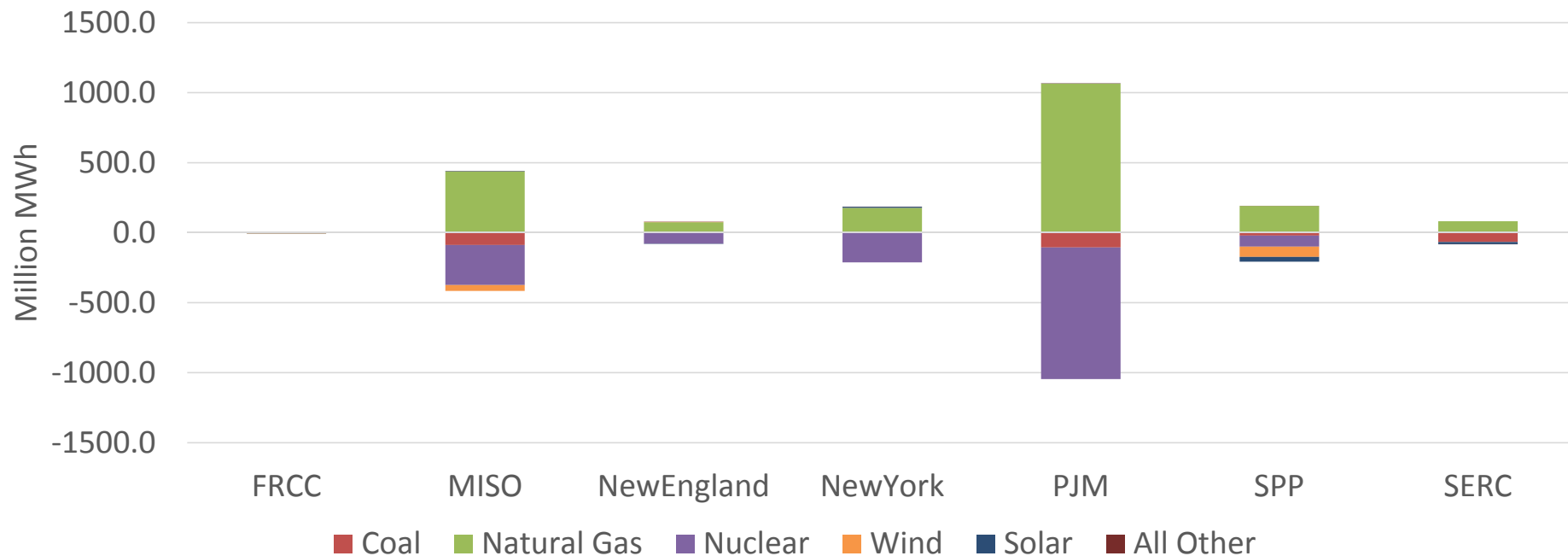
Results – Natural Gas generation makes up all the difference



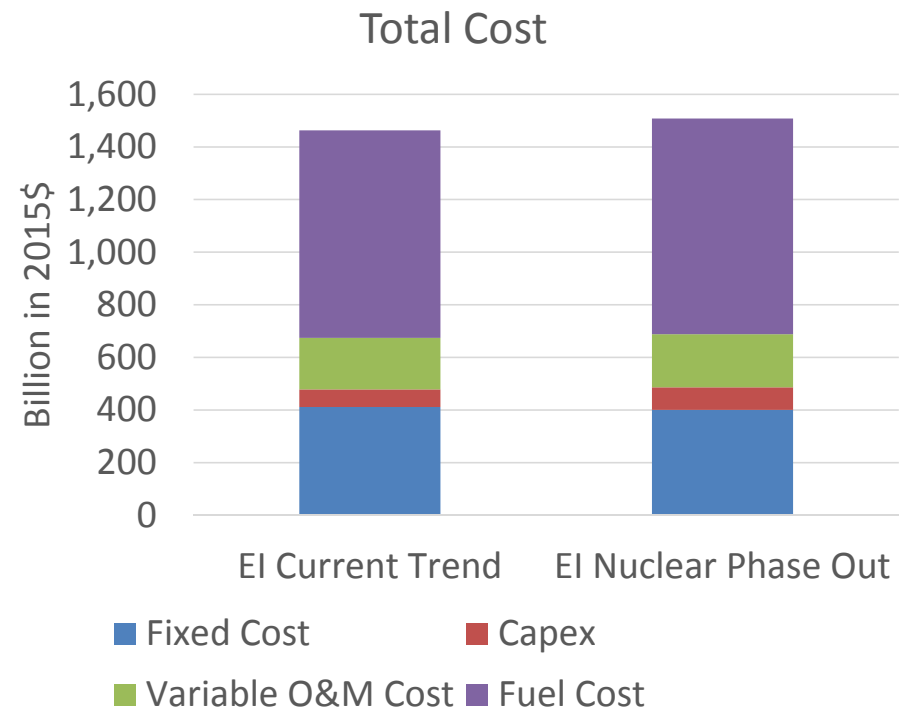
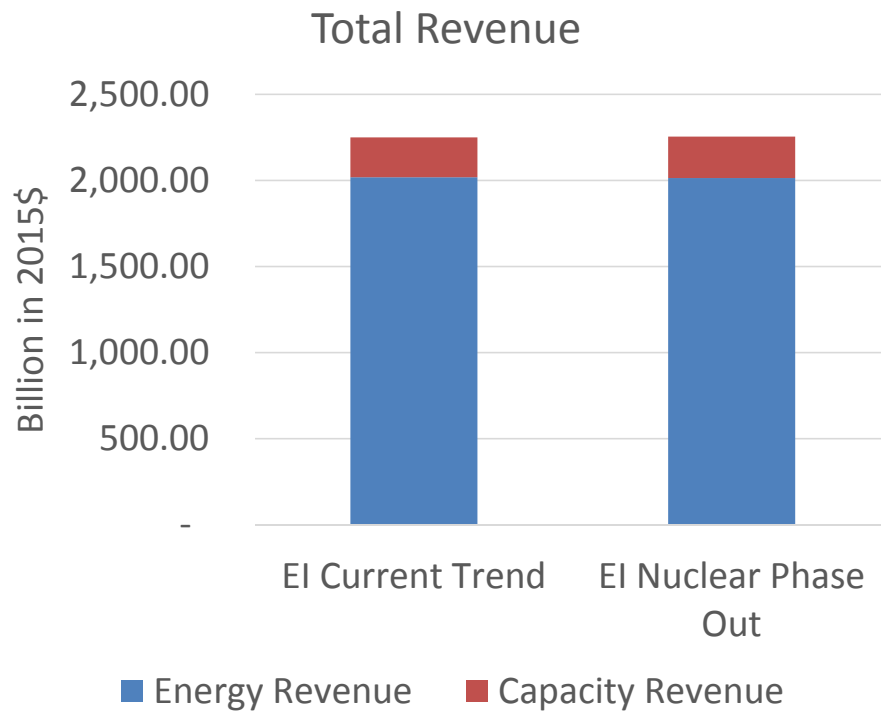
Fuel	Difference in Output (Million MWh)
Coal	-273
Natural Gas	2,020
Wind	-115
Solar	-40

With the majority of nuclear capacities located, PJM and MISO see significant increases in natural gas generation output

Difference of generation output between [Nuclear Phase Out] and [Current Trend] scenario by region, 2016-2030



Total resources revenue vs cost



Can we replace nuclear with all renewables?

- PG&E to close Diablo Canyon by 2025 (Hot Off the Press)
 - 2,160 MW capacity; supplies 20% of load in PG&E territory
 - Bloomberg Intelligence: \$15 billion if replaced with 11GW solar
 - Does not include costs of potential new transmission lines, or back-up resources for solar
- In Sweden, a mix of wind power at 22.3GW plus a gas-based back-up system with 8.6GW to replace 9GW nuclear power
 - CO2 emissions double



The screenshot shows the top portion of a Wall Street Journal article. At the top, the WSJ logo and navigation links for 'Subscribe' and 'Sign In' are visible. Below the header, there are two featured articles: 'VW to Pay More Than \$10 Billion to Settle Emissions Claims' and 'Macy's CEO Lundgren to Step Down Next Year'. The main article is titled 'Environmental Groups Change Tune on Nuclear Power' and is categorized under 'BUSINESS'. The author is listed as 'AMY HARDER' and the date is 'June 16, 2016 2:10 p.m. ET'. The article's lead paragraph states: 'Focus on climate change has raised profile of reactors, now viewed as reliable, carbon-free source of energy'. A sub-headline reads: 'Some of the nation's most influential environmental groups are softening their longstanding opposition to nuclear power, marking a significant shift in the antinuclear movement as environmentalists' priority shifts to climate change.'