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.
Results – Natural Gas generation makes up all the difference

<table>
<thead>
<tr>
<th>Fuel</th>
<th>Difference in Output (Million MWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>-273</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>2,020</td>
</tr>
<tr>
<td>Wind</td>
<td>-115</td>
</tr>
<tr>
<td>Solar</td>
<td>-40</td>
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</tbody>
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Difference of generation output between [Nuclear Phase Out] and [Current Trend] scenario, 2016-2030
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

- FRCC
- MISO
- NewEngland
- NewYork
- PJM
- SPP
- SERC

Coal | Natural Gas | Nuclear | Wind | Solar | All Other
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