40 MW Offshore Wind Energy
Estimated Economic & Rate Impacts
(Preliminary Results)

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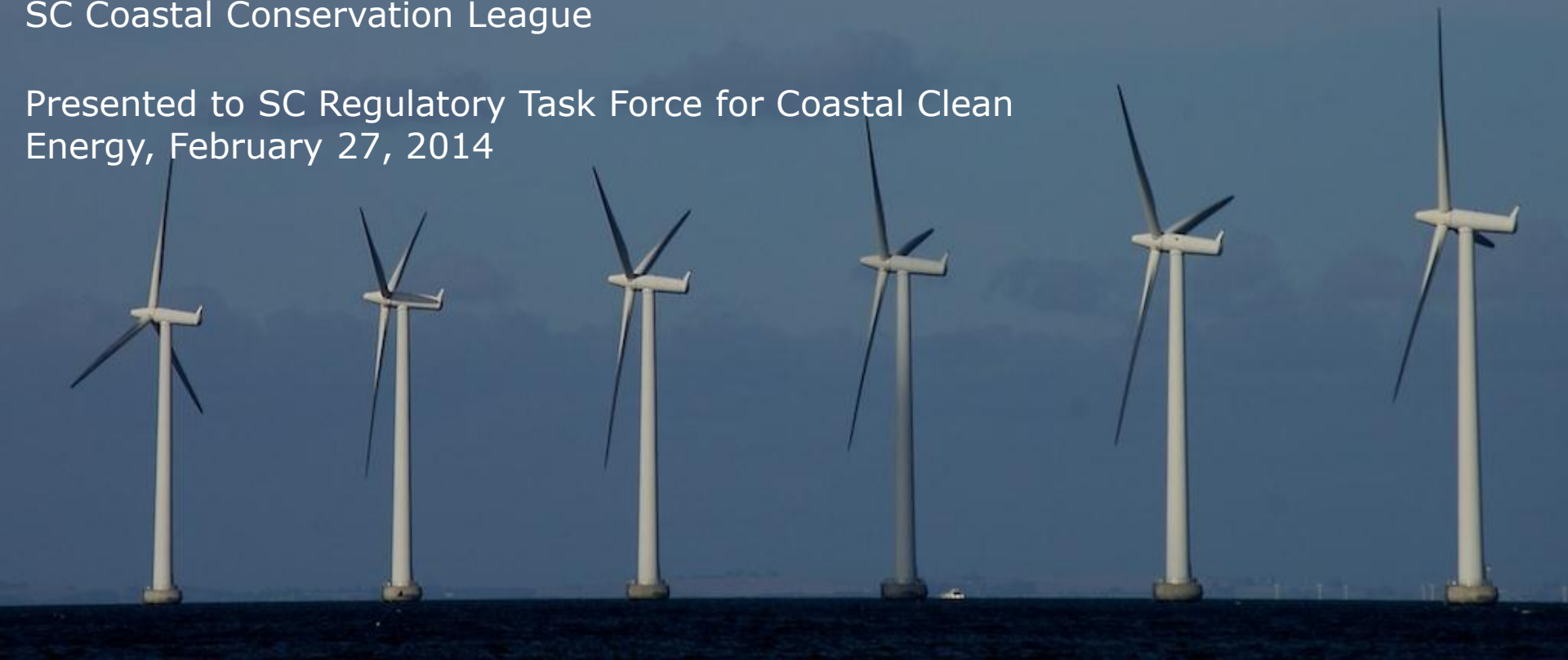
Presented to SC Regulatory Task Force for Coastal Clean Energy, February 27, 2014



Background

- 2008 - present
  - Regulatory Task Force for Coastal Clean Energy (US DOE grant, 2008-)
  - Wind Energy Production Farms Feasibility Study Committee established (SC Act 318 of 2008)
    - 2010 report to SC General Assembly
  - Palmetto Wind Project (SCEO, Santee-Cooper, CURI, Coastal Carolina)
  - CURI and USDOE wind turbine drive train testing facility (2009-)
  - Offshore Renewable Energy State-Federal Task Force (with US BOEMRE, 2012-)

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SC Wind Energy Supply Chain Survey & Offshore Wind Economic Impact Study

- STI & CURI partnership, funded by USDOE through SCEO (2012)
- Wind Energy Census of manufacturers
  - 33 firms, 1,134 employees, 14% of total employment
  - 1 – 400 employees
  - Wind specific activity included: engineering services (6 firms), other consulting services (6), and manufacture of wind energy components (8 firms)
- All respondent firms had US markets

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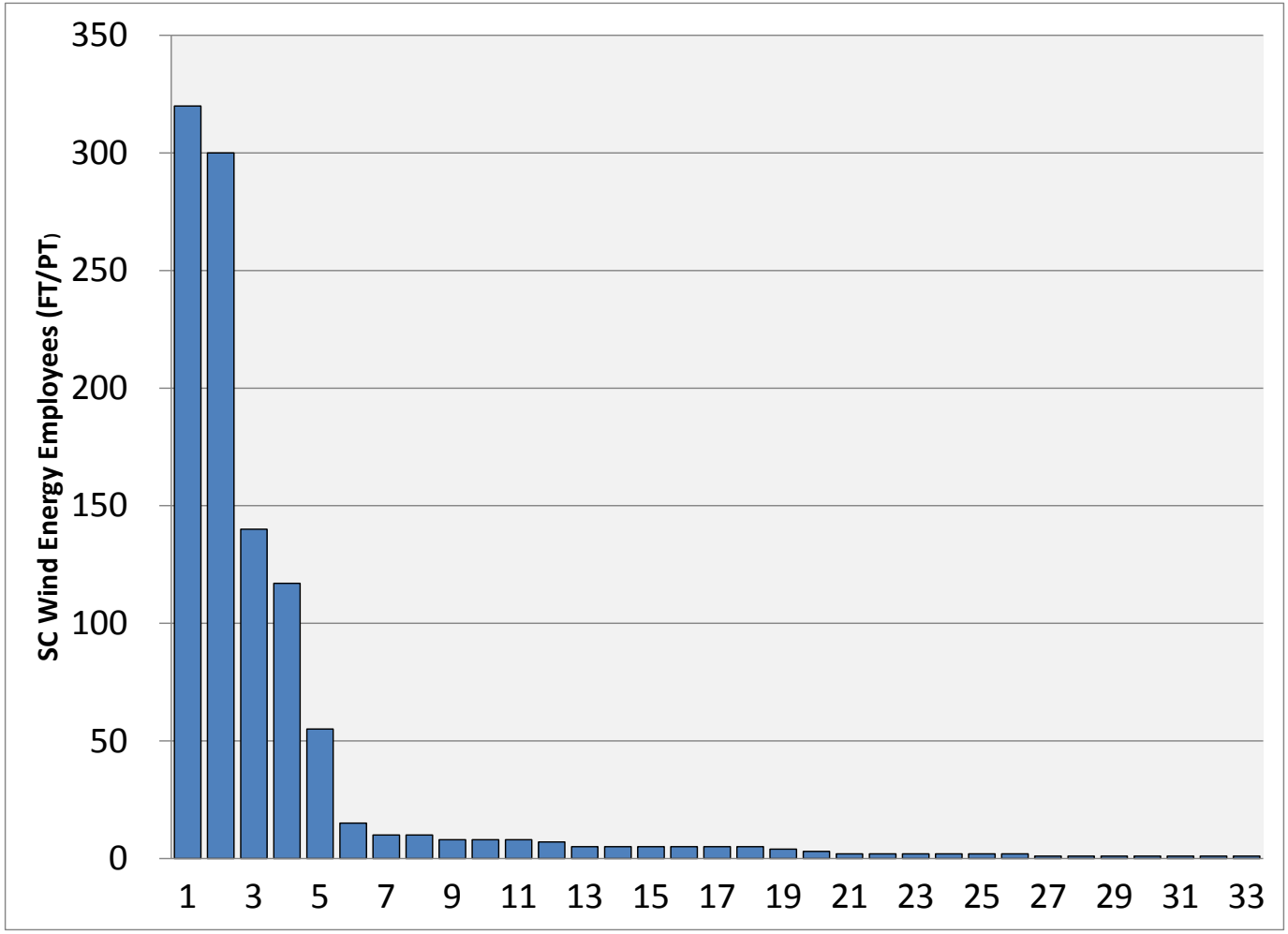
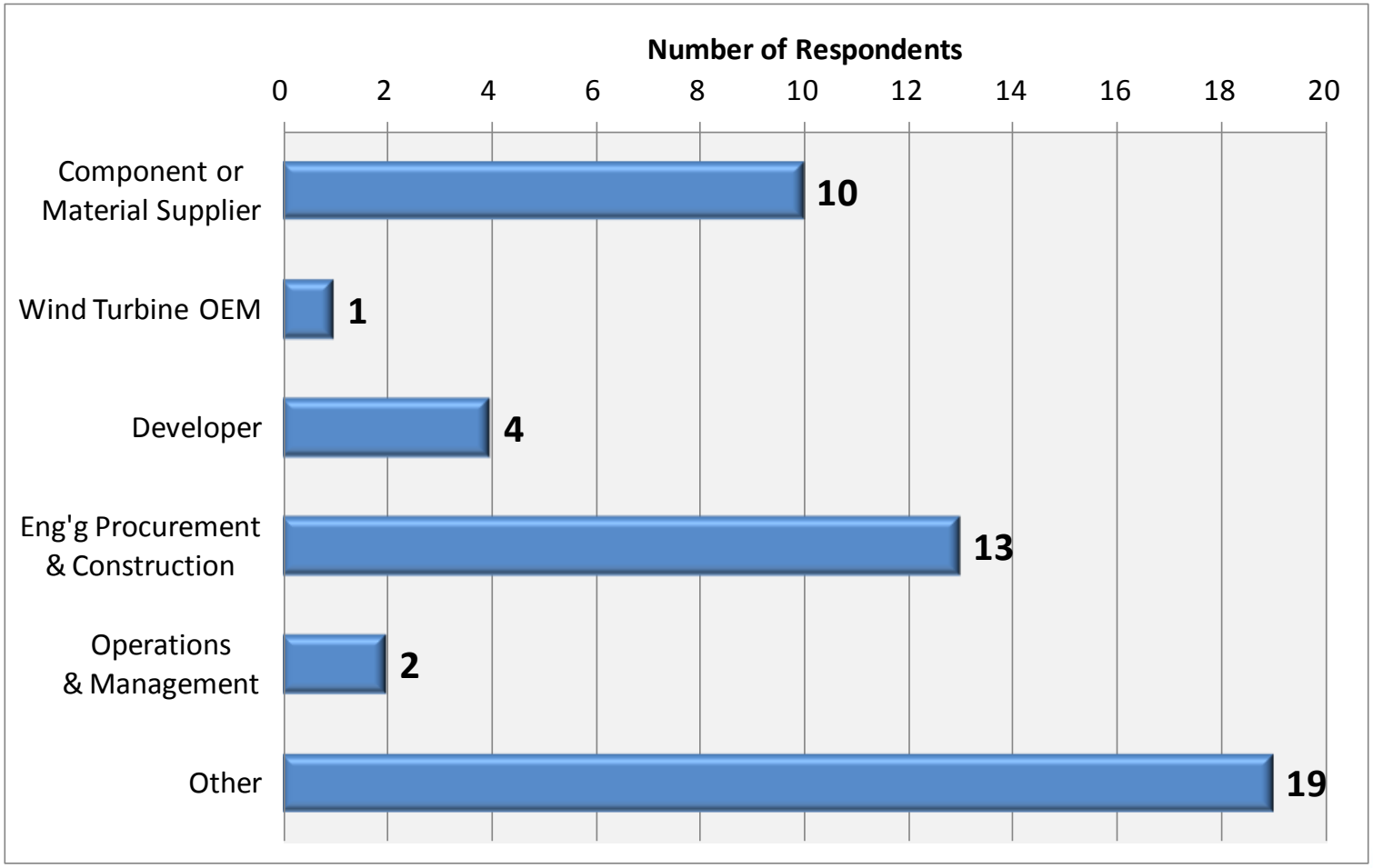
SC Wind Energy Employees by Firm
2012



Primary Firm Functions
(not limited to wind related)



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Wind Energy Specific Products or Services in SC Supply Chain 2012

- Manufacturing (8 firms, products include power cables, seals, bearings, and lubricants)
- Engineering Services (6 firms)
- Other Consulting Services, including site selection, regulatory, and permitting (6 firms)
- Construction Management (3 firms)
- Land and/or Marine Transportation (3 firms)

Economic Impact of SC's Wind Energy Supply Chain (2012)

- 1,134 jobs in wind energy related production or service activities
- 1,797 additional jobs generated through indirect and induced effects for total impact of 2,931 jobs
- $530 million in output in 2012
- $29 million in revenue to state government
- $21 million in revenue to local governments

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Phase 2 Purpose & Funding

To assess the estimated economic impact of a 40 MW demonstration offshore wind farm on South Carolina, including electric rate impacts.

Funded by the State Energy Office, a division of the South Carolina Budget & Control Board, with a U.S. Department of Energy grant.

Phase 2 Tasks

1. Estimate economic and fiscal impact of 40 MW to 60 MW offshore wind farm construction and O&M
2. Estimate impact of utility capital recoupment on electricity rates
3. Estimate savings and rate impact from wind offset of electric generation from coal & natural gas

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Economic Impact Model

- Estimated impact of demonstration-scale 40 MW wind farm using REMI PI+ model
  - I/O & CGE modeling uses inter-industry linkages and interregional trade patterns (New Economic Geography) to estimate economic and fiscal impacts based on user inputs
- Estimated impacts include:
  - Direct Effects
  - Indirect Effects
  - Induced Effects

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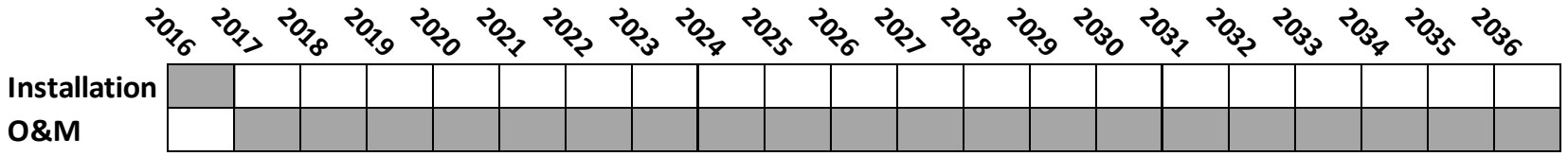
40 MW Demonstration Offshore Wind Farm

- Construction and O&M cost estimates from
  - NREL
  - REPP
  - Industry sources
- One year for construction (2016)
- 20 years of O&M (2017-2036)



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Offshore Wind Farm Assumptions

- Installation of 3 to 5 MW turbines
- 25 meter water depth at the site
- 100 miles between site and staging port
- 50 miles to electrical interconnection on land
- Less than 30 miles to servicing port
- Wind farm size consistent with recommendations from SC Wind Energy Production Farms Feasibility Study Committee

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Manufacturing & Installation Estimated Economic Impact on SC (2016)

	Impact in 2016
Employment	1,106 jobs
Private Non-Farm Employment	1,008 jobs
Total Compensation	$54.1 million
Total Impact (Output)	$164.7 million
State GDP	$87.8 million
Net Local Govt. Revenue	-$0.15 million
Net State Govt. Revenue	$1.6 million

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Avg. Annual Operations & Maintenance Est. Economic Impact on SC (2017-2036)

	Impact per Year
Employment	13 jobs
Private Non-Farm Employment	11 jobs
Total Compensation	$1.2 million
Total Impact (Output)	$3.2 million
State GDP	$1.8 million
Net Local Govt. Revenue	-$63,000
Net State Govt. Revenue	$14,000

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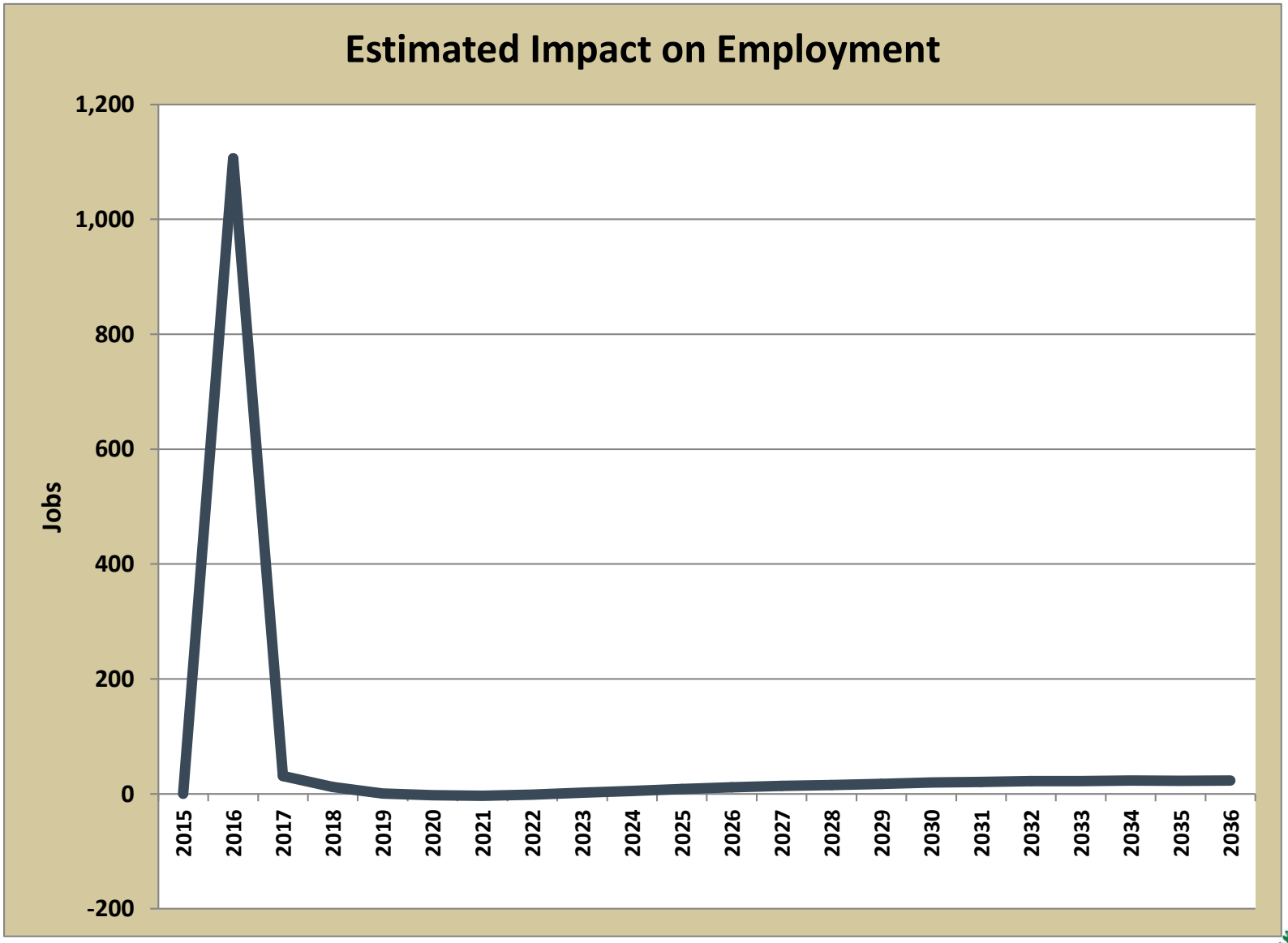

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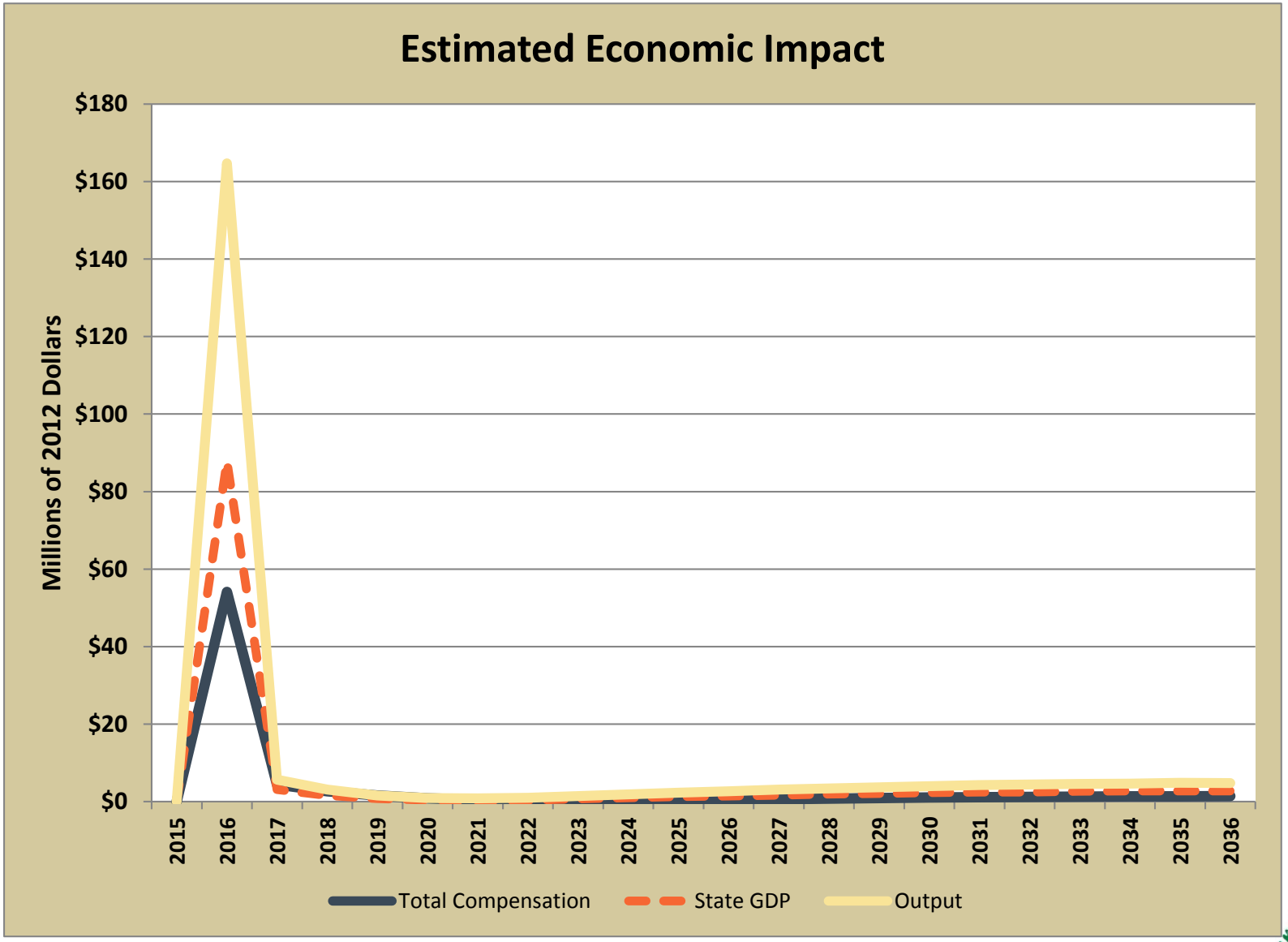

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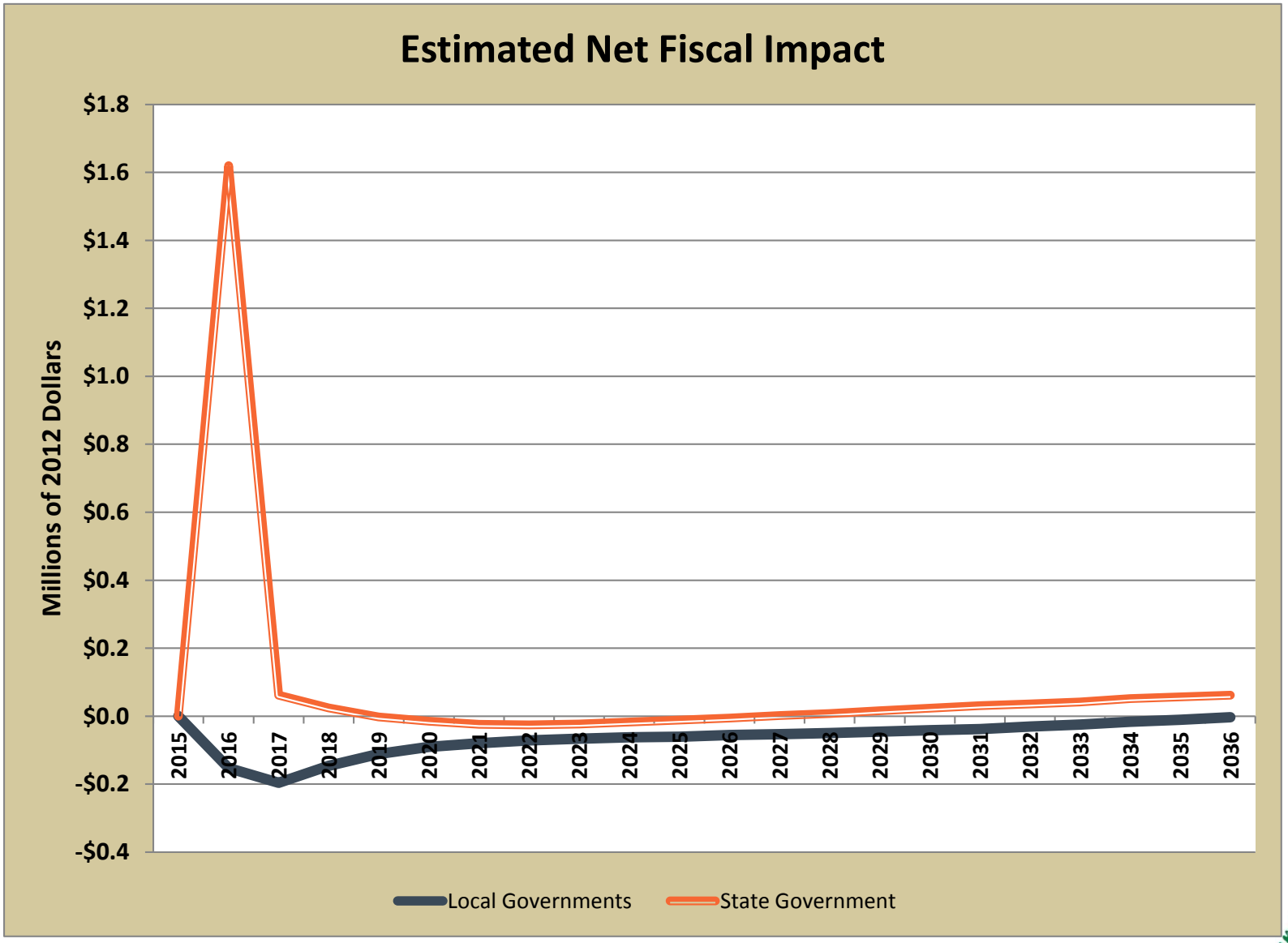

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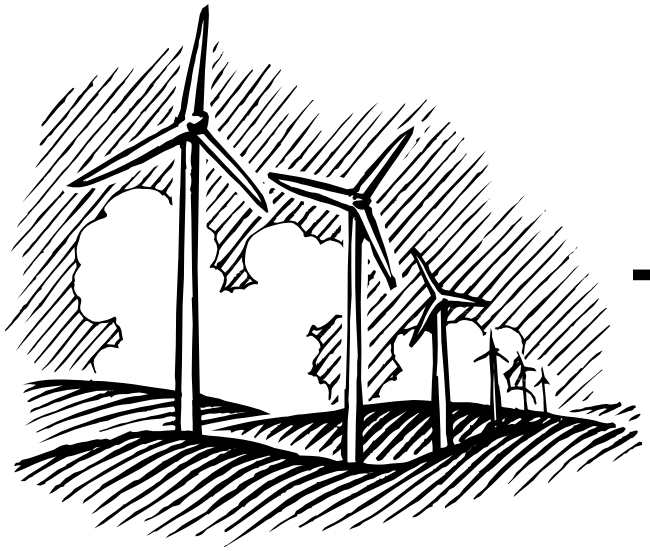
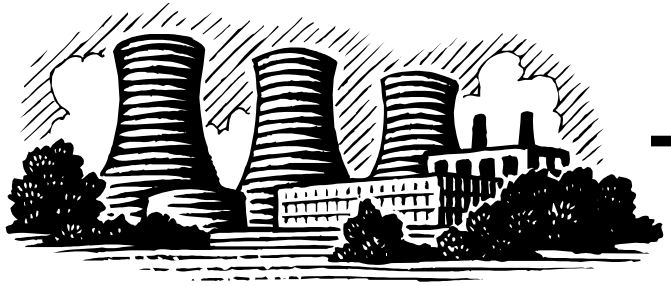
Rate Impact – Conceptual Framework



Annual Capital Cost

Allocate by Customer Class

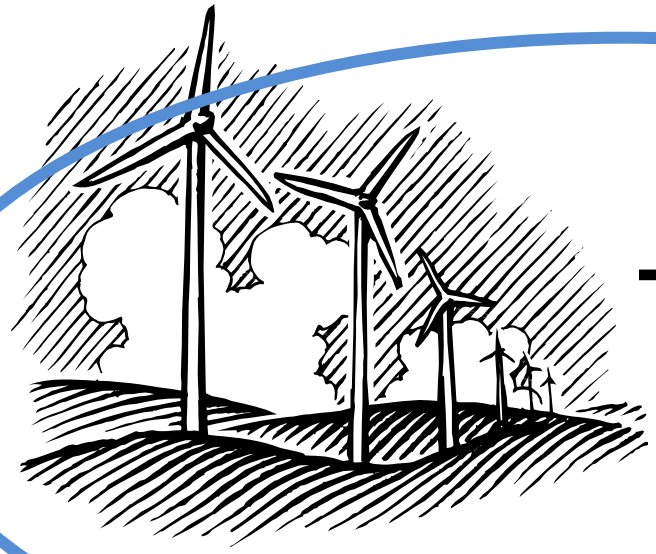


Annual Avoided Production Cost

Allocate by kWh

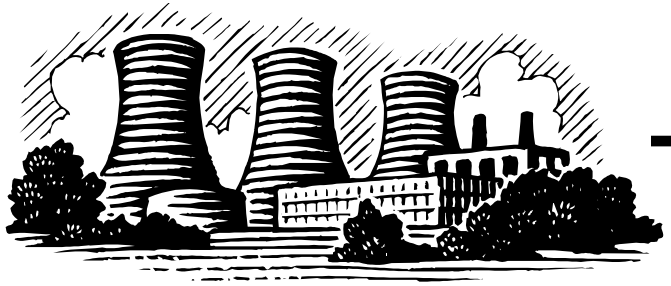
Net Rate Impacts

Rate Impact – Conceptual Framework



Annual Capital Cost

Allocate by Customer Class



Annual Avoided Production Cost

Allocate by kWh

Net Rate Impacts

Annual Capital Cost

Cost of Renewable Energy Spreadsheet Tool (CREST; US NREL)

Input	Value	Units
Generator nameplate capacity	40	MW
Project useful life	20	Years
Total installed cost	6,459	$/kW
Fixed O&M cost	66.16	$/kW-yr
Variable O&M cost	0.73	cents/kWh
Annual O&M cost inflation	2	% per year
Blended after-tax WACC	6.11	% per year
Federal incentives	None	--
State incentives	None	--
Depreciation	Straight-line	--

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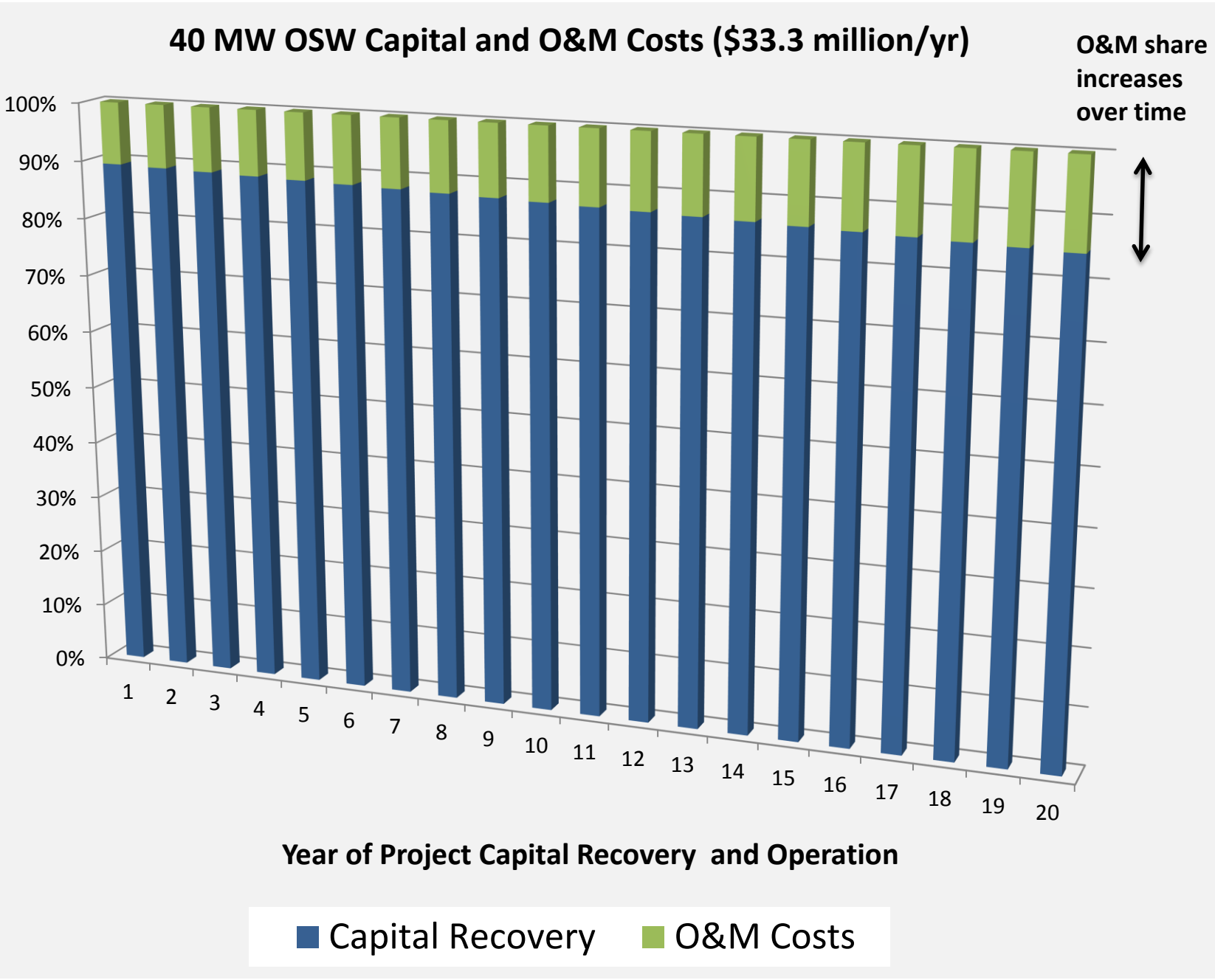
Annual Capital Cost Example (CREST Model)

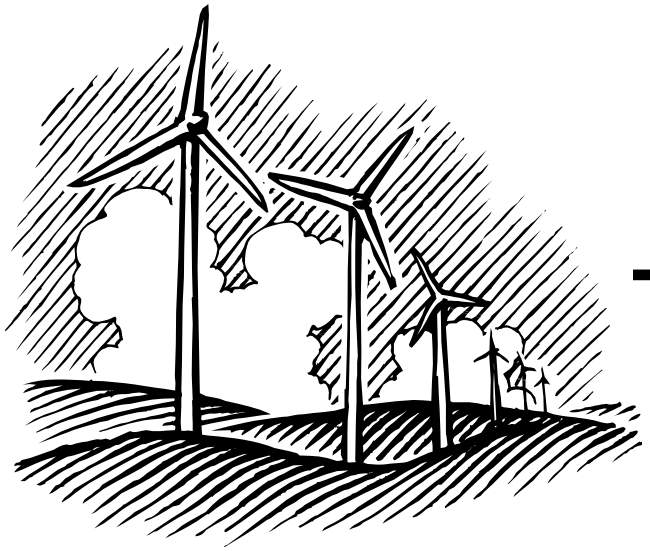
Annual Project Cash Flows, Returns & Other Metrics

Project Year	Tariff or Market Value ¢/kWh	Revenue $	Operating Expenses $	Debt Service $	Reserves $	Pre-Tax Cash Flow $	Federal Taxable Income $	State Taxable Income $	Federal Tax Benefit/ (Liability) $	State Tax Benefit/ (Liability) $	After Tax Cash Flow $	Cumulative Cash Flow $
0											($27,500,000)	($27,500,000)
1	16.75	$5,135,550	($885,418)	($1,794,758)	$0	$2,455,374	($6,327,868)	($6,327,868)	$2,104,016	$316,393	$4,875,784	($22,624,216)
2	16.83	$5,135,422	($901,985)	($1,794,758)	$0	$2,438,679	($12,014,363)	($12,014,363)	$3,994,776	$600,718	$7,034,173	($15,590,044)
3	16.92	$5,135,293	($918,866)	($1,794,758)	$0	$2,421,669	($5,970,076)	($5,970,076)	$1,985,050	$298,504	$4,705,223	($10,884,820)
4	17.00	$5,135,165	($936,068)	($1,794,758)	$0	$2,404,339	($2,331,721)	($2,331,721)	$775,297	$116,586	$3,296,223	($7,588,598)
5	17.09	$5,135,036	($953,596)	($1,794,758)	$0	$2,386,683	($2,302,238)	($2,302,238)	$765,494	$115,112	$3,267,289	($4,321,309)
6	17.17	$5,134,908	($971,457)	($1,794,758)	$0	$2,368,694	$435,332	$435,332	($144,748)	($21,767)	$2,202,179	($2,119,130)
7	17.26	$5,134,780	($989,657)	($1,794,758)	$0	$2,350,365	$3,171,653	$3,171,653	($1,054,575)	($158,583)	$1,137,208	($981,922)
8	17.35	$5,134,651	($1,008,202)	($1,794,758)	$0	$2,331,691	$3,199,917	$3,199,917	($1,063,972)	($159,996)	$1,107,723	$125,801
9	17.43	$5,134,523	($1,027,101)	($1,794,758)	$0	$2,312,665	$3,228,448	$3,228,448	($1,073,459)	($161,422)	$1,077,783	$1,203,585
10	17.52	$5,134,395	($1,046,358)	($1,794,758)	$0	$2,293,279	$3,258,808	$3,258,808	($1,083,554)	($162,940)	$1,046,785	$2,250,370
11	17.61	$5,134,266	($1,065,981)	($1,794,758)	$0	$2,273,528	$3,291,091	$3,291,091	($1,094,288)	($164,555)	$1,014,685	$3,265,055
12	17.69	$5,134,138	($1,085,977)	($1,794,758)	$0	$2,253,403	$3,325,730	$3,325,730	($1,105,805)	($166,286)	$981,311	$4,246,367
13	17.78	$5,134,010	($1,106,353)	($1,794,758)	$0	$2,232,898	$3,362,524	$3,362,524	($1,118,039)	($168,126)	$946,733	$5,193,099
14	17.87	$5,133,881	($1,127,117)	($1,794,758)	$0	$2,212,006	$3,401,920	$3,401,920	($1,131,138)	($170,096)	$910,772	$6,103,871
15	17.96	$5,133,753	($1,148,276)	($1,794,758)	$0	$2,190,719	$3,443,729	$3,443,729	($1,145,040)	($172,186)	$873,492	$6,977,363
16	18.05	$5,133,625	($1,169,838)	($1,794,758)	$0	$2,169,029	$3,510,536	$3,510,536	($1,167,253)	($175,527)	$826,249	$7,803,613
17	18.14	$5,133,496	($1,191,809)	($1,794,758)	$0	$2,146,929	$3,580,115	$3,580,115	($1,190,388)	($179,006)	$777,535	$8,581,148

Introduction | Inputs | Summary Results | **Annual Cash Flows & Returns** | Cash Flow | Complex Inputs


40 MW OSW Capital and O&M Costs ($33.3 million/yr)
O&M share increases over time
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
Year of Project Capital Recovery and Operation
Capital Recovery
O&M Costs

Rate Impact – Conceptual Framework



Annual Capital Cost

Allocate by Customer Class

Net Rate Impacts

Annual Avoided Production Cost

Allocate by kWh

Wind Power Benefits:
Conventional Production Costs Avoided

- Fuel purchases
- Other variable O&M
- CO2 emissions allowance costs

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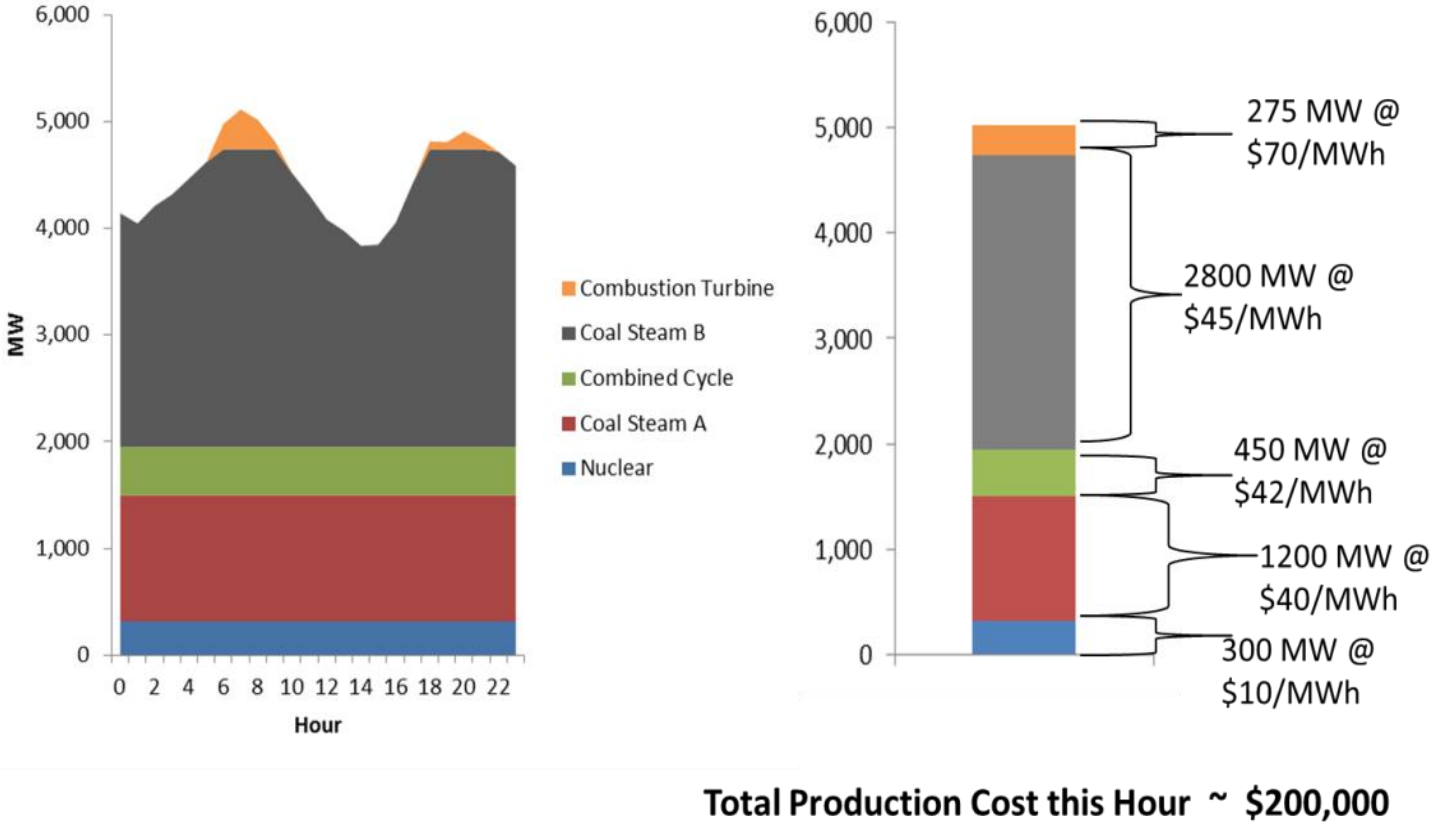
How the PC model works: Annual Avoided Production Cost



Total Production Cost this Hour ~ $200,000

Annual Avoided Production Cost

- Custom hourly production cost model built by CCL with input from STI
- 'Representative' South Carolina utility system based on existing and planned Carolinas generation
- Historical SC load data and SC load growth projections
- Wind output from publicly available AWS Truepower data
- Fuel price projections from US Energy Information Administration
- CO_2 allowance price projections based on EIA and SC utility planning documents

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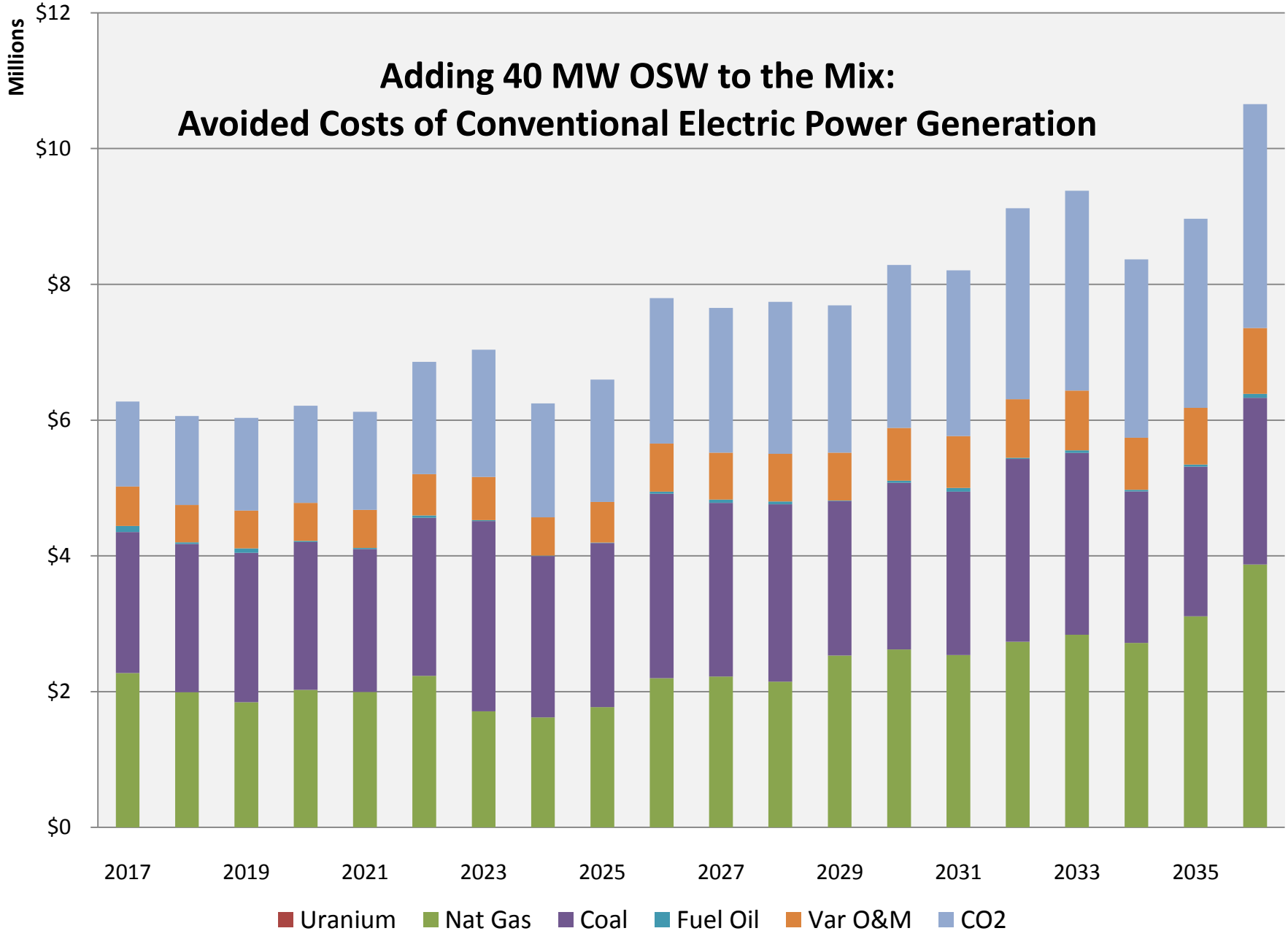
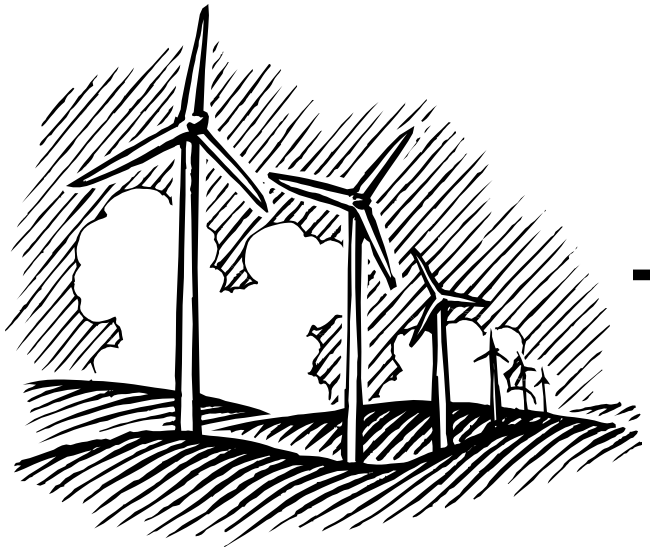

Adding 40 MW OSW to the Mix:
Avoided Costs of Conventional Electric Power Generation
Millions
$12
$10
$8
$6
$4
$2
$0
2017
2019
2021
2023
2025
2027
2029
2031
2033
2035
Uranium
Nat Gas
Coal
Fuel Oil
Var O&M
CO2

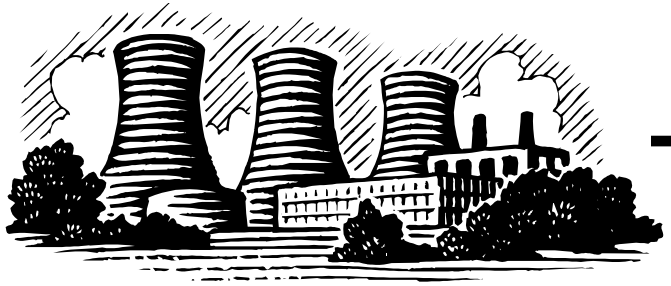
Rate Impact – Conceptual Framework



Annual Capital Cost

Allocate by Customer Class

Net Rate Impacts



Annual Avoided Production Cost

Allocate by kWh

Adding Wind to the System: Estimated Rate Impacts 1

Rate Class	Rate Change ($/Kwh)
Residential	0.00045
Commercial	0.00031
Industrial	0.00011

Adding Wind to the System: Estimated Rate Impacts 2

Rate Class	Average Rate/kWh 2011	Average kWh/mo 2012	Avg Monthly Bill	Monthly Increase ($)	Avg Bill Increase (%)
Resid.	0.1105	1,119	$123.66	$0.50	0.41%
Comm.	0.0930	5,167	$480.34	$1.60	0.33%
Industrial	0.0594	534,380	$31,742.88	$57.74	0.18%

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Offshore Wind Energy in SC?

- SC's already in the wind energy supply chain.
- The offshore environment is favorable.
- The statewide economic impact is positive.
- The electric rate impact is modest.

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The mission of the Coastal Conservation League is to protect the natural environment of the South Carolina coastal plain and to enhance the quality of life of our communities by working with individuals, businesses and governments to ensure balanced solutions.

coastalconservationleague.org

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The mission of the Strom Thurmond Institute is to provide objective research and outreach in economic and regional development and natural resources; serving business, government and community constituents; and supporting interdisciplinary graduate education. **sti.clemson.edu**

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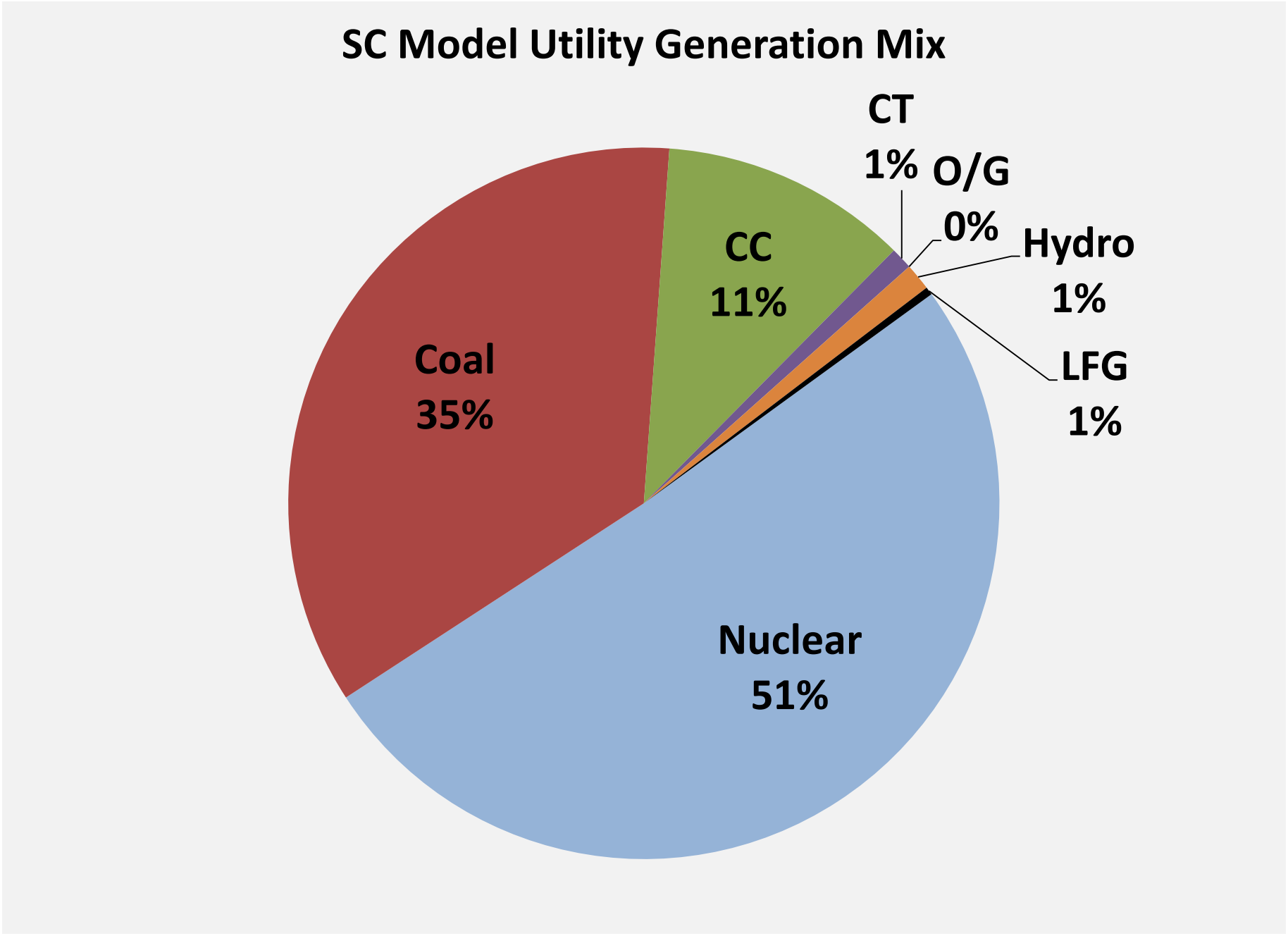
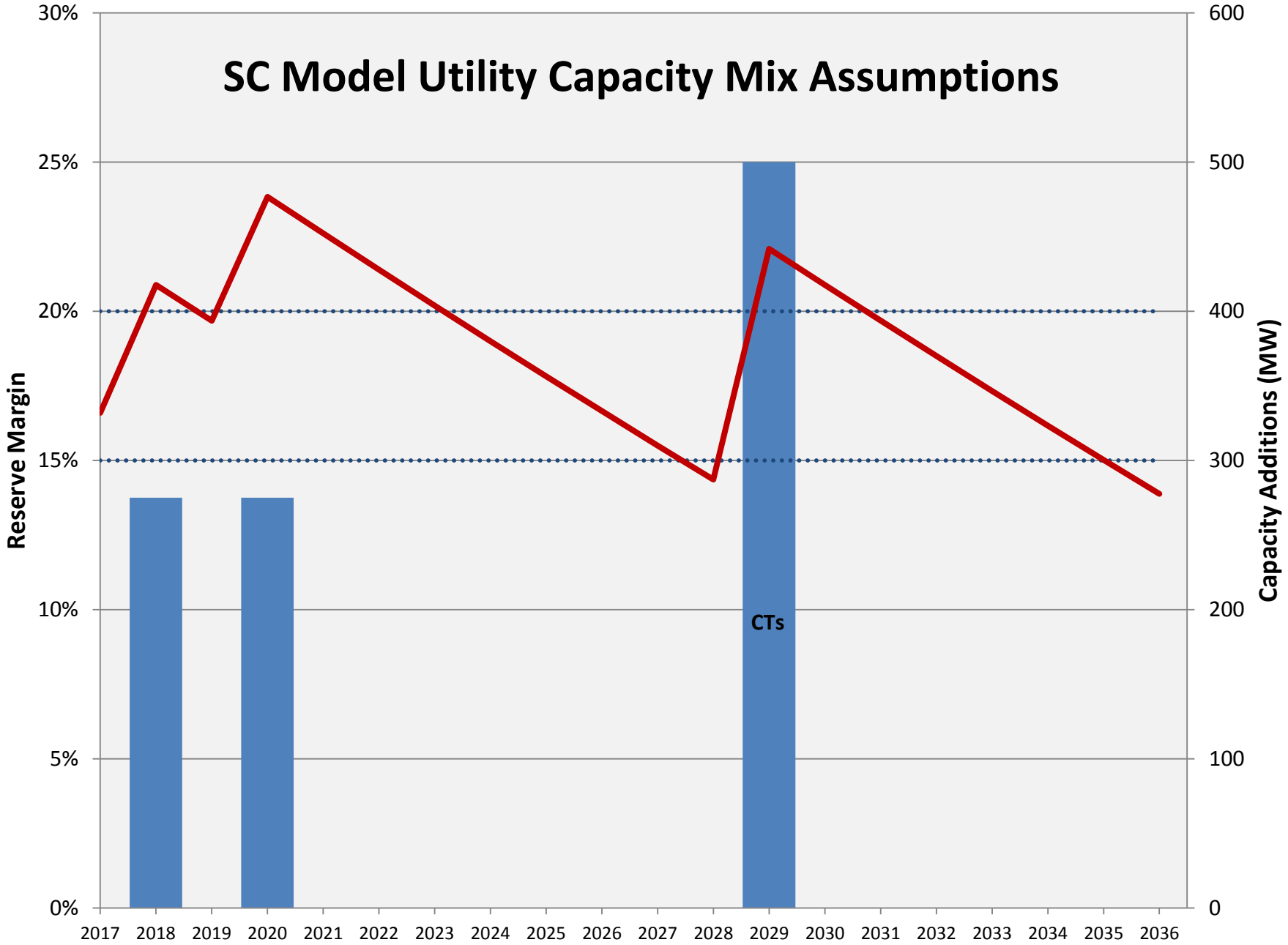

SC Model Utility Generation Mix
CT
1%
O/G
0%
Hydro
1%
LFG
1%
CC
11%
Coal
35%
Nuclear
51%


SC Model Utility Capacity Mix Assumptions
Reserve Margin
Capacity Additions (MW)
30%
25%
20%
15%
10%
5%
0%
600
500
400
300
200
100
0
CTs
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036