Renewable Energy Growth Program Analysis

Economic, Jobs, and Environmental Impacts for Program Years 2015 and 2016 and the Overall Program Years 2015 to 2019

PRESENTED TO

The Rhode Island
Distributed Generation Board

PRESENTED BY

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June 26, 2017

THE Brattle GROUP

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REG Program Overview

- Designed to contribute to meeting RI's Renewable Energy Standard targets
- Up to 160 MW of renewable energy in RI through contracts awarded over five year period 2015-2019. Broad set of technologies qualify
- Contracts ("Tariffs") awarded for mostly 20 years
- Each year, tariff ceiling is set for each program category, which applies to all projects awarded tariff in that year
  - Tariff is lowered for each successful program year to reflect lower costs
  - Small scale solar projects receive the tariff ceiling, but all other projects make bids and receive their bid if selected (typically below tariff ceiling)
- Administered by National Grid, which recovers cost of tariffs above value received from avoided wholesale purchases, plus administrative cost and 1.75% remuneration, through a (very small) surcharge on customer bills

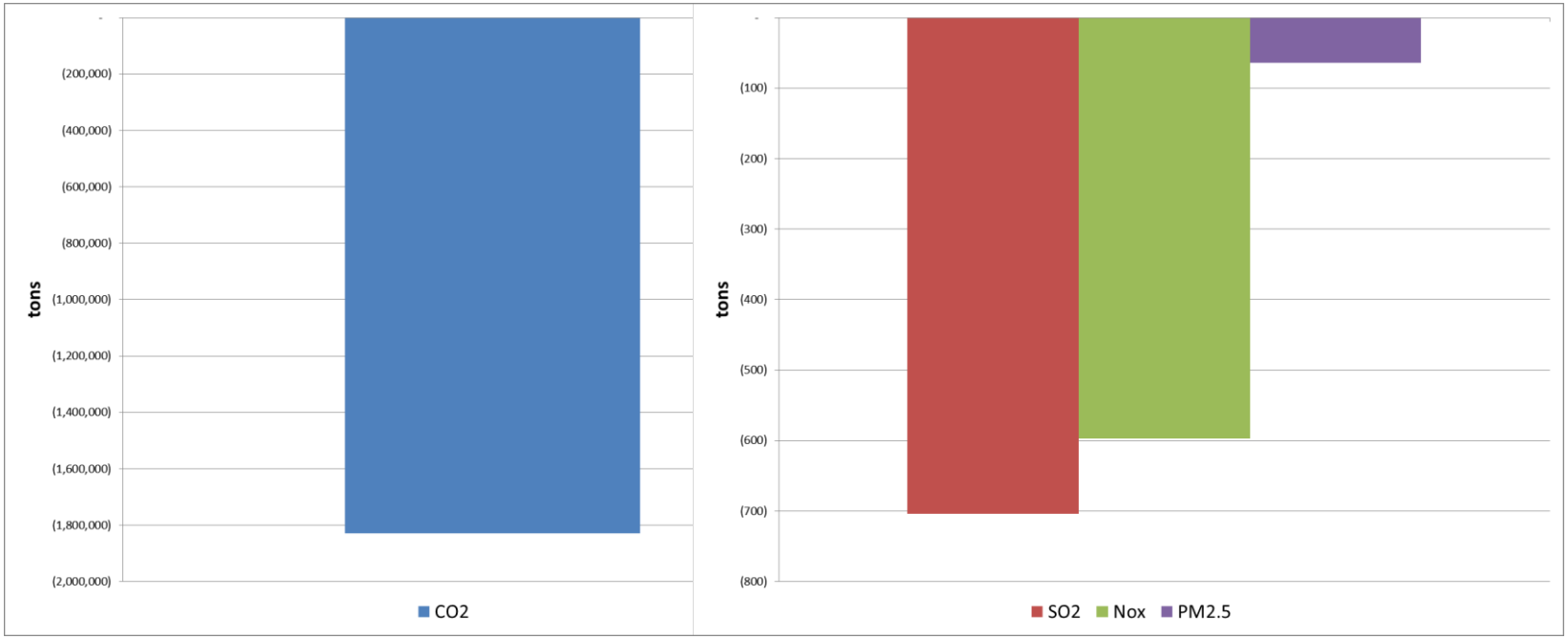
Overall Positive Economic Impact on RI in Addition to Contributing to Meeting RES

	Employment	Labor Income	GDP	Output
Direct Effect	62	$108,800,000	$176,300,000	$266,500,000
Indirect Effect	2	$1,600,000	$2,400,000	$4,100,000
Induced Effect	25	$32,000,000	$57,300,000	$94,000,000
Total Effect	88	$142,400,000	$236,000,000	$364,700,000

Note: Employment impacts are averaged across all years. All other metrics are totals over the time period measured in present value terms.

- (Small) positive employment impact
- Positive impact on GDP ($236 million in PV terms), mostly driven by construction phase of program (2015-2019)
  - Intuition: RI builds new power generation facilities in the state (rather than using existing and mostly out of state generation sources)
  - This impact significantly exceeds the very small increase in rates to pay for tariffs at levels above market values of energy, capacity and RECs

REG Programs will Contribute to Significant Emissions Reductions



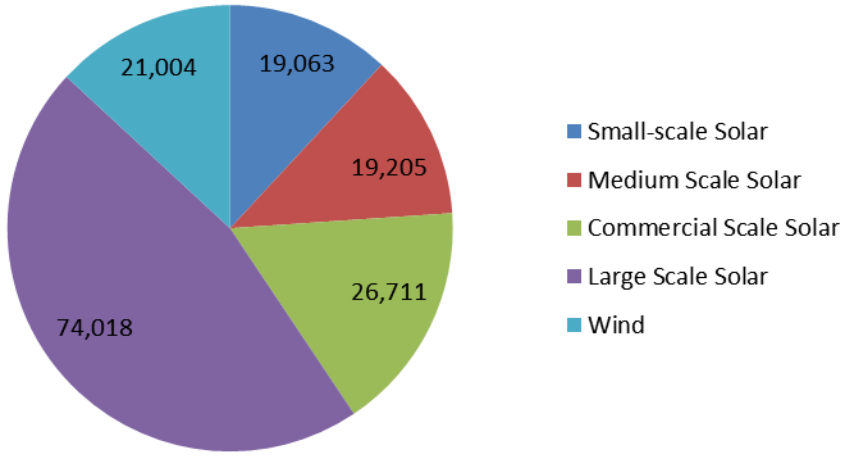
- Estimated 1.8 million tons of CO2 emissions reductions through 2040
- Estimated several hundred tons of SO2 and Nox emissions reductions, some PM2.5

REG Program Summary (Actual and Projected)

REG Total Capacity (kW Installed) by REG Program Category

	Actuals		2015-2016	Projections			2015-2019
	2015	2016	**Total**	2017	2018	2019	**Total**
Small-Scale Solar	845	6,213	**7,059**	5,502	4,001	2,501	**19,063**
Medium-Scale Solar	2,705	4,496	**7,201**	4,001	4,001	4,001	**19,205**
Commercial-Scale Solar	4,147	7,559	**11,706**	5,002	5,002	5,002	**26,711**
Large-Scale Solar	6,644	7,854	**14,498**	19,840	19,840	19,840	**74,018**
Wind I	1,500	3,000	**4,500**	4,001	4,001	4,001	**16,504**
Wind II	4,500	0	**4,500**	0	0	0	**4,500**
Total	**20,341**	**29,122**	**49,464**	**38,346**	**36,845**	**35,345**	**160,000**

- About equal shares of small scale, medium, commercial scale solar and wind (together slightly more than 50%)
- Rest larger scale solar PV (<5 MW)



REG Program Projected to Result in $390M investment - $126M in First Two Years

(Expected) REG Total Investment by Class ($ millions)

	Actuals		2015-2016	Projections			2015-2019
	2015	2016	**Total**	2017	2018	2019	**Total**
Small-Scale Solar	$3.66	$24.77	**$28.43**	$22.16	$16.12	$10.07	**$76.77**
Medium-Scale Solar	$6.74	$11.21	**$17.95**	$9.98	$9.98	$9.98	**$47.88**
Commercial-Scale Solar	$10.34	$18.84	**$29.18**	$12.47	$12.47	$12.47	**$66.59**
Large-Scale Solar	$13.45	$15.90	**$29.36**	$40.18	$40.18	$40.18	**$149.89**
Wind I	$3.52	$7.04	**$10.56**	$9.39	$9.39	$9.39	**$38.72**
Wind II	$10.56	$0.00	**$10.56**	$0.00	$0.00	$0.00	**$10.56**
Total	**$48.27**	**$77.77**	$126.04	**$94.17**	**$88.12**	**$82.08**	$390.40

- First two program years have resulted in an estimated $126 million in investment in renewable facilities, mostly solar, but also a bit of wind
- Expect approximately two times more through the end of the program
- REG projects secured $38million in ITC during first 2 years, expected to reach $117million through 2019

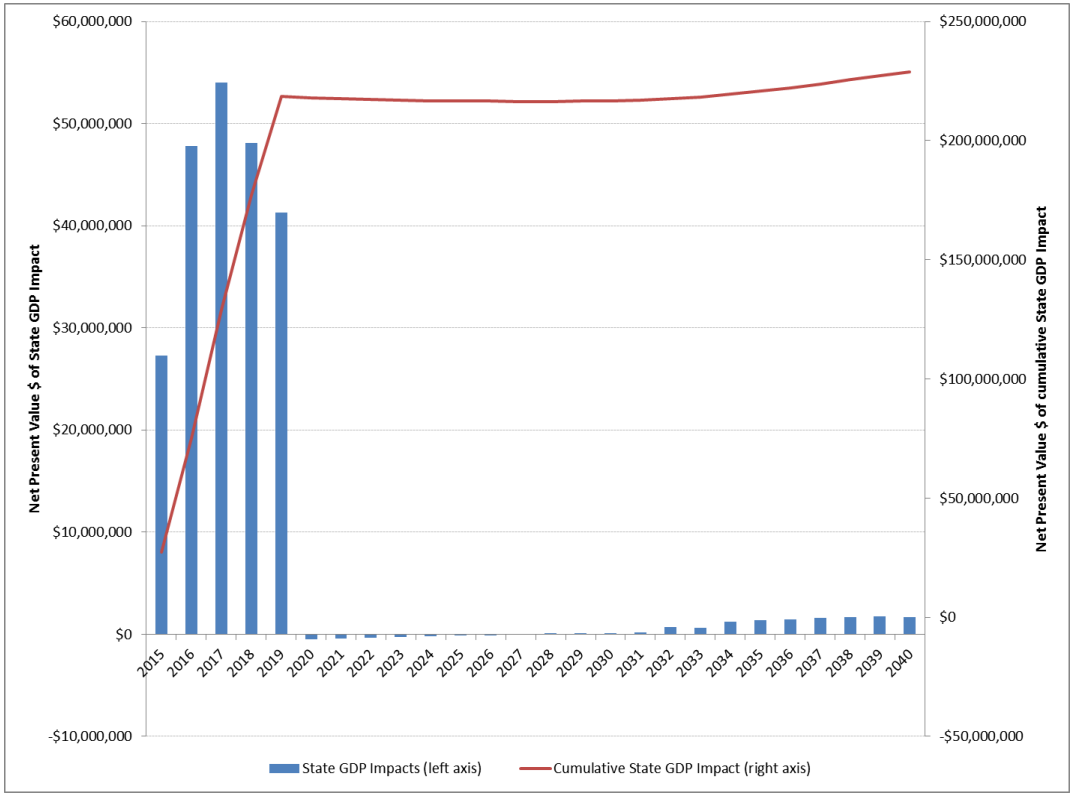
Expected Instate Share of Project Spending Varies by Technology

	In-State (%)
Solar	63%
Wind	27%
Overall	58%

- Well over half of solar technology equipment and construction spending is expected to occur in Rhode Island
- Expectations for wind technology reflects the mirror image of this spending share in-state
- Across both technologies, 58% of spending is expected to occur instate

Incremental Impact of REG Program on RI State GDP Strongest During Construction, then Mildly Positive

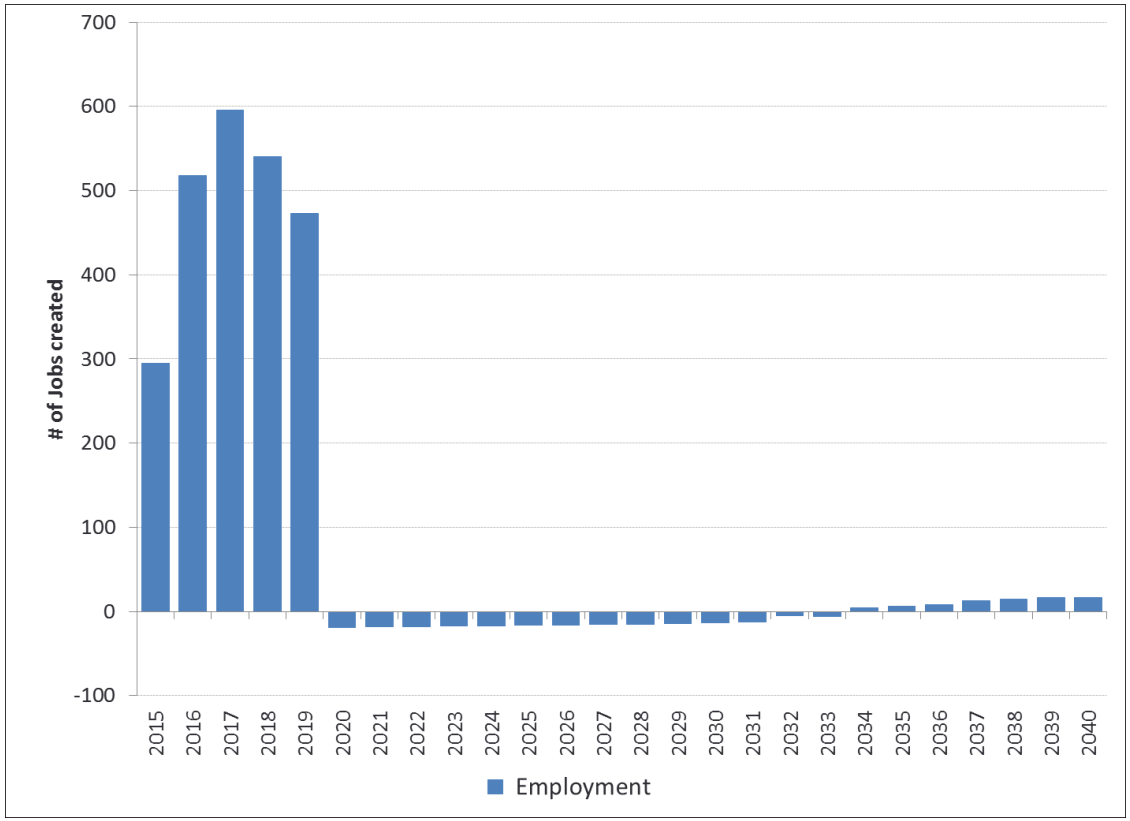
- Construction Phase (2015-2019) leads to $30-$50 million in additional economic activity
- Tariff Phase (2020-2040) is mix of tariff impacts (slightly negative) and taxes, and Operations and Maintenance (slightly positive)



The Same Pattern Applies to Job Creation due to REG Program

Several hundred additional jobs during construction phase, followed by essentially no job impacts during tariff phase

- Tariffs slighly above market value result in very small increase in customer bills
  - NG estimates $0.05 per month
  - Leads to very small impact on jobs
- O&M and taxes have offsetting positive impacts



Tariff Ceilings and Actual Tariff Prices drive Tariff Payments

	Program Year				
	2015	2016	2017	2018	2019
	cents/kWh	cents/kWh	cents/kWh	cents/kWh	cents/kWh
Small Scale Solar 15	41.35	37.65	34.75	31.86	29.20
Small Scale Solar 20	37.75	33.45	30.85	27.89	25.22
Medium Scale Solar	24.40	22.55	22.75	21.99	21.25
Commercial Scale Solar	18.86	17.77	16.74	15.77	14.86
Large Scale Solar	16.27	13.03	11.73	11.14	10.87
Wind I	22.75	18.75	19.45	19.10	19.10
WindII	22.35	18.00	18.25	18.13	18.13

Note: 2015-2016 Actual, 2017-2019 Estimated

- Tariff Ceilings (and average tariffs) decline over time as technology costs drop
- Only small-scale solar receive tariff caps, otherwise competitive bids - actual prices could decline more rapidly

Construction Phase Results in Close to 500 Additional Jobs on Average over 5 Years

	Employment	Labor Income	GDP	Output
Direct Effect	312	$93,600,000	$140,500,000	$230,200,000
Indirect Effect	48	$14,800,000	$23,900,000	$40,600,000
Induced Effect	124	$31,400,000	$56,300,000	$92,300,000
Total Effect	484	$139,800,000	$220,700,000	$363,100,000

Note: Employment impacts are averaged across all years. All other metrics are totals over the time period measured in present value terms.

- Mostly direct jobs related to construction of renewable facilities

Tariff Phase Likely Leads to Very Small Rate Increase due to Tariffs above Market Value

Sample year shows

- About $18 million in tariff costs above market value
- NG estimates bill impact to residential customers of $0.05 per month
- REG projects also pay some taxes that flow to various RI state and local entities (tangible, gross earnings, sales and RI income)
- Net Program costs about $12 million during “tariff phase”, much lower than during “construction phase”

Sample Tariff Phase Year

[1]	**Total MWh**	209,311
[2]	**Total Tariff Costs**	**$37,236,720**
	Avoided Costs	
	Total Energy Value REG program	-$11,512,126
	Total REC Value REG program	-$8,581,766
	Total Capacity Value REG program	-$841,174
[3]	**Total Avoided Costs**	**-$20,935,066**
	Administrative Costs	
	Remuneration for NG	$651,643
	REG Program Admin Costs	$625,000
	Capacity Market Admin Costs	$157,210
[4]	**Total Administrative Costs**	**$1,433,852**
[5]	**Total Net Market Cost of REG Program**	**$17,735,506**
[6]	**Total Offsetting Tax Revenues**	**-$5,768,122**
[7]	**Total Net Program Cost**	**$11,967,385**

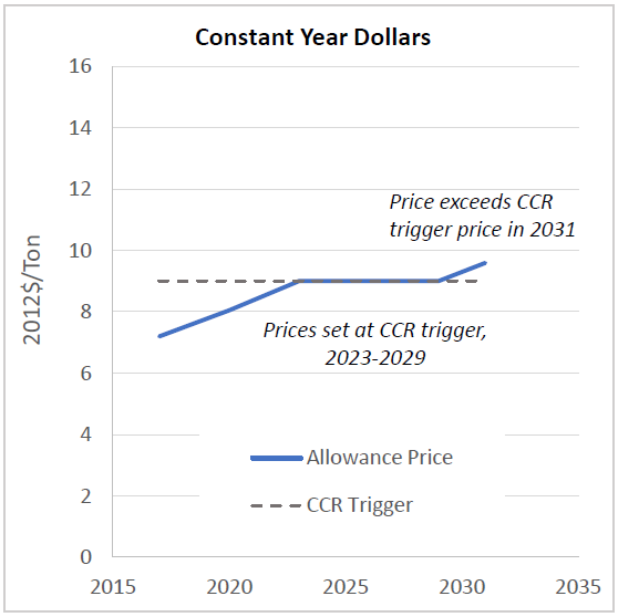
Average Tariff Phase Economic Impacts are Very Small

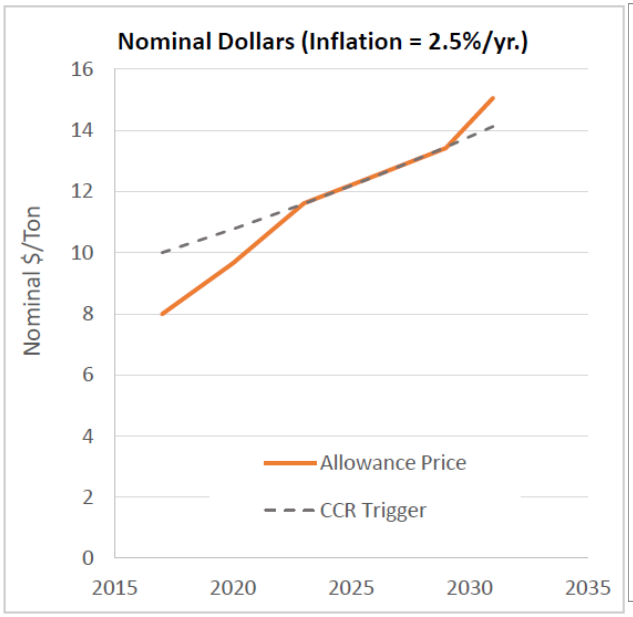
	Employment	Labor Income	GDP	Output
Direct Effect	2	$15,200,000	$35,800,000	$36,400,000
Indirect Effect	-9	-$13,200,000	-$21,500,000	-$36,500,000
Induced Effect	1	$600,000	$1,000,000	$1,700,000
Total Effect	-6	$2,600,000	$15,300,000	$1,600,000

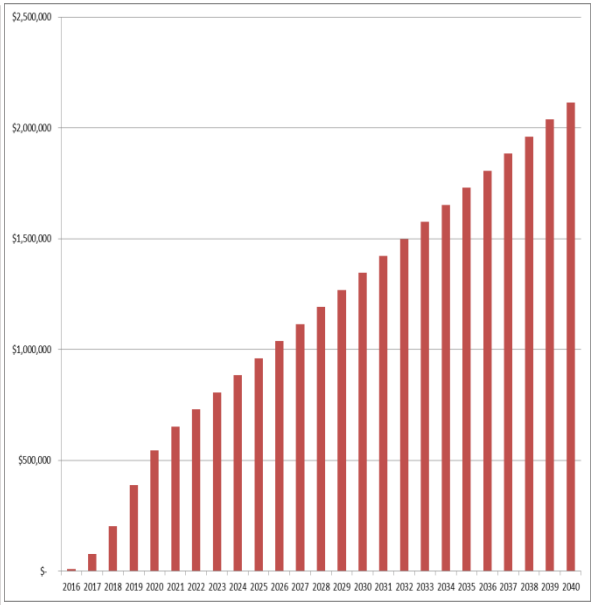
Note: Employment impacts are averaged across all years. All other metrics are totals over the time period measured in present value terms.

- Very small (statistically not different from zero) negative jobs impact due to higher taxes
  - reverses and becomes positive due to ongoing operations and maintenance after projects roll off tariffs
- Small positive GDP impact
  - Intuition: in-state O&M jobs are higher paying than the in-state jobs that get displaced due to slightly lower disposable income

Value of Avoided RGGI Allowance Reflects Potential GHG Value of REG Program





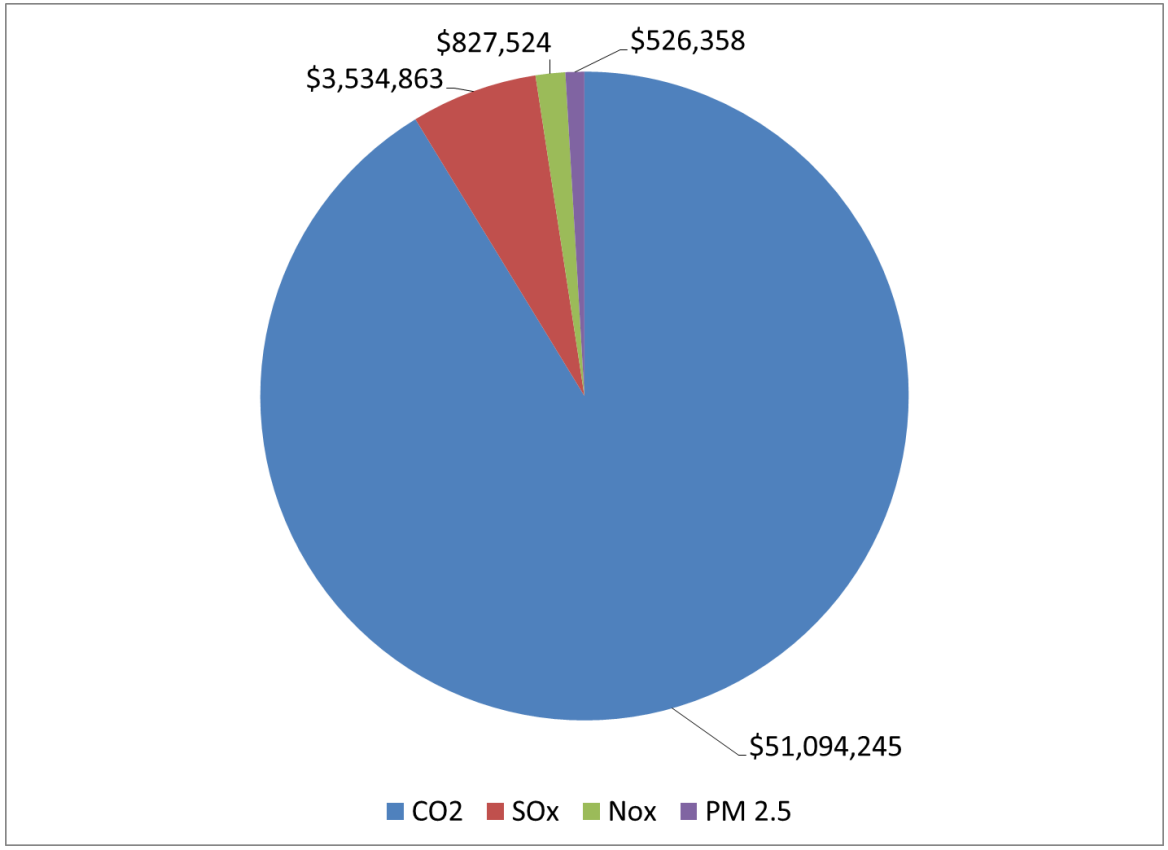


- RGGI allowance prices are projected to increase
  - Even current projections don't reflect carbon prices needed to meet longer term regional GHG reduction goals
- Assuming RGGI prices will increase at the rate projected between now and 2030 all the way through 2040 would result in NPV of $13 million
  - Not additional benefit, since allowance value gets recycled and benefits RI

Alternative Measures of Avoided Damages due to Lower Emissions are Also Significant

- Using $42/ton of CO2 (social cost of carbon) would result in NPV of $51 million in avoided GHG damages
- Approximately $5 million in avoided damages from criteria pollutants
- Again, greening grid and pollution reduction post tariff phase not considered

	Damages ($/ton)
SO2	$ 7,500
Nox	$ 2,000
PM2.5	$ 12,400



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Dr. Mark Berkman is an expert in applied microeconomics. His experience spans the areas of the environment, energy, and natural resources; and environmental health and safety. Dr. Berkman has frequently quantified the costs and benefits and economic impacts of projects and regulations. He has also published numerous articles and several book chapters on related topics and testified before the courts, regulatory commissions, and legislative bodies on related matters.

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