

RGGI Program Review: REMI Modeling Results

Inputs and Draft Results from MRPS Case Run

December
2017





Modeling Inputs



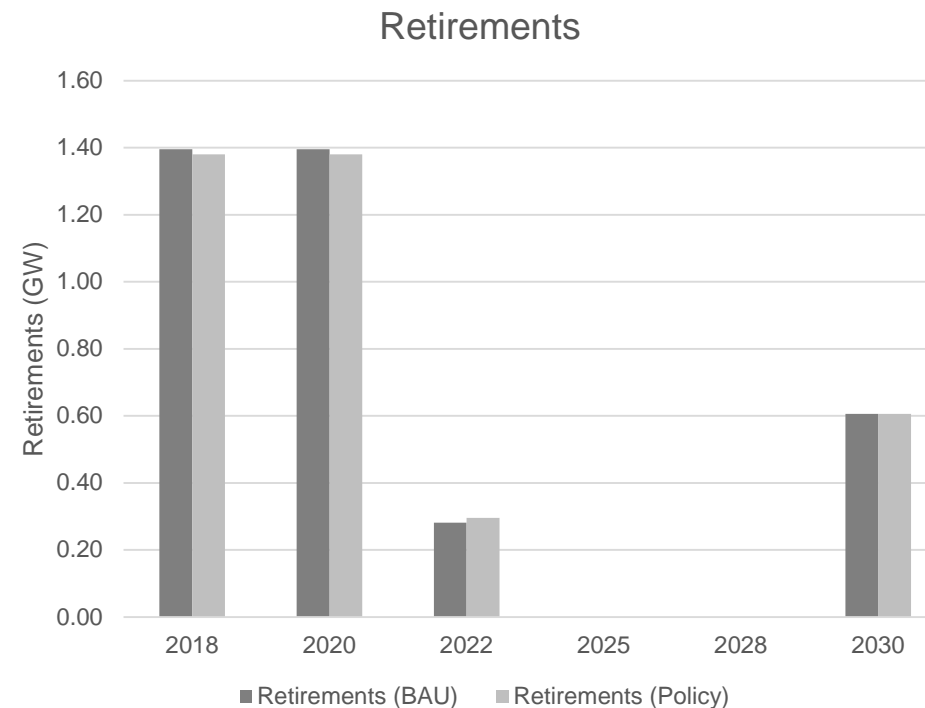
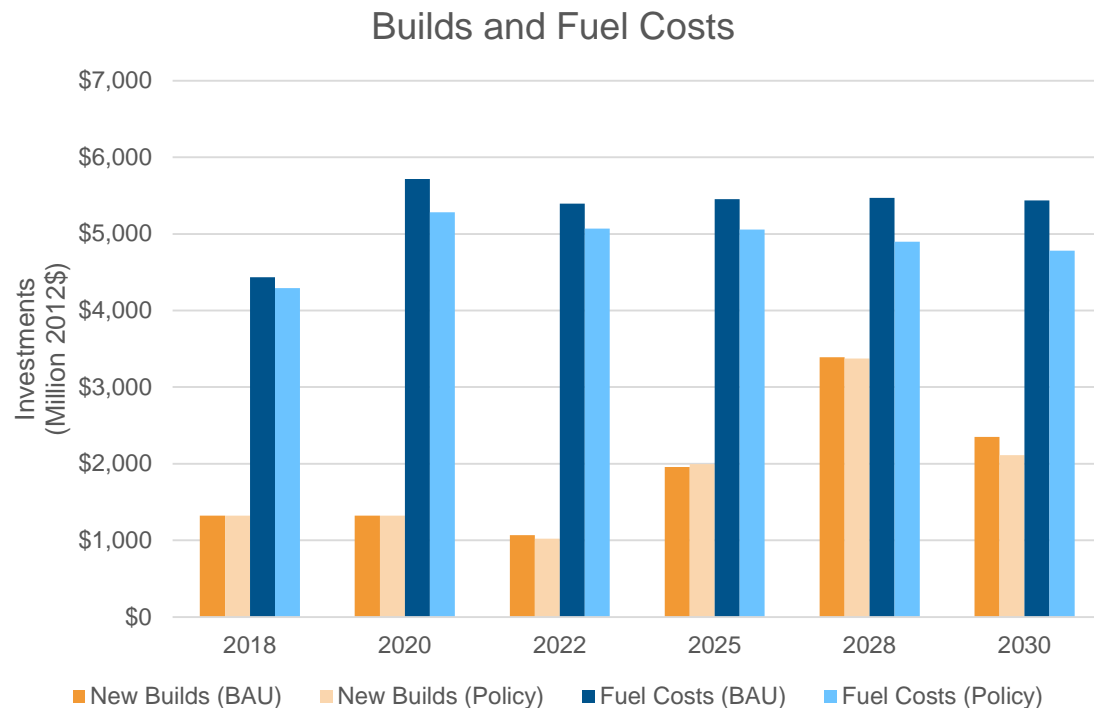
Overall Modeling Methodology

- **Two broad set of inputs used to model the economic impacts of the policy changes**
- **First set of inputs derived directly from relevant IPM runs**
 - Reference Case (No National Program on carbon – No NP)
 - Model Rule Policy Scenario (MRPS) (No NP)
- **Second set comes from the allowance proceeds calculations provided by the RGGI states**
- **Everything modeled at the individual state-level and rest of US**
 - Results discussed here are at the RGGI region level
- **Modeling does not include benefits of avoided carbon emissions**
 - REMI modeling focuses on regional economic impacts, not social benefits of environmental policies

REMI Inputs Derived Directly from IPM Runs

- **Extension of the RGGI cap decline to 2031 leads to additional changes in the energy markets, relevant for economic modeling**
- **Changes captured include**
 - Changes in new generation capacity
 - Changes in fuel demand
 - Changes in retirements
 - (Small) changes in retrofit use
 - Impact of allowance prices on electricity ratepayers

REMI Inputs Derived Directly from IPM Runs



- Relatively small incremental changes under the MRPS Case (over the BAU Reference Case)
 - Decrease in fuel costs mostly due to shift away natural gas in RGGI states
 - Drop in new builds mostly driven by move away from CCs
 - Small shifts in retirements (e.g., less in 2018 and 2020, but more in 2022) mostly driven by coal retirements in some RGGI states

Allowance Proceeds Reinvestments

- **Second set of REMI inputs derived from different states' plans to reinvest RGGI allowance proceeds**
- **Five different avenues for reinvestments modeled**
 - Electric Energy Efficiency
 - Fossil Fuel Energy Efficiency
 - Clean and Renewable Energy
 - Greenhouse Gas Abatement
 - Direct Bill Assistance
- **REMI modeling reflects different states differing assumptions about the levels of spending on each stream**
 - Net economic impacts of these inputs are positive, though we account for both positive and negative effects, where applicable
 - NOTE: Modeling inputs shown in the slides below are all presented in terms of incremental over the Reference Case

Proceeds Investments Allocation

- Table represents current shares for state-level investment by categories used in the REMI modeling

State	Electric EE	Fossil Fuel EE	Clean & Renewable Energy	GHG Abatement & Climate Change	Direct Bill Assistance	Admin/ Other	Total
Connecticut	4%	65%	23%	6%	--	1%	100%
Delaware	50%	20%	5%	15%	5%	5%	100%
Maine	--	74%*	--	--	19%*	7%	100%
Maryland	25%*	--	10%	10%	50%	5%	100%
Massachusetts	92%	--	--	5%	--	3%	100%
New Hampshire	7%*	3%*	--	--	88%*	1%	100%
New York	35%	20%	20%	13%	--	12%	100%
Rhode Island	50%	--	40%	--	--	10%	100%
Vermont	--	98%	--	--	--	2%	100%

*Reflects percentages from the MRPS policy case.



Allowance Proceeds Reinvestments: Electric EE

- Table summarizes total flow of dollars modeled for the entire RGGI region, including
 - Spending on Equipment**
 - Includes Program and Participant (customer out-of-pocket) spending on electric energy efficiency equipment
 - Residential Consumer Impacts**
 - Consists of customer-out-of-pocket costs (-) and energy savings impacts (+)
 - Consumers have more money to spend on other goods and services when bill savings are larger than customer-out-of-pocket costs
 - Bill savings estimated using retail rates
 - Revenue decoupling adjustment to “make utilities whole”

\$ Millions	RGGI Region Inputs								
	2018	2020	2022	2025	2028	2030	2035	2040	2045
Spending on Equipment	\$182	\$200	\$266	\$327	\$396	\$425	\$0	\$0	\$0
Residential Consumer Impacts	\$19	\$88	\$147	\$256	\$393	\$516	\$508	\$388	\$138
Production Cost (C&I)*	\$13	-\$83	-\$155	-\$287	-\$452	-\$627	-\$661	-\$505	-\$204
Lost Generator Revenue	-\$7	-\$16	-\$21	-\$25	-\$25	-\$31	-\$32	-\$24	-\$9
Total Flow of Dollar Inputs**	\$180	\$356	\$546	\$845	\$1,217	\$1,537	\$1,138	\$869	\$333
*Negative Production Costs imply decreases in costs that generate positive impacts									
**Total Flow = Final Demand + Bill Savings – Production Cost + Lost Generator Revenue									

- Production Cost (C&I)**
 - Same as consumer impacts but for commercial and industrial entities
 - C&I entities have a lower production cost when their bill savings are larger than their out-of-pocket costs
- Lost Generator Revenue**
 - Output from IPM
 - Lower bills for customers results in generators selling less electricity and getting less revenue

Allowance Proceeds Reinvestments: Fossil EE

- Table summarizes total flow of dollars modeled for the entire RGGI region, including
 - Spending on Equipment**
 - Includes Program and Participant (customer-out-of-pocket) spending on fossil energy efficiency equipment
 - Residential Consumer Impacts**
 - Consists of customer-out-of-pocket costs (-) and bill savings (+)
 - Consumers have more money to spend on other goods and services when bill savings are larger than customer-out-of-pocket costs
 - Bill savings are calculated using EIA Annual Energy Outlook liquid fuel price projections and state specific MMBtu savings

\$ Millions	RGGI Region Inputs								
	2018	2020	2022	2025	2028	2030	2035	2040	2045
Spending on Equipment	\$89	\$97	\$129	\$161	\$193	\$210	\$0	\$0	\$0
Residential Consumer Impacts	-\$18	\$0	\$14	\$51	\$107	\$155	\$258	\$199	\$70
Production Cost (C&I)*	\$15	\$11	\$10	\$3	-\$10	-\$22	-\$74	-\$57	-\$20
Lost Oil and Gas Revenue	-\$11	-\$25	-\$43	-\$77	-\$123	-\$160	-\$175	-\$135	-\$47
Total Flow of Dollar Inputs**	\$45	\$61	\$90	\$132	\$186	\$227	\$157	\$121	\$42

*Negative Production Costs imply decreases in costs that generate positive impacts
 **Total Flow = Final Demand + Bill Savings – Production Cost + Lost Generator Revenue

- Production Cost (C&I)**
 - Same as consumer impacts but for commercial and industrial entities
 - C&I entities have a lower production cost when their bill savings are larger than their out-of-pocket costs
- Lost Oil and Gas Revenue**
 - Lower bills for customers results in oil and gas companies selling less fuel and receiving less revenue

Allowance Proceeds Reinvestments: Clean & Renewable Energy

- Table summarizes total flow of dollars modeled for the entire RGGI region, including
 - Spending on Equipment**
 - Includes Program and Participant (customer-out-of-pocket) spending on solar, wind, and other clean and renewable equipment
 - Residential Consumer Impacts**
 - Consists of customer-out-of-pocket costs (-) and bill savings (+)
 - Consumers have less money to spend on other goods of services due to large amount of leveraged consumer expenditures compared to resulting bill savings
 - Bill savings calculated from GWh savings and EIA Annual Energy Outlook electricity price projections

\$ Millions	RGGI Region Inputs								
	2018	2020	2022	2025	2028	2030	2035	2040	2045
Spending on Equipment	\$137	\$149	\$196	\$246	\$295	\$320	\$0	\$0	\$0
Residential Consumer Impacts	-\$73	-\$60	-\$71	-\$65	-\$44	-\$26	\$176	\$130	\$44
Production Cost (C&I)*	\$23	\$22	\$27	\$30	\$31	\$30	-\$27	-\$18	-\$3
Lost Generator Revenue	-\$4	-\$10	-\$16	-\$28	-\$44	-\$55	-\$58	-\$43	-\$15
Total Flow of Dollar Inputs**	\$38	\$57	\$83	\$123	\$175	\$209	\$145	\$105	\$32
*Negative Production Costs imply decreases in costs that generate positive impacts									
**Total Flow = Final Demand + Bill Savings – Production Cost + Lost Generator Revenue									

- Production Cost (C&I)**
 - Same as consumer impacts but for commercial and industrial entities
 - C&I entities have a higher production cost when their out-of-pocket costs are larger than their bill savings
- Lost Generator Revenue**
 - Lower bills for customers results in generators selling less electricity and receiving less revenue

Allowance Proceeds Reinvestments: GHG Abatement and Research

- Table summarizes total flow of dollars modeled for the entire RGGI region, including
 - Program Spending**
 - Program spending on research and other investments such as EV charging
 - Residential Consumer Impacts**
 - Consumers have more money to spend on other goods and services because they have bill savings from increases in electric vehicle charging (compared to internal combustion engines)
 - Bill savings calculated from GWh savings and projected electricity prices (currently from EIA's Annual Energy Outlook)

\$ Millions	RGGI Region Inputs								
	2018	2020	2022	2025	2028	2030	2035	2040	2045
Program Spending	\$33	\$35	\$47	\$58	\$70	\$76	\$0	\$0	\$0
Residential Consumer Impacts	\$3	\$6	\$12	\$21	\$32	\$42	\$45	\$35	\$12
Production Cost (C&I)*	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Lost Gas Revenue	-\$2	-\$5	-\$9	-\$16	-\$26	-\$33	-\$36	-\$28	-\$10
Total Flow of Dollar Inputs**	\$18	\$20	\$28	\$36	\$44	\$50	\$9	\$6	\$2
*Negative Production Costs imply decreases in costs that generate positive impacts									
**Total Flow = Final Demand + Bill Savings – Production Cost + Lost Generator Revenue									

- Production Cost (C&I)**
 - No impacts
- Lost Gas Revenue**
 - Switching to electric vehicle charging results in gas companies selling less fuel

Allowance Proceeds Reinvestments: Bill Assistance and Other Spending

- Table summarizes total flow of dollars modeled for the entire RGGI region, including
 - **Government Spending (Admin costs)**
 - Payments to RGGI, Inc., salaries, and other expenditures
 - **Direct Bill Assistance/Consumer Impacts**
 - Direct bill assistance gives residential consumers more money to spend on other goods and services
 - **Production Cost (C&I)**
 - None
 - **Lost Generator Revenue**
 - None

	RGGI Region Inputs									
	\$ Millions	2018	2020	2022	2025	2028	2030	2035	2040	2045
Government Spending	\$21	\$23	\$30	\$38	\$45	\$49	\$0	\$0	\$0	
Direct Bill Assistance (R)	\$35	\$38	\$50	\$63	\$75	\$82	\$0	\$0	\$0	
Production Cost (C&I)*	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	
Lost Generator Revenue	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	
Total Flow of Dollar Inputs**	\$56	\$60	\$80	\$100	\$120	\$131	\$0	\$0	\$0	
*Negative Production Costs imply decreases in costs that generate positive impacts										
**Total Flow = Final Demand + Bill Savings – Production Cost + Lost Generator Revenue										



Results



Reference Case: Business as Usual

Economic Indicator	Region	Regional BAU Levels								
		2018	2020	2022	2025	2028	2030	2035	2040	2045
Total Employment (000' Jobs)	RGGI	26,335	26,437	26,525	26,571	26,595	26,628	27,409	28,211	28,964
	Rest-of-U.S.	167,186	167,353	167,835	167,866	167,804	167,758	171,977	176,367	180,351
Gross State Product (Billion Fixed 2015\$)	RGGI	\$2,927	\$3,050	\$3,176	\$3,370	\$3,569	\$3,712	\$4,033	\$4,372	\$4,738
	Rest-of-U.S.	\$16,928	\$17,585	\$18,316	\$19,410	\$20,544	\$21,340	\$23,136	\$25,032	\$27,063
Disposable Personal Income (Billion Fixed 2015\$)	RGGI	\$2,192	\$2,305	\$2,428	\$2,606	\$2,794	\$2,914	\$3,127	\$3,341	\$3,579
	Rest-of-U.S.	\$12,678	\$13,301	\$14,023	\$15,015	\$16,076	\$16,733	\$17,877	\$19,067	\$20,388

- **Default REMI Baseline was calibrated to be consistent with IPM's Reference Case (No NP)**
 - Existing RGGI program cap till 2020
 - IPM outputs extend to 2031; flat lined beyond to extend REMI modeling to 2046
 - No National Program on carbon (No NP)
- **Modeling is annual but we present a subset of years**
- **Three economic indicators are reported for the RGGI region as a whole and the rest of the U.S.**
 - Employment, GSP, Disposable Personal Income

MRPS Case Modeling: Cumulative Impacts

Cumulative RGGI Results (2017-2031)	
Economic Indicator	3% Discount Rate*
Total Employment (Job-Years)	34,397
% Change from BAU	0.009%
BAU Level	400,000,000
Gross State Product (Billion Fixed 2015\$)	\$2.79
% Change from BAU	0.007%
BAU Level	\$39,000
Disposable Personal Income (Billion Fixed 2015\$)	\$1.45
% Change from BAU	0.005%
BAU Level	\$30,000

*Employment numbers are undiscounted

Cumulative RGGI Results (2017-2046)	
Economic Indicator	3% Discount Rate*
Total Employment (Job-Years)	130,119
% Change from BAU	0.016%
BAU Level	820,000,000
Gross State Product (Billion Fixed 2015\$)	\$9.50
% Change from BAU	0.013%
BAU Level	\$72,000
Disposable Personal Income (Billion Fixed 2015\$)	\$6.21
% Change from BAU	0.011%
BAU Level	\$55,000

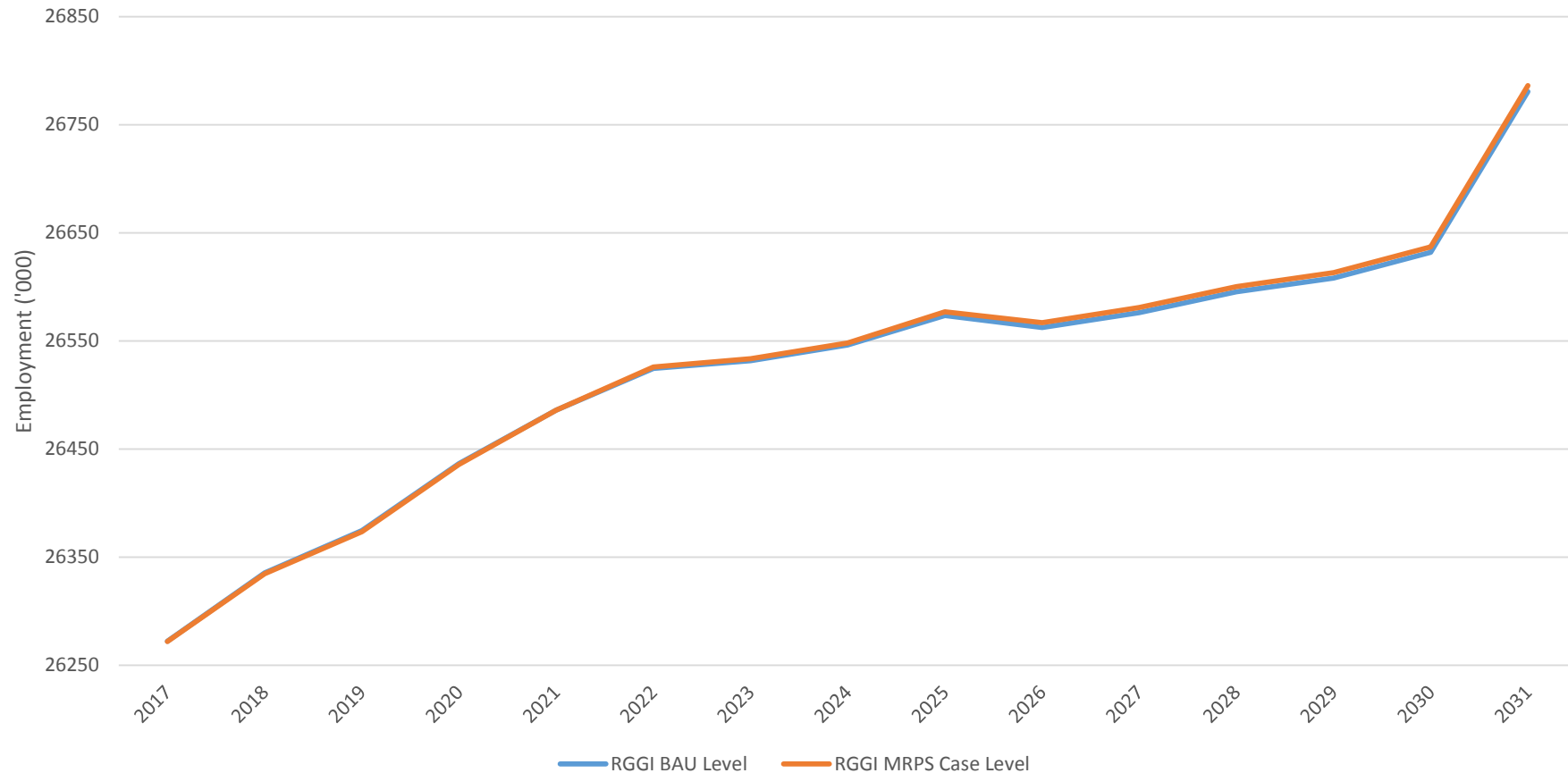
*Employment numbers are undiscounted

- First table shows the aggregated economic impacts of the MRPS Case only during the IPM modeled RGGI cap years (2017-2031)**
 - Cumulatively, RGGI is estimated to support around 35,000 job-years during 2017-2031 (the IPM modeled period).
- Second table shows aggregate economic impacts of the MRPS Case for the entire REMI modeling period (2017-2046) which captures the lifetime impacts of investments made during the IPM modeled period (e.g., bill savings from energy efficiency)**
 - Cumulatively, RGGI is estimated to support around 130,000 job-years during 2017-2046 (the REMI modeled period).
 - Changes are small, on the order of 0.011% to 0.016% of BAU levels.

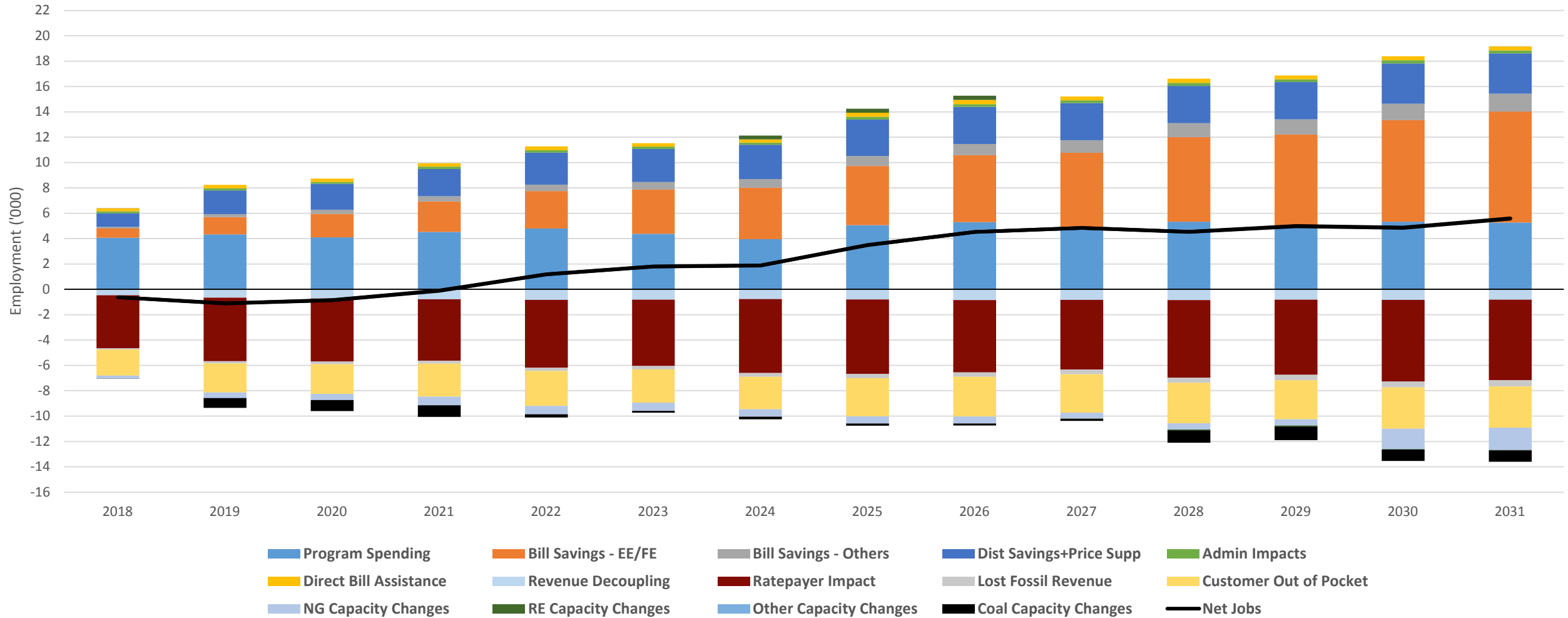
Trends Over Time

- Graph shows the employment growth trends over time under Reference (BAU) and MRPS Policy cases
- Employment impacts from previous graph are the heights between orange and blue lines
- Very small impacts under the scenario

RGGI Region Employment Levels Under Business-as-Usual and MRPS Case



MRPS Case Modeling: Employment Impacts by Components



Results Summary

- **RGGI region sees initial slight negative economic impacts from the MRPS case cap reduction but quickly grow to small but consistent economic benefits**
 - Impacts exclude health, environmental, and climate related benefits due to emission reductions
- **While the effect of the RGGI cap decline (i.e., the other IPM-based inputs) is generally negative, the cumulative effect is positive due to the positive benefits of the allowance proceeds reinvestments**
 - See results by individual components in the Appendix section of presentation
- **MRPS Case results show that changes are very small**
 - Largest annual delta (MRPS compared to BAU case) is 3 hundredths of a percent
 - Results are consistent with the general consensus in the economics literature – properly designed cap-and-trade programs are likely to produce small but positive economic impacts over the long run



Appendix



Appendix

- **Appendix provides additional results from the MRPS Case REMI run**
 - Undiscounted results

MRPS Case Modeling: Cumulative Impacts

Cumulative RGGI Results (2017-2031)	
Economic Indicator	Undiscounted
Total Employment (Job-Years)	34,397
% Change from BAU	0.009%
BAU Level	400,000,000
Gross State Product (Billion Fixed 2015\$)	\$3.95
% Change from BAU	0.008%
BAU Level	\$50,000
Disposable Personal Income (Billion Fixed 2015\$)	\$2.11
% Change from BAU	0.006%
BAU Level	\$38,000

Cumulative RGGI Results (2017-2046)	
Economic Indicator	Undiscounted
Total Employment (Job-Years)	130,119
% Change from BAU	0.016%
BAU Level	820,000,000
Gross State Product (Billion Fixed 2015\$)	\$16.57
% Change from BAU	0.014%
BAU Level	\$114,000
Disposable Personal Income (Billion Fixed 2015\$)	\$11.17
% Change from BAU	0.013%
BAU Level	\$88,000

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 - Cumulatively, RGGI is estimated to support around 35,000 job-years during 2017-2031 (the IPM modeled period).
- **Second table shows aggregate economic impacts of the MRPS Case for the entire REMI modeling period (2017-2046) which captures the lifetime impacts of investments made during the IPM modeled period (e.g., bill savings from energy efficiency)**
 - Cumulatively, RGGI is estimated to support around 130,000 job-years during 2017-2046 (the REMI modeled period).
 - Changes are small, on the order of 0.013% to 0.016% of BAU levels.