Transportation & Climate Initiative

2019 Cap-and-Invest Modeling Results

COG & MPO – TCI Convening

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Metropolitan Washington
Council of Governments

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2019 TCI Modeling & Analysis Overview

- Develop Reference Case assumptions
  - Public input following webinar
- Run Reference Case (what happens with no cap?)
  - Public input following webinar
- Revised Reference Case
- Run emissions cap scenarios (what happens with emissions caps?)
- Conduct macroeconomic & initial public health analysis
- Release modeling results and solicit stakeholder input on policy scenarios

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How does the **CAP** affect the transportation sector (& others)?

How do the **INVESTMENTS** affect the transportation sector?

What are the impacts from the program?

(economic effects, public health benefits)

How are the benefits and costs distributed?

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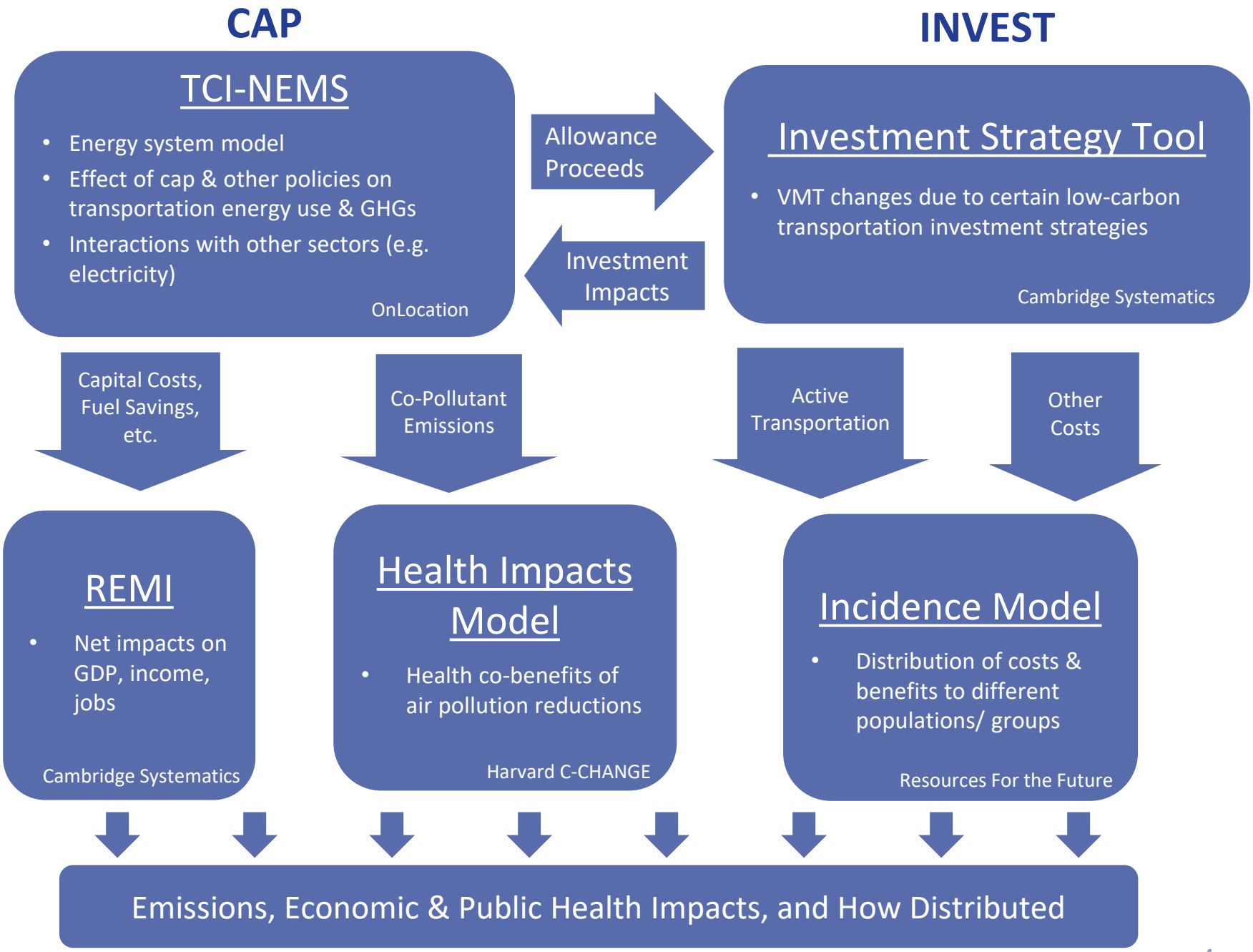
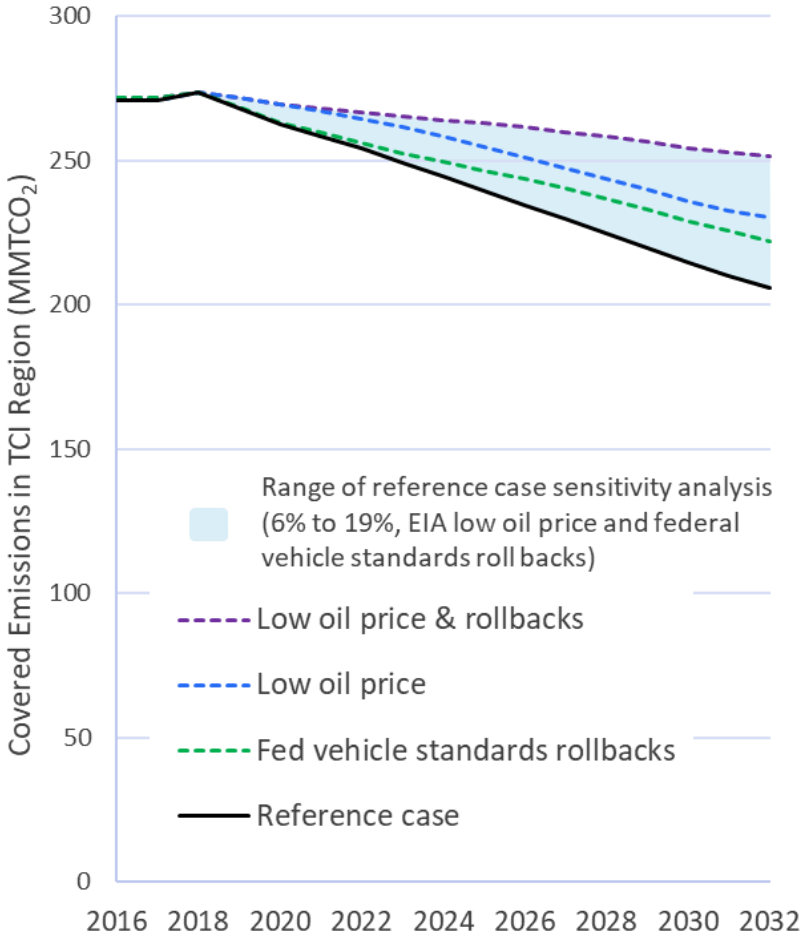

CAP
INVEST
TCI-NEMS
Energy system model
Effect of cap & other policies on transportation energy use & GHGs
Interactions with other sectors (e.g. electricity)
OnLocation
Allowance Proceeds
Investment Impacts
Investment Strategy Tool
VMT changes due to certain low-carbon transportation investment strategies
Cambridge Systematics
Capital Costs, Fuel Savings, etc.
Co-Pollutant Emissions
Active Transportation
Other Costs
REMI
Net impacts on GDP, income, jobs
Cambridge Systematics
Health Impacts Model
Health co-benefits of air pollution reductions
Harvard C-CHANGE
Incidence Model
Distribution of costs & benefits to different populations/ groups
Resources For the Future
Emissions, Economic & Public Health Impacts, and How Distributed

TCI Reference Case & Reference Case Sensitivity Analyses

- Transportation emissions in the Reference Case are projected to decline by 19% from 2022 to 2032 in the TCI Region
- Sensitivity analyses included EIA Low Oil Price scenario and rollbacks of federal vehicle emissions and fuel economy standards
- Policy actions by states and cities could help lock in needed reductions.



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Modeling Runs Conducted

All policy scenarios assume a regional CO_2 emissions cap is applied to the fossil portion of motor gasoline and on-road diesel combusted in vehicles (e.g., light-duty cars and trucks, commercial light trucks, freight trucks, and buses).

Model Run	Projected Emissions
Reference Case	19% CO_2 reductions from 2022 to 2032
Combined Sensitivity: Rollback of federal vehicle standards and low oil price	6% CO_2 reductions from 2022 to 2032
Below are policy cases with the same investment portfolio but different cap levels	
Policy: 20% Cap Reduction	20% CO_2 reductions from 2022 to 2032
Policy: 22% Cap Reduction	22% CO_2 reductions from 2022 to 2032
Policy: 25% Cap Reduction	25% CO_2 reductions from 2022 to 2032

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Modeled Clean Transportation Investment Scenario

For the purposes of modeling, an illustrative portfolio of clean transportation investments was developed. This includes a broad range of options, with a significant portion of proceeds focused on the most cost-effective emission reduction strategies.

30% Electric cars, light trucks and vans

23% Low & zero-emission buses and trucks

18% Transit expansion and upkeep

14% Pedestrian and bike safety, ride sharing

8% System efficiency

8% Indirect/ Other

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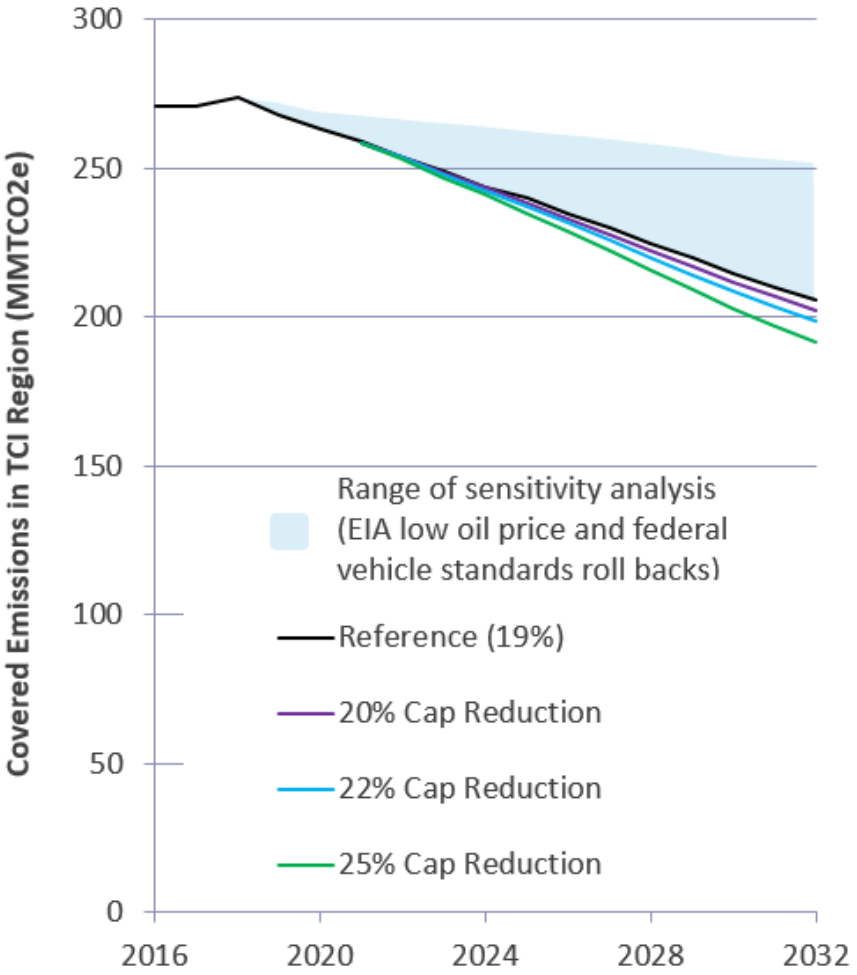
Emissions Cap Scenarios Results: Projected Transportation CO_2 Emissions

- A declining emissions cap could lock in decreases in CO_2 emissions that are expected through 2032 and drive additional reductions.
- More stringent caps result in greater emissions cuts and more proceeds for investments.
- Initial annual proceeds range from $1.4 billion at start in the 20% case up to $5.6 billion in the 25% case.



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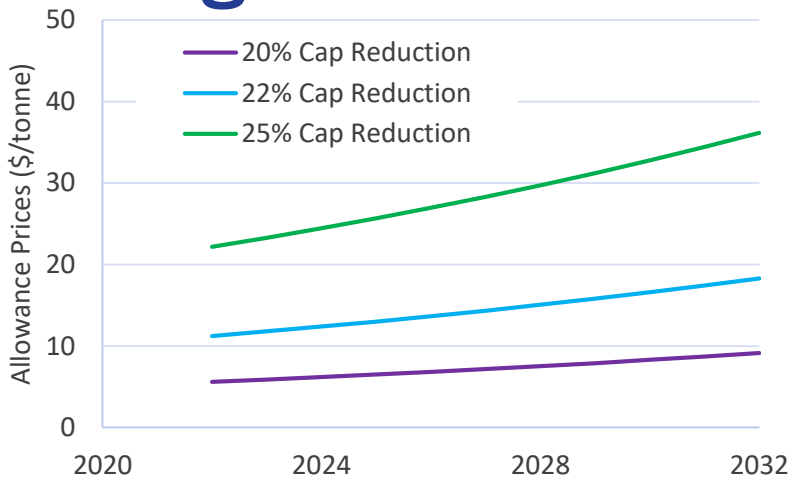
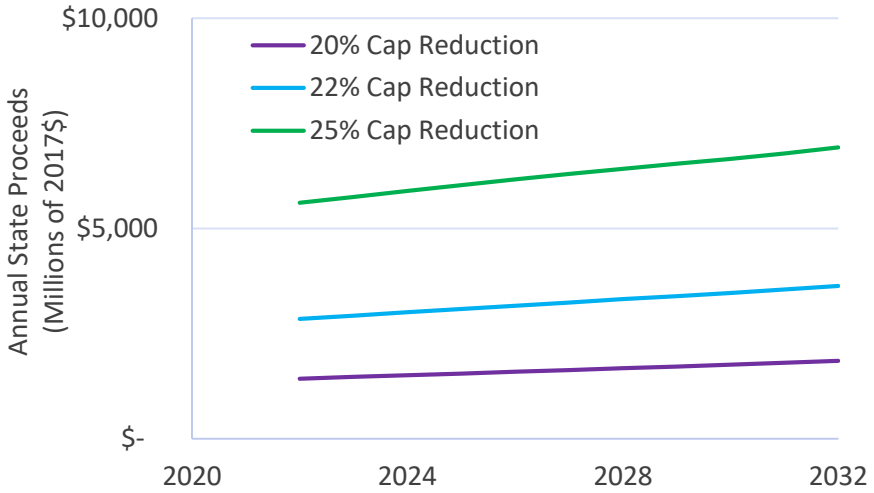
Emissions Cap Scenarios Results: CO_2 Allowance Prices & Program Proceeds

- Initial annual proceeds range from $1.4 billion at start in the 20% case up to $5.6 billion in the 25% case.
- Allowance prices reflect the combined effect of the cap and the investments
- More stringent caps result in greater proceeds for investments.





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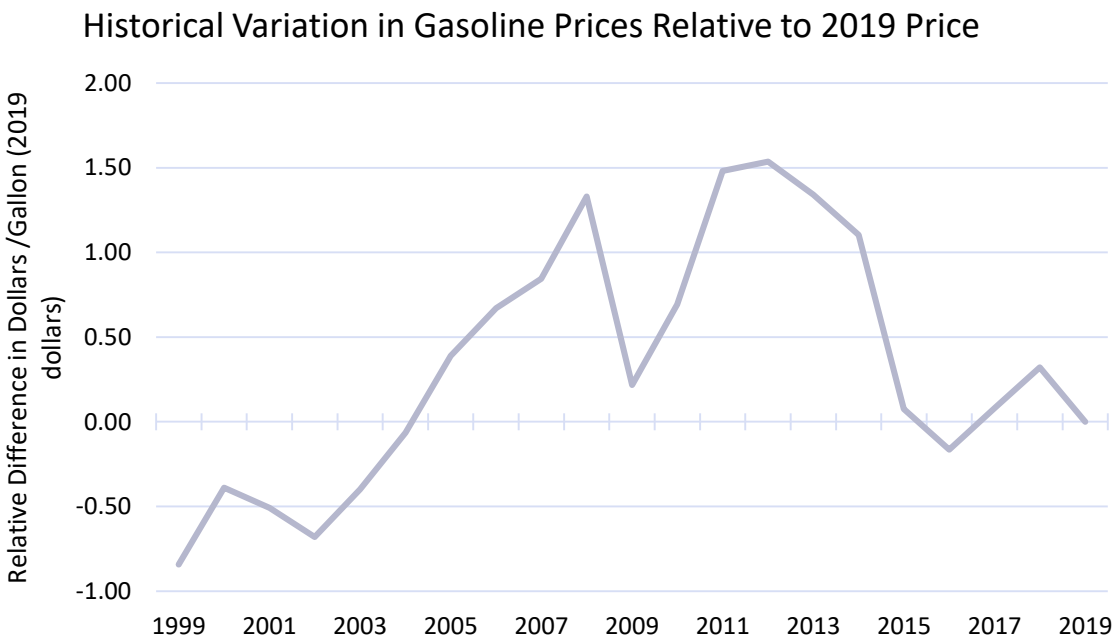
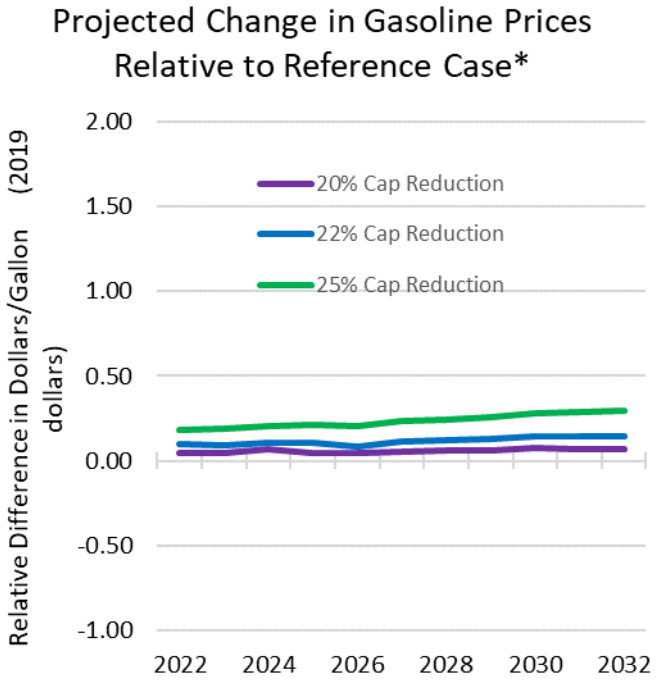
Modeled Changes in Fuel Price in Policy Scenarios

Compared with historical variations





*If fuel companies decide to pass on allowance costs it could mean an incremental price increase in 2022 of $0.05, $0.09 or $0.17 / gallon in the 20%, 22% and 25% Cap Reduction Scenarios, respectively. This is not a prediction of gasoline prices in the future. Several factors affect future gas prices, including policy and market forces.

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Range of Clean Transportation Investments in Modeled TCI Scenarios

- Modeled **annual clean transportation investments by strategy** in 2032
- Combined $1.84 billion to $6.92 billion in modeled scenarios

	**$554 million to $2 billion**	Electric cars, light trucks and vans
	**$425 million to $1.6 billion**	Low & zero-emission buses and trucks
	**$333 million to $1.2 billion**	Transit expansion and upkeep
	**$259 million to $970 million**	Pedestrian and bike safety, ride sharing
	**$148 million to $554 million**	System efficiency
	**$148 million to $554 million**	Indirect/ Other

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Clean Transportation Investments to Reduce Pollution in Modeled TCI Scenarios

- **Electric Transit Buses:**
  Up to 44,000 transit buses by 2032
- **Bus Service and Transit Improvements:**
  Up to $1.1 billion annually
- **Electric School Buses:**
  Up to 42,000 by 2032
- **Electric Trucks:**
  Up to 84,000 by 2032
- **Bike Lanes and Sidewalks:**
  Up to $5.6 billion region-wide through 2032

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Preliminary Public Health Benefits (in 2032)

- 1,300 Fewer asthma symptoms
- 1,000 Fewer premature deaths
- 1,700 Fewer traffic-related injuries
- Total estimated public health benefits: **$3 billion to $10 billion**

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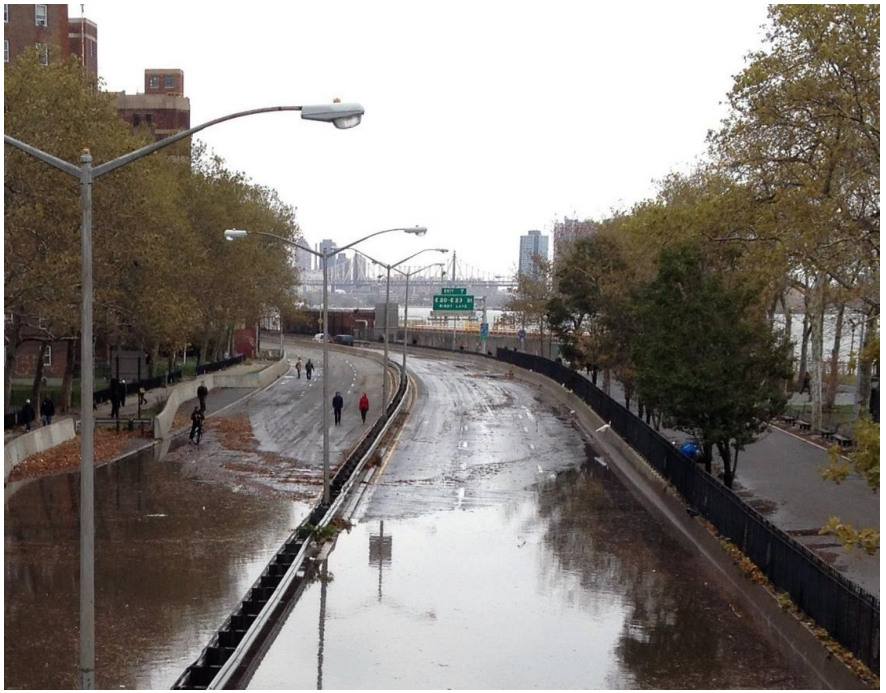
Avoided Climate Impacts



$249 million – $892 million annually in avoided climate impacts

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Conclusions from Macroeconomic Modeling

- Program has a positive impact on the economy.
- GDP, income, and jobs are projected to be greater than business as usual in 2032 and substantially net positive over the 2022-2040 timeframe.
- Significant progress towards achieving climate goals by reducing GHG and other pollution from transportation at modest cost and net benefit to the economy.

Economic Indicators in 2032	20% Cap Reduction	22% Cap Reduction	25% Cap Reduction
Increase in GDP growth, from Reference Case	$0.7B (0.01%)	$1.4B (0.03%)	$2.9B (0.05%)
Increase in DPI growth, from Reference Case	$0.5B (0.01%)	$0.9B (0.02%)	$1.9B (0.04%)
Increase in Jobs, from Reference Case	1,900 (0.004%)	3,982 (0.01%)	8,900 (0.02%)

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Conclusions from Modeling

- A declining emissions cap could lock in decreases in carbon dioxide emissions that are expected through 2032 and drive additional reductions throughout the region.
- The modeled program would have a modest positive impact on GDP, income, and jobs, all of which would be greater than business as usual in 2032 and substantially net positive over the 2022-2040 timeframe.
- Significant region-wide benefits to public health would result from improvements to air quality, public safety, and greater access to active transportation options, including walking and cycling.

We can make significant progress towards achieving climate goals by reducing GHG and other pollution from transportation at modest cost and net benefits to the economy

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Next Steps

- Public input will continue to be welcome and encouraged through the TCI online portal. *Please provide input by Friday, February 28, 2020*

https://www.transportationandclimate.org/main-menu/tci-regional-policy-design-stakeholder-input-form

- Modeling
  - More sensitivity analysis, to reflect uncertainties and inform the design of stability mechanisms
  - More policy cases, based on sensitivity analysis
  - Detailed modeling on benefits for public health is underway by a multi-university team led by Harvard C-CHANGE
  - Incidence modeling to evaluate benefits and costs for households, led by Resources of for the Future
- Public engagement through webinars and in-person events

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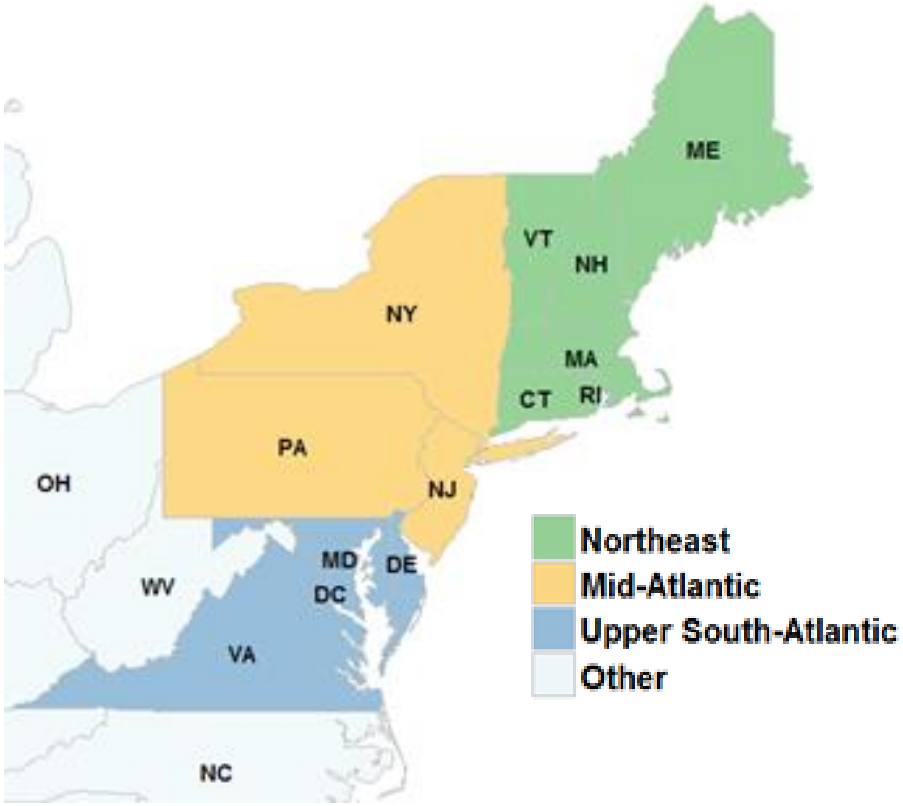
Appendix

“TCI-NEMS” Energy System Model



- In the TCI-NEMS model run to inform the TCI policy development process, the region is represented by three subregions:
  - Northeast,
  - Mid-Atlantic and
  - Upper South-Atlantic*

** For this analysis, we have split the South Atlantic Census Division into 2 subregions and renamed the model TCI-NEMS*

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Key Assumptions in TCI Reference Case

- **Electricity Sector**
  - National Renewable Energy Lab (NREL) 2018 Annual Technology Baseline costs for wind, utility solar photovoltaics (PV), and residential solar PV
  - Annual Energy Outlook (AEO*) 2018 High Efficiency case for building energy demand
  - Updated offshore wind and battery storage mandates
  - Updated planned capacity additions and retirements in Regional Greenhouse Gas Initiative (RGGI) states
- **Electric Vehicles**
  - Battery costs trajectories were revised downward based on Bloomberg New Energy Finance (BNEF) and the New York State Energy Research and Development Authority (NYSERDA) cost estimates
  - Non-battery EV costs were revised downward, based on NYSERDA and International Council on Clean Transportation estimates
  - Electric vehicle introduction years were accelerated for several light-duty vehicle (LDV) categories based on market analysis
- **Federal Corporate Average Fuel Economy (CAFE) / Vehicle Emissions Standards**
  - Vehicle standards are based on current regulations and remain flat after 2025
- **Federal Electric Vehicle (EV) Tax Credit**
  - Phase-out of the tax credit is based on OnLocation analysis and phases out somewhat more slowly than AEO 2018
- **Vehicle Miles Traveled (VMT)**
  - Calibrated projected vehicle miles traveled (VMT) estimates to be consistent with TCI state estimates
- **State EV policies**
  - Estimated regional impact of state policies on EV prices is incorporated into TCI Reference Case
  - State zero-emission vehicle (ZEV) regulation is already accounted for in AEO 2018
- **Regional Greenhouse Gas Initiative (RGGI)**
  - New Jersey and Virginia are included as participants in the RGGI program

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* The AEO is developed by the United States Energy Information Administration

	No Cap No Investments		20% Cap Reduction with Investments		22% Cap Reduction with Investments		25% Cap Reduction with Investments	
	Reference Case		Policy Case		Policy Case		Policy Case	
	2022	2032	2022	2032	2022	2032	2022	2032
Emissions Total, million metric tons; and percent reduction from 2032 to 2022	254	206 **-19%***	254	202 **-20.5%**	254	199 **-22%**	253	192 **-24%**
Allowance Prices per metric ton (2017$)	*n/a*	*n/a*	$6	$9	$11	$18	$22	$36
Total Proceeds (Billion/ year)	*n/a*	*n/a*	$1.4	$1.8	$2.8	$3.6	$5.6	$6.9
Public Health Benefits, *Prelim.* (Billions of 2017$)	*n/a*	*n/a*	-	$3	-	$6	-	$10
Avoided Climate Impacts (Billions of 2017$)	*n/a*	*n/a*	-	$0.25	-	$0.46	-	$0.89

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*Reference case projections represent TCI's best estimates. Sensitivity analysis assumptions—such as a roll back of federal vehicle standards and low oil prices—could lead to CO_2 emission reductions of as little as 6% from 2022 to 2032.

Illustrative Clean Transportation Investment Scenario (B)

	**30%**	Electric cars, light trucks and vans	Consumer incentives to purchase full battery electric (EV) and plug-in hybrid electric (PHEV) light-duty vehicles
	**23%**	Low & zero-emission buses and trucks	Electric trucks MDT/urban, Electric school buses, Electric transit buses, CNG trucks, Passenger rail electrification, Hydrogen trucks - long-haul
	**18%**	Transit expansion and upkeep	Bus service efficiency, Bus service expansion, Bus rapid transit, Transit fare reduction, Urban rail, Commuter rail, Intercity rail, Bus maintain, Urban rail maintain, Commuter/intercity rail maintain
	**14%**	Pedestrian and bike safety, ride sharing	Strategies to reduce VMT: Bicycle investment, Pedestrian investment, Land use/smart growth, Shared ride incentives, Travel demand management
	**8%**	System efficiency	Highway preservation, System operations, Freight/intermodal
	**8%**	Indirect/ Other	Proceeds are invested in ways that do not directly reduce transportation GHG emissions (e.g., returned directly to consumers).

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Illustrative Portfolios of Clean Transportation Investments

	A	B* (introduced on slide 22)	C	
	5%	30%	54%	Electric cars, light trucks and vans
	21%	23%	27%	Low & zero-emission buses and trucks
	35%	18%	-	Transit expansion and upkeep
	16%	14%	10%	Pedestrian and bike safety, ride sharing
	7%	8%	8%	System efficiency
	17%	8%	-	Indirect/ Other

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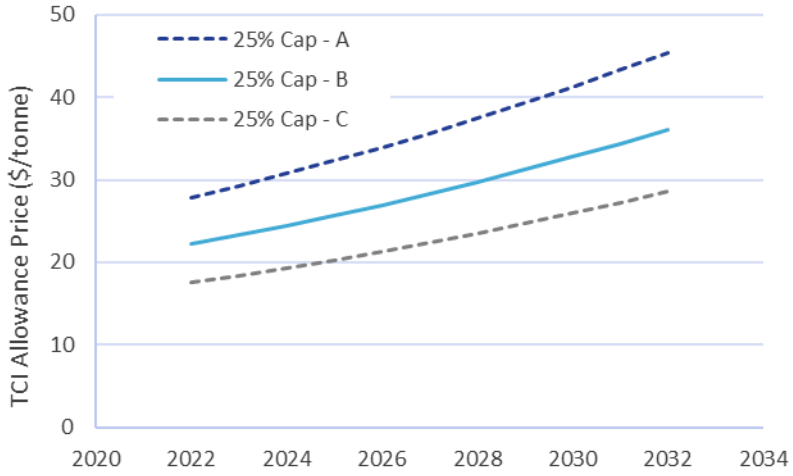
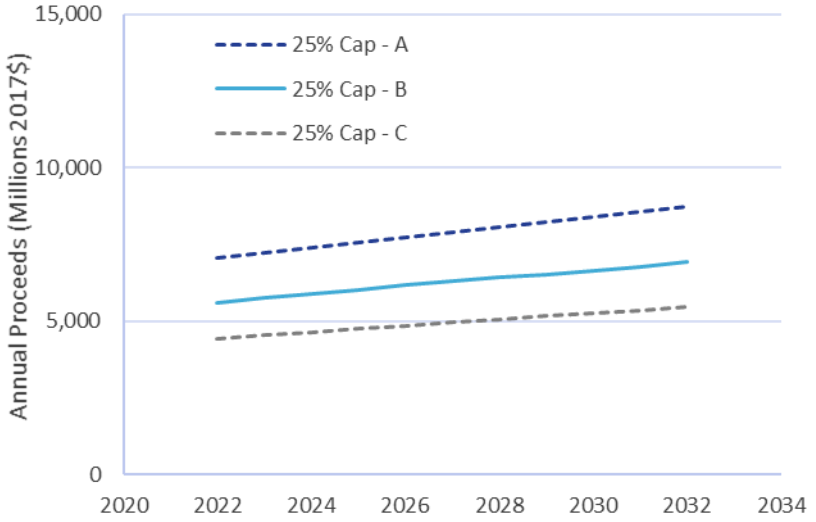
*Scenario B is the illustrative portfolio used for most TCI cap reduction scenarios, including those used as the basis for economic and health benefit analysis.

Investment Scenarios Results: CO_2 Allowance Prices & Program Proceeds for 25% Cap Reduction Scenario

- Allowance prices reflect the combined effect of the 25% Cap Reduction scenario and the investments
  - Investments in more cost-effective solutions lower allowance prices.
- Higher allowance prices result in greater proceeds for investments.
- Initial annual proceeds range from $4.4B during the first year with investment portfolio C and up to $7B with investment Portfolio A.





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