A Proposal for a Carbon Cashback Policy in New Jersey

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Executive Summary

Greenhouse gas and air pollutant emissions pose an urgent public health problem, with fossil fuel combustion-related pollution contributing to 8,312 premature deaths annually in New Jersey.[1] Furthermore, New Jersey faces significant threats from climate change: sea-level rise alone is projected to force 174,000 - 480,000 New Jersey residents to relocate by 2100.[2] New Jersey faces extensive economic and human costs from increased extreme weather and flooding,[3] agricultural[4] and fishing[5] damages, heat-related health problems,[6] and increased rates of disease.[7] It is clear that we must take action to combat carbon emissions, but an effective solution must balance the need to cut emissions with maintaining the health of New Jersey's economy.

A carbon cashback policy presents a simple, efficient solution to carbon emissions, while promoting the economic welfare of many New Jersey citizens and businesses. It has a proven track record: previous similar policies have significantly reduced emissions without hurting the economy in British Columbia, Canada; Denmark; Ireland; and Boulder, Colorado. This policy places a fee on emissions-generating fuels, making carbon pollution more expensive and adjusting the market to reflect the social costs of carbon. This encourages actors across the economy to reduce their emissions. The vast majority of the money collected under the fee would be returned to households and vulnerable businesses through dividends to help adapt to the increases in energy costs, ensuring that this policy does not significantly harm low and moderate-income families. In addition, a portion of the collected fees would be used for investment in programs with significant emissions-reduction potential and adaptation to the threats posed by carbon emissions, climate change, and a changing energy economy.

We propose three different pricing scenarios, starting at \$10/metric ton of CO_2 (tCO_2; "Low"), \$30/tCO_2 ("Moderate"), and \$50/tCO_2 ("High"). In each scenario, the fee rises at a rate of \$5 per year for 5 years, at which point the price is re-evaluated and a new one established. The Moderate and High scenarios were chosen based on 1) the reduced mortality associated with reducing air pollutants from CO_2 emissions, yielding \$30-600 of health-related co-benefits per

[1] We use PM2.5 values from Caiazzo et. al 2013: http://www.sciencedirect.com/science/article/pii/S1352231013004548. PM2.5 derives primarily from fossil fuel combustion in electric power generation, transportation, and commercial and residential usage.
[2] Hauer et al. 2016: https://www.nature.com/articles/nclimate2961
[3] Miller et al: http://www.margate-nj.com/sites/margatenj/files/file/file/kenmillersealevelfactsheet.pdf
[4] NJADAPT 2014: http://njadapt.rutgers.edu/docman-lister/resource-pdfs/96-njcaa-agriculture/file
[5] EPA 2017: https://19january2017snapshot.epa.gov/sites/production/files/2016-09/documents/climate-change-nj.pdf
[6] NJDEP 2017: http://www.nj.gov/dep/dsr/trends/pdfs/climate-change.pdf
[7] NJADAPT 2017: http://njadapt.rutgers.edu/docman-lister/conference-materials/171-chprpublicreviewdraft/file

ton of reduced CO_2[8] and 2) the Paris Climate Agreement, whose warming objectives will require a global carbon price of \$40-80/tCO_2 by 2020.[9]

The Low scenario, beginning at \$10/tCO_2, would initially cause gasoline prices to rise by 3.0%-3.7% (+\$0.09/gallon), and natural gas prices by 4.4%-6.8% (+\$0.053/therm). This scenario would neither accurately reflect the social costs of carbon nor be sufficient to meet the Paris Agreement. The Moderate scenario, beginning at \$30/tCO_2 would initially cause gasoline prices to rise by 8.9%-11.0% (+\$0.27/gallon), and natural gas prices by 13.1%-20.5% (+\$0.159/therm). The High scenario, beginning at \$50/tCO_2 would initially cause gasoline prices to rise by 14.8%-18.4% (+\$0.44/gallon), and natural gas prices by 21.9%-34.2% (+\$0.265/therm). This scenario could be politically infeasible due to the high price increases. We propose that the fee be levied at the first point of sale in-state in order to minimize administrative costs and effect change in all levels of the production and distribution process, as well as to use the existing framework for the application of the Motor Fuels Tax.

We propose the following revenue distribution scenario: 70% to households, 20% for targeted investment, 7% to vulnerable businesses, and 3% for administrative costs. The household dividend, applied as a flat dividend based upon household size, will especially benefit low and moderate income families, as the dividend constitutes a larger portion of their total income. Targeted investment in emission reduction and adaptation strategies will allow this policy to be more comprehensive by enhancing mitigation capacity and addressing the harms caused by carbon emissions. The vulnerable business dividend will ensure those businesses are equipped with the resources to transition to less emissions-intensive practices, encouraging them to remain in New Jersey.

In this paper, we discuss in detail the political history of the carbon cashback policy, examples of its successful and unsuccessful implementation, and its comparison to similar market-adjustment policies. We also address some key legal issues, including how to avoid conflict with the Motor Fuels Amendment; how imported energy can be priced so as not to violate the Commerce Clause; and how the policy complements with the Regional Greenhouse Gas Initiative. We also offer a preliminary economic analysis of its effects on energy prices, households, and businesses by sector. We find that the households in the bottom three quintiles, regardless of size, would be substantially benefited by the policy. By examining the examples of British Columbia in Canada, Denmark, and Ireland, we find that in all cases, emissions decreased significantly and GDP increased; for British Columbia in particular, economic growth surpassed that of the rest of Canada. We also detail examples of initiatives that targeted investment could

[8] West et al. 2013: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4051351
[9] Hallegatte et al. 2017: https://www.carbonpricingleadership.org/report-of-the-highlevel-commission-on-carbon-prices/

support, including emission reductions programs, job retraining programs, and climate adaptation.

However, our research is preliminary. We recommend substantial follow-up studies into the following issues:

- Economic impact on low-to-moderate income households in as fine a granularity as possible, to account for variability among households in income, energy usage, size, etc.
- Simulated effects on the New Jersey macroeconomy, aggregate emissions, accounting for risks of leakage
- Further revenue distribution options as they relate to consumers, businesses, vulnerable communities, and those disproportionately affected by carbon emissions

Currently, we are seeking input from key stakeholders on this issue to ensure the most effective implementation of this policy. Input from the New Jersey population on this policy, especially those disproportionately affected by carbon emissions and climate change and those traditionally underrepresented groups, is crucial to ensuring its effective implementation. Environmental groups, labor groups, the business community and utility companies must also take a key role in this dialogue process, as each will be heavily affected by this proposal.

Introduction

This paper examines the viability of a state level carbon cashback policy in New Jersey. This policy reduces carbon emissions, which brings significant economic benefits by reducing mortality from air pollution, and sea level rise and natural disasters from climate change. This policy also returns the vast majority of its revenue to citizens and businesses, ensuring that the economy and low-to-moderate income households are not harmed. Such a policy is politically expedient, appealing to both progressive and conservative values, and its implementation in British Columbia, Ireland, Denmark, and Boulder, Colorado, combined with substantial economic research and simulations, provide strong evidence that the policy effectively reduces emissions without hurting the economy.

In the following, the paper aims to:

- Document and discuss the direct, significant, and adverse effects of carbon emissions on the wellbeing of New Jersey's individual citizens, economy, and environment (Hidden Costs of Carbon Emissions)
- Discuss existing emissions reductions methods and why a carbon cashback program is preferable to other possibilities (Carbon Cashback , and Other Emissions Reduction Policies)
- Highlight the opportunities in renewables and energy efficiency while describing the shifting energy landscape (Clean Energy Trends and Prospects)
- Discuss existing and potential carbon cashback policies, and their effectiveness at reducing emissions and protecting the economy (Existing Cashback Programs)
- Provide an overview of energy usage, emissions, and existing carbon prices in New Jersey (New Jersey Energy Usage and Emissions, Existing Carbon Prices in New Jersey)
- Lay out the implementation details of the proposed program (Proposed Carbon Cashback Policy), and their initial impacts on energy prices (Energy Price Increases Per Fee Scenario

- Discuss the popularity of a carbon cashback program amongst voters, (Political Feasibility) as well as its widespread support among politicians, business leaders and economists

- Provide a preliminary discussion of the major legal issues to be resolved, regarding Interstate Commerce and the Motor Fuels Tax Amendment (Legal Issues)

- Provide a preliminary discussion of the economic effects of this program's implementation (Economic Issues), including on energy prices, households divided by size and income, business sectors, facilities with high emissions, and employment.

- Suggest avenues for targeted investment in adaptation, energy efficiency, and other sustainability programs; discuss an energy assistance program for low income households (Potential Avenues for Targeted Investment)
- Respond to common objections (Common Objections)
- Make recommendations for follow-up studies (Recommendations for Further Research)

Hidden Costs of Carbon Emissions

Air Pollution and Respiratory Health

 [10]

Fossil fuel emissions contribute to air pollution such as PM2.5 and ozone, making people more vulnerable to airborne disease such as lung cancer, asthma, and respiratory failure.[11] One study estimates that combustion-derived PM2.5 concentrations cause 8,312 premature deaths annually in New Jersey, a mortality rate of 97.9 deaths per 100,000 people per year (see Premature Deaths in New Jersey attributable to PM2.5 from Combustion Emissions for details). Nationally, the U.S. suffers about 200,000 premature deaths from this cause. According to the World Health Organization, based on data from 2014, 7 million people globally die each year from air pollution, representing one out of every eight deaths.[12]

The health consequences of air pollution also have economic consequences as well. One study found that each ton of reduced CO_2 emissions would provide a co-benefit of between $30-600, due to reduced premature deaths.[13]

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[10] Image courtesy of Kaiser Health News: https://health.usnews.com/health-care/for-better/articles/2016-12-01/how-to-know-when-to-send-a-child-with-asthma-to-school

[11] Caiazzo et al. 2013: http://www.sciencedirect.com/science/article/pii/S1352231013004548

[12] WHO 2014: http://www.who.int/mediacentre/news/releases/2014/air-pollution/en/

[13] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4051351

Climate Change

The main cause of climate change is the human amplification of the "greenhouse effect"— warming that results when the atmosphere traps heat radiating from Earth toward space.[14] Certain gases in the atmosphere block heat from escaping— greenhouse gases.[12] Of the many greenhouse gases, carbon dioxide, CO_2, is important as it is the primary greenhouse gas emitted by human activities. Humans have increased atmospheric CO_2 concentration by more than a third since the Industrial Revolution began and in 2016, CO_2 accounted for about 82.2% of all U.S. greenhouse gas emissions from human activities.[15,16] In order to lessen climate change, it is imperative that New Jersey begin reducing its CO_2 emissions.

Sea Level Rise and Flooding

New Jersey is particularly vulnerable to the threat of climate change because of the effect of sea level rise on its coastal cities. The sea level along the New Jersey coastline has risen at a rate of 3.5 mm/year (.14 inch/year) over the last century – nearly twice the global average of 2 mm/year (.08 inch/year).[17] The best estimates for sea-level rise along New Jersey's coast show an increase of 10 inches by 2030 and by 1.5 feet by 2050.[18] Importantly, sea-level rise is projected to force between 300,000 - 825,000 NJ residents to relocate by 2100.[19]

Higher storm surges from sea level rise will cause more flooding, leading to infrastructure damage and higher insurance rates. Hurricane Sandy reached a peak storm tide of 8.9 ft in Atlantic City, but sea level rise of 1.5 ft (the average projection for 2050 at Atlantic City) would mean that the "10-year" flood level would be even higher (i.e. there would be a 10% chance every year that a flood surge would exceed Sandy levels).[20] Homes along the ocean are especially vulnerable to erosion and storm waves. The bay sides of several barrier islands are so low that some streets and yards flood at high tide when strong winds blow from the east. Increased floods and storms would increase flood insurance and wind insurance rates, respectively.[21] Given the length of New Jersey's coastline and the extensive development on

[14] NASA 2017: https://climate.nasa.gov/causes/
[15] Ibid.
[16] EPA 2018: https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks
[17] Williamson et al. 2008: http://cier.umd.edu/climateadaptation/NewJersey%20Economic%20Impacts%20of%20Climate%20Change.pdf
[18] Georgetown Climate Center et al. 2014: http://www.georgetownclimate.org/reports/understanding-new-jersey-s-vulnerability-to-climate-change.html
[19] Hauer et al. 2016: https://www.nature.com/articles/nclimate2961
[20] Miller et al.: http://www.margate-nj.com/sites/margatenj/files/file/file/kenmillersealevelfactsheet.pdf
[21] EPA 2016: https://19january2017snapshot.epa.gov/sites/production/files/2016-09/documents/climate-change-nj.pdf

vulnerable barrier islands such as Long Beach Island and Atlantic City, the damage associated with a 4-foot rise in sea level would exceed $10 billion.[22]

Extreme Weather and Natural Disasters

[23]

Not only will climate change affect our coastal cities, but it will also affect New Jersey as a whole. Average annual temperatures for the state have increased 2° F (1° C) since 1900. Precipitation has increased by 5 to 10% in parts of New Jersey and the entire Mid-Atlantic region of the US has received 12-20% more major weather events relative to the previous century.[19] Hurricane Sandy cost New Jersey an estimated $37 billion and with more extreme weather events expected to occur in the future, costs this high will become a regularity.[24] In the last decade, one severe water-supply drought (2001-2002) and three minor ones (2005, 2006 and 2010) have struck New Jersey; such weather events are only expected to become more common in future years.[25] New Jersey forests face increasing risk of wildfires as they enter hotter and drier conditions. In 2007, a forest fire in the Pine Barrens scorched more than 15,500 acres, damaged homes, and forced more than 1,000 residents to evacuate.[26]

Health Impacts: Heat, Air, and Disease

The health of New Jersey residents will be severely impacted due to rises in temperatures, precipitation, and CO_2. Extreme heat is already the leading cause of

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[22] Williamson et al. 2008: http://cier.umd.edu/climateadaptation/NewJersey%20Economic%20Impacts%20of%20Climate%20Change.pdf
[23] Image courtesy of USGS: https://coastal.er.usgs.gov/hurricanes/sandy/photo-comparisons/images/NJ_Loc5_SeasideHeights_Overwash-lg.jpg
[24] Georgetown Climate Center et al. 2014: http://www.georgetownclimate.org/reports/understanding-new-jersey-s-vulnerability-to-climate-change.html
[25] Drought.gov 2018: https://www.drought.gov/drought/states/new-jersey
[26] Georgetown Climate Center et al. 2014: http://www.georgetownclimate.org/reports/understanding-new-jersey-s-vulnerability-to-climate-change.html

weather-related death in the U.S. and 95% of New Jersey residents live in urban areas where higher temperatures are more common.[26, 27] With the current trend of heat stress, by the 2020s, climate change could result in an increase in summer heat-related mortality of 55% and a more than doubling in mortality by the 2050s.[28] Higher temperatures will also lead to increased levels of ground level ozone; the number of days failing to meet federal air-quality standards is projected to quadruple.[29] A combination of rises in temperatures, precipitation, and CO_2 will increase the amount of allergy-related illnesses, and coupled with the rise in humidity, vector-borne and zoonotic diseases are expected to expand. An increase in precipitation and extreme weather events increases the risk of contracting food- and water-borne diseases, which is only exacerbated by flooding.[30]

Agriculture

New Jersey's food and agriculture industry is the third largest industry in the state, with the net value of agricultural products from New Jersey at about $864 million annually.[31] In agriculture, higher temperatures have been linked to unsuitable conditions for crops like cranberries and blueberries, higher costs for irrigation and pest control, shifts in the distribution of fish stocks, and decreased milk production in cattle. Many of the at-risk crops, including blueberries and cranberries, are substantial portions of the New Jersey agricultural economy.[32] Extreme conditions like droughts can also have a significant impact on crops and livestock, negatively impacting agricultural production and threatening the security of our food supply.[33]

As sea level rises, salt water can mix farther inland or upstream in bays, rivers, and wetlands. Because water on the surface is connected to ground water, salt water can also intrude into aquifers near the coast. Because of this, soils may become too salty for crops and trees that currently grow in low-lying areas.[34]

Ocean Acidification and Fishing

Changing the climate may harm commercial fishing in New Jersey. Higher ocean acidity would impair the ability of young scallops and surf clams to build shells, and potentially reduce the populations of these two shellfish, which account for about two-thirds of New Jersey's

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[27] Moran et al. 2017: http://njadapt.rutgers.edu/docman-lister/conference-materials/171-chprpublicreviewdraft/file
[28] Kinney et al. 2004: https://dash.harvard.edu/bitstream/handle/1/12775262/NYCHP_Briefing_Paper_June04.pdf?sequence=1&isAllowed=y
[29] NJDEP 2012: https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data
[30] Moran et al. 2017: http://njadapt.rutgers.edu/docman-lister/conference-materials/171-chprpublicreviewdraft/file
[31] Williamson et al. 2008: http://cier.umd.edu/climateadaptation/NewJersey%20Economic%20Impacts%20of%20Climate%20Change.pdf
[32] NJCAA 2014: http://njadapt.rutgers.edu/docman-lister/resource-pdfs/96-njcaa-agriculture/file
[33] Moran et al. 2017: http://njadapt.rutgers.edu/docman-lister/conference-materials/171-chprpublicreviewdraft/file
[34] EPA 2016: https://19january2017snapshot.epa.gov/sites/production/files/2016-09/documents/climate-change-nj.pdf

commercial fishing revenues. Higher acidity in estuaries, as well as the loss of wetlands and eelgrass, could harm crabs and hard shell clams, which account for another 15% of fishing revenues. As ocean temperatures rise, some fish species are moving northward or into deeper waters to remain within their normal temperature ranges.[34]

Beaches and Ecosystems

Beaches will erode as sea level rises. Public and private beaches will erode at a rate of 50 to 100 times faster than the rate of sea level elevation. It is estimated that the state will need $6 billion over the next 50 years to keep up with beach maintenance.[35] A higher ocean level makes it more likely that storm waters will wash over a barrier island or open new inlets. The United States Geological Survey estimates that barrier islands of the New Jersey shore from Bay Head to Cape May would be broken up by new inlets or lost to erosion if sea level rises three feet by the year 2100, unless people take actions to reduce erosion. Bay beaches may also be eliminated in some areas. Many of Delaware Bay's beaches are narrow, with wetlands immediately inland. Along parts of Delaware Bay and bay sides of most barrier islands, people have built walls and other shore protection structures that will eliminate the beach once the shore erodes up to them.[36]

Additionally, as a result of just a 1% decrease in the amount of tourists visiting New Jersey's coastal region each year, we can expect an indirect economic impact of over $3.7 billion by 2017 and over 40,000 jobs.[37]

Lastly, New Jersey's ecosystem could be negatively affected. Warmer temperatures and associated changes in the water cycle could lead to loss of critical habitat and further stress on some already threatened and endangered species (11 listed under the Endangered Species Act).[38]

Clean Energy Trends and Prospects

In 2016, energy sectors employed 6.4 million Americans. The sectors increased by 5% in 2016, adding 300,000 new jobs, which corresponds to 14% of the total new jobs added to the U.S. economy that year.[39] In particular, the renewable energy sector has seen tremendous growth: from 2006 to 2016, the total amount of renewable energy produced in the U.S. has increased by

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[35] Williamson et al. 2008: http://cier.umd.edu/climateadaptation/NewJersey%20Economic%20Impacts%20of%20Climate%20Change.pdf
[36] EPA 2016: https://19january2017snapshot.epa.gov/sites/production/files/2016-09/documents/climate-change-nj.pdf
[37] Williamson et al. 2008: http://cier.umd.edu/climateadaptation/NewJersey%20Economic%20Impacts%20of%20Climate%20Change.pdf
[38] Oppenheimer et al. 2005: https://www.princeton.edu/step/people/faculty/michael-oppenheimer/recent-publications/Future-Sea-Level-Rise-and-the-New-Jersey-Coast-Assessing-Potential-Impacts-and-Opportunities.pdf
[39] Department of Energy, 2017: https://energy.gov/sites/prod/files/2017/01/f34/2017%20US%20Energy%20and%20Jobs%20Report_0.pdf

55%.[40] In 2016, renewable energy sources accounted for about 15% of total U.S. energy generation. For comparison, coal accounted for 30.4% of U.S. electricity generation and natural gas accounted for 33.8%.[41]

A 2017 U.S. Department of Energy (DOE) report[42] quantified growth in energy jobs, nationally. Energy jobs were divided into four principal sectors: Electric Power Generation and Fuels, Transmission Distribution and Storage, Energy Efficiency and Motor Vehicles (vehicles were included due to the sector's high-energy production processes and the energy-dependence of the end product).

In 2016, the Electric Power Generation and Fuels sector directly employs 1.9 million workers: 55% in traditional oil and gas and 45% in low carbon emissions jobs. In 2016, employment in solar increased by 25% and the wind energy workforce increased by 32% nationally. While net electricity generation from coal sources declined by 53% between 2006 and 2016, electricity from natural gas increased by 33%. Additionally, solar energy generation increased from 508,000 MWh in 2006 to more than 28,000,000 MWh in 2016, an increase of over 5,000%. Solar is clearly growing quickly; the DOE study estimated that total solar electricity generation increased by 52% between September 2015 and September 2016.

The Transmission, Distribution and Storage sector employs 2.3 million Americans, about 800,000 of whom work at gasoline stations with convenience stores. 36% of the 2.3 million Americans working in the transmission, distribution and storage work in utilities and construction firms and 18% are employed by construction companies to build energy infrastructure, such as pipelines.

In the Energy Efficiency sector, accounting for 2.2 million jobs, about 6 out of every 10 occupations are related to construction activities installing or servicing Energy Efficiency goods or performing related services. Construction employers reported that their expected Energy Efficiency job growth was 11% by the end of 2017. Additionally, the DOE study found that the market penetration of ENERGY STAR® appliances and building materials are continually increasing. Jobs related to the production of ENERGY STAR® appliances represented 13% of the total workforce in this sector.

The Motor Vehicle sector employs about 2.4 million Americans, 489,000 of whom produce parts that increase fuel economy, and 259,458 do work involving vehicles which use alternative fuels.

Fossil fuels continue to dominate our energy system: they are projected to provide 53% of total U.S. electricity in 2040;[43] therefore a carbon cashback policy could greatly aid renewable

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[40] U.S. Energy Information Administration, 2018: https://www.eia.gov/totalenergy/data/monthly/pdf/sec10.pdf

[41] https://www.eia.gov/tools/faqs/faq.php?id=427&t=3

[42] Department of Energy, 2017: https://energy.gov/sites/prod/files/2017/01/f34/2017%20US%20Energy%20and%20Jobs%20Report_0.pdf

[43] U.S. Energy Information Administration, Annual Energy Outlook 2016, August 2016: https://www.eia.gov/outlooks/aeo/pdf/0383(2016).pdf

energy growth in New Jersey. The potential for a renewable-based economy is very real. According to a 2012 study from the National Renewable Energy Laboratory:

> "Renewable energy resources, accessed with commercially available generation technologies, could adequately supply 80% of total U.S. electricity generation in 2050 while balancing supply and demand at the hourly level."[44]

The transition to an economy that is more energy-efficient would be accompanied by significant job growth.[45] For every $1 million invested, it has been shown that investment in energy efficiency creates 21.5 jobs, compared with 11.5 jobs in natural gas.[46]

By economically incentivising growth in the renewable energy sector, a carbon cashback policy will encourage a shift from old coal plants to the rapidly growing renewable energy industries. The 2017 Bloomberg New Energy Outlook report projects that by 2023, onshore wind and photovoltaics will be competitive with new-build gas plants in the U.S. Looking forward to 2040, photovoltaics will average 15GW of additions per year. By then, coal consumption will drop by 45% as coal plants are replaced by cheaper natural gas and renewables.[47] Ensuring the competitiveness of renewables would help place New Jersey on the leading edge of this transition.

Carbon Cashback, and Other Emissions Reduction Policies

Fossil fuels contain a hidden cost to the economy, health, and the environment that is not captured in their current price, known as a negative externality. Three main approaches have been taken to offset this additional social and environmental cost:

1. Regulation, whereby entities such as power plants are forced to source some portion of their energy from non-fossil fuel sources,
2. Renewable energy subsidies, which invest in or aid deployment of renewable alternatives to fossil fuels, and
3. Carbon pricing methods, which raise the monetary cost of consuming fossil fuels.

The two dominant types of carbon pricing are

1. Carbon Cashback, which places a fee on fossil fuels at a given rate per ton of carbon dioxide emissions, with multiple possibilities for the revenue, including returning it as a dividend or investment in other priorities.

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[44] National Renewable Energy Laboratory, 2012: https://www.nrel.gov/docs/fy13osti/52409-ES.pdf
[45] Public Service Enterprise Group, 2009: https://www.pseg.com/info/careers/pdf/green_jobs_white_paper_05_28_2008_v1.pdf
[46] The Apollo Alliance, 2004: https://cows.org/joel/pdf/a_150.pdf
[47] Bloomberg New Energy Finance, *New Energy Outlook 2017* [Executive Summary], June 2017: https://www.res4med.org/wp-content/uploads/2017/06/BNEF_NEO2017_ExecutiveSummary.pdf

2. Cap-and-Trade, in which the government issues a capped number of emissions permits that business must trade in order to lawfully emit a certain amount of emissions.

In this section, we seek to make the case for pursuing a carbon cashback approach in New Jersey, as it is proven to be effective at reducing emissions while maintaining a stable, predictable pricing mechanism so businesses can adjust as needed.

Carbon pricing efficiently reduces emissions

Currently, fossil fuel prices do not reflect the economic damages that they pose to human health and the environment — the "hidden costs" of carbon emissions (negative externalities). Carbon pricing adjusts the price of emission-generating activities to reflect the real social and environmental costs of carbon. Such mechanisms improve the overall efficiency of the market by accounting for these external harms, resulting in consumption of fossil fuels decreasing and approaching the socially optimal quantity.[48]

As such, carbon pricing has overwhelming support among economists spanning the ideological gamut, almost all of whom (90%) agree that carbon pricing would be more efficient at reducing emissions than a collection of government regulations, and that a carbon pricing policy would be economically preferable to an equivalently sized increase in income tax.[49] A survey of prominent economists and environmental economists found that the vast majority (75%) agreed that the most efficient way for states to comply with the Environmental Protection Agency's "Clean Power Plan" would be through market-based mechanisms such as carbon cashback or emission trading systems.[50] Finally, major financial organizations such as the International Monetary Fund[51] and the World Bank[52] have publicly endorsed carbon pricing.

Carbon Prices vs Renewable Subsidies

Although revenues from a carbon cashback can be and have been used to fund subsidies for green energy, it is worthwhile to compare carbon cashback with a policy that utilizes green energy subsidies alone to highlight the advantages of a carbon fee and dividend.

Economists widely recognize that a broad-based carbon cashback will do more to spur green innovation and incentivize economic actors to adopt carbon efficient technologies and practices which already exist than targeted green energy subsidies can do alone.[53] John Freebairn

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[48] Morris et al. 2016: https://www.brookings.edu/wp-content/uploads/2016/07/State-level-carbon-taxes-Options-and-opportunities-for-policymakers.pdf
[49] IGM 2011: http://www.igmchicago.org/surveys/carbon-tax
[50] Howard and Sylvan 2015: http://policyintegrity.org/files/publications/ExpertConsensusReport.pdf
[51] IMF 2016: http://www.imf.org/external/pubs/ft/sdn/2016/sdn1601.pdf
[52] World Bank 2014: http://www.worldbank.org/en/programs/pricing-carbon#Statement
[53] IGM 2011: http://www.igmchicago.org/surveys/carbon-tax

of the Economic Society of Australia conducted a study on the difference in outcomes of a carbon cashback versus a policy of green energy subsidies alone, concluding that: "The [carbon cashback] option will be more cost effective per unit of GHG reduction, that it will be simpler and easier to operate, and that as part of a budget package it can provide at least as good a net distribution outcome."[54]

One reason for the effectiveness of carbon pricing is that subsidies are not guaranteed to be allocated to the long-term cheapest option. Allowing the free market to decide the cheapest technology, through a carbon price, can be more efficient than targeting revenue to propping up one specific technology, whose effectiveness cannot be fully known *a priori*. Furthermore, a carbon price can affect all energy sectors and encourage many different types of mitigation to create a multi-faceted approach to reducing emissions. For example, the increase in energy costs is felt by not just utilities, but also businesses and households, who are incentivized to reduce their own energy use via energy efficiency improvements and changes in habits in order to retain more of their dividend. Additionally, a carbon tax, unlike renewable energy subsidies, reduces emissions from motor fuels and natural gas heating, which comprise a significant amount of NJ emissions.

Finally, renewable energy subsidies require the appropriation of government funding from other sources, while a carbon cashback policy by design has a built-in revenue stream, and could potentially be entirely revenue neutral.

Carbon Cashback vs Cap-and-Trade

Similarities

A carbon cashback program and cap-and-trade systems can, to a significant degree, produce the same desired policy outcomes. Both act as carbon prices, and so can reduce the overall level of carbon emissions and award revenue collected in that process back to households and businesses in the form of dividends or tax cuts.

Differences

Charles Frank of the Brookings Institute explains, "A carbon [cashback policy] sets the price of carbon dioxide emissions and allows the market to determine the quantity of emission reductions. Cap-and-trade sets the quantity of emissions reductions and lets the market determine the price."[55]

To illustrate this distinction in mechanism, the carbon fee and dividend in British Columbia, Canada, levied on all fossil fuels at their point of entrance into the economy, set the

[54] Freebairn 2014: http://onlinelibrary.wiley.com/doi/10.1111/1759-3441.12082/pdf
[55] https://www.brookings.edu/blog/planetpolicy/2014/08/12/pricing-carbon-a-carbon-tax-or-cap-and-trade/

fee price at $\$10/tCO_2$ pollution in 2008, and increased $\$5/tCO_2$ each year until 2012.[56] The Regional Greenhouse Gas Initiative (RGGI), a cap-and-trade system effective in nine northeastern states, sets the maximum amount of permitted carbon emissions in the energy sector within these states and auctions carbon allowances to power producers. In 2014, the RGGI cap was set to 91 million short tons of CO_2, a cap that will decline by 2.5% every year until 2020.[57]

This distinction in mechanism creates further differences between the two options that policymakers should consider. The main advantage of a carbon cashback policy over cap and trade programs is its ease of administration and ability to cover more carbon emitting sectors. A carbon fee could be collected with means similar to a sales tax collections, which means regulators can avoid the administrative hassle of auctioning allowances and inspecting power producers to ensure compliance. Charles Frank of the Brookings Institute explains: "Clearly a carbon [cashback policy] is easier to administer…with Cap-and-Trade there is an additional administrative requirement – the allocation of allowances…Cap-and-Trade would be prohibitively expensive to administer if applied to automobile transportation or residential heating and cooling. Thus a fee on fuels used for transportation, heating, and cooling is the preferred way to promote CO_2 emissions abatement in these sectors."[58]

Additionally, the National Bureau of Economic Research finds that carbon cashback programs create less carbon emission price volatility compared to cap-and-trade programs, because carbon fees are clear and scheduled price signals which all sectors in the economy are able to see and anticipate before the policy's implementation.[59] This will allow businesses and utilities to better plan for the future, as they can more easily make decisions about how to invest in technologies to reduce emissions if they can better predict their forthcoming costs. A common argument against carbon cashback is that one cannot predict exactly how much emissions will be reduced without explicit emissions caps. However, a carbon cashback policy can be designed such that emissions reduction targets can be set, and the price reviewed and adjusted at intervals of several years if it is found that the policy is not reaching the emissions targets.

Past/Ongoing NJ Policies

New Jersey has passed a number of bills targeting climate change. Notable policies include the Clean Stormwater and Flood Reduction Act, which allows towns and cities to tax non-permeable surfaces (e.g. parking lots) and directs the money into funding stormwater

[56] Government of B.C. 2018: https://www2.gov.bc.ca/gov/content/environment/climate-change/planning-and-action/carbon-tax
[57] RGGI, Inc. 2018: https://www.rggi.org/design
[58] Frank 2014: https://www.brookings.edu/blog/planetpolicy/2014/08/12/pricing-carbon-a-carbon-tax-or-cap-and-trade/
[59] Goulder & Schein 2013: https://www.nber.org/papers/w19338.pdf

utilities to clean pollution from and manage stormwater[60]. Among the bills passed are those directed at carbon neutrality by 2050 in New Jersey: The Clean Renewable Energy Bill[61] and Executive Order no. 28[62], as well as bill S2313[63], which creates a zero-emissions certification program for nuclear power plants. Such efforts are also seen locally in Hoboken, where in 2019 Mayor Ravi S. Bhalla passed the Hoboken Climate Action Plan, which aims to achieve carbon neutrality by 2050, reduce emissions below Paris Accords standards, and achieve a NJ Gold Star in energy.[64] New Jersey has also passed legislation aimed at upgrading offshore wind capacity, such as Governor Murphy's Executive Order no. 8 of 2018. The order aims to generate 3,500 megawatts of wind energy by 2030, create an Offshore Wind Strategic Plan with the input of stakeholders, and has the general goal to fully implement the Offshore Wind Economic Development Act (OWEDA). [65] New Jersey has also joined the Transportation and Climate Initiative (TCI)[66] and will rejoin RGGI in 2020[67].

For a full list of past and ongoing climate policies in New Jersey, see List of Past and Ongoing NJ Climate Policies.

Corzine Energy Plan

The Corzine Administration Energy Master Plan (EMP) consisted of progressive and detailed policy, with some elements that are relevant to our Carbon Cashback policy. A substantial amount of the policies however were cut after Gov. Chris Christie was sworn into office. Some key actions taken in the plan are:

- Building code overhaul which creates a 30% more energy efficient building code than that in 2008
- The introduction of a tax on commercial, industrial, and residential consumers who consume a large amount of electricity
- Using the aforementioned tax to incentivize those who use a low amount of electricity.
- Providing rebates to new combined heat and power (CHP) facilities, and exempt all fuels used by new and existing CHP facilities from sales and use tax.
- Investing in R&D support, gap funding, equity investments, and generating market demand for innovative/new clean energy technologies.

[60] New York Public Radio: https://www.wnyc.org/story/new-utility-nj-will-manage-flood-water/
[61] New Jersey State Legislature: https://www.njleg.state.nj.us/bills/BillView.asp?BillNumber=A3723
[62] The State of New Jersey: https://nj.gov/infobank/eo/056murphy/pdf/EO-28.pdf
[63] New Jersey State Legislature: https://www.njleg.state.nj.us/bills/BillView.asp?BillNumber=S2313
[64] The City of Hoboken: https://www.hobokennj.gov/resources/greenhouse-gas-emissions-inventory-and-climate-action-plan
[65] The State of New Jersey: https://nj.gov/infobank/eo/056murphy/pdf/EO-8.pdf
[66] Transportation and Climate Initiative: https://www.transportationandclimate.org/content/about-us
[67]The State of New Jersey: https://www.nj.gov/infobank/eo/056murphy/pdf/EO-7.pdf

- Creating a curriculum based off the input of industry experts and ensures that there is enough of a trained workforce needed for the spread of clean energy technologies in various sectors.
- Ensuring state facilities are all energy efficient to set a standard for private buildings

Existing Carbon Cashback Programs

In Other Countries

Canada, Costa Rica, Denmark, Finland, France, Iceland, India, Ireland, Japan, Mexico, The Netherlands, Norway, Portugal, Sweden, Switzerland, The United Kingdom, and Zimbabwe all price carbon at the national level.[68] Other carbon prices exist at the sub-national level, most notably in the Canadian provinces of British Columbia and Alberta. Many other countries and smaller sub-national states and localities price carbon emissions with cap and trade programs. In this paper, we will examine carbon pricing programs in Denmark, Ireland, Sweden and Canada in detail because of their relative resemblance to our proposed program as well as the significant amount of data available on these programs.

Denmark

Denmark adopted a set of emissions targets in 1990 calling for a "20% reduction in CO_2 emissions, relative to 1988 levels, by 2005". In order to comply with those targets, the Danish government introduced a carbon tax of \$16.91/tCO_2 emissions. This tax applied only to fossil fuels used for heat production, and businesses were charged lower rates.[69] Recognizing that manufacturers could easily move to Germany, Denmark ensured that CO2 taxes, gasoline taxes, electricity prices, and water supply tariffs did not reach the levels of those in Germany.[70] In 1996, Denmark adopted more comprehensive legislation, which included an increased CO_2 tax for businesses, a sulfur dioxide tax, and further taxes on space heating, along with reductions in other taxes to offset the impact of increased energy costs. A high level of annual revenue was generated: \$485.7 million in 1994, \$585.5 million in 1995 and \$905 million in 2008.[71] Additionally, energy-intensive businesses could apply for a partial refund on their CO_2 tax payments in order to ease the transition process.[72] The current tax is about DKK

[68] World Bank 2014: https://www.worldbank.org/content/dam/Worldbank/document/SDN/background-note_carbon-tax.pdf
[69] World Bank 2017: https://openknowledge.worldbank.org/bitstream/handle/10986/26300/Carbon%20Tax%20Guide%20-%20Appendix%20web%20FINAL.pdf
[70] M. S. Andersen: "The Green Tax Reform in Denmark: Shifting the Focus of Tax Liability"
[71] https://blogs.ubc.ca/cindybae/2013/02/07/denmarks-carbon-tax-policy/
[72] Ibid.

170/tCO_2($32/$tCO_2$).[73] The revenue is distributed such that 40% is dedicated to environmental incentives and 60% is intended to offset increases in business costs through "reduced social insurance, reduced pension contributions, and compensation of administrative expenses for small businesses".[74] Energy-intensive companies can also choose whether or not to establish a "voluntary agreement" (VA) with the Danish government. If they enter into such an agreement, then the company will pay the carbon tax at a reduced rate. In exchange, however, they must implement an energy management system, carry out both an energy audit and special investigations into the company's "core processes" to identify energy saving projects, and execute all such profitable projects.[75]

Denmark's CO_2 emissions decreased by 14% between 1990 and 2012 after the implementation of the carbon tax, and are projected to reduce by 23% from 1990 levels in 2035. [76] The carbon tax did not harm Denmark's economy: most increases in energy costs were offset by reduced tax burdens and energy efficiency subsidies, and the impact on employment, consumption, and international competitiveness was insignificant according to the Danish National Bank.[77] In fact, because so many companies transitioned to more efficient and less energy intensive practices, "businesses and industries became less sensitive to energy prices all together," such that the average percentage of costs devoted to energy among all businesses is now significantly lower than the regional average. According to the Danish National Bank, "this gives Danish industry a competitive advantage, especially when energy prices rise."[78]

Ireland

In 2010, the Republic of Ireland placed a carbon tax on all residential and commercial use of gas and oil not covered by the EU Emissions Trading System, under Part 3 of the 2010 Budget Act. In 2013, a tax was placed on residential and commercial use of solid fossil fuels not covered by the EU ETS. The tax was introduced during a financial crisis after public debt had reached unprecedented levels, with the goals of simultaneously reducing GHG emissions and raising revenue.[79]

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[73] Currency conversions performed on 9/25/2018.
[74] https://blogs.ubc.ca/cindybae/2013/02/07/denmarks-carbon-tax-policy/

[75] K. Ericsson: "Evaluation of the Danish Voluntary Agreements on Energy Efficiency in Trade and Industry." p. 7
[76] https://blogs.ubc.ca/cindybae/2013/02/07/denmarks-carbon-tax-policy/
[77] Danish Energy Agency. 2000b. "Green Taxes in Trade and Industry – Danish Experiences." Copenhagen, Denmark: Danish Energy Agency.
[78] Danish National Bank 2009:
http://www.nationalbanken.dk/da/publikationer/Documents/2009/06/kvo_2kvt09_web.pdf
[79] World Bank 2017:
https://openknowledge.worldbank.org/handle/10986/26300&sa=D&ust=1544889160963000&usg=AFQjCNF8azt4WzMWLRsnwouJMFGBA8Otzw

The initial carbon tax rate was set at €15/tonne of CO_2 emissions ($21.61/t$CO_2$) in 2010 and the taxes on different types of fuels were increased in stages to €20/tCO_2 ($25.88/t$CO_2$) in 2012. The carbon tax rate is reviewed each year as part of the annual budgetary process.[80]

The tax revenues are directed to the general budget to allow for flexibility in use. Although the carbon tax was originally intended to be revenue-neutral, the government has not been able to use the revenues to decrease labor costs, given the significant public deficit. However, the revenues from the carbon tax have prevented additional increases in labor taxes.[81]

Between 1990 and 2013, use of coal decreased by 16.4%, use of peat decreased by 9.5%, use of natural gas decreased by 8.3%, and use of renewables increased by 6.6%. Additionally, since its economic recession, Ireland has used the carbon tax to raise revenue instead of using other taxes thought to be more harmful to economic growth. Ireland has not had to raise its corporate tax rates.[82]

Over 2015 and 2016, Irish per capita GDP growth measured an average of 5.4% even when correcting for the statistically skewing GDP growth of 26% in 2015 which occurred largely from foreign companies redomiciling in Ireland.[83] This means that Ireland had the highest per capita GDP growth in the EU over 2015-2016.[84]

British Columbia

A revenue-neutral carbon tax was introduced in the Canadian province of British Columbia in 2008 on emissions-generating fuels, covering about 70% of BC's total greenhouse emissions. The tax began at C$10/t$CO_2$, rising by C$5 per year to C$30/t$CO_2$ ($23/t$CO_2$) in 2012, which remains the current rate (the rate is set based on the type of fuel (gasoline, diesel, natural gas, heating oil, propane, and coal 224) since they generate different amounts of GHG emissions).

The BC policy was designed to be revenue-neutral, with all of the revenue generated by the carbon tax returned to businesses and households through tax reductions and credits, including:

- A reduction of 5% in the first two personal income tax rates.
- A low income climate action tax credit.
- A northern and rural homeowner benefit of up to $200.
- Reductions in the general corporate income tax rate.
- Reductions in the small business corporate income tax rate.
- An industrial property tax credit.[85]

[80] Ibid.
[81] Ibid.
[82] Ibid.
[83] World Bank 2017: https://data.worldbank.org/indicator/NY.GDP.PCAP.KD.ZG
[84] Ibid.
[85] Ibid.

Between 2008/09 and 2016/17, the government brought in about $8.5 billion in revenue from the carbon tax and provided tax reductions and credits of about $10.6 billion, an estimated net benefit to BC taxpayers of $2.1 billion.[86] BC achieved a 15% reduction in residential consumption of fossil fuels and a reduction of gasoline sales by 11-17% between 2008 and 2014, reducing overall per capita fuel consumption between 5-15% while usage increased in the rest of Canada over the same time period.[87,88] Although some critics of the policy claimed that other variables were responsible for the decrease in fossil fuel usage, usage patterns for fuels that were not taxed under the plan, such as aviation fuel, remained consistent with the rest of Canada, while a significant reduction in the usage of taxed fuels compared to the rest of the country suggests that the tax played a significant role in the change in usage patterns.[89]

British Columbia's economy has kept pace or outperformed that of the rest of the rest of Canada since the implementation of its carbon fee and dividend. Between 2007 and 2015, provincial real GDP grew more than 17%, while net emissions declined by 4.7%.[90] While the increase in GDP over this period cannot be attributed to the carbon tax alone, clearly the carbon tax did not harm the economic growth of BC, which remained competitive with the rest of the country, according to researchers from the University of Pennsylvania.[91] More recently, British Columbia has ranked first among Canadian provinces in metrics of GDP growth. The growth of the province was even slightly faster than the country as a whole in recent years.[92] In 2015 and 2016, British Columbia's economy grew 3.1% and 3.7% while Canada's overall economy grew only .9% and 1.3%.[93]

Experience from British Columbia suggests that the normative effects a carbon tax has on consumption choices are dramatically larger than effects from cyclical gas price fluctuations. Rivers and Schaufele conclude, "The carbon tax has a much larger impact on gasoline demand than do market prices... The BC carbon tax generated a demand response that is 7.1 times greater than an equivalent increase in market prices."[94] By signaling to consumers that part of the price they pay for fossil fuels reflect the environmental and economic harms such consumption inflicts on society, which British Columbia effectively did by posting explanatory signs at all gas

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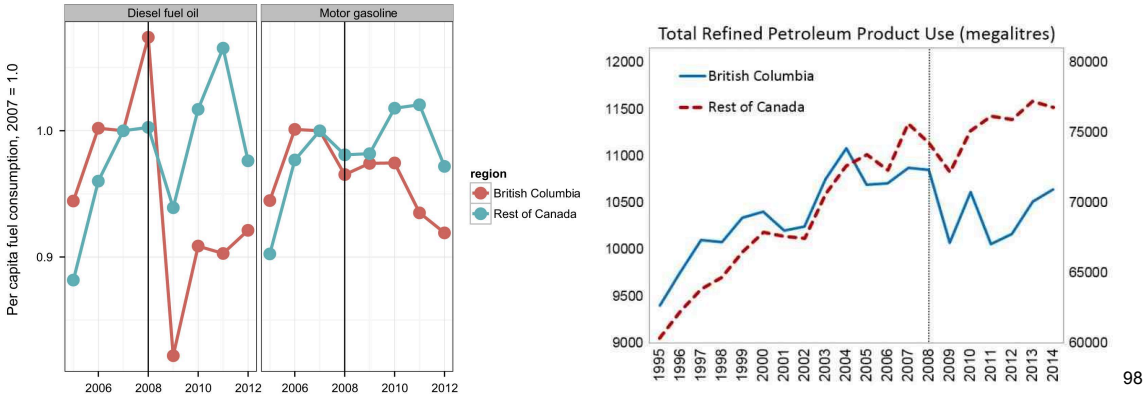
[86] Ibid.
[87] Rodio 2016: https://publicpolicy.wharton.upenn.edu/live/news/1520-analyzing-british-columbias-carbon-tax
[88] Durning & Bauman 2014: http://www.sightline.org/2014/03/11/all-you-need-to-know-about-bcs-carbon-tax-shift-in-five-charts/
[89] Rodio 2016: https://publicpolicy.wharton.upenn.edu/live/news/1520-analyzing-british-columbias-carbon-tax
[90] Government of B.C. 2018: https://www2.gov.bc.ca/gov/content/environment/climate-change/planning-and-action/carbon-tax
[91] Rodio 2016: https://publicpolicy.wharton.upenn.edu/live/news/1520-analyzing-british-columbias-carbon-tax
[92] Statistics Canada: https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610022201
[93] Statistics Canada 2017: http://www.statcan.gc.ca/daily-quotidien/170501/dq170501a-eng.htm
[94] Rivers & Schaufele 2014: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2131468

stations, individuals chose to consume seven times less fuel than if the price increased by the same amount due to causes other than a carbon fee.[95]

Public support in British Columbia in British Columbia now outweighs opposition by a two-to-one margin.[96] Moreover, there continues to be a comparable level of public support for a BC-style carbon tax in most other provinces; this endorsement is most evident in Atlantic Canada and Quebec, but even in Alberta there are now as many supporters as opponents. The policy has been so successful that the Canadian government has mandated that every province adopt a $10/metric ton carbon tax by the end of 2018, which will rise $10 annually until it reaches $50/metric ton.[97]



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Sweden

The most successful carbon pricing program was implemented in Sweden, which introduced a CO2 tax in 1991 and has evolved over time to reflect economic developments.[99] As of 2016, the full tax rate corresponded to $132/tCO2, the highest existing carbon pricing mechanism in the world. The tax covers fossil fuels used for heating purposes and motor fuel consumption, and has been widely considered an effective tool to significantly reduce Sweden's CO2 emissions, which have fallen on average 0.5% annually since 1990.[100] Between 1990 and 2014, GHG emissions in Sweden fell by 24%, while GDP increased by more than 60%. In

[95] Mooney 2014: https://www.citylab.com/solutions/2014/03/how-british-columbia-enacted-most-effective-carbon-tax-north-america/8732/
[96] Environics Institute for Survey Research 2015: https://davidsuzuki.org/wp-content/uploads/2017/09/focus-canada-2015-public-opinion-climate-change.pdf
[97] Government of Canada 2017: https://www.canada.ca/en/environment-climate-change/news/2017/05/pricing_carbon_pollutionincanadahowitwillwork.html
[98] https://publicpolicy.wharton.upenn.edu/live/news/1520-analyzing-british-columbias-carbon-tax
[99] Ludovino Lopes Advogados et al. 2014, 74; World Bank 2014a, 82
[100] Ibid.

addition, the use of heating fuel has decreased and exempt biofuel production has rapidly increased.[101]

Canada

The Canadian Greenhouse Gas Pollution Pricing Act implements a national carbon tax that starts at $20/tCO2, and rises at $10/tCO2 per year until 2022 when it reaches $50/tCO2 (all prices in CAD).[102] However, many provinces (in particular British Columbia, Quebec, and Alberta), have already enacted their own policies. The nation-wide tax only applies to states who opt in, or whose current policies fail to meet a sufficiently thorough standard. It also implemented a output-based pricing system (OBPS) for industrial facilities, and is intended to be revenue-neutral, with revenue returned to each province's government or citizens. The province-led initiatives are very diverse and state-specific, ranging from a market-based carbon tax in British Columbia, to a cap-and-trade system in Quebec in alignment with California[103].

With the exception of British Columbia's carbon tax and Quebec's carbon cap and trade, most of Canada's provincial policies were put in place in the last 3 years, and so are not sufficiently developed to study their effects. The national policy as well is too recent to be able to accurately analyze its impacts.

Alberta

Alberta implemented a carbon tax (called a carbon levy) on energy consumption in 2017, at a price of $20/tCO2, which has since risen to $30/tCO2. This tax also applies to most sectors, including transportation and heating fuels, only exempting fuel used for farming and certain gas emitters. Revenue obtained from the tax is used for a variety of programs, including transfers to low and middle income households, helping coal workers and impacted communities transition, as well as infrastructure and renewable energy projects[104].

Alberta also has an output-based pricing system in place, which covers large facilities emitting over 100,000 tCO2 each year (and allows facilities emitting less to opt in). These facilities must meet some product-specific benchmarks, which they can avoid by purchasing performance credits to high performing companies or use GHG offsets. According to Alberta's website, industries will be allowed a certain number of free GHG emissions determined on a product-specific basis. Facilities emitting less than the free allowance will receive performance

[101] Partnership for Market Readiness: https://openknowledge.worldbank.org/bitstream/handle/10986/26300/Carbon%20Tax%20Guide%20-%20Appendix%20web%20FINAL.pdf

[102] London School of Economics 2018: http://www.lse.ac.uk/GranthamInstitute/law/greenhouse-gas-pollution-pricing-act/

[103] Government of Canada 2018: https://www.canada.ca/en/services/environment/weather/climatechange/climate-action/pricing-carbon-pollution/compliance-options-output-based-system.html

[104] Center for Climate and Energy Solutions: https://www.c2es.org/document/canadian-provincial-carbon-pricing

credits, and facilities exceeding their allowance must either purchase performance credits from a sister company, purchase carbon offset credits from the state, contribute to the state's Climate Change and Emissions Management Fund, or reduce emissions intensity from their production line[105].

Quebec

Quebec implemented a GHG cap & trade system in 2012, whose current price in April 2019 is at $15/tCO2 (USD) and covers CO2, CH4, N20, SF6, HFCs, PFCs, and NO3[106]. Quebec is still a member of the Western Climate Initiative, and its auction system has been linked to California's since 2014. The province's targets are a 20% GHG reduction by 2020, and 37.5% reduction by 2030 compared to 1990 levels.

The policy was divided into six compliance periods: the first introduced it solely on electricity and industry, the second added fuels used for transportation and building sectors. All companies that emit over 25,000 tons of CO2 equivalent in a year are covered by the cap & trade, and since 2019, companies emitting between 10,000-25,000 tCO2/year can voluntarily opt into the program.

Table Summarizing Current Canadian Provincial Carbon Pricing Situation[107]

Province:	System:	Current Fee Level (CAD/tCO2):
National	Carbon Tax	$20
British Columbia	Carbon Tax, Revenue Neutral	$35
Quebec	Cap & Trade, with WCI	$20
Alberta	Carbon Tax + Output-Based System	$30
New Brunswick	Nothing; Will Adopt National	$0
Newfoundland & Lab.	Nothing; Will Adopt National	$0
Nova Scotia	Planning Cap & Trade System	$0
Manitoba	Planning Carbon Tax, Revenue Neutral	$0

[105] Government of Alberta 2019: https://www.alberta.ca/output-based-allocation-engagement.aspx
[106] International Carbon Action Partnership: https://icapcarbonaction.com/en/?option=com_etsmap&task=export&format=pdf&layout=list&systems[]=73
[107] Center for Climate and Energy Solutions: https://www.c2es.org/document/canadian-provincial-carbon-pricing/

Saskatchewan	Planning Output-Based System	$0
Ontario	Cap & Trade, but Changing	$?

In the United States

Heating Fuels Taxes

The United States places taxes on transportation fuels, but not on the chemically similar heating fuels. Implementing a more consistent fuel taxation system could be an economically efficient policy. At the federal level, there is an excise tax of 18.4c/gallon for gasoline, 24.4c/gallon for diesel fuel; 19.4c/gallon for aviation gasoline, and 24.4c/gallon for jet fuel. These rates were set in 1993, *and were not indexed for inflation*. 19 states place additional taxes on gasoline and/or other fuels.

At the state level, there is significant disparity, but few states tax heating fuels. Some states like Vermont tax heating oils, but exempt federal and state government entities, quantifiable nonprofits, agricultural organizations, and schools.[108] Alaska exempts heating (and jet fuel) from its Motor Fuels Tax.[109] An example of a state which has successfully passed legislation to tackle heating fuel emissions is California, which has provided state-level incentives for low-emissions affordable housing.[110] On a city level, New York City has mandated fuel-efficiency upgrades for large buildings and fined non-compliant buildings up to $268 annually per excess ton of carbon they emit.

Boulder, Colorado

The Boulder Climate Action Plan (CAP) tax, passed in 2007, is the "nation's first voter-approved tax dedicated to addressing climate change."[111] The tax is levied on the electricity consumption of residents and businesses at different rates for each sector: residential, $0.0049/kWh; commercial, $0.0009/kWh; industrial, $0.0003/kWh. This generates about $1.8 million in revenue each year,[112] of which 38% is allocated for promoting commercial and industrial building energy efficiency, 25% for promoting residential building energy efficiency,

[108] https://tax.vermont.gov/sites/tax/files/documents/TaxationofFuelsFS.pdf
[109] The Great State of Alaska: http://www.tax.alaska.gov/programs/programs/index.aspx?60210
[110] Government of California 2018: https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180AB3232
[111] City of Boulder 2018: https://bouldercolorado.gov/climate/climate-action-plan-cap-tax
[112] Ibid.

25% for promoting local renewables, electric vehicles and market innovation, and 12% for strategy development, outreach, and program evaluation.[113]

The CAP tax successfully reduced CO_2 emissions by 50,000 metric tons between 2007 and 2015, despite population and economic growth. The $1.8 million of annual revenue from the program has helped implement energy efficiency improvements for thousands of residents and businesses, and resulted in one of the highest rates of solar installation in the country.[114]

Proposals in Other States

Similar bills have been introduced in Vermont, Rhode Island, Massachusetts, Washington D.C., Oregon, and Washington.

Connecticut has proposed a carbon fee at $15/ton CO_2, starting in 2019 and increasing the rate by $5 per year. It is currently contingent on Rhode Island and Massachusetts following in similar suit. The revenue would be distributed with 40% for household dividends, 30% for business dividends, 25% for a "Clean Energy and Jobs Fund," and 5% for administrative costs[115].

Washington, D.C., proposes a $20/ton CO_2 fee, where revenue is distributed with 75% going to household and business rebates, 20% for green energy projects, and 5% for a property tax shift. It is expected that 75% of people will see incomes increase, with the poorest families getting back $4 for every dollar in fee increases[116].

Massachusetts currently has bills being discussed in the House and Senate. We discuss the House bill here; the Senate bill is quite similar. The House bill begins with a $20/ton CO_2 fee, increasing $5 per year to $40/ton CO_2. The revenue distribution will be 80% household and business dividends (10% of total extra given to each of the first two quintiles of household income levels; 5% of total extra given to the third quintile) and 20% to Massachusetts' Green Infrastructure Fund.[117] Positive net income for the lowest three quintiles and a $50-$100 net loss for the upper two quintiles are expected, along with a net gain of 3,000 jobs by 2020, and 9,000 jobs by 2040.[118]

Rhode Island's bill, titled the Clean Energy Investment and Carbon Pricing Act of 2017, proposes a fee of $15/ton CO_2, increasing $5 per year. Revenue distribution would be 40% towards household dividends, 30% towards business dividends, 25% for Rhode Island's Clean Energy and Jobs Fund, and 5% for administrative costs. A positive net income for the lowest

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[113] City of Boulder 2017: https://www-static.bouldercolorado.gov/docs/CAP_document_2017_updated_FINAL-1-201709121536.pdf,
[114] City of Boulder 2018: https://bouldercolorado.gov/climate/climate-action-plan-cap-tax
[115] Kall et al. 2017: https://mcdonaldhopkins.com/Insights/Blog/Tax-and-Benefits-Challenges/2017/03/30/Connecticut-Carbon-tax-proposal-conditioned-upon-Massachusetts-and-Rhode-Island-following-suit
[116] Put a Price on it DC 2017: http://www.carbonpricedc.org/wp-content/uploads/2017/10/CarbonFee-Factsheet-December-2017.pdf
[117] Breslow et al. 2014: https://www.mass.gov/files/documents/2016/08/pg/mass-carbon-tax-study.pdf
[118] Ibid.

three quintiles, and $17-$36 net loss for the upper two quintiles is expected, along with a net gain of over 1,000 jobs in the first few years (mostly construction) and 4,000 jobs by 2040.[119]

In Washington State, voters rejected the carbon fee bill in 2016, but at the time of this writing (January 2018), there were three bills under consideration in the Washington State Senate, including one proposed by Governor Inslee and endorsed by Senate Energy, Environment and Technology Chair Reuven Carlyle.[120]

This momentum at other state levels is promising for the success of a carbon cashback policy in New Jersey, as the more states that are involved will improve the competitiveness of New Jersey businesses and promote regional cohesion.

New Jersey Energy Usage and Emissions

First, let us discuss overall energy usage in New Jersey. 76.9% of energy consumption was from fossil fuels, 16.0% arose from nuclear, 3.9% arose from renewables, and 3.3% was net imported electricity. The 76.9% of fossil fuel energy consumption splits into 35.6% from natural gas, 20.8% from motor gasoline, 10.1% for jet fuel, 7.9% from distillate fuel oil, 1.1% from residual fuel, and 1% from coal.[121] (See Appendix: New Jersey Primary Energy Usage).

More than 90% of New Jersey's electricity generation comes from nuclear energy or natural gas, with natural gas utilized slightly more than nuclear. 75% of households mainly use natural gas for heating, while 10% use fuel oil and 12% use electricity. New Jersey does not produce crude oil, coal, or natural gas, but it runs three major oil refineries and has five major interstate natural gas pipelines. Pennsylvania is New Jersey's main natural gas supplier. About 5% of New Jersey's electricity is from alternative energy, with 75% of this solar and the rest biomass. The state has a renewable portfolio standard (RPS) that sets minimum requirements for the percentage of in-state electricity sales in NJ that must come from renewables (21% by 2021, 35% by 2025, and 50% by 2030).[122] One tenth of the state's electricity is imported.[123]

Next, let us discuss overall emissions in New Jersey. All the following statistics about emissions and their sources reference values from year 2015, and are sourced from the U.S. Energy Information Administration.[124]

New Jersey emitted 111.9 million metric tons of CO_2 per year, which is 2.1% of total U.S. emissions and the 16th greatest emissions among states. By fuel, 68.4 million metric tons of CO_2 (61.1%) came from petroleum, 41.3 million metric tons of CO_2 (36.9%) came from natural gas, and 2.2 million tons of CO_2 (1.9%) came from coal.

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[119] Energize Rhode Island 2017: https://www.energizeri.org/uploads/5/4/5/8/54586171/legpros2017_edited_pdf_3.pdf
[120] Carbon Washington 2018: http://carbonwa.org/2018-carbon-tax-bill-matrix-updated-1212018/
[121] EIA 2017: https://www.eia.gov/state/?sid=NJ#tabs-1
[122] Energy.gov 2018: https://www.energy.gov/savings/renewables-portfolio-standard-0
[123] EIA 2017: https://www.eia.gov/state/analysis.php?sid=NJ
[124] EIA 2018: https://www.eia.gov/environment/emissions/state/analysis/pdf/stateanalysis.pdf

By sector, 58.1 million metric tons of CO_2 (52.0%) came from the Transportation sector, 17.9 million (16.0%) came from the Electrical Power sector, 15.5 million (13.9%) came from the Residential Sector, 10.7 million (9.6%) came from the Commercial Sector, and 9.6 million (8.6%) came from the Industrial Sector.

New Jersey has the 10th lowest carbon intensity of its energy supply (50.5 kg of energy-related CO_2 per million BTU), the 11th lowest carbon intensity of its economy (221.7 tons of energy-related CO_2 per chained 2009 million dollars), and the 17th lowest per capita CO_2 emissions (12.5 tCO_2/year).

In recent years, natural gas emissions have been growing the most, up to 41.3 million metric tons from 33.9 million metric tons five years ago. Within natural gas emissions, 13.7 million metric tons come from residential areas, 13.7 million from electric power, 11.2 million from the commercial sector, and 3.4 million from the industrial sector.[125] As natural gas generation is increasing in New Jersey, a carbon fee will be needed to to internalize the corresponding costs that emissions have on natural disasters, health, and agriculture.

Existing Carbon Prices in New Jersey

Motor Fuels Tax

New Jersey currently taxes fuel oils, motor fuels, and aviation fuels. Gasoline and gasoline blends are taxed at 10½¢ per gallon. Diesel and diesel blends are taxed at 13.5¢ per gallon. Aviation fuels destined for General Aviation Airports are taxed at an additional 2¢ per gallon. Liquefied petroleum gas (LPG) used as a motor fuel is taxed at 5.25¢ per gallon.[126]

The existing infrastructure for collecting these taxes can be adopted for carbon fee collection. According to the statute in question, §54:39-104, fossil fuel taxes are collected on fuel removed from the "terminal transfer system," which includes refineries, pipelines, vessels, and terminals.[127] Additionally, for fuel imported into the state, provision §54:39-118 allows suppliers of motor fuels with terminals outside New Jersey to treat removals of fuel from those terminals as though they are removals from a terminal within the State, allowing the tax to apply to imported motor fuels as well.[128] This provision is essential because New Jersey is a small state with many terminals just over the state line, and it creates a consistent mechanism through which to apply the tax to imported fuels.

[125] EIA 2017: https://www.eia.gov/environment/emissions/state/
[126] NJ Dept. of Treasury 2010: http://www.state.nj.us/treasury/taxation/pdf/motorfuels_notice.pdf
[127] Justia 2014: https://law.justia.com/codes/new-jersey/2014/title-54/section-54-39-104/
[128] Ibid.

Regional Greenhouse Gas Initiative

New Jersey will be rejoining the Regional Greenhouse Gas Initiative (RGGI), a cap-and-trade system initiated by New Jersey and 9 other states (Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont) to reduce their greenhouse gas emissions in the power sector.[129] New Jersey left RGGI in 2011, but rejoined per Governor Murphy's Executive Order 7 on June 17, 2019.[130][131]

RGGI focuses solely on the electric power sector, capping the CO_2 emissions from the approximately 168 facilities in the region that have capacities of over 25 MW. CO_2 allowances are issued in accordance with the cap, and can be traded amongst emitters. The distribution of the vast majority of allowances is through quarterly auctions. Following a 2012 program review, the RGGI states implemented a new 2014 RGGI cap of 91 million tons, with the cap declining 2.5% each year from 2015 to 2020.[132]

The RGGI clearing price has ranged up to \$7.50/ton CO_2, and was \$4.50 at the most recent September 2018 auction (RGGI Price Auction History). While New Jersey was in RGGI (2009-2011), the price ranged between \$1.86/ton CO_2 and \$3.51/ton CO_2 (RGGI Price Auction History).

Each state has the authority to choose how its RGGI auction proceeds are distributed. As of an April 2018 study, the average revenue distribution in the region was as follows: 52% on energy efficiency; 18% on renewable energy projects; 13% on bill-payment assistance to consumers; 7% on program administration; 4% on emission reduction programs; 3% on clean technology research and development; 2% on education, outreach, and job training; and 1% for payments into a general fund.[133]

As of a May 2017 study, the RGGI states had reduced annual power sector carbon pollution by 80 million short tons since 2005, even as the regional economy has grown.[134] This represents a reduction in power sector carbon emissions of more than 45%. There has been a considerable shift away from coal and petroleum, as the electricity generation from those sources dropped from 33% in 2005 to 7% in 2016.[135] In the same period, electricity generation from

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[129] Ramseur 2017: https://fas.org/sgp/crs/misc/R41836.pdf
[130] Racioppi 2018: https://www.northjersey.com/story/news/new-jersey/governor/2018/01/29/murphy-directs-new-jersey-re-enter-regional-greenhouse-gas-initiative/1074921001/
[131] NJDEP, 2019: https://www.state.nj.us/dep/aqes/rggi.html#:~:targetText=NJ%20in%20RGGI&targetText=In%202005%2C%20New%20Jersey%20was,trading%20program%2C%20such%20as%20RGGI.&targetText=New%20Jersey%20formally%20rejoined%20RGGI%20on%20June%2017%2C%202019.
[132] Ramseur 2017: https://fas.org/sgp/crs/misc/R41836.pdf
[133] Analysis Group 2018: http://www.analysisgroup.com/uploadedfiles/content/insights/publishing/analysis_group_rggi_report_april_2018.pdf
[134] Ramseur 2017: https://fas.org/sgp/crs/misc/R41836.pdf
[135] Ibid.

natural gas increased from 25% to 43%,[136] while generation from non-hydroelectric renewables increased from 2% to 4%.[137] Thus, most of the emissions reduction has occurred via switching to natural gas, which emits less CO_2 than coal or petroleum but still intensifies climate change as a fossil fuel energy source, especially when its fugitive methane emissions are considered. While RGGI's cap and reinvestment strategies probably contribute to some of the decline in the region's power sector emissions, there are likely other factors in play as well.

A 2017 study examined the public health impacts of the first six years of the RGGI program (2009-2014).[138] This study concluded that the RGGI program's air quality improvements from emissions reductions led to public health benefits, including the avoidance of premature deaths and illnesses. The study estimated the cumulative economic value of the health benefits at $5.7 billion.

Additionally, RGGI has also boosted the region's economy, according to a recent study by the Analysis Group.[139] By reinvesting in renewable energy and energy efficiency programs, RGGI reduces the money that would otherwise leave the states to pay for out-of-state fossil fuels. In the latest three-year period studied (2015-2017), this value came to an estimated $1.4 billion. In the same period, RGGI led to 14,500 added job years in the region.

Unfortunately, RGGI fails to cover 85% of New Jersey emissions that do not originate from the electric power sector, and results in a carbon price far below what is needed to comply with the warming objectives established under the Paris climate agreement.[140] Our proposal seeks to comprehensively cover carbon emissions in New Jersey, and is meant to complement, not compete with, RGGI.

Proposed Carbon Cashback Policy

Overview

We propose a rising fee on fossil fuels, placed at the furthest point upstream in the flow of fuels into New Jersey. Energy providers, including utilities and generators, will pass the price increase down to consumers. The vast majority of collected fees will be returned to households and vulnerable businesses as dividends, in order to help them adjust to the price increases. The fee will send a strong price signal, incentivizing actors across the economy to pursue cheaper

[136] Ibid.
[137] EIA 2018: https://www.eia.gov/electricity/data/browser/#/topic/0?agg=2,0,1&fuel=gf04&geo=80060048&sec=008&freq=A&start=2005&end=2016&ctype=linechart&ltype=pin&rtype=s&pin=&rse=0&maptype=0
[138] Abt Associates 2017: http://abtassociates.com/AbtAssociates/files/7e/7e38e795-aba2-4756-ab72-ba7ae7f53f16.pdf.
[139] Analysis Group 2018: http://www.analysisgroup.com/uploadedfiles/content/insights/publishing/analysis_group_rggi_report_april_2018.pdf
[140] CPLC 2017: https://www.carbonpricingleadership.org/report-of-the-highlevel-commission-on-carbon-prices/

(lower-emissions) options. A portion of the collected fees would also be used to support various green investments and adaptation initiatives.

Qualifying Fuels and Fee Schedule

We are proposing a fee to be levied on all fuels that generate carbon dioxide emissions, proportional to their estimated CO_2 content, with an exemption for electricity. Qualifying fuels include natural gas distributed by utilities for home heating purposes; and all of the motor fuels that qualify under the motor fuels tax, including gasoline, diesel fuel, and liquefied petroleum blend (aviation fuel is exempt).[141]

The proposed initial and final rates per relevant unit of the fuel are calculated based on the standard rates published by the EPA. These values are well-tracked; see (See: Fee Schedule for Different Fuel Types). After five years, the price schedule would be reevaluated by the New Jersey Department of Environmental Protection to assess compliance with New Jersey's emissions reduction goals (80% reduction by 2050 from 2006 levels).

Fee Schedule	Initial Price 2019 (per tCO_2)	Annual Rate of Increase	Final Price 2024 (per tCO_2)
	$30	$5	$55

Other Greenhouse Gases and Air Pollutants

Although carbon dioxide is by far the most prevalent greenhouse gas, other GHGs do play a non-negligible role in global warming. According to EPA's latest Inventory of U.S. Greenhouse Gas Emissions and Sinks, 81% of US emissions in 2016 came from CO_2, while 10% came from methane and 6% came from nitrous oxide. In particular, methane emissions have increased as unconventional gas drilling (i.e. hydraulic fracturing) has become more economical. The burning of shale gas, for example, emits at least 30% more methane than conventional gas, on average.[142] Annual methane leakage in the U.S. is estimated to be as high as 13 million metric tons,[143] a value that could grow if natural gas use increases.

We have considered pricing these other greenhouse gases as well, based on the CO_2 emissions fee multiplied by the gas's 100-year Global Warming Potential (GWP). We would

[141] NJ Dept. of Treasury 2010: http://www.state.nj.us/treasury/taxation/pdf/motorfuels_notice.pdf
[142] Howarth et al. 2011: https://link.springer.com/article/10.1007/s10584-011-0061-5
[143] Environmental Defense Fund 2018: https://www.edf.org/climate/methane-studies

choose the 100-year timeframe over the 20-year timeframe because it is more widely used. These multipliers would be 28 for methane and 265 for nitrous oxide.[144] We have also considered pricing other air pollutants, such as $PM_{2.5}$. For each air pollutant, we would estimate its social cost, compare that social cost to the social cost of carbon, and scale the fee on the pollutant accordingly. Due to the uncertainties surrounding the sources and social costs of many pollutants, we focus on pricing CO_2 in this proposal. However, once more data is obtained, the scope of the policy could be expanded to include other greenhouse gases and pollutants.

Point of Assessment and Imported Energy

The carbon fee would be applied to the entity purchasing the electricity for distribution to households, fuel for producing electricity, or motor fuel at the first point of in-state transfer, with exceptions where existing infrastructure for petroleum taxation can be conveniently utilized. This means that in the case of imported electricity and natural gas that is ready for distribution by an electric or gas utility, the fee will be charged on the utility in the state when it first transfers the imported electricity inside New Jersey, before distribution. In the case of coal, natural gas, and crude oil imported into New Jersey in order to generate electricity, the fee will be applied where the electricity generator first transfers the fuel inside New Jersey before its generation into electricity for sale to utilities. The first point of in-state sale criterion is important for applying the fee to imported electricity, as well as for accommodating the fact that out of New Jersey's four largest electric utility companies, only one has a parent company (PSEG) that is headquartered in-state.

Existing protocols support applying the carbon fee at the terminal storage and distribution level for fuels unrelated to electricity production or natural gas distribution. New Jersey Tax Code §54:39-104 defines the terminal transfer system as "the fuel distribution system consisting of refineries, pipelines, vessels, and terminals," and further clarifying that "Fuel in a refinery, pipeline, vessel, barge or terminal is in the terminal transfer system. Fuel in the fuel supply tank of an engine, or in a tank car, rail car, trailer, truck, or other equipment suitable for ground transportation is not in the terminal transfer system."[145] Additionally, for fuel imported into the state, provision §54:39-118 allows suppliers of motor fuels with terminals outside New Jersey to treat removals of fuel from those terminals as though they are removals from a terminal within the State[146]. This provision is essential because New Jersey is a small state with many terminals just over the state line Applying the fee at such a so-called "choke point" midstream in the extraction-to-consumption energy flow would also ensure widespread coverage of carbon

[144] Myhre et al. 2013: https://www.ipcc.ch/report/ar5/wg1/

[145] NJ Legislature Chapter 22 2010: http://www.njleg.state.nj.us/2010/Bills/PL10/22_.HTM
[146] Ibid.

emissions by the fee, an approach endorsed by nonpartisan groups, including the Congressional Budget Office[147] and the Congressional Research Service[148].

Fee Collection Mechanism

This fee should be administered by the New Jersey Division of Taxation, which already administers comparable fees and taxes. The Division of Taxation already administers the existing Motor Fuels Tax[149], and as the proposed fee would be administered via the same framework, the need to devise an entirely new collection mechanism is greatly reduced. Furthermore, the Division of Taxation also collects fees, such as the Litter Control Fee[150], which operates in a very similar way, applying the fee on "sales of litter-generating products sold within or into New Jersey by each person engaged in business in the State as a manufacturer, wholesaler, distributor, or retailer of such products." This alleviates some of the tax vs. fee concerns that may arise from the administration of this fee by a department of taxation, as the primary function of the fee will not be to generate revenue for general use by the government, but to reimburse New Jersey citizens for the costs associated with carbon emissions through a dividend and, potentially, programs that promote energy efficiency and mitigate the effects of climate change.

One major concern brought up by several stakeholders is the tendency of money that is dedicated by statutory legislation to a specific purpose is often "raided" for different purposes than its original intent. For example, an estimated $1.5 billion were raided from the Clean Energy Fund to fill budget shortfalls during Governor Christie's tenure, diverting revenue intended for energy efficiency programs to unrelated purposes in the appropriations bill.[151] This is possible because annual appropriations bills in New Jersey can override any statutory legislation, making it possible for funds to be allocated for different purposes than originally dedicated.[152] In Burgos v. New Jersey, the New Jersey Supreme court ruled that "each year's appropriations act will reflect the present legislative and executive judgment as to the budgetary priorit[ies]" and therefore takes precedence over statutory legislation.[153] To avoid this, a constitutional amendment would need to be passed in order to constitutionally dedicate funds to a specific purpose, as in the example of the Motor Fuels Tax amendment passed in 2016.[154] It is possible that concurrent with this legislation, a constitutional amendment would have to be passed in order to prevent the diversion of funds from rebates or targeted investment and thus severely impact households and businesses.

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[147] CBO 2013: https://www.cbo.gov/sites/default/files/113th-congress-2013-2014/reports/Carbon_One-Column.pdf
[148] Ramseur et al. 2013: http://nationalaglawcenter.org/wp-content/uploads/assets/crs/R42731.pdf
[149] NJ Dept. of Treasury 2010: http://www.state.nj.us/treasury/taxation/pdf/motorfuels_notice.pdf
[150] NJ Dept. of Treasury 2016: http://www.state.nj.us/treasury/taxation/littercontrolfee_over.shtml
[151] Johnson 2017:
http://www.njspotlight.com/stories/17/06/26/clean-energy-fund-raided-again-to-plug-last-hole-in-state-budget/
[152] Justia 2015: https://law.justia.com/cases/new-jersey/supreme-court/2015/a-55-04.html
[153] Ibid.
[154] NJ Senate Concurrent Resolution No. 26 2016: ftp://www.njleg.state.nj.us/20162017/SCR/26_I1.PDF

To pass a constitutional amendment in New Jersey, a resolution must first be proposed in either the assembly or the senate, 20 days after which a public hearing is held and the amendment is introduced again in both houses. If it passes with a three fifths majority in both houses, it is submitted to the people as a ballot measure; if passes with a majority but not three-fifths, it is submitted to the legislature again the following year. Once submitted to the people, it will appear on the ballot in the next general election. If it passes with a majority of voters approving, it then becomes part of the constitution 30 days after the election. If not, it cannot be submitted as an amendment again until two more election cycles have passed.[155]

Similar amendments have been passed relatively recently: for example, in 2017, New Jersey voters approved an amendment that dedicated any settlement funds from environmental contamination lawsuits to either the costs of the case or cleanup and conservation efforts.[156] If such an amendment were passed, revenue could go into a newly created "Trust Fund for Climate Change Mitigation and Resilience." A government-appointed board would choose the specific way to allocate funds, adhering to the guidelines in the following sections.

Revenue Use Structure

Revenue could be used for each of the following purposes. We do not specify specific percentages in this work as this work is ongoing. Instead we focus on feasibility, benefits, and costs of each approach in this section.

- Household dividends
- Investment in clean energy alternatives, energy efficiency and climate adaptation
- Tax credit to vulnerable businesses
- Administrative costs

Distribution of Dividends

We currently propose three options for the household rebate:

1. The dividend is applied to all taxpayers as a **tax credit** that would reduce the amount of income tax owed on their paychecks. This rate would vary based on the number of dependents an individual claims on their W-4. For businesses (dependent on whether or not the dividend will apply to all or just energy intensive businesses), this would be applied via a tax credit on the corporation business tax that would vary based on the number of wage hours worked by employees at that business. This approach has the advantage of limited administrative costs, as it uses existing tax structures and would

[155] Ballotpedia 2014: https://ballotpedia.org/Article_IX,_New_Jersey_Constitution
[156] Ballotpedia 2017: https://ballotpedia.org/New_Jersey_Public_Question_2,_Revenue_from_Environmental_Damage_Lawsuits_Dedicated_to_Environmental_Projects_Amendment_(2017)

simply decrease the amount of income withheld as business income tax or individual income tax. Additionally, under the recent national tax reform, it would not be considered taxable income, unlike a rebate.[157] However, it can potentially exclude those who do not work or file W-4s, which would require the imposition of an application process so others could receive a rebate. Additionally, a tax credit can only be administered annually, to our knowledge, while it would be important to rebate households more frequently to help them cope with increased energy costs.

2. The dividend is returned to all taxpayers and businesses via a **regularly mailed rebate** check equivalent to the dividend rate, for which they would have to apply, similar to the process for issuing property tax rebates. The advantage of a check in the mail is that it is highly visible, allowing residents to directly see how the policy is affecting them. However, the checks would count as taxable income, leading to substantial deductions from the dividend (see Effect of Income Tax: Projected Increases). Moreover, the sending would cost a substantial amount. Mailing a check in the mail may cost anywhere from $0.32 to $8.94 per check. In 2006, the Internal Revenue Service sent a letter to taxpayers across the nation to inform them to expect rebate checks. The notice cost $41.8 million to send to about 130 million households, working out to about 32 cents per letter.[158] Alternatively, the U.K. considered a Government Electricity Rebate; they estimated that rebating to 48 million domestic electricity and gas account holders would cost £310 million, which led to 6.46 pounds per person, or $8.94 per person.[159]
3. **Electronic payments** are more effective, both cost- and time-wise, compared to mailing checks. Less labor and fewer costs are involved with this alternative. In addition, since electronic transfers are online, they can be directed to home owners much faster than a physical transfer. According to the US Census, 88.9% of New Jersey homeowners have a computer, which is a majority of the state.[160] As of now, everyone is mailed their checks, but if that 88.9% could access the internet and electronically process the checks, the government would then have to mail only 11.1% of the checks it currently does- a significant cost reduction. Additionally, electronic payments are just as visible as physical checks.

[157] CNN 2017: http://money.cnn.com/2017/12/20/pf/salt-deductions-new-tax-plan/index.html
[158] Associated Press 2008: http://www.nbcnews.com/id/23525100/ns/business-personal_finance/t/dear-taxpayer-letter-cost-you-million/#.WoEIA5M-e8U
[159] Department of Energy and Climate Change 2014: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/321320/Government_Electricity_Rebate_Consultation.pdf
[160] https://www.census.gov/quickfacts/nj

Targeted Investment

Various stakeholders have indicated that there are other statewide priorities related to climate change that should be addressed by this proposal, especially focusing on reducing emissions through investment in emissions reductions programs and infrastructure (e.g. energy efficiency and charging stations) and reducing the harms of climate change on local communities by investing in adaptation initiatives. More information on potential avenues for targeted investment can be found here.

Relationship to RGGI and Fees for Electric Power

Our proposed carbon cashback policy is meant to be complementary to the Regional Greenhouse Gas Initiative (RGGI). RGGI places a carbon price on fossil-fuel-fired electric power plants with a capacity of over 25 MW. By being confined to the electricity sector, RGGI only affects about 16% of New Jersey's emissions.[161] Our proposed policy will apply to fuels in non-electricity sectors, such as gasoline and natural gas used for heating that make up the great majority of New Jersey's emissions.

In addition, our policy has the option of also applying to electricity; namely, to fossil fuels used for electricity production and imported electricity.

We outline three main options for our policy's application to electricity, and relationship with RGGI:

1. Impose the fee on all sectors, with no electricity sector rebate for the additional prices faced by RGGI.
    - While this option is the simplest to implement, it leads to a double-carbon price on power plants in their electricity generation.
2. Impose the fee on all sectors, rebating the electricity sector for RGGI prices
    - This option is more complex to implement because electric power plants must be rebated for all of their carbon allowances. This depends on the new RGGI price. Moreover, it effectively nullifies New Jersey's participation in RGGI, because the effective carbon price is only the one set by our policy.
3. Impose the fee on all sectors, excluding the electricity sector.
    - This option allows our policy to complement RGGI: it preserves the RGGI price on electricity, and applies our fee to the remaining sectors. However, it is complex to implement, as imported fuels such as coal and natural gas must be carefully monitored to see if they will be used for electric power generation or not.

[161] EIA 2018: https://www.eia.gov/environment/emissions/state/analysis/pdf/stateanalysis.pdf

We choose the third option and exclude the electricity sector. We do so because RGGI and New Jersey's Renewable Portfolio Standards already target the electricity sector, and it is more important to influence the other sectors that account for 84% of the state's emissions.

Other Details

As a regional or national carbon cashback would be more effective and simpler to navigate than multiple individual state-level carbon prices, the policy should include wording to allow itself to be overridden/revised in the event that a regional or national policy of an emissions price of within the same or greater range is implemented.

The implementing department should review the rate after five years to see if the rate should be adjusted to ensure compliance with the Renewable Portfolio Standards and other emissions targets set by the legislature, as well as to mitigate any undue burden on New Jersey communities and businesses.

It is imperative that rebates are returned to all households in New Jersey, as all households will be paying the increased energy costs. In particular, for low-income individuals who do not pay taxes, programs like the Low-Income Home Energy Assistance Program (LIHEAP) should be enlisted to send the rebates. Legislation should include wording to allow the agencies to share the necessary data in order to return the dividends.

Public transit agencies should be rebated their increased costs, as they help reduce overall emissions.

Households and employers should be given the option to opt-out of their rebate, in which case the funds should be retained for future dividends or investments.

Legislatory Consideration: Simultaneous Reduction of Other Taxes

Since New Jersey taxes are relatively high already, reducing other taxes when a carbon cashback policy is implemented could help the state's economy. According to the Yale Program in Climate Change Communication, 73% of NJ adults support taxing fossil fuel companies if other taxes are equally reduced.[162] Reducing other taxes along with the policy could also help alleviate concerns of business leakage into neighboring states.

According to the Tax Foundation, New Jersey taxes are some of the least business-friendly in the country.[163] When ranked among all 50 states regarding how favorable a tax makes states for business, NJ came 50th overall, 42nd in corporate tax, 49th in income tax, 46th in sales tax, 36th in unemployment insurance tax, and 50th in property tax. Since the local

[162] Marlon et al. 2018: http://climatecommunication.yale.edu/visualizations-data/ycom-us-2018/?est=reducetax&type=value&geo=state
[163] Tax Foundation 2018: https://files.taxfoundation.org/20180411102900/Facts-Figures-2018-How-Does-Your-State-Compare.pdf

control of property taxes is outside of the scope of this policy, and since business leakage is probably less affected by unemployment insurance tax and sales tax, we focus on potential changes in income and corporate taxes.

With respect to income taxes, a NJBIA report found that between 2004 and 2014, New Jersey lost 2M residents, $18B in net income, leading to the loss of 75,000 jobs and billions of dollars of lost spending.[164] The top three states New Jerseyans migrate to are Pennsylvania, New York, and Florida, which compared to NJ's income tax climate index of 49th have indices of 17th, 49th (though this is combined with better property tax and especially corporate tax rates), and 1st for Florida.[165] The NJBIA report also indicates that many NJ residents who move to PA and NY take advantage of a loophole where they reside in the neighboring state for 6 months and one day.[166] While marginal changes in income tax may not always be the deciding factor in outmigration, the NJBIA points out the large effect it has on the decisions of the millenials and retirees, who may have tighter budgets.

Therefore, a reduction in the income tax along with our proposal might be the best way to reduce outmigration. An income tax shift could also be politically favorable, as perhaps the most visible tax shift to the electorate. According to a national-scale RFF study, a $30/t$CO_2$ carbon price could allow for a 1.4% reduction in income tax and a 4.8% reduction in the corporate tax.[167]

The RFF study also finds that a corporate tax would be the only tax cut to grow GDP, with an income tax shift leading to bare GDP decline of -0.5%, and larger decreases in GDP from a sales tax shift or equal-dividend model. It also finds that lump sum dividends reduce emissions the most, followed by sales taxes, income taxes, and corporate taxes, although the difference between options never exceeds 3%.

When these small differences between plans are compared to the large benefits of limiting outmigration, an income tax shift may still be the best option. In addition, some corporate tax relief for vulnerable businesses could minimize leakage and make the most of a Pareto Principle, providing most of the value of the cut with a much smaller cut. The exact balance between the income tax and the corporate tax would be the subject of further research, likely requiring sophisticated macroeconomic modeling.

Political Feasibility

General Viewpoints

There is widespread support in New Jersey and across the U.S. for taking action on climate change and regulating fossil fuels. According to the 2018 Yale study, 67% of adults in NJ

[164] NJBIA 2016: https://www.njbia.org/wp-content/uploads/2016/05/njbiaoutmigrationreport.pdf
[165] Freeman 2018: https://www.wsj.com/articles/my-clients-are-fleeing-nj-like-its-on-fire-1525289556
[166] NJBIA 2016: https://www.njbia.org/wp-content/uploads/2016/05/njbiaoutmigrationreport.pdf
[167] RFF 2013: http://www.rff.org/files/sharepoint/WorkImages/Download/RFF-Rpt-Carbone.etal.CarbonTaxes.pdf

are worried about global warming, 86% support funding research into renewable energy sources, 82% support regulating CO_2 as a pollutant and 68% support requiring utilities to produce 20% of their electricity from renewable energy sources.[168] In addition, according to an older study by the Yale program, 49% of adults in New Jersey support a carbon tax if it was refunded to every American household (21% opposed it and 30% were undecided).[169] There is clear political will in New Jersey for climate action.

Republicans such as Senator Lindsey Graham; former Secretaries of State James Baker, III, and George Shultz; and former Director of the EPA and former Governor of New Jersey Christine Todd Whitman have voiced their support for a carbon tax.[170, 171, 172] Democrats such as Senators Cory Booker and Brian Schatz, and former President Barack Obama have also called for carbon pricing.[173, 174, 175] Nationally, 49-53% of self-identified Republicans support a similar carbon fee and dividend policy, and according to a survey conducted by political scientists at Stanford University and Resources for the Future, about 61% of Americans favor a tax on companies that release carbon emissions. Favorability rises to 67% if the carbon tax provides rebates to American households.[176, 177] Finally, 62% of those who voted for President Trump are in favor of taxing or regulating greenhouse gas emissions.[178] We address further objections to the political feasibility of our policy under Common Objections.

However, the implementation of our policy will involve an increase in gas prices. According to the Rutgers-Eagleton Poll, from 2014 to 2016, the percentage of New Jersey residents who opposed a gas tax hike decreased from 66% to 56% while the percentage of those who supported it increased from 31% to 42%. Thus, the opposition remained in the majority.[179] The two main reasons for opposing the tax increase are doubts on where the money will go and the tax already being too high.[180] Interviews with residents have echoed similar concerns on how

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[168] Marlon et al. 2018: http://climatecommunication.yale.edu/visualizations-data/ycom-us-2018/
[169] Marlon et al. 2015: http://climatecommunication.yale.edu/visualizations-data/ycom/
[170] TIME 2017: http://time.com/4947960/lindsay-graham-climate-change-carbon-tax/
[171] Baker et al. 2017: https://www.clcouncil.org/media/TheConservativeCaseforCarbonDividends.pdf
[172] Ruckelshaus et al. 2013: http://www.nytimes.com/2013/08/02/opinion/a-republican-case-for-climate-action.html
[173] Friedman 2013: http://www.nj.com/politics/index.ssf/2013/10/where_cory_booker_and_steve_lonegan_stand_on_the_issues.html
[174] Friedman 2017: https://www.nytimes.com/2017/08/17/climate/carbon-tax-reform-climate-change.html
[175] Lehmann 2015: https://www.scientificamerican.com/article/obama-calls-carbon-price-better-than-regulations/
[176] Leiserowitz et al. 2016: http://climatecommunication.yale.edu/publications/politics-global-warming-november-2016/2/
[177] RFF 2015: http://www.rff.org/files/sharepoint/Documents/RFF-NYTimes-Stanford-global-warming-poll-Jan-2015-topline-part-3.pdf
[178] Marlon et al. 2015: http://climatecommunication.yale.edu/visualizations-data/ycom-us-2016/?est=regulate&type=value&geo=state&id=34
[179] Rutgers-Eagleton 2016: http://eagletonpoll.rutgers.edu/category/gas-tax/
[180] FDU 2015: http://view2.fdu.edu/publicmind/2015/151119/

the increase was too drastic and the effect of it on their businesses and finances.[181] Nevertheless, 54.5% of New Jersey voters approved of a 2016 constitutional amendment that dedicated all revenue from the state Motor Fuels Tax and the tax from gross receipts of the sale of petroleum products to the Transportation Trust Fund, indicating that residents support dedication of the revenue.[182]

Legal Issues

Interstate Commerce

New Jersey does not produce any crude natural gas, oil, or coal, so all fees will apply to imported fossil fuels. Thus, our proposal must take steps to prevent entanglement with the "Dormant" Commerce Clause, an implicit part of Article I, Section 8, Clause 3 of the US Constitution which prevents states from using regulatory tools to discriminate against citizens of other states to give a competitive advantage to in-state businesses.[183] However, in the case of the proposed carbon cashback legislation, any objections posed on Dormant Commerce Clause grounds are either moot due to the structure of the fee, or stand up to legal tests established by the U.S. Supreme Court.

The pertinent point for commerce clause purposes is that the fee will generally be applied at the first point of in-state sale. Applying the carbon fee at the first point of sale within New Jersey is procedurally no different from the normal and accepted practice of levying a sales tax on a good sold in New Jersey but produced out of state. There is no legal interstate commerce issue because there is no fee being applied at the interstate level. The fee could not be applied to any fuel being transported through New Jersey, for instance, but as long as an energy source is being sold to a New Jersey user, there is no legal objection.[184]

Even if the proposal were to be challenged on Dormant Commerce Clause grounds, it would satisfy the established legal requirements for waiving the clause. The unanimous U.S. Supreme Court decision in *Pike v. Bruce Church, Inc.* (1970) put a two-step balancing test in place. First, the policy in question cannot discriminate against out-of-state businesses - rather, the same standards must be applied to in-state and out-of-state entities. The current proposal clearly satisfies this requirement, as the magnitude of the carbon fee designed herein is tied not to the location of energy production, but to the carbon content of a given fuel - identical rates apply to in-state and out-of-state production. Second, the opinion holds that, "Where the statute regulates

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[181] Rose 2016: https://www.npr.org/2016/11/01/500252021/shock-at-the-pump-a-jump-in-n-j-gas-tax-marks-an-end-to-cheap-fuel
[182] NJ Elections 2016: http://www.njelections.org/2016-results/2016-official-general-results-question2.pdf
[183] U.S. Constitution. Art. I, Sec. 8: https://www.archives.gov/founding-docs/constitution-transcript
[184] Morris et al. 2016: https://www.brookings.edu/wp-content/uploads/2016/07/State-level-carbon-taxes-Options-and-opportunities-for-policymakers.pdf

evenhandedly to effectuate a legitimate local public interest, and its effects on interstate commerce are only incidental, it will be upheld unless the burden imposed on such commerce is clearly excessive in relation to the putative local benefits."[185] As already discussed in Hidden Costs of Carbon Emissions, a carbon cashback policy addresses essential environmental, public health, public safety, and consumer protection needs at the state and regional levels, comprising very strong evidence of local benefits within the scope of the accepted police powers of the state government and satisfying the Pike test.

Motor Fuels Tax Amendment

A New Jersey state constitutional amendment approved by public referendum in 2016 dedicates all of the revenue from the motor fuels tax (gas tax) and the tax on the gross receipts of the sale of petroleum products (petroleum products tax) to the Transportation Trust Fund (TTF), [186] a special capital fund under the New Jersey Department of Transportation designed to "finance the cost of planning, acquisition, engineering, construction, reconstruction, repair, and rehabilitation of the state's transportation system."[187] This amendment has potentially dramatic ramifications for a carbon cashback system because, in New Jersey as of 2014, 68.2 million tons, or 60.1%, of carbon emissions originated from petroleum.[188] These emission figures indicate that petroleum would make up the majority of the revenue under a carbon cashback policy, however the amendment would seem to severely limit the amount of dividends distributed back to households, ensuring that households bear an undue burden for the costs of the fee without compensation via dividends.

There are three options of varying desirability for resolving the issue posed by the amendment. First, by far the most desirable option would be for the carbon fee to be considered exempt from the TTF requirement, freeing up all revenue from the fee to be returned to consumers as dividends. According to correspondence with Prof. Robert Williams on Rutgers University's Center for State Constitutional Studies, this distinction could potentially be accomplished if the policy were legally classified as a regulatory fee and not as a tax. New Jersey is not unique in having judicial precedent stating that as long as a specific fee has a primary purpose distinct from raising general revenue, and as long as that fee is proportional to the cost of the action it prohibits, it can be classified as a regulatory fee. This standard has been established and upheld through several New Jersey court cases including *Bellington v. Township of East Windsor*, *Holmdel Builders Ass'n v. Township of Holmdel,* and *Resolution Trust Corp. v. Lanzaro. Bellington v. Township of East Windsor*, a decision that upheld a fee on trailer parks and camps, is particularly notable as it authorized a regulatory fee on public health and safety grounds, with the distinction between fees and taxes described, respectively, as "one is to license

[185] Philadelphia v. New Jersey 1978: https://www.law.cornell.edu/anncon/html/art1frag56_user.html
[186] NJ Senate Concurrent Resolution No. 26 2016: ftp://www.njleg.state.nj.us/20162017/SCR/26_I1.PDF
[187] State of New Jersey 2015: http://www.state.nj.us/ttfa/
[188] EIA 2018: https://www.eia.gov/environment/emissions/state/analysis/pdf/table2.pdf

and regulate under the police power; the other, to raise revenue," a decision affirmed by *Holmdel Builders Ass'n v. Township of Holmdel,* which further specifies that "if, however, the primary purpose if to reimburse the municipality for services reasonably related to development, it is a permissible regulatory exaction".[189] However, in *Resolution Trust Corp. v. Lanzaro*, the court cautioned that "where the disproportion between the charge and the cost of the service is excessive," regardless of the intention of the fee, it ceases to act as a fee. Thus, the case for the policy to satisfy both classification requirements is reasonable, given that its primary purposes relate to environmental and public health concerns, and that it is priced so as to accurately address the negative externality of carbon emissions, as the government of New Jersey can be considered to be providing a "service" in the form of mitigating the effects of climate change. Since the majority of the fee will be returned to households, we can comfortably label the policy a fee and not a tax.

The other two conceivable options would allow carbon cashback revenues to go to the TTF. One would then steer that revenue, within the TTF, towards green transportation projects, such as NJ TRANSIT improvements. This, however, would be limited by the specific capital projects proposed by agencies such as NJ TRANSIT, while the loss of revenue for dividends would still potentially disproportionately harm consumers.[190] The other option would place revenues in the TTF, but remove an equivalent amount of non-constitutionally mandated funds from the TTF to apply to household dividends. However, this option is likely financially infeasible given that the only current non-constitutionally-mandated funding source for the TTF is toll road revenues, which do not currently bring in enough receipts to offset the carbon cashback revenue: only about $12 million per year.[191]

Effect on Emissions and Energy Usage

Where a carbon fee has been implemented, it has shown to be effective at reducing greenhouse gas emissions. For example, Sweden's carbon fee of $120/ton CO_2 is estimated by the Swedish Ministry of the Environment to have reduced CO_2 levels by 20-25% in 2000 compared to the estimate without the carbon fee, while having a negligible effect on the economy, which has grown by 100% since the implementation of the tax.[192] An additional example is the carbon fee implemented in British Columbia, which has reduced emissions by

[189] Henchman 2013: https://files.taxfoundation.org/legacy/docs/TaxesandFeesBook.pdf
[190] State of New Jersey 2015: http://www.nj.gov/ttfa/faq/
[191] Ibid.
[192] Johansson 2000: https://books.google.com/books?hl=en&lr=&id=5YIHp5F_LWoC&oi=fnd&pg=PA85&dq=sweden+carbon+tax&ots=rKIHNWZt4-&sig=IfMvTXlvHWxLQFWJPKo35nAHJPw#v=onepage&q=sweden%20carbon%20tax&f=false

5-15%, again with negligible impact on economic performance[193,194]. In Denmark, it was found that CO_2 emissions decreased by 14% between 1990 and 2012, after the implementation of a carbon tax, and are projected to have reduced by 23% compared to 1990 in 2035.[195]

In the United States, the Regional Economic Modeling Institute (REMI) report modeling for a federal carbon fee throughout the US at $\$50/tCO_2$ would see a decline in CO_2 emissions to just under 6 million metric tons by 2040, which would correspond to a 16% decrease in CO_2 emissions from a 2016 baseline.[196] CBO has also conducted a range of studies into emission-reducing policies. CBO estimated that a $\$20/tCO_2$ charge would reduce total U.S. CO_2 emissions between 2012 and 2021 by about 8 percent.[197]

Economic Issues

Effect on Renewable Energy

Renewable energies are becoming cheaper, but public policies that encourage the adoption of emissions-free energy are crucial to the continued reduction in price of renewables. In the past 30 years, the price of renewables has fallen steeply. Photovoltaic module costs have decreased 10% per year over the past 30 years and the cost of wind turbines have decreased by 5% per year over the same time period. Production levels for both technologies have risen by approximately 30% per year.[198] Technical advances in renewable energies have been driven by public policies and industries' responses to them. Government incentives are essential to market growth and investment in renewable technologies in the private sector, which currently amounts to about $250 billion globally.[199] The fee imposed on carbon extraction by the carbon cashback policy would incentivize the investment in renewable technologies, which will decrease the cost of these technologies and also spur technological advances that will make them more effective.[200] In New Jersey specifically, about 3.4% of energy generated in-state comes from renewable sources, 74% of which is solar. The majority of solar production is distributed, meaning it comes from small scale installations in homes and businesses.[201] Under New Jersey's renewable

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[193] Rodio 2016: https://publicpolicy.wharton.upenn.edu/live/news/1520-analyzing-british-columbias-carbon-tax
[194] World Bank 2017: https://openknowledge.worldbank.org/bitstream/handle/10986/26300/Carbon%20Tax%20Guide%20-%20Appendix%20web%20FINAL.pdf
[195] Ibid.
[196] REMI 2014: https://www.dropbox.com/s/22lrokkdaf4a8fh/The-Economic-Climate-Fiscal-Power-and-Demographic-Impact-of-a-National-Fee-and-Dividend-Carbon-Tax-6.9.14.pdf?dl=0
[197] CBO 2013: https://www.cbo.gov/sites/default/files/113th-congress-2013-2014/reports/Carbon_One-Column.pdf
[198] Trancik 2014: https://www.researchgate.net/publication/261000409_Renewable_energy_Back_the_renewables_boom
[199] Ibid.
[200] Meltzer 2014: http://www.felj.org/sites/default/files/docs/elj351/14-45-Meltzer_Final%205.13.14.pdf
[201] EIA 2017: https://www.eia.gov/state/print.php?sid=NJ

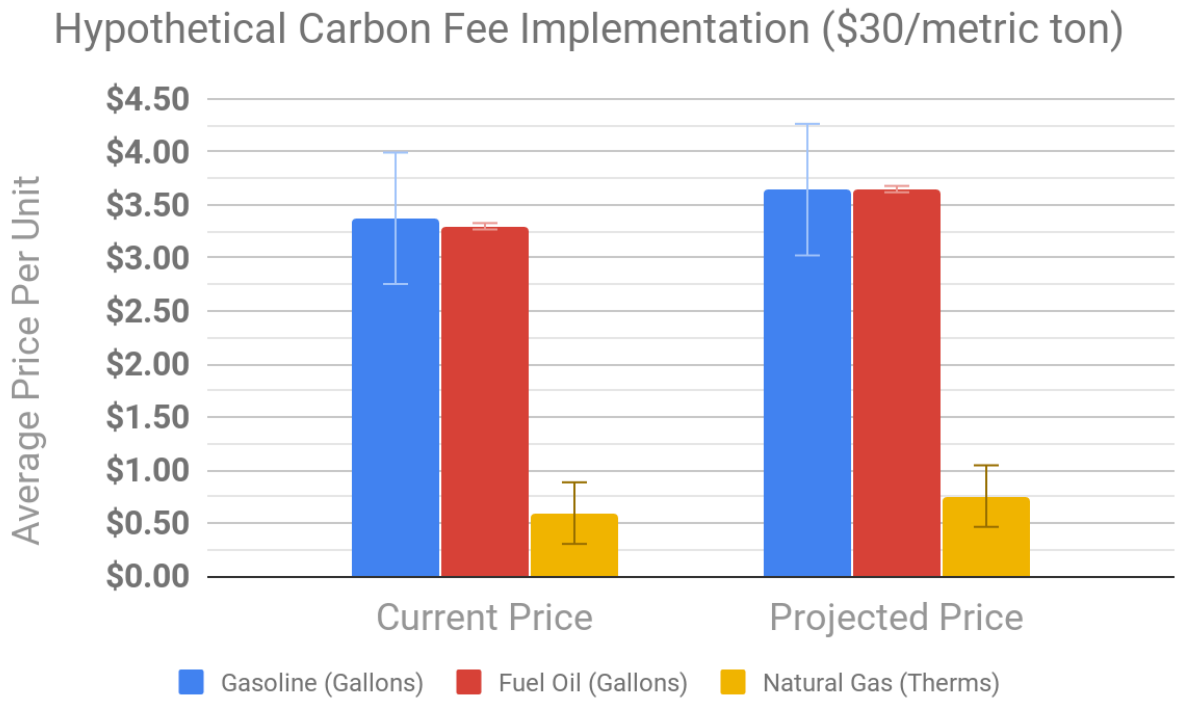
portfolio standard (RPS), 50% of the energy sold in-state must come from renewables by 2030.[202] However, current NJ utility portfolios have only 5-16% renewables.[203] Though New Jersey has begun to accelerate its installation of solar in recent years, as well as opening the possibility of offshore wind installation on the Atlantic coastline[204], according to the EIA's 2018 Annual Energy Outlook, the national share of renewables will only increase ~4% by 2030 if no new policies are put in place. Assuming that New Jersey trends similarly, policies that incentivize renewables will be crucial for New Jersey to meet its RPS targets. While New Jersey lacks the capacity to significantly increase onshore wind energy and hydropower, there are significant opportunities for investment in solar, offshore wind, and biomass technology, which will be needed to ensure compliance with the renewable portfolio standards.

Energy Price Increases Per Fee Scenario

A carbon cashback policy reduces emissions by increasing the relative cost of carbon-intensive processes. To calculate this cost increase, we use the EPA Greenhouse Gas Equivalencies Calculator with the average CO_2 emissions of gasoline and natural gas.[205] As shown below, gasoline prices are expected to increase by roughly 10%, while natural gas prices would increase somewhat more. Prices would gradually increase further if the carbon fee rose by \$5/tCO_2 per year. Considering that the average gasoline price in NJ fluctuated between \$2.30/gallon to \$2.93/gallon in the most recently analyzed 365-day span,[206] a 27-cent increase would not be unheard of. Nevertheless, the household dividend is crucial for protecting consumers from these higher rates.

Fuel	Increase from \$30/tCO2	Relative Increase
Gasoline	\$0.267 per gallon	9.4% - 11.2%
Natural Gas	\$0.1589 per therm	13.7% - 15.9%

[202] Energy.gov 2018: https://www.energy.gov/savings/renewables-portfolio-standard-0
[203] Utility portfolio data from the most recent (2017) statements: PSEG, Jersey Central Power & Light, Atlantic City Electric, and Rockland.
[204] EIA 2017: https://www.eia.gov/state/print.php?sid=NJ
[205] EPA 2018 (accessed 9/25/2018): https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references
[206] Historical Gas Price Charts, Gas Buddy New Jersey 2019: http://www.newjerseygasprices.com/retail_price_chart.aspx



Average Revenue and Cost per Household

Based on total fossil fuel consumption in New Jersey in 2015 and associated emissions, we find that a $30/ton CO_2 price would raise approximately $3.2 billion annually, which, with 70% of the proceeds equally divided among New Jersey's 8.95 million residents (where children receive half of a share) corresponds to $282 in returned revenue per person per year.

Based on average energy usage and emissions per household in New Jersey, we estimate the average annual cost per New Jersey household to be $383. Note that this is per household, not per person. One should also note that this is only an average; the effects will vary significantly by residents' energy usage. More details are shown below.

Poverty and Energy in Context

Approximately 10% of residents of New Jersey live in poverty.[207] Since low-income households pay a disproportionate amount of their income on direct energy costs, a carbon fee could significantly increase their living expenses.[208] A study by Drehobl and Ross of the American Council for an Energy-Efficient Economy examined energy costs for metropolitan

[207] US Census 2017: https://www.census.gov/quickfacts/NJ
[208] Drehobl & Ross 2016: https://energyefficiencyforall.org/sites/default/files/Lifting%20the%20High%20Energy%20Burden_0.pdf

households across the U.S. in various income brackets. They found that the median US energy burden (the percentage of household income spent on energy bills) across all cities was 3.5%, whereas the median low-income household's energy burden was 7.2%. The study found that households with a median annual income of $90,000 had an energy burden of 2.3%. They also found that the average energy burdens were 5.0% for low-income households living in multifamily buildings, and 4.0% for renting households. In more than a third of the cities studied, a quarter of low-income households experienced energy burdens greater than 14%. It is therefore important that any carbon cashback policy meant to include any outstanding externalities in the price of fossil fuels be carefully designed with vulnerable households like these in mind. Some of these costs are offset in New Jersey by assistance programs such as LIHEAP.

We discuss one option to quickly and easily reduce household energy costs for low-income households: retrofit programs. This suggestion is complementary to our current proposal.

Effects on Energy Demand

We highly recommend that a detailed study be performed to see how this would affect energy demand. Unfortunately, we currently lack the data or economic background to perform such a calculation at a precise enough detail. In this section we provide a general calculation.

A price on carbon can have two effects on energy: demand can reduce or energy supply can transition to emissions-free energy. Here we consider the possible effect of a carbon fee on energy demand, based on energy price elasticities.

Energy price elasticity is the proportion by which energy demand decreases given a certain proportional change in energy price. Many studies have concluded that energy prices are relatively inelastic. Gholami estimates that the price elasticity for natural gas in the commercial sector subject to a carbon fee is -0.35; previous researchers had identified values ranging from -0.05 to -1 (Gholami 2014). Rivers and Schaufele, 2015 estimate the short-term price elasticity for gasoline in British Columbia to be -0.1. In power, long-run price elasticity has been estimated at between -0.15 and -0.35.[209] When summarizing results from a few countries around the world, the IPCC claimed that residential energy price elasticities tend to be lower in the richest countries. In the UK, long-run price elasticity for the household sector is only –0.19, in the Netherlands –0.25 and in Texas only –0.08.[210, 211, 212] A recent result based on large metropolitan

[209] Sebold & Parris 1989: https://www.researchgate.net/publication/236555202_Residential_End-Use_Energy_Consumption_A_Survey_of_Conditional_Demand_Estimates
[210] Eyre 1999: https://www.researchgate.net/publication/222734334_A_golden_age_or_a_false_dawn_Energy_efficiency_in_UK_competitive_energy_markets
[211] Joosen et al. 2004: https://inis.iaea.org/search/search.aspx?orig_q=RN:35101360
[212] Bernstein & Griffin 2006: https://www.nrel.gov/docs/fy06osti/39512.pdf

areas in the U.S. over 1997-2007 finds electricity demand elasticity of -0.667 to -0.860, and gas demand elasticity of -0.566 to -0.693.[213] Thus, energy demand can be seen as relatively inelastic.

The high uncertainty associated with estimating elasticities complicates matters; to understand the outcome range, the table below shows the effects on consumption for a low elasticity scenario (-0.15) and a high elasticity scenario (-0.60), based on the price increases from Section: Energy Price Increases Per Fee Scenario. Because the calculated changes in energy consumption are short-term estimates, there are certain factors that may not be accounted for. For gasoline, it is unlikely that residents will drastically change their consumption over a few months (e.g. selling their car and buying a new one, changing the commute between their home and workplace, etc.), since cars usually stay on the road for 15 years. Similarly, appliances can be kept for many years and heating systems last 20-30 years (or longer) in homes. Finally, we do not include the elasticity of future energy demand as New Jersey's energy sources will likely be much different by then.

Energy Commodity	Consumption Decrease: Low Scenario (-0.15)	Consumption Decrease: High Scenario (-0.60)
Gasoline	1.3-1.7%	5.3-6.6%
Natural Gas	2.0-3.1%	7.9-12.3%

In practice, following the implementation of British Columbia's \$30/tCO_2 fee, it is estimated that residential energy consumption fell by about 15% and gasoline sales fell by 11-17% between 2008 and 2014. Since 2008, the tax has reduced fuel consumption by 5-15%, while the rest of Canada saw its usage increase during this same time frame (Rodio 2016).[214] We therefore expect our policy to cause a small yet non-negligible decrease in NJ's energy demand.

Leakage

One potential problem with the implementation of the carbon cashback proposal is the potential for leakage - defined as "the increase in CO_2 emissions outside the countries taking domestic mitigation action divided by the reduction in the emissions of these countries", although the definition is also extended to states as well as countries in this paper.[215] Leakage usually entails the movement/outsourcing of industry or movement of economic activity such as consumer spending in order to avoid the carbon fee, which would render the fee ineffective at reducing global carbon emissions, and would lead to a loss of jobs.

[213] Alberini et al. 2011: https://www.sciencedirect.com/science/article/pii/S0140988311000351
[214] Rocio 2016: https://publicpolicy.wharton.upenn.edu/live/news/1520-analyzing-british-columbias-carbon-tax
[215] IPCC AR4 2007: https://www.ipcc.ch/publications_and_data/ar4/wg3/en/ch11s11-7-2.html

Leakage has been a significant worry for carbon mitigation schemes in the past, both nationally and internationally. One example is seen with the Kyoto Protocol which was estimated to cause a 10.5% leakage of GHGs from developed to developing countries[216] while in British Columbia certain groups such as the BC Chamber of Commerce were concerned with the threat of leakage via cross-border gasoline purchases between both Alberta and Washington.[217] Any proposal to implement a carbon cashback policy in New Jersey must therefore take measures to prevent carbon leakage.

California provides a specific case study of how leakage can be addressed between US states after the passage of the 2006 AB32. One study showed that California would have increased out-of-state emissions by 45% if the cap and trade policy did not apply to imported electricity, while the leakage drops to 9% when imported electricity is included.[218] This demonstrates how an out-of-state adjustment can minimize leakage, provided that such a policy is uniformly applied, albeit showing that leakage may not be completely avoided. We therefore recommend a similar adjustment for New Jersey.

In addition, because the initial carbon fee would increase average state gasoline prices by 27 cents, there would likely be some leakage from drivers in NJ's border counties refueling in the neighboring states of Delaware, New York, and Pennsylvania (where average gasoline prices in 2017 were 11 cents lower, 13 cents higher, and 19 cents higher, respectively, than New Jersey's.[219] As a rough calculation for the potential for gasoline leakage in New Jersey, comparisons were conducted between gas prices of the border countries of NJ, DE, PA, and NY. For example, there is a border between Salem County, NJ, and New Castle County, DE. The average gasoline prices per US gallon for each county were sourced from AAA, and as an approximation for the initial carbon fee, a cost of $0.27 per US gallon was added to any New Jersey gasoline price.

To find the maximum distance from the NJ border where it would be cost-effective to refuel out-of-state (shown in table below), we used the following equation:

*NJ Price * Normal Refill = Out-of-state Price * (Normal Refill + Round-trip distance / mpg),* or
*Round-trip distance = [(NJ Price / Out-of-state Price) - 1] * Normal Refill * mpg*

Vehicle Type	Tank Size	Fuel Efficiency	Miles from	Miles from	Miles from

[216] Paltsev 2001: http://www.jstor.org/tc/accept?origin=/stable/pdf/41322930.pdf?refreqid=excelsior:5865db60fdd7a3c4954f3b3ac562c970
[217] Harrison 2013: https://search.proquest.com/docview/1447222759?pq-origsite=gscholar
[218] Caron et al. 2012: https://www.researchgate.net/profile/Justin_Caron/publication/267508014_Leakage_from_Sub-national_Climate_Policy_The_Case_of_California's_Cap-and-Trade_Program/links/5451001a0cf249aa53dc8dd5/Leakage-from-Sub-national-Climate-Policy-The-Case-of-Californias-Cap-and-Trade-Program.pdf
[219] AAA 2018: https://gasprices.aaa.com/state-gas-price-averages/

	(gallons)	(miles per gallon)	Delaware	Pennsylvania	New York
Compact Car	16	30	36-43	8-14	0-22
Sports Utility Vehicle	30	21	51-60	11-19	1-31

When using an upper bound of a 16 US gallon gasoline tank, and an efficiency of 40 mpg we calculated the distance that you would have to live away from the state border for it to be cost-ineffective (I.e: it would remain cheaper to fill up in NJ, thus ensuring that there is no carbon leakage). In almost all cases, it is cost-effective to travel to another state when living in a border county. It is still possible that leakage would not be as significant due to the additional factor of time: having to drive a long distance, especially in regions of heavy traffic, could easily deter people from driving out of state to fill up (especially in Bergen or Middlesex County), however, this is very hard to quantify.

Using different estimates for tank capacity and fuel efficiency gives slightly different results. It is always cost-effective to cross the border in counties bordering Delaware for a compact car (16 US Gal, 30 mpg), but it is not always cost-effective in counties bordering Pennsylvania or New York. Due to the high fuel tank capacity of SUVs (30 US Gal, 25mpg), transportation leakage is cost-effective for such vehicles in almost any border county.

These calculations may overestimate leakage for multiple reasons:

1) They ignore the additional factor of time, which could provide an additional deterrent from driving out of state to refuel (particularly in regions of heavy traffic such as Bergen or Middlesex county).
2) They assume that nearby states will not adopt other policies to reduce transportation emissions; in reality, the region is already working to implement such policies with the Transportation and Climate Initiative. Should they continue to do so, the risk and impact of leakage would be significantly reduced.

In addition, a carbon fee could incentivize carbon-intensive industries and manufacturers to relocate to neighboring states, which could negatively impact New Jersey's economy. This underscores the importance of allocating part of the revenue as a vulnerable business rebate to minimize business leakage.

Finally, it is important to realize that if New Jersey successfully introduces a carbon cashback policy, it encourages other states to follow by improving the political feasibility of other ongoing proposals. Indeed, many states, including Massachusetts, Maryland, and Rhode Island, are all already considering similar policies (Proposals in Other States). Not only would this minimize any risk of leakage, but it would be instrumental in establishing New Jersey as a leader of environmental policy, and mitigating climate change caused by the United States.

Effects on Employment

Currently, NJ is at near full employment, with recent unemployment rates below 5%.[220] The imposition of a carbon cashback policy increases the cost of a key input (energy), and therefore has the potential to have negative effects on output. Generally, that means that a carbon fee will reduce output, real wages (since the costs of living increase without wages increasing) and employment. However, these effects can be addressed by recycling the revenue internally, such as in the form of targeted investments.

The most direct real world evidence comes from British Columbia, where a carbon fee was imposed in 2008. Overall employment rose in British Columbia by 0.74% per year on average from 2007 to 2013. The same study found that energy-intensive and trade-intensive industries faced increased unemployment risk, but growth in cleaner industries offsetted the effect on energy-intensive industries.[221] Another recent study found that the fee's negative output effects in energy-intensive sectors were compensated with stronger growth in cleaner sectors and that employment was positively affected.[222,223]

No NJ-specific employment model was available for our use. However, Regional Economic Modeling, Inc. (REMI) has modelled the effect of similar proposals in the states of Arkansas,[224] Massachusetts,[225] Rhode Island,[226] Vermont,[227] and Washington[228] and found a slight increase in employment for each case, from 0.25% in Vermont to 1.5-2.0% in Arkansas (Nystrom 2015a, Nystrom 2015b, Nystrom 2014, Breslow et al. 2014, Office of Financial Management 2015). Assuming a similar response in New Jersey, we would expect our proposal to result in a slight increase in NJ's long-term employment, also considering that NJ has little fossil fuel extraction industry.

Finally, a 2014 REMI model of a national, revenue-neutral policy estimated that 2.1 million jobs could be created, in part because the dividend could encourage consumer spending. A fee beginning at $10 and increasing annually by $10 is estimated to create 322,000 jobs in the Mid-Atlantic region (New Jersey, Pennsylvania, New York) by 2035 (Nystrom and Lucknow 2014). While these figures apply nationally, they are indicative that a carbon cashback scheme is in fact a job creator.

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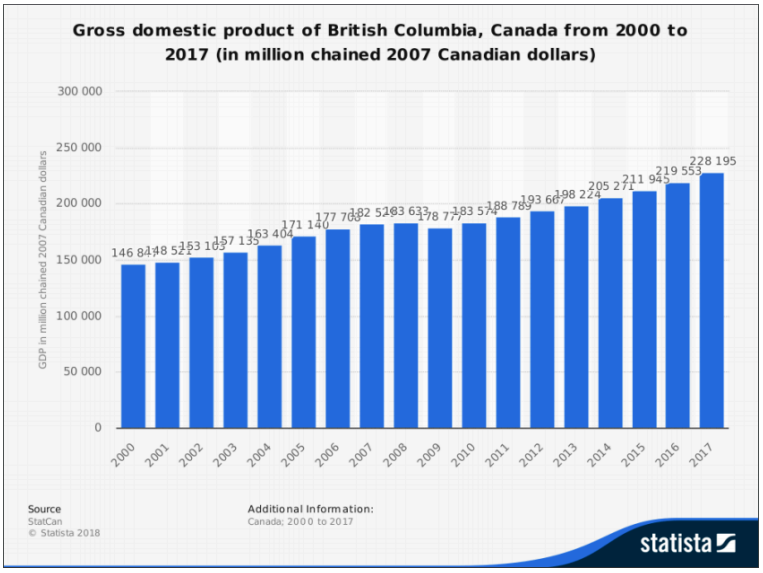
[220] BLS 2018: https://www.bls.gov/eag/eag.nj.htm
[221] Yamazaki 2017: https://ideas.repec.org/a/eee/jeeman/v83y2017icp197-216.html
[222] Murray & Rivers 2015: http://nicholasinstitute.duke.edu/publications
[223] Yamazaki 2017: https://ideas.repec.org/a/eee/jeeman/v83y2017icp197-216.html
[224] REMI 2015: https://drive.google.com/open?id=0B9liTcwr6uHoaG5oaXB5SmFzb2M
[225] Breslow et al. 2014: https://drive.google.com/open?id=0B9liTcwr6uHoU0hKeTJNQm1Oa0k
[226] REMI 2015: https://drive.google.com/open?id=0B9liTcwr6uHoWkpNWDdFQ0Y0SDA
[227] REMI 2014: https://drive.google.com/open?id=0B9liTcwr6uHoX3J3RDQycjF1NXc
[228] Washington State Office of Financial Management 2015: https://drive.google.com/open?id=0B9liTcwr6uHoSzhfLTBxUmdVTE0

Effects on Overall Economy

Because no statewide carbon cashback policy has yet been implemented in the US, we use British Columbia's 2008 carbon tax as the closest analog. As shown below, BC's GDP grew at a similar rate in 2010-2017 as it did before the tax in 2000-2007. Although BC's GDP declined slightly in 2009 (Statista, 2018), we suspect this is due to the 2008 Financial Crisis rather than the carbon tax . We therefore conclude that the carbon tax did not harm BC's economic growth. Assuming that NJ's economy would respond similarly, we would expect our policy to have a negligible effect on New Jersey's overall GDP.



Effects on Vulnerable Sectors

New Jersey's sectors, in descending order of employment, are listed in the below graph[229]

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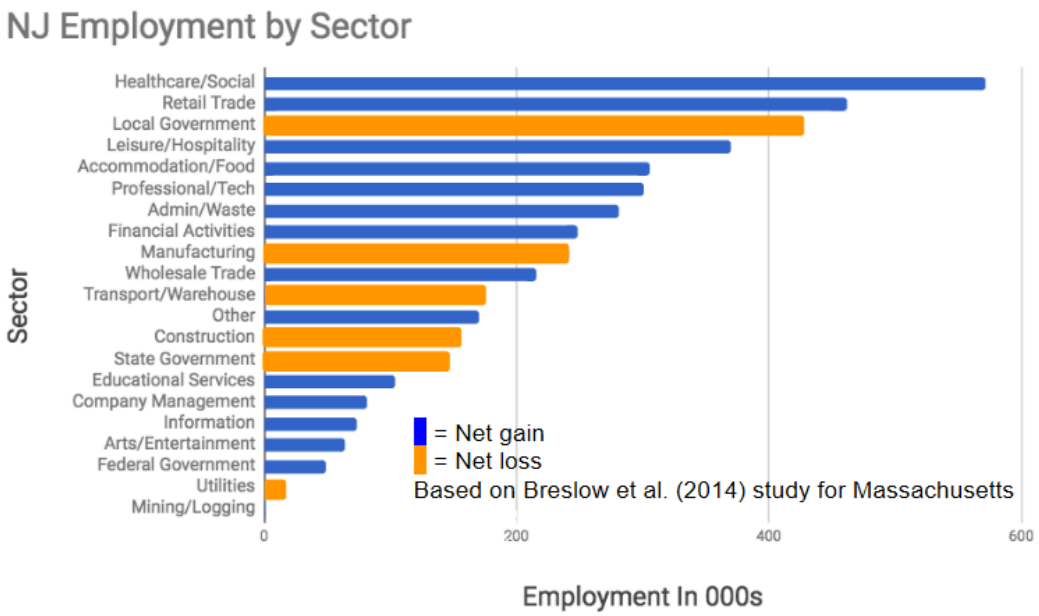
[229] 2016 Employment Data. http://lwd.state.nj.us/labor/lpa/employ/ces/ces_index.html



The Massachusetts Department of Energy Resources report analyzed a \$10/ton CO_2 fee that increases \$5 each year until it reaches \$30, and then increases to \$75 after another 20 years. A mixed household and business rebate was proposed. It found that most industries are either benefitted or unaffected by a carbon cashback policy, with rebate uniform to all industries. Finance, Information, Health, Education, Retail and Wholesale Trade, Entertainment/Recreation, and others all see increases in employment. However, State and Local Government, Construction, Utilities, Transportation and Warehousing, Manufacturing and Mining are hurt in employment. On net, employment increases, and gains tend to occur in localized, labor-intensive industries with more staples-spending, instead of on energy commodities.[230]

We next analyzed the national study by REMI, with a \$10/tCO_2 fee rising \$10 per year and 100% household rebate. Out of all 70 NAICS (North American Industry Classification System) sectors in the Mid-Atlantic Region (New Jersey, Pennsylvania, New York), only 9 sectors: oil and gas extraction, mining, utilities, computer and electronic manufacturing, electrical equipment and appliance manufacturing, apparel manufacturing: Leather and allied manufacturing, air transportation, scenic and sightseeing transportation, support activities for transportation, and management of companies and enterprises, lose in employment. These losses are substantially outweighed by gains in employment elsewhere, leading to the projected 327,000 jobs gained in the region by 2035 (Nystrom and Luckow 2014).[231]

In conclusion, although overall employment in New Jersey may increase, a minority of sectors are projected to lose jobs. Sectors that may be vulnerable to employment losses include Local Government (10.2% of NJ employment), Manufacturing (5.9%), Construction (3.8%),

[230] Breslow et al. 2014, Figure IV.22: https://drive.google.com/open?id=0B9liTcwr6uHoU0hKeTJNQm1Oa0k
[231] REMI 2014, Figure 6.9: https://citizensclimatelobby.org/wp-content/uploads/2014/06/REMI-carbon-tax-report-62141.pdf

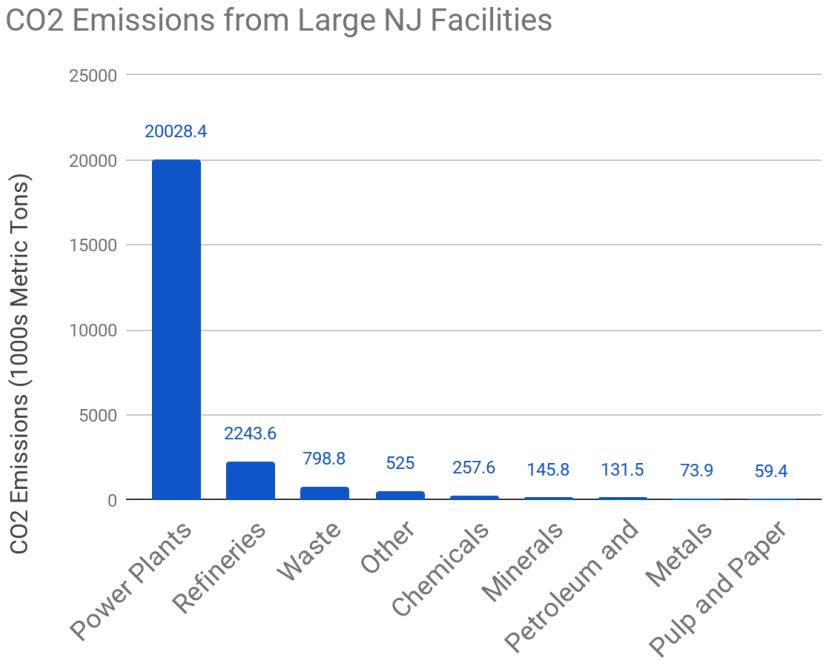
State Government (3.5%), Transportation (3.3%), Utilities (0.35%), and Mining (0.03%). Collectively, these sectors make up 28% of total New Jersey employment. These sectors should be considered when designing the rebate for vulnerable businesses and institutions.

Effect on High-Emissions Facilities, by Sector

To identify those facilities and sectors that would be most impacted, we analyzed a list of 90 high CO_2-emitting facilities in New Jersey from the EPA FLIGHT database.[232] These facilities emitted a combined 24.3 MMt/CO_2e in 2016, making up about 22% of New Jersey's 112 MMt/CO_2 emissions (EIA 2015). The represented sectors are Power plants, Refineries, Waste, Chemicals, Minerals, Petroleum and natural gas, Metals, Pulp and paper, and others. Unfortunately, the EPA database cannot distinguish between emissions from electricity and other sources. Therefore, this analysis does not account for the policy's electricity exemption, which would make costs somewhat lower than are presented here.

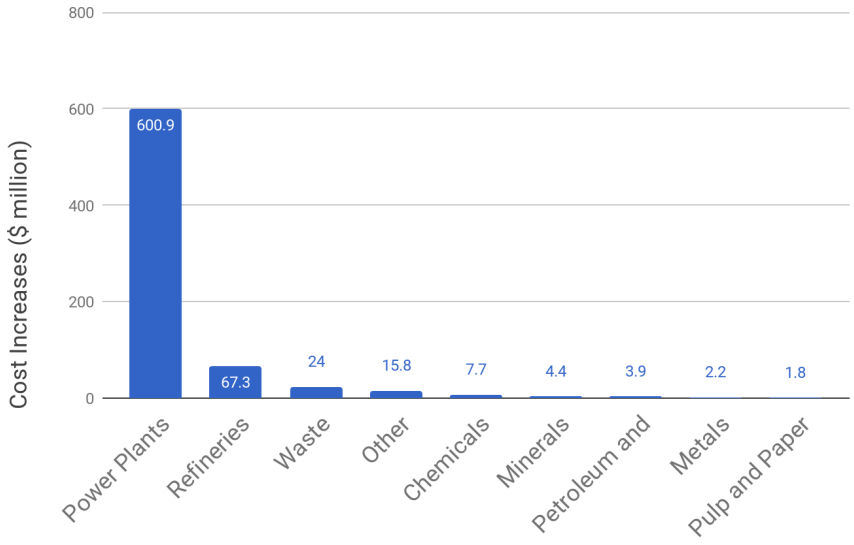
The figure below shows the potential cost to each sector under a \$30/tCO_2 carbon fee, which is directly proportional to the sector's CO_2 emissions. The Power plant, Refineries, and Waste Sectors would pay the most, since they are the largest emitters (20 million tons of CO_2, 2.2 million tons of CO_2 and 0.8 million tons of CO_2). Further details can be found in Appendix: Effect on High-Emissions Facilities.

We recommend that the vulnerable business rebate be designed with these facilities in mind, while still encouraging businesses to reduce their carbon footprints**.**



[232] EPA 2018 (accessed 1/30/2018): https://ghgdata.epa.gov/ghgp/main.do

Cost Increases, Without Excluding Electricity



Emissions and Carbon Fees of Large Facilities, Without Excluding Electricity

SECTORS	GHG QUANTITY (METRIC TONS CO_2 equivalent)	$30 fee ($m)
Power plants	20,028,392	600
Refineries	2,243,614	672
Waste	798,783	24
Other	524,996	16
Chemicals	257,635	8
Minerals	145,777	4
Petroleum and natural gas systems	131,523	4
Metals	73,920	2
Pulp and paper	59,379	2
ALL SECTORS	24,264,019	728

Economic Effects in Existing Implementations

Where a carbon cashback policy has been implemented, it was found to have either a positive or negligible effect on the economies of those regions. In Denmark, the carbon feedid not harm the economy: most increases in energy costs were offset by reduced tax burdens and energy efficiency subsidies, and the impact on employment, consumption, and international competitiveness was insignificant. In fact, because so many companies transitioned to more efficient and less energy intensive practices, "businesses and industries become less sensitive to energy prices all together," with the average percentage of costs devoted to energy amongst all businesses significantly lower than the regional average.[233] According to the Danish National Bank, "this gives Danish industry a competitive advantage, especially when energy prices rise.[234] Over 2015 and 2016, Irish per capita GDP growth measured an average of 5.4%, despite being heavily hit by the global recession that began in 2008.[235] In British Columbia, after the implementation of their carbon tax in 2008, real GDP increased by 12.4%.[236] While the increase in GDP cannot be attributed to the carbon tax alone, clearly the carbon tax did not harm the economic growth of BC, which remained competitive with the rest of the country.[237]

Effect on Agriculture

Agriculture represents 9% of all greenhouse gas emissions in the United States,[238] although this percentage is much lower in New Jersey.[239] The energy usage can be broken down into the categories of direct and indirect: direct constitutes the energy consumed as a result of activities on farms, while indirect is from the manufacturing of agriculture inputs like fertilizers and pesticides.[240] As an example, energy costs for common New Jersey crops of soybeans and corn[241] are about 37% of total operating costs.[242] A carbon fee would likely increase the cost of energy-intensive processes like producing fertilizer, and therefore increase the energy cost of crops. However, while it has been shown that farmer operators often "adjus[t] their production in

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[233] Danish Energy Agency. 2000b. "Green Taxes in Trade and Industry – Danish Experiences." Copenhagen, Denmark: Danish Energy Agency.
[234] Ibid.
[235] World Bank 2017: https://openknowledge.worldbank.org/bitstream/handle/10986/26300/Carbon%20Tax%20Guide%20-%20Appendix%20web%20FINAL.pdf
[236] Government of British Columbia: https://www2.gov.bc.ca/gov/content/environment/climate-change/planning-and-action/carbon-tax
[237] Ibid.
[238] EPA 2018: https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions#agriculture
[239] NJDEP 2017: https://www.nj.gov/dep/aqes/NJ_GHGinventory2015Update.pdf
[240] EIA 2014: https://www.eia.gov/todayinenergy/detail.php?id=18431#
[241] NASS 2018: https://www.nass.usda.gov/Quick_Stats/Ag_Overview/stateOverview.php?state=NEW%20JERSEY
[242] EIA 2014: https://www.eia.gov/todayinenergy/detail.php?id=18431#

response to higher fuel and fertilizer prices,"[243] energy price increases in the 2001-2011 period actually resulted in increased adaptation of more energy-efficient practices and input use so that energy usage stayed constant or fell.[244] In this way, though overall production costs might rise, increased energy efficiency could mitigate the policy's financial effects on agriculture.[245]

Using Carbon Fee Revenue to Support Sustainable Agricultural Practices

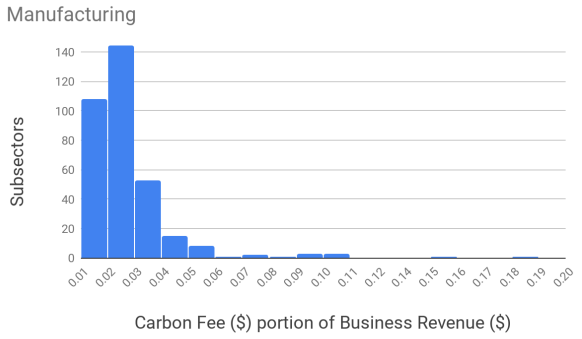
There are a variety of state programs involving sustainable agricultural practices that are available to farmers. As such, they could benefit from funding support from the carbon fee revenue. The Departments of Environmental Protection and Agriculture provide grants for research and education for different purposes, including commercial producers, service providers, educators, academic institutions, and local districts[246,247]. Other states have policies promoting soil health and sustainable practices. For example, Maryland unanimously passed the Healthy Soils Act, which provides education, research, technical and financial assistance to farmers to improve soil health[248]. This is echoed by the aforementioned grants and other efforts by the Natural Resources Conservation Service. The NRCS provides funding opportunities to help farmers reduce soil erosion and improve water quality[249]. However, one caveat to this program is that some stakeholders do not trust its effectiveness and deem it more of a name than a substantial institution.

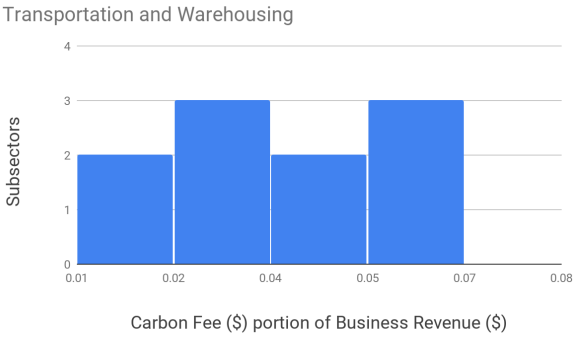
Impact of a $30/ton Fee on Operating Costs by Sector

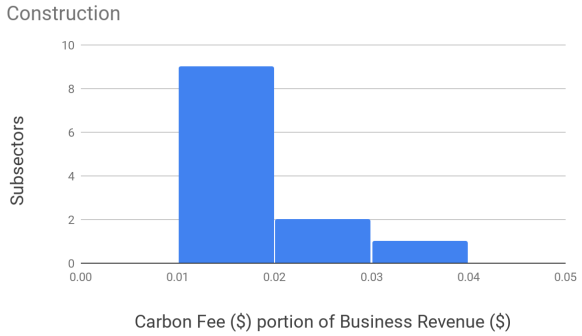
The Economic Input-Output Life Cycle Assessment (EIO-LCA) is a mathematically defined procedure that estimates the materials and energy resources required for, and the environmental emissions resulting from, activities in our economy. This is just one technique for performing a life cycle assessment, an evaluation of the environmental impacts of a product or process over its entire life cycle. The method uses information about industry transactions-purchases of materials by one industry from other industries, and the information about direct environmental emissions of industries, to estimate the total emissions throughout the supply chain. Most businesses and manufacturers do not experience a significant reduction in revenue except for a few exceptions, which are heavily dependent on carbon emissions, such as lime manufacturing. The most impacted sectors are Manufacturing and Transportation and Warehousing. Out of 490 total sectors, about 78 sectors had revenue cuts less than 1%, and many were nonessential. The average fee per dollar revenue for all sectors in the data is $0.02 while the median is $0.02. The (rounded) minimum is $0.00; the rounded maximum is $0.44. The

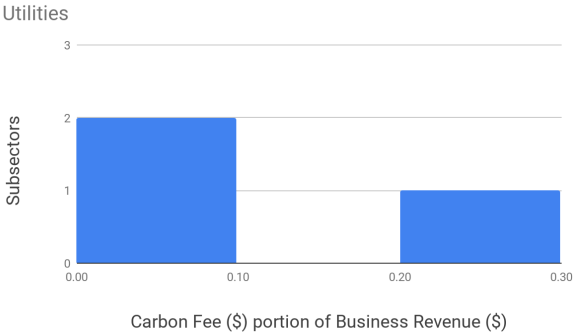
[243] Hitaj and Suttles 2016: https://www.ers.usda.gov/webdocs/publications/74658/60128_eib159.pdf?v=0
[244] Beckman et al. 2013: https://ageconsearch.umn.edu/bitstream/149033/2/eib-112.pdf
[245] Ibid.
[246] https://www.nj.gov/dep/
[247] https://www.nj.gov/agriculture/
[248] https://fairfarmsnow.org/press-release-gov-sign-healthy-soils-legislation/
[249] https://www.nrcs.usda.gov/wps/portal/nrcs/site/national/home/

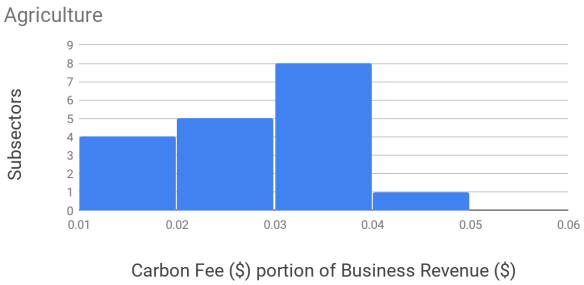
average fee per dollar revenue for all sectors impacted by over $0.01 in fee per dollar revenue is $0.03 while the median is still $0.02. A more detailed report can be found here. Below are the histograms of costs for the sectors of most concern (Manufacturing, Transportation and Warehouse, Construction, Utilities, and Agricultural).











Potential Avenues for Targeted Investment

Investments can help mitigate emissions, assist heavily impacted communities, and promote adaptation to the effects of climate change. This section explores potential avenues for the 20% of the policy's revenue that would go toward investments.

Climate Adaptation

Climate adaptation can be defined as "efforts to reduce the vulnerability of society to climate change impacts."[250] It acknowledges that unavoidable changes are already occurring to our climate and that we must take measures to protect vulnerable communities from the massive disruption that rising temperatures, extreme weather, and sea-level rise, among other issues, are already creating.

As discussed earlier in this paper, NJ will face severe impacts from climate change in the following areas: coastal communities; the fishing industry; agriculture; air quality; extreme heat; extreme weather/natural disasters; and sea level rise/flooding. While the Department of Environmental Protection (NJDEP) has convened the New Jersey Climate Adaptation Alliance, a coalition of various NGOs, businesses, academic institutions, and government agencies to assess the risks from climate change and adaptation needs of the state,[251] no formal, comprehensive adaptation plan has been adopted by the NJDEP to address these issues[252].

Thus far, the majority of work on climate change adaptation in New Jersey has occurred in the wake of Hurricane Sandy in 2012 in response to the allocation of disaster assistance funding under the FEMA hazard mitigation program. The state created the Office of Flood Hazard Risk Reduction Measures under the NJDEP, which is responsible for a number of initiatives: beach and dune construction and protection programs; buyouts of property in repetitive flood loss areas, to minimize effects on people and property; the RREM and HMGP Elevation Programs, which provide grants to homeowners to incorporate more flood resilience measures in their homes; and the Flood Hazard Risk Reduction and Resiliency Grant Program, which provides funding to municipalities to pursue projects that reduce flood risk.[253]

The state also has several initiatives to promote energy resiliency in the face of weather emergencies, including setting aside $25 million in HMGP Energy Allocations for municipalities and other local entities for the development of alternative energy sources in the event of the failure of the main power grid, such as "microgrids, solar power with battery back-up, and natural gas-powered emergency generators". A further $13 million was allocated as a result of high demand and additional HMGP funding acquired to create the "Lifeline / Life Safety Program", which supports critical energy facilities.[254] Additionally, the New Jersey Energy Resilience Bank (ERB), funded by the federal grants, funds infrastructure projects that provide alternative energy sources specifically at critical facilities around the state, such as "water and

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[250] Bierbaum et al. 2014: https://nca2014.globalchange.gov/report/response-strategies/adaptation
[251] NJ Adapt 2015: https://njadapt.rutgers.edu/nj-climate-brochure/file
[252] Georgetown Climate Center 2017: https://www.georgetownclimate.org/adaptation/state-information/new-jersey/overview.html
[253] NJ GORR 2018: http://nj.gov/gorr/resiliency/
[254] NJ Office of Emergency Management 2014: http://ready.nj.gov/mitigation/hazard-mitigation-grant-program.shtml

wastewater treatment plants, hospitals and long-term care facilities and shelters". Additional initiatives address resiliency concerns in transit infrastructure and liquid fuel facilities.[255]

Other areas have not yet received committed action from the state. In particular, the agricultural sector has identified improved vector and disease surveillance, the development of adaptive species to respond to changes in temperature and water quality, and the identification of alternative water sources as the highest priorities for the state. The NJCAA recommends that action be taken by the state to account for climate change effects in water supply planning, develop cost-effective weed/vector control strategies, formulate best management practices for reducing stormwater runoff, and to create "incentive programs to preserve, increase, or improve climate-resilient agricultural land".[256]

Public health is also a major concern area for environmental resilience, with stakeholders also identifying the need for a concerted policy effort to address the challenges posed by declines in air quality, increased spread of diseases, and new challenges for the operation of healthcare facilities. The NJCAA recommends that action be taken to develop and enforce of mold standards; to create educational programs for healthcare professionals in New Jersey to address the changing landscape of public health in the face of increased extreme weather events, air quality reductions, and other consequences of climate change; and to increase the number of studies regarding the impacts of flooding on the spread of contaminated soil.[257]

Finally, we also recognize the particular concerns of environmental justice communities, who are defined as predominantly low-income and minority communities who tend to be more vulnerable to environmental hazards and excluded from the environmental decision-making process.[258] When considering how to invest revenues from the carbon fee, the particular concerns of these communities should be carefully considered, and these communities must be consulted often in the policy development process to ensure that their challenges are addressed. We recommend that at least one fifth of the investments (4% of total revenue) are focused on these communities.

Environmental Justice Community

Typically, EPA anticipates awarding 50 grants on EJ projects nationwide, with each award being for up to $30,000. The total estimated funding for this competitive opportunity is approximately $1,500,000. The EJ Program is providing $1,200,000 of funding and the Urban Waters program contributing an additional $300,000.[259] In New Jersey, other than the EPA, the Clean Energy Fund (Public) and the Fund For New Jersey (Non Profit) also provide grants to EJ projects at times. Past EPA-funded programs in New Jersey include waste disposal (Hazardous

[255] NJ GORR 2018: http://nj.gov/gorr/resiliency/
[256] NJCAA 2014: http://njadapt.rutgers.edu/docman-lister/resource-pdfs/91-agriculture-stakeholder/file
[257] NJCAA 2014: http://njadapt.rutgers.edu/docman-lister/resource-pdfs/99-public-health-1/file
[258] NJDEP 2018: https://www.nj.gov/dep/ej/
[259] https://www.epa.gov/sites/production/files/2018-11/documents/fy2019_ejsg_rfp.pdf

Waste Permitting Program), policy development (New Jersey Energy Master Plan, Newark Resilience Action Plan, EJ Climate Change Policy, Air Monitoring Study), and environmental issues (Flood planning, Fish Advisories in the New York-New Jersey Harbor & Estuary, Sustainable Community Building).

Heating Assistance Program

New Jersey's Low Income Home Energy Assistance Program (LIHEAP) aids low income families with heating bills. Its funding depends on the allocation from the United State Department of Health and Human Services combined with unspent funds from the previous year.[260] The program's components are heating assistance, cooling assistance, crisis assistance, and weatherization assistance. It provides no incentive to adapt more efficient heating and cooling technologies.[261] There are several eligibility requirements for LIHEAP. First, the household must be responsible for heating/cooling costs either directly or have them included in rent. Thus, it does not apply to persons living in public housing nor those who receive rental assistance. In addition, the household's gross income must be less than or equal to 200% of the federal poverty level. Eligible households using natural gas or electricity for heating may have benefits directly sent to utilities, though in most cases will receive a two-party check in the name of applicant and fuel supplier if the households directly pay the fuel supplier. Households that have heating costs included in rent receive a single party check. Medically necessary cooling assistance is set at $200 issued as direct credit or as a one party check.[262] On the other hand, heating assistance depends on the circumstances and usually ranges from $0-$3502, but can exceed $3503.[263] Crisis and weatherization assistance offers heating system repairs and replacements.[264]

Energy Efficiency Programs

Energy efficiency programs in New Jersey are good potential investments, particularly those that reduce natural gas use (since natural gas is priced while electricity is not). The Clean Energy Program, which derives its funding from a charge on customers' utility bills, provides many incentives for improving the efficiency of appliances.[265] On one hand, there are residential programs, one of which is the rebates for Energy Star appliances. There are several rebates offered for LED lighting, washers, dryers, and fridges, and recycling of old machines (e.g. fridges, freezers, AC units, and dehumidifiers). However, the maximum rebate is $500 per

[260] NJ Department of Community Affairs: http://www.nj.gov/dca/divisions/dhcr/offices/docs/liheap_handbook.pdf
[261] NJ Department of Community Affairs: http://www.nj.gov/dca/divisions/dhcr/offices/docs/liheap_model_plan.pdf
[262] NJ Department of Community Affairs: http://www.nj.gov/dca/divisions/dhcr/offices/heausfincomefact.html
[263] NJ Department of Community Affairs: http://www.nj.gov/dca/divisions/dhcr/offices/docs/liheap_benefit_amt_tbl.pdf
[264] NJ Department of Community Affairs: http://www.nj.gov/dca/divisions/dhcr/offices/docs/liheap_model_plan.pdf
[265] NJ Clean Energy: http://www.njcleanenergy.com/

household.[266] The Home Performance with Energy Star Program is a rebate and loan program. It applies to 2-4 unit single family homes, townhouses, and 5+ unit multifamily dwellings. Multifamily dwellings must be at maximum 3 stories, under single ownership, and have available data of total building energy use. The work must be performed by a BPI GoldStar contractor who is a registered Trade Ally of the Clean Energy Program. Single families can receive loans and rebates. The maximum 7-10 year loans can go up to $15,000 while rebates range from $2,000-$4,000. Multifamily loans range from $5,000-$15,000.[267] For builders of new homes, there is the Residential New Construction Program. Beneficiaries must meet one of 3 standards: Energy Star Certified Home v3.1 Requirements; Zero Energy Ready Home & Zero Energy Home + RE; or Energy Star Multifamily High Rise. Incentives start at $1000 for single family homes and $500 for multi-single and multi-family homes, with increasing benefits depending on home certification and energy savings.[268]

Next, the COOLAdvantage Program gives incentives ranging from $300-$500 to any resident with efficient heating/cooling technologies, including central AC; ductless mini split AC; and air source and geothermal heat pumps. However, new homes are not eligible.[269] This rule also applies to the WARMAdvantage Program, which requires installations to be retrofits. The program designates rebates for different appliances based on the heat source. Gas customers who use propane for heating have incentives for solar hot water heaters, gas furnaces, boilers, and water heaters. The gas appliances have concessions ranging from $250-$500, but the solar water heater has an incentive of $1,200. Appliances for electric customers also include the solar water heater, along with a heat pump water heaters; geothermal heat pumps; and air-source or ductless mini-split heat pumps. Not including the solar appliance, electric appliances have approximately the same incentive prices as the gas appliances, ranging from $300-$500. Oil heating customers only have oil furnaces and boilers, with incentive prices of $250 and $300, respectively. Larger rebates ranging from $700-$950 are given to combinations of water heaters with boilers or furnaces.[270] The Comfort Partners Program gives free efficiency upgrades (e.g. lighting, home and equipment insulation, HVAC system repairs, and appliance replacement) after an energy analysis. It applies for most New Jersey households with significant energy usage and an income at or below 225% of the federal poverty guidelines. Other stipulations include: the

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[266] DSIRE 2017: http://programs.dsireusa.org/system/program/detail/3031
[267] NJ Clean Energy 2018: http://www.njcleanenergy.com/files/file/Residential%20Programs/HP/Contractor%20Portal%20Documents/FY2019/2019%20FY%20NJ%20HPwES%20Eligible%20Measures%20and%20Cust%20Eligibility%20final(1).pdf
[268] NJ Clean Energy 2018: http://www.njcleanenergy.com/files/file/Residential%20Programs/NJ%20ENERGY%20STAR%20Homes/FY2019/Notice%20of%20FY19%20NJCEP%20Program%20Changes_RNCfinal.pdf
[269] NJ Clean Energy 2018: http://www.njcleanenergy.com/files/file/Program%20Guides/FY19%20HVAC%20Program%20Guide%20Final.pdf
[270] Ibid.

home must be used as the primary residence; the person must be the ratepayer of record with the utility.[271]

In addition, there are utility-based programs offered by other organizations besides the Clean Energy Program. The PSE&G Solar Loan Program accepts applications every other month until the capacity of 97.7 MW is met.[272] It also has the Government and Non-Profit Facility Direct Install Efficiency Program, which installs appliances for governments, non-profits, and some utilities. The facility must receive natural gas or electricity from PSE&G, and peak energy demand must be 200 kW or less to qualify.[273] New Jersey Natural Gas (NJNG) supplements the WARMAdvantage Program through the SAVEGREEN Project, which offers rebates and loans for appliance installation in houses.[274] NJNG has a similar program that gives the same benefits to industries and businesses.[275]

On the other hand, the Clean Energy Program also has non-residential programs. The SmartStart Build Program gives incentives to commercial and industrial organizations for efficiency measures, such as applications.[276] The Local Government Energy Audit offers a complete reimbursement of qualified energy audits, up to an incentive cap, for governments and nonprofits.[277] The New Jersey Energy Savings Improvement Program allows public facilities to enter into long-term energy savings agreements.[278] For buildings with peak demands over 200 kW, Pay for Performance provides experts to assist with energy reduction[279]. Similarly, the Large Energy Users Program give eligible industrial facilities incentives for decreasing energy usage. The requirements are that the entities have contributed a minimum of $200,000 to New Jersey's Clean Energy Program in the fiscal year of 2017 and the peak demand of the facilities must be at least 400 kW.[280] Direct Install gives customers with a peak demand less than 200 kW an energy assessment and pays for up to 70% of installation cost for updates.[281] The Combined Heat and

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[271] NJ Clean Energy 2018: http://www.njcleanenergy.com/residential/programs/comfort-partners/comfort-partners
[272] PSEG 2018: https://nj.pseg.com/businessandcontractorservices/solarloanprogramforbusinesses/capacity
[273] PSEG 2018: https://nj.pseg.com/businessandcontractorservices/saveenergyandmoneyforbusiness/directinstallprogram
[274] NJNG 2018: https://www.savegreenproject.com/homeowners
[275] NJNG 2018: https://www.savegreenproject.com/businesses
[276]NJ Clean Energy 2017: http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/nj-smartstart-buildings
[277] NJ Clean Energy 2018: http://www.njcleanenergy.com/commercial-industrial/programs/local-government-energy-audit/local-government-energy-audit
[278] NJ Clean Energy 2018: http://www.njcleanenergy.com/commercial-industrial/programs/energy-savings-improvement-program
[279] NJ Clean Energy 2018: http://www.njcleanenergy.com/commercial-industrial/programs/pay-performance
[280] NJ Clean Energy 2018: http://www.njcleanenergy.com/commercial-industrial/programs/large-energy-users-program
[281] NJ Clean Energy 2018: http://www.njcleanenergy.com/commercial-industrial/programs/direct-install

Power (CHP) and Fuel Cell Incentive Program offers rebates for generating power and recovering waste heat to commercial sectors, hospitals, municipalities, and schools.[282]

While there is an exhaustive list of effective energy efficiency programs active in New Jersey, they are often left underfunded, as their funding is diverted to other purposes under the annual appropriations bill. This can override any statutory legislation that dedicates funding to a specific purpose (see Fee Collection Mechanism for more details). Revenues from our proposal could be used to create a more consistent funding source for these energy efficiency programs, especially if paired with a constitutional amendment codifying the destination of said revenue. This would bring crucial stability to these programs, enabling more citizens and business to take advantage of these programs and reduce their energy usage.

Essential Green Infrastructure

Part of the revenues from a carbon fee could also be used to fund other sustainability initiatives. One option is electric vehicle charging stations. Electric vehicle infrastructure is important for reducing transportation emissions, which account for over half of the state's carbon emissions (see New Jersey Emissions by Sector, 2005-2015). In 2016, the Workplace Charging Grant Program allocated $725,000 for employers to install charging stations in their parking lots. The program also awarded reimbursement grants ranging from $250-$5,000, depending on the tier of station.[283] However, of January 2017, the funding was exhausted and applications for the overall It Play$ to Plug In Program were put on a waitlist.[284] A related incentive is the Zero Emission Vehicle Sales Tax Exemption.[285] Higher gas prices would also make electric vehicles more competitive.

An additional high-priority investment area is energy storage. Like the charging station projects, they will require more funding as the Renewable Electric Storage Program is currently not being funded nor accepting new applications.[286] Given that the programs for charging stations and energy storage have depleted funds or are no longer active, they are excellent prospects for investment and some of the dividend could be used to revive them. Wind and solar energy have a lesser priority for funding, since there are many existing incentives. For example, in August 2010, former Governor Chris Christie signed the Offshore Wind Economic Development Act, which provides financial incentives and tax credits for offshore wind projects. The goal is to develop 1,100 MW of offshore wind capacity by 2020.[287] Furthermore, the state is part of the

[282] NJ Clean Energy 2018: http://www.njcleanenergy.com/commercial-industrial/programs/combined-heat-power/combined-heat-power
[283] NJ.com 2016: http://www.nj.com/news/index.ssf/2016/06/nj_looking_to_make_it_easier_to_plug_in_electric_c.html
[284] Bureau of Mobile Source 2018: https://www.drivegreen.nj.gov/plugin.html
[285] NJ Division of Taxation 2017: https://www.state.nj.us/treasury/taxation/zevnotice.shtml
[286] NJ Clean Energy 2017: http://www.njcleanenergy.com/renewable-energy/programs/energy-storage
[287] State of New Jersey 2010: ftp://www.njleg.state.nj.us/20102011/S2500/2036_R2.PDF

Atlantic Offshore Wind Energy Consortium.[288] In fact, Atlantic City has the nation's first coastal wind farm, the Jersey-Atlantic Wind Farm. Two offshore wind companies- Ocean Wind LLC and U.S. Wind Inc.- have been given commercial leases to further develop facilities off the coast of Atlantic City. The site assessment plan for Ocean Wind LLC was approved in May 2018, while the plan for U.S. Wind Inc. must be submitted by March 2019.[289] Overall, the leases have the potential to support 3,400 MW of wind capacity.[290]

Further sustainability initiatives include the Clean Energy Program (see Energy Efficiency Programs). While this program is important, it is not the first concern for investment, since the program already derives its funds from utility bills. The New Jersey Department of Transportation also has programs such as the Transit Village Program, which incentivizes municipalities to re-develop areas around transit stations.[291] However, in the past, some of these funds have been appropriated to other programs, which raises the concern of whether or not investments are reaching their intended target.[292] Thus, because these programs have enough funding to be diverted to subprograms or appropriated for other uses, they do not seem to be a good investment target.

Retrofits: Reducing Household Energy Burden for Low-Income Homes

We recommend that the carbon cashback policy be supplemented with programs supporting efforts to retrofit New Jersey's infrastructure. A retrofit is a renovation that makes a building more energy-efficient. Some examples include installing weather stripping in windows to prevent heat loss through cracks, or replacing fluorescent light bulbs with LEDs. Many of these retrofits pay for themselves within a few years or even months, leading to substantial energy savings. Based on a sample calculation from the Department of Energy's Home Energy Saver, savings from various retrofits amount to 30% of household energy costs.[293]

Widespread retrofitting, incentivized by a clearer price signal on the cost of energy, represents an opportunity to lower energy costs for property owners, increase cash flow for business owners, and reduce the energy burden on lower-income households. This is evidenced by the findings of The Energy Efficiency Financial Institutions Group (EEFIG).[294] This European database contains energy data for over 7,800 individual retrofit projects across the continent.

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[288] U.S Dept. of Interior 2010: https://www.doi.gov/news/pressreleases/Salazar-Signs-Agreement-with-10-East-Coast-Governors-to-Establish-Atlantic-Offshore-Wind-Energy-Consortium
[289] BOEM 2018: https://www.boem.gov/Commercial-Wind-Leasing-Offshore-New-Jersey/
[290] Climate Lawyers Blog 2015: http://climatelawyers.com/post/2015/10/06/orecs-or-ercs-how-will-new-jersey-pay-for-offshore-wind.aspx
[291] NJDOT 2018: https://www.state.nj.us/transportation/business/localaid/transitvillagef.shtm
[292] Johnson 2017: http://www.njspotlight.com/stories/17/05/15/push-to-make-diversions-from-clean-energy-fund-unconstitutional/
[293] Home Energy Saver 2018: http://hes.lbl.gov/consumer/. We use an Atlantic City house and all the default values. Results may vary with increasing customization
[294] EEFIG 2018: http://eefig.eu/index.php/

EEFIG findings provide clear evidence that retrofits are one of the fastest and most cost-effective means of saving energy. For residential investments, the median price to save a unit of energy (3 cents/kWh) is over eight times lower than the average retail price to consume a unit of energy (24 cents/kWh).[295] For industrial projects, the median price to save a unit of energy was 1 cent/kWh compared to nearly 12 cents/kWh for consumption. The median payback period for investments in retrofits is about two years. This result is consistent with case studies on retrofitting in the United States, such as one San Francisco study which compiled extensive data on retrofits performed on a variety of buildings within the city.[296]

Given that the upfront costs of small-scale retrofit projects can be prohibitive for property owners, a policy to reduce such barriers is needed. A mixture of private and public financing options indicate that such a policy is possible, and a portion of carbon fee revenues could be used to fund retrofitting in New Jersey. One important government retrofitting program is the Property Assessed Clean Energy (PACE) program. PACE is a mechanism that allows for energy efficiency, renewable energy and water conservation upgrades to be financed by some entity besides the property owner (for example, a local government or the utility itself). This addresses the primary barrier to retrofits: the large upfront costs. PACE financing is repaid as an assessment on the property's regular tax bill. The annual energy savings for a PACE project usually exceed the annual assessment payment. Financing terms of up to 20 years enable more expensive retrofits to be performed.[297] A 2011 study by ECONorthwest found that every $1 million in PACE project spending results in 15 new jobs and $2.5M in economic output.[298] PACE programs are formed when states pass laws that enable local governments to offer PACE financing to property owners. Once established, a property owner begins the process of performing retrofits by meeting with PACE service providers. These service providers determine the most effective retrofits to perform. PACE programs then process applications and provide or arrange financing to the property owner.[299]

We also recommend that the New Jersey government study the possibility of private-sector initiated retrofits. The private sector has also demonstrated a willingness and capacity to finance retrofits. SolarCity, for example, offers numerous financing options for the installation of solar panels for residential and commercial customers. Several of these involve no upfront costs and can be paid in instalments that are often less than the customer's monthly utility bill.[300] Another company, BlocPower, focuses on acquiring financing for low-income

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[295] These medians are based on the latest EUROSTAT averages for EU-28 retail energy prices, as used by EEFIG.
[296] SF Environment 2017: https://sfenvironment.org/energy-efficiency-case-studies/overview/commercial-energy-efficiency-case-studies
[297] PACE 2017: https://pacenation.us/what-is-pace/
[298] PACE 2014: https://www.pacenation.us/wp-content/uploads/2014/11/Economic-Impact-Analysis-of-Property-Assessed-Clean-Energy-Programs-PACE.pdf
[299] Ibid.
[300] Tesla 2018: https://www.tesla.com/support/energy/learn/solar-panels/cost-and-payment-options?energy_redirect=true

households and businesses to perform retrofits.[301] The costs to a bank for assessing the viability of the small loans required in these cases are generally too high to justify making the loan. To circumvent this process, BlocPower aggregates a series of homes, community centres, and small businesses in lower-income neighbourhoods into a single loan (of approximately $5 million). This bundling mechanism is beneficial for all of the involved parties. Banks are able to diversify their pool of borrowers, mitigating the risk associated with making a loan to a single borrower. Borrowers are able to access capital at lower interest rates because the risk they present to a bank is reduced. BlocPower can handle the retrofit project at all steps of the process. They begin by consulting community leaders in financially underserved areas and identifying potential buildings on which to perform retrofits. Each business or household identified in this process submits their financial statements to BlocPower, which analyzes these statements to identify the property owners who are most likely to pay off their loan. After this process is complete, a building inspection is conducted for each building to identify the most effective retrofits to perform. The projects are then bundled together and financed by a bank or outside investors. Local community members who graduate from third-party-certified green job training programs are hired to perform the retrofits.[302]

Retrofits by the Numbers: The Potential Short-Term Benefits of Implementing Household Energy Upgrades

Because of our proposed increase on the price of carbon, it is important to demonstrate to New Jersey residents that retrofitting their home to reduce their carbon footprint will be a worthwhile investment, even in the short term.

In order to obtain estimates of the energy and cash savings of retrofitting a typical New Jersey house, we consulted the Home Energy Saver™ (HES) calculator, an online tool developed by the U.S. Department of Energy for the purpose of informing homeowners and renters on the potential benefits of pursuing energy-saving upgrades that reduce the carbon footprint of their homes.[303]

The calculator offers the user to specify a vast array of parameters about their household, including location, house age, energy prices, building design, and thorough appliance and equipment details. For the sake of generalizability of our calculations, we used the default settings (link to appendix, where defaults are specified) for parameters pertaining to building design and appliance and equipment details. We evaluated the energy and cash savings for 27 different combinations of household parameters assuming a six-year payback time. We looked at three different specification categories: city of residence, age of household, and makeup of the household. Because the calculator provided only three options for city of residence within New

[301] BlocPower 2017: http://blocpower.io/#how-it-works
[302] Ibid.
[303] Home Energy Saver 2018: http://homeenergysaver.lbl.gov/consumer/about

Jersey — Newark, Lakehurst, and Atlantic City — we must generalize the calculations for these three cities to all of New Jersey's cities and towns. The calculator indicates that the selected location determines which "weather tape" is used to simulate the heating and cooling demands of the house, which affects energy use and saving calculations.[304] In general, Newark households saved the most money on their electricity bill, followed by Atlantic City, and then Lakehurst. However, savings relative to a household's current energy were roughly uniform across all cities. For each city parameter, the three selected household ages depended on the top three most common house ages for that city. Since data on the most common year houses were built was only available with respect to New Jersey counties, we determined the county in which each of the cities was located and resorted to its county data for the top three most common ages of houses.[305] It turned out, however, that house age had very little impact on the household's energy savings when accounting for house location and household makeup. For example, for the city of Newark, emissions savings did not vary at all between the three ages of houses: 1939, 1959, and 1969. The greatest difference in cash savings due to carbon emissions savings was $6 for both Lakehurst and Atlantic City, although this amounted to the difference between a 36% and 37% savings in one's energy bill. Finally, we examined the effect of three types of living situations — one adult, two adults, and two adults and two children — on energy bill and energy savings for a six-year retrofit payback time. Holding our other two variables constant (city of residence and age of house), we noted that energy bill savings differed by one or two percentage points across the three household types, with the one-adult household tending to save the most and the four-person household tending to save the least, although this difference was very slight. We also controlled for energy prices to the best of our ability for each scenario. That is, we researched the electricity and fuel oil rates for each city and tailored that city's data to these specifications, overwriting the calculator's default values, which were state averages.[306] Because we could not find data specific to each city on piped natural gas and liquid propane gas price rates, we used the calculator's statewide default settings. One notable trend with the data was that, at least with the six-year retrofit upgrades, small appliances did not contribute to any savings. Not including the 0% savings for small appliances across the board, the percentage of current energy bill savings for the retrofits specified by the calculator ranged from 18% for hot water and 65% for lighting. Please refer to the link to the full spreadsheet to view the comprehensive table of data collected for these 27 scenarios.

We then decided to control house location and age and just vary payback time and household makeup. We again collected data on households with one adult, two adults, and two adults and two children. For payback time, we selected combinations of upgrades that would

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[304] Home Energy Saver 2018, "Describe" section of HES™

[305] City-Data.com 2017: http://www.city-data.com/county/Union_County-NJ.html
New Jersey Municipalities: http://www.state.nj.us/infobank/revmuni.htm

[306] Electricity Local 2018: https://www.electricitylocal.com/states/new-jersey/atlantic-city/#ref
CashHeatingOil.com 2018: http://www.cashheatingoil.com/oilpricesinnj

result in a simple payback time of one year, five years, and six years. For example, for the one-year retrofit upgrades, we selected the top two upgrades in terms of return on investment (ROI). For the five-year retrofit calculations, we selected, in addition to the one-year retrofit upgrades, the next six upgrades in terms of ROI. By examining three different family structures for three different retrofit plans, we analyzed data for nine different scenarios. Because the calculator started defaulting to Newark and didn't allow us to vary the city location as before, we restricted our calculations to savings for the city of Newark. In addition, we limited our calculations to the year of 1939, as this city-year combination corresponded to the greatest absolute energy bill savings of all of the 27 different scenarios in the previous data set.

Family Type	Simple Payback Time (yr)	Yearly Cash Savings ($)	Estimated Added Cost ($)	How Much is Too Much? ($)	Simple Payback Time (yr)	Estimated Return on Investment, ROI (%)	Avoided Emissions (lbs. CO2)	Yearly Electricity Savings (kWh)	Yearly Natural Gas Savings (Therms)
1A	1	368	173	3680	0	213	2934	1025	168
1A	5	708	3557	7080	5	20	5635	1997	320
1A	10*	914	5222	9140	6	17	7418	2231	454
2A	1	367	173	3670	0	208	2923	1025	167
2A	5	711	3555	7110	5	20	5646	2026	319
2A	10*	912	5220	9120	6	17	7395	2260	450
2A+2C	1	367	173	3670	0	208	2923	1025	167
2A+2C	5	708	3552	7080	5	20	5613	2026	316
2A+2C	10*	905	5217	9050	6	17	7324	2231	446

*Actually 6 years because longest simple payback time of an individual upgrade was 8 years, but since other upgrades would payback sooner, this shrinks the overall payback time to 6 years; 10 years was used as a threshold for the payback time of any individual upgrade.

Please refer to the link to the full spreadsheet of data tables generated for this data set and each of its nine scenarios, including individual upgrade savings. Overall simple payback time for each combination of upgrades tended to be less than the maximum simple payback time of an individual upgrade, as other upgrades with shorter payback times would contribute to an earlier

overall payback time. The calculator determined "Estimated Added Cost" in two ways. For upgrades involving a unit upgrade, like switching to an energy-saving thermostat, the total cost of this upgrade was taken into account. For upgrades that involved the full replacement of an existing unit, however, such as upgrading to a more efficient clothes washer, the estimated added cost was the increased cost of such an upgrade compared to the cost of the generic minimum-efficiency unit. Although this detail would seem to result in overestimates of the yearly cash savings of such upgrades, the "Yearly Savings" values took this fact into account, only calculating the additional energy savings of upgrading to a more energy-efficient unit. The "How Much is Too Much?" values indicate the maximum one could pay for an upgrade while still recovering the initial investment in a 10-year period. The ROI values were calculated by dividing cash savings generated by a unit upgrade over the course of its lifespan by the initial investment into the upgrade. For some of the upgrades, there was a list of upgrade choices to choose from. We defaulted to the minimum efficiency level as specified by ENERGY STAR, and in the case of attic insulation, defaulted to the most commonly recommended insulation upgrade choice. It also should be noted that the sum of yearly savings for each individual upgrade tends to exceed the yearly savings indicated in the head of the column, "Yearly Savings." This discrepancy is due to the fact that some upgrades overlap in their energy-saving capabilities. For example, by upgrading to a more efficient clothes washer and gas water heater, you end up saving less than if you upgraded each in isolation, as the gas water heater savings contribute to the savings of the clothes washer.

UPGRADE	UPGRADE CHOICE	UPGRADE DESCRIPTION	UPGRADE COST
Thermostat	ENERGY STAR-labeled programmable	4 pre-programmed options to regulate home temperature during winter and summer, when you're home, asleep, or away[307]	$120 to $600
Indoor lights	CFLs in high-use fixtures	CFL = compact fluorescent lamp 4x more efficient than and 10x the lifespan of incandescent bulbs, but also produce the same light effect[308]	$4.65 to $10.10 per CFL Assuming 82 CFLs being replaced in house
Clothes washer	MEF=1.42 WF=9.5 ENERGY STAR	MEF = Modified Energy Factor (cubic feet capacity of washer divided by total energy consumption per cycle, the higher the more efficient the washer), WF = water factor (gallons of water used per cycle divided by cubic feet of washer capacity, the lower the less water used relative to machine size)	For MEF = 1.42: $80 to $180 → additional cost compared to minimum-efficiency clothes washer
Gas water heater	EF=0.62	EF = Energy Factor (overall efficiency of water heater based on model's recovery efficiency, standby losses, and energy input)	$80 to $400 → additional cost compared to

[307] EnergyStar.gov: https://www.energystar.gov/products/heating_cooling/programmable_thermostats
[308] 1000Bulbs.com 2018: https://www.1000bulbs.com/category/cfl-bulbs/

			minimum efficiency water heater
Duct sealing	Reduce leakage to 6% of total air flow	"Percent leakage measures fraction of total airflow through air handler (furnace fan) that is lost due to leaks in the ducts (either supply or return side)."[309]	$320 to $1500 (assuming you hire a contractor)
Electric clothes dryer	Switch to gas dryer	Initially more expensive, but lower upkeep cost and more efficient and gentler in drying clothes; does require gas line and vent, though[310]	$130 to $200 (assuming gas line already installed) → additional cost compared to electric models
Gas furnace	AFUE=90 ENERGY STAR	AFUE = Annual Fuel Utilization Efficiency (percentage of fuel converted into usable heating energy)	$1989 to $4199 → additional cost compared to minimum-efficiency gas furnace
Air sealing	25% air leakage reduction	Along with attic sealing, can help prevent dangerous ice dams from forming during winter[311]	$520 to $1100 (assuming you hire a contractor)
Attic sealing	R-38	R-value measures the resistance of a material to heat flow; higher R-values provide more insulation. EPA/ENERGY STAR recommended R-value: R-38 (10 to 14 inches of insulation, depending on insulation type)[312]	$91 to $376

We found that varying household makeup had a negligible effect on yearly utility savings. For the two-upgrade / one-year payback time scenario, families could expect yearly savings of $367-368; for eight-upgrade / five-year payback time scenario, families could expect yearly savings of $708-711; and for the 10-upgrade / six-year payback time scenario, families could expect yearly savings of $905-914 on their utility bills. Although we collected data for a two-upgrade / one-year payback time, and eight-upgrade / five-year payback time, and a 10-upgrade / six-year payback time, we would like to provide the example of a three-upgrade / one-year payback time for a four-person household to demonstrate how much a typical New Jersey family could save by making upgrades to three independent house units. By upgrading to an ENERGY STAR-programmable thermostat, replacing high-use fixtures with CFLs, and by replacing one's washer with a basic ENERGY STAR efficiency washer, a family could experience yearly savings of $395 and payback initial investment into these upgrades in a year,

[309] HES™ Upgrade > Recommendations: http://homeenergysaver.lbl.gov/consumer/upgrade-recommend
[310] Sears.com: http://www.sears.com/articles/appliances/washers-dryers/gas-vs-electric-dryers.html
[311] EnergyStar.gov: https://www.energystar.gov/index.cfm?c=home_sealing.hm_improvement_attic
[312] DIY ENERGY STAR Guide: https://www.energystar.gov/ia/partners/publications/pubdocs/DIY_Guide_2016.pdf?2d18-0d3a

resulting in a 147% ROI. In fact, by upgrading one's thermostat alone, one can recover one's initial investment of between $120 to $600 in less than a year, resulting in a 270% ROI.

By increasing heating prices, our proposal would also encourage investment into energy-efficient household upgrades. It is evident that upgrading just one or several units with high ROI percentages can reap significant savings and overcome the upfront cost of investment within a year or less. Retrofitting would not only further decrease household emissions, but it would also pay dividends back to those who can commit to these cost-effective and simple upgrades.

Transportation and Climate Initiative

The Transportation and Climate Initiative is a group of 11 states (CT, DE, ME, MD, MA, NH, NJ, NY, PA, RI, and VT) and DC committed to reducing emissions from transportation. Within this grouping, Connecticut, Delaware, the District of Columbia, New York, Rhode Island and Vermont have announced they will be working together to develop market-based solutions to reduce GHGs in the transportation sector, which may include a transportation market-based program or pricing policy, such as an emissions budget program, carbon fee, or mileage-based user fee. The TCI has recommended the following distribution of investment into different areas of transportation in order to reduce GHG emissions and have economic benefits. As a thought experiment, we show what could be accomplished with an investment of 300 million (about one half of the revenue available for investments):

Area	% of Investment	Amount ($ million)*
Electric Vehicle/Alternatives	20	60
Transit	25	75
Smart Growth	7.5	22.5
Active Transportation	7.5	22.5
Travel Demand Management	10	30
System Operations	15	45
Freight	15	45

* given approximate investment of $300 million.

The breakdown of the categories can be summarized as follows:

- Electric Vehicles/ Fuel Alternatives – Three types of plug-in electric/alternative fuel vehicles are included in this analysis: full battery electric (EV) and plug-in hybrid electric (PHEV) light-duty vehicles, and heavy-duty vehicles running on compressed natural gas (CNG) or liquefied natural gas (LNG).
- Land Use/Smart Growth – Examples include infill, compact development, and transit-oriented development, which may be achieved through land use planning, public investment (e.g: complete streets projects, pedestrian infrastructure), and/or funding incentives to municipalities. The TCI use as a benchmark the Commonwealth of Massachusetts' Chapter 40R program (Smart Growth Zoning Overlay District Act), which since 2005 has offered cities and towns an incentive of up to $3,500 per newly built dwelling unit in areas rezoned as "smart growth" districts meeting certain criteria.
- Transit – Looks at urban and intercity transit investment.
- Active Transportation – Non-motorised improvements (as walking is covered in smart growth, this section focuses on cycling). Examples include increased bike lanes, cycle tracks, separated paths, bike boulevards, and parking; as well as supportive programs such as education, enforcement of traffic laws, and bike share programs.
- TDM/Ecodriving – Examples include Rideshare, bikepool, subsidised transit passes, and education on how to drive more efficiently.
- System Operations – The primary goal of this investment is to reduce congestion, and examples include Signal timing and coordination and improved traveller information.
- Freight – These are investments to shift freight from truck to rail or water, and methods to improve freight efficiency. One example of this is the NY – Arlington Intermodal Yard Capacity improvements to a rail yard, which cost $9.0 million and saw 52,401 annual tons of GHG reduced.

Summary of the Economic Impacts of Transportation Investment

The Regional Economic Models, Inc. (REMI) Policy Insight model was used to estimate the macroeconomic benefits of investing in GHG emission reduction strategies for transportation, by the Transportation and Climate Initiative. The specific report from TCI assumes an investment of $3 billion, which is 10 times larger than the hypothetical investment above, so the return on investment and other benefits will obviously be smaller. If one assumes that the benefits correlate linearly with cost, then the following tables can be corrected for by dividing the figures by a factor of 10.

In any case, the investment scenarios are expected to show significant economic benefits to the

TCI region. At $3 billion, this is on the order of 100,000 jobs annually by 2030, $12 to $18 billion in new GRP, and $10 to $14 billion in new personal disposable income. Even divided by 10, such investment would be a significant boost to New Jersey's economy.

Economic Benefits to TCI Region of Pricing and Reinvestment Strategies (for $3 billion):

Industry	2030	2030 Percent of Region	Cumulative, 2015-2030
Change in Regional Employment	91,000 – 125,000	0.23% - 0.31%	794,000 – 1,167,000
Change in Gross Regional Product ($ billions, 2009)	11.7 – 17.7	0.25% - 0.38%	92 - 144
Change in Disposable Personal Income ($ billions, 2009)	9.9 – 14.4	0.19% - 0.28%	71 - 109

* Note: This table uses the TCI model of an investment of $3 billion.

There are also additional benefits that have been calculated by the TCI (see Appendix 2 of their report) by implementing investment in the way they suggest:

	2030	2015-2030	Average Annual
Reduction in petroleum consumption (millions of gallons)	1,279	11,168	698
Personal Time Savings (millions of hours)	718	5,590	349
Air Pollution			
Premature Deaths Prevented	35	344	22

Asthma Cases Prevented	2,011	19,703	1,231
Monetary Value ($, predicted)	265	2,966	185
Pavement Damage			
Roadway Maintenance Cost Savings ($ millions)	801	5,399	337

* Note: This table uses the TCI model of an investment of $3 billion.[313]

Investing in Job Training Programs

Some stakeholders are concerned with the amount of revenue dedicated to job training programs, which can be quite expensive. Labor groups especially want to ensure that sufficient funds are allocated to effective programs in order to assist transitioning and soon-to-be-retired workers. According to a list of occupational education programs provided by the NJ Department of Labor and Workforce Development and the State Employment and Training Commission, they cost from approximately $400 to $5000 per person. Assuming that only 0.5% of the investment revenue is dedicated to this (~$1 million), several hundred to a few thousand workers can be trained per year[314]. For example, the Isles Center for Energy and Environmental Training provides effective education on green jobs and fit within the aforementioned cost range[315]. However, one caveat to note is that not all programs are effective and as such, it will be important to identify them.

Common Objections

New Jersey lacks the Political Will to pass a Carbon Cashback Policy

One may argue that there is not enough political will in New Jersey to pass a carbon fee and dividend. This is inaccurate: first, a majority of New Jersey residents support taking action

[313] http://www.georgetownclimate.org/reports/reducing-greenhouse-gas-emissions-from-transportation-opportunities-in-the-northeast-and-mid-atlantic.html

[314] NJ Training Opportunities: http://www.njtrainingsystems.org/Search/Results.aspx?SearchType=Occupation+or+Training&SearchSubmit=1&cboOccupation=&cboOccupationSoccode=&cboClusterID=2&cboCIPCode=460412&Button1=Search&ZipCode=&cboZipCode=15&Keyword=&cboKeywordSearchTypeID=2&ddlTI=-999

[315] Isles, Inc.: https://isles.org/sites/default/files/2018%20CEET%20Energy%20Efficiency%20Course%20List.pdf

on climate change. As we detail in the Political Feasibility section, 67% of adults in NJ are worried about global warming, 86% support funding research into renewable energy sources, 82% support regulating CO_2 as a pollutant,[316] and 49% supported a carbon tax if it is refunded to every American household (21% were opposed and 30% were undecided).[317]

Prominent politicians on both sides of the aisle, as well as many major fossil fuel companies, have all publicly expressed support for carbon cashback-type policies. In February 2017, senior Republican statesmen made the conservative case for a national carbon fee and dividend, arguing that it would strengthen the economy without expanding government roles. This stance has gained the support of prominent Republicans such as Senator Lindsey Graham from South Carolina.[318] Former Director of the EPA and former Governor of New Jersey Christine Todd Whitman has also voiced her support for a carbon tax.[319] Democrats such as New Jersey Senator Cory Booker and Hawaii Senator Brian Schatz, and former President Barack Obama have also called for carbon pricing.[320, 321, 322] Fossil Fuel companies have also publicly stated their support for carbon pricing. Companies like Exxon Mobil, Royal Dutch Shell, and BP, have encouraged governments to implement carbon pricing systems.[323] This evidence demonstrates even among those traditionally opposed to action on climate change, there is strong support for carbon pricing action.

Carbon Cashback is Not Conservative or Not Progressive Enough

There may be fears that a carbon cashback policy is not conservative enough (from the perspective of the right), or not progressive enough (from the perspective of the left). However, we argue carbon cashback strikes an effective balance between the two. The policy embodies conservative limited-government, free-market principles because it is technology-neutral and returns the majority of revenue back to the economy through dividends for households and businesses. It allows the free market to decide which energy type will succeed for a given institution or region, rather than using subsidies for energy sources that may not be the cheapest option. This lays the basis for Republican support of the policy.[324]

One may also recall the failure of the Washington state carbon pricing proposal, which faced unexpected backlash from progressive groups who claimed that the policy would hurt the

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[316] Marlon et al. 2018: http://climatecommunication.yale.edu/visualizations-data/ycom-us-2018/
[317] Howe et al. 2014: http://climatecommunication.yale.edu/visualizations-data/ycom/
[318] Baker et al. 2017: http://time.com/4947960/lindsay-graham-climate-change-carbon-tax/
[319] Ruckelshaus et al., 2013: http://www.nytimes.com/2013/08/02/opinion/a-republican-case-for-climate-action.html
[320] Friedman 2013: http://www.nj.com/politics/index.ssf/2013/10/where_cory_booker_and_steve_lonegan_stand_on_the_issues.html
[321] Friedman 2017: https://www.nytimes.com/2017/08/17/climate/carbon-tax-reform-climate-change.html
[322] Lehmann 2015: https://www.scientificamerican.com/article/obama-calls-carbon-price-better-than-regulations/
[323] Milman, *The Guardian*, 2017: https://www.theguardian.com/environment/2017/jun/20/exxon-bp-shell-oil-climate-change
[324] Baker et al. 2017: https://www.clcouncil.org/media/TheConservativeCaseforCarbonDividends.pdf

working people and poor, and did not do enough to invest in green infrastructure projects or in communities that have been most affected by fossil fuel pollution and climate change.[325] We aim to show that our policy can appeal to the political left, because lower-income households come out ahead, as we show in Section Effect on Low-Income Households. Moreover, we provide options that invest a significant portion of the revenue into green projects and to communities that are disproportionately impacted by carbon pollution and climate change. Finally, we are currently engaging in a stakeholder process with environmental, labor, and other groups across the state to gain their feedback on this policy. We recognize that our analysis of the impact to low-income households is preliminary, still insufficient to guarantee that every household be benefited, and we encourage a full analysis by a government agency with access to the full data. If the current revenue distribution policy turns out to be regressive, we recommend it be altered in order to be progressive.

Carbon Cashback is not guaranteed to reduce emissions

Another objection is about the lack of certainty in emission decrease under a carbon cashback policy. This objection is commonly accompanied by the proposal of the cap-and-trade approach, also called an emissions trading scheme. As seen in Section (Existing Carbon Cashback Programs), there were significant reductions in CO_2 emissions after carbon fees were passed in different countries. We argue additionally that cap-and-trade is fundamentally similar to carbon cashback, and that the latter is simpler to administer and more economically predictable (see Carbon Cashback vs Cap-and-Trade). While emissions are not given explicit caps, by adjusting the market to account for the social cost of carbon, utilities will be able to save money by investing in less carbon-intensive energy sources, and the cost of transportation will become relatively more expensive. If utilities, businesses, and consumers act rationally, they will adjust their consumption habits to use less carbon-intensive energy sources as long as the benefit from doing so outweigh the costs.

Additionally, this policy can be designed so that explicit emissions targets are laid out in legislation, and the price reviewed at regular intervals to ensure compliance with those targets. That would act as a *de facto* long-term emissions cap, while retaining price stability and low administrative costs.

Carbon Cashback will hurt the economy

We have argued based on the example of British Columbia, Denmark, various state and national-level studies by REMI, and our own calculations that employment would not be harmed, that households would generally come out ahead, and that leakage could be partially

[325] Lavalle 2016: https://insideclimatenews.org/news/09112016/washington-state-carbon-tax-i-732-ballot-measure

addressed through applying the price to imported energy. Moreover, the carbon cashback policy could accelerate the economy toward a transition to renewable energy, which would make New Jersey more competitive in the long term.[326] Finally, unmitigated climate change would cause far worse damage to New Jersey's economy (especially in agriculture) and society.[327, 328, 329]

The price is too high

Reducing carbon-related emissions in the U.S. yields $30-600 co-benefits per ton of CO_2 reduced, by reducing pollutant-associated premature mortality.[330] In other words, our Moderate Fee scenario is more than repaid in human lives saved from cutting pollution. Moreover, a team of international experts at the High-Level Commission on Carbon Prices recommend a price that reaches $40-80/ton CO_2 in 2020 and $50-100/ton CO_2 in 2030, in order to efficiently achieve the Paris temperature objective of 2 degrees Celsius., the threshold for catastrophic climate change. The authors recommended such a price in order to send a strong price signal, and encourage efficiency and renewable energy innovation.[331] Furthermore, our low and moderate pricing scenarios are in line with what has been suggested in other state-level proposals (see Proposals in Other States) as well as the price implemented where a carbon price is already in place (see In Other Countries). In order to be in line with other states, the majority of the price scenarios we are proposing are actually lower than the price needed to comply with the emissions reduction targets set by international agreements.

New Jersey's Carbon Policies will not significantly affect global aggregate carbon emissions

While New Jersey alone cannot mitigate enough carbon emissions to impact climate change globally, action in New Jersey can create momentum so that other states will follow suit and the impact is magnified. Additionally, there are other impacts of GHG emissions that will be mitigated by action to reduce emissions in New Jersey, including improvement in air quality and decreased risk of asthma, lung cancer, and other diseases (see Air Pollution and Respiratory Health). Finally, climate action on the federal level is very unlikely in today's political climate: the current administration has signaled its opposition to investment in clean energy and commitment to fossil fuels by seeking to cut 72% of the Department of Energy's FY2019 budget

[326] Meltzer 2014: http://www.felj.org/sites/default/files/docs/elj351/14-45-Meltzer_Final%205.13.14.pdf
[327] Hauer et al. 2016: https://www.nature.com/articles/nclimate296
[328] Caiazzo et al. 2013: http://www.sciencedirect.com/science/article/pii/S1352231013004548.
[329] NJADAPT 2014: http://njadapt.rutgers.edu/docman-lister/resource-pdfs/96-njcaa-agriculture/file
[330] West et al. 2013: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4051351
[331] Hallegatte et al. 2017: https://static1.squarespace.com/static/54ff9c5ce4b0a53decccfb4c/t/59244eed17bffc0ac256cf16/1495551740633/CarbonPricing_Final_May29.pdf

for renewable energy and energy efficiency programs.[332] Given that, action at the state-level provides the next best opportunity for the United States to make a significant reduction in their GHG emissions and mitigate the impacts of climate change.

The Policy will hurt Low-Income Communities

We recognize the particular concerns of environmental justice communities, who are defined as predominantly low-income and minority communities who tend to be more vulnerable to environmental hazards and excluded from the environmental decision-making process.[333] When considering how to invest revenues from the carbon fee, the particular concerns of these communities should be carefully considered, and these communities must be consulted often in the policy development process to ensure that their challenges are addressed. We recommend that at least one fifth of the investments (4% of total revenue) be focused on these communities.

Recommendations for Further Research

We have sought in this work to provide an overview of the relevant issues, but more research must be performed into this policy before implementation, to guarantee maximum effectiveness and minimal harm.

- How should we price imported energy when we cannot be certain of the composition/emissions generated by energy coming from out-of-state sources? Is the current price on utilities, calculated based on their Environmental Disclosure Labels, reasonable?
    - Should we adjust the price ascribed to imported energy as information becomes available, an annual review for example?
    - Is it possible to check what the fuel will be used for (e.g. electricity vs. natural gas heating) when it enters the state? This is important if we exempt electricity.
- What are the benefits/disadvantages of returning the dividend to businesses and households as a tax credit vs. a rebate?
    - What are the administrative structures/costs associated with each scenario?
    - What precedent is there for each scenario in New Jersey?
    - Would either be counted as taxable income and thus reduce the revenue returned as a dividend?
- How can we address leakage of emissions and businesses?

[332] Mooney and Mufson 2018: https://www.washingtonpost.com/business/economy/white-house-seeks-72-percent-cut-to-clean-energy-research-underscoring-administrations-preference-for-fossil-fuelsv/2018/01/31/c2c69350-05f3-11e8-b48c-b07fea957bd5_story.html?hpid=hp_hp-top-table-main_doe-4pm%3Ahomepage%2Fstory&utm_term=.087e3945f35e
[333] NJDEP 2018: https://www.nj.gov/dep/ej/

    - How should we identify the most vulnerable businesses? The small ones with large fixed costs that cannot adapt?
    - Are there explicit policy measures we can take?
- How can the policy ensure that its revenue is used as intended?
    - Would a separate fund need to be set up to prevent diversion into general state revenue streams?
    - What body should administer the investment usage?
    - What is the feasibility of passing a constitutional amendment to codify how the money is spent, given that annual appropriations bills take precedence over all other legislation?
- Should the policy include a corporate income tax cut for EITE businesses as a form of vulnerable businesses help?
- How can the policy be designed to minimize the risk of transportation leakage?
- What is the impact of a carbon cashback policy on low-to-moderate income households in as fine a granularity as possible (accounting for variability in driving, household size)?
- What impact will this policy have on emissions over the course of a decade?
- What impact will this policy have on the renewables sector -- will it actually spur economic growth in the industry?

Conclusion

Our research thus far has indicated that a carbon cashback policy would not only be an effective option for New Jersey to pursue in order to reduce emissions, but also a potential economic boon to the state, driving innovation in the renewable energy sector and increasing employment.[334] Furthermore, if 70% of the policy's dividend is allocated to households, low and moderate income individuals can come out ahead, ensuring that the most vulnerable families in New Jersey would benefit from this proposal and the burden of addressing climate change will not fall disproportionately on people of lower income. .[335] This policy has been proven to reduce emissions while encouraging economic growth in places that have already implemented the policy. [336]

The time for action on climate in New Jersey is now. New Jersey is already seeing firsthand the impacts of climate change, and public support for action to reduce emissions is strong. The leadership of New Jersey is clearly supportive of action on climate: Governor Murphy's recent decision to rejoin RGGI indicates the prioritization of climate action at the state level in New Jersey.[337] Moreover, momentum for carbon cashback is growing nationwide, with

[334] Effects on Employment, Effect on Renewable Energy
[335] Effect on Households by Size and Income
[336] Existing Carbon Fee and Dividend Programs
[337] NJ Spotlight 2018:
http://www.njspotlight.com/stories/18/01/29/gov-murphy-signs-executive-order-for-nj-to-rejoin-rggi/

carbon pricing legislation already in place or in the works in 11 different states and Washington, D.C.[338] By passing a simple, effective, and bipartisan statewide carbon cashback policy New Jersey has the opportunity to be a leader in climate action nationwide while improving the quality of life for its citizens.

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[338]Climate X-Change: https://climate-xchange.org/state-carbon-pricing-network/#NewJersey

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Appendix

Fee Effects for Different Fuel Types

Fuel Increases under the Moderate Scenario		
Type of Fuel	EPA equivalency[339]	Initial Rates: $30/ton
Imported Natural Gas for Utility Distribution	0.056 metric tons CO_2/Mcf	$1.65Mcf of Natural Gas
Imported Gasoline	8.887 × 10-3 metric tons CO_2/gallon of gasoline	$0.267/gallon of gasoline

Premature Deaths in New Jersey attributable to PM2.5 from Combustion Emissions

Approximately 8,312 premature deaths occur in New Jersey per year, as a result of increased PM2.5 concentrations from combustion-related air pollution. The breakdown per sector is summarized in the below table.[340]

A full geographic model was used; as such, the listed emissions did not necessarily arise in-state.

Premature Deaths from PM2.5 Concentration from Combustion Emissions		
Sector	Premature Mortalities per year	Mortality Rate, per 100,000 per year
Electricity Generation	1885	22.2
Industry	1260	14.8
Commercial/Residential	2341	27.6
Road	2420	28.5

[339] EPA 2018: https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references
[340] Caiazzo et al. 2013: http://www.sciencedirect.com/science/article/pii/S1352231013004548 All values were obtained from Table 5.

Marine	328	3.9
Rail	78	0.9
Total	**8312**	**97.9**

New Jersey Emissions by Sector, 2005-2015

Sectors are defined by the EIA.[341] We quote from their glossary:[342]

Commercial:

- "An energy-consuming sector that consists of service-providing facilities and equipment of businesses; Federal, State, and local governments; and other private and public organizations, such as religious, social, or fraternal groups. The commercial sector includes institutional living quarters. It also includes sewage treatment facilities. Common uses of energy associated with this sector include space heating, water heating, air conditioning, lighting, refrigeration, cooking, and running a wide variety of other equipment. Note: This sector includes generators that produce electricity and/or useful thermal output primarily to support the activities of the above-mentioned commercial establishments."

Electric Power

- "An energy-consuming sector that consists of electricity only and combined heat and power (CHP) plants whose primary business is to sell electricity, or electricity and heat, to the public--i.e., North American Industry Classification System 22 plants."

Industrial

- "An energy-consuming sector that consists of all facilities and equipment used for producing, processing, or assembling goods. The industrial sector encompasses the following types of activity: manufacturing (NAICS codes 31-33); agriculture, forestry, fishing and hunting (NAICS code 11); mining, including oil and gas extraction (NAICS code 21); and construction (NAICS code 23). Overall energy use in this sector is largely for process heat and cooling and powering machinery, with lesser amounts used for facility heating, air conditioning, and lighting. Fossil fuels are also used as raw material inputs to manufactured products. Note: This sector includes generators that produce electricity and/or useful thermal output primarily to support the above-mentioned industrial activities. Various EIA programs differ in sectoral coverage."

Residential

[341] EIA 2018: https://www.eia.gov/environment/emissions/state/analysis/
[342] EIA 2018: https://www.eia.gov/tools/glossary/index.php

- "An energy-consuming sector that consists of living quarters for private households. Common uses of energy associated with this sector include space heating, water heating, air conditioning, lighting, refrigeration, cooking, and running a variety of other appliances. The residential sector excludes institutional living quarters. Note: Various EIA programs differ in sectoral coverage."

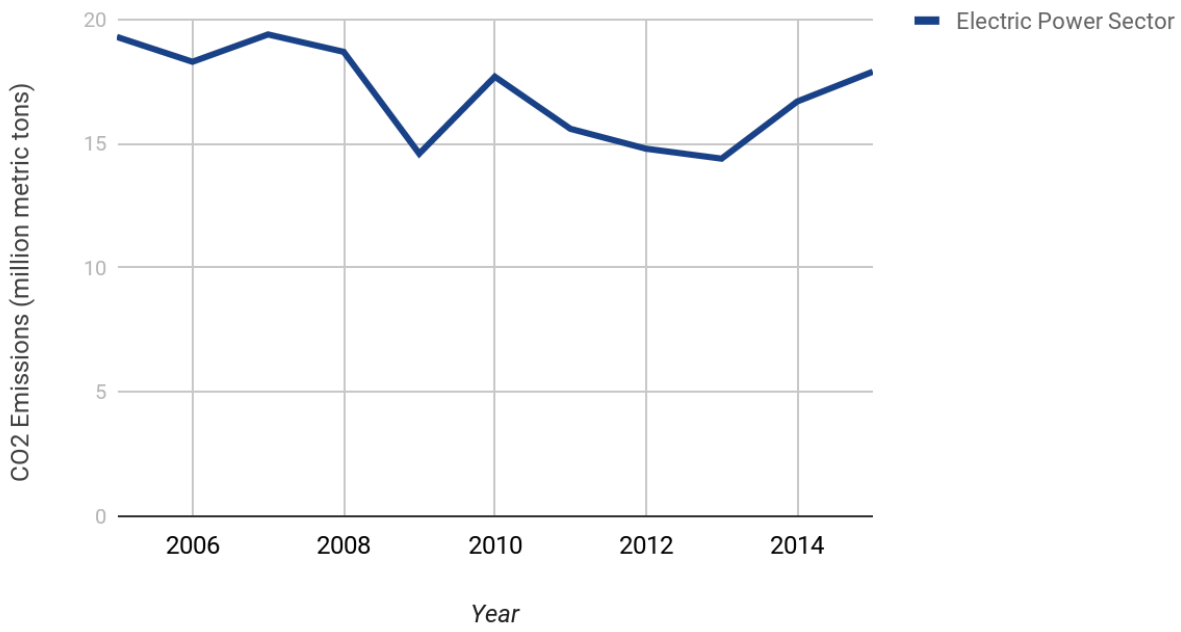
Transportation

- "An energy-consuming sector that consists of all vehicles whose primary purpose is transporting people and/or goods from one physical location to another. Included are automobiles; trucks; buses; motorcycles; trains, subways, and other rail vehicles; aircraft; and ships, barges, and other waterborne vehicles. Vehicles whose primary purpose is not transportation (e.g., construction cranes and bulldozers, farming vehicles, and warehouse tractors and forklifts) are classified in the sector of their primary use. Note: Various EIA programs differ in sectoral coverage."

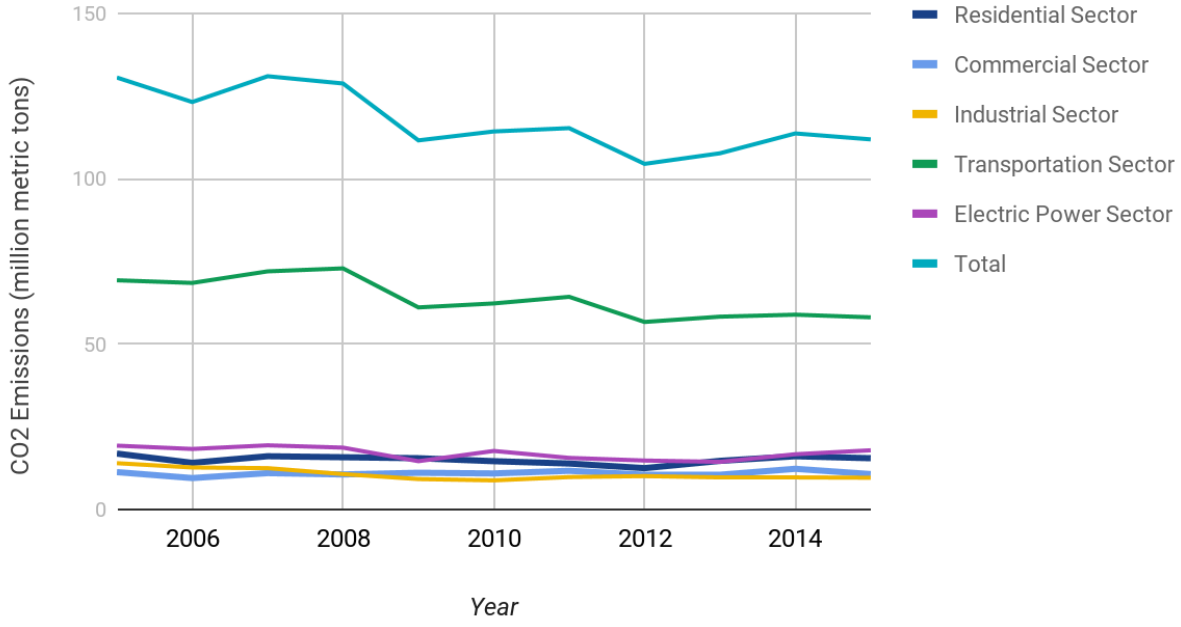
Emissions by Sector in New Jersey, Millions of metric tons of CO_2

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Residential Sector	16.9	14.1	16.1	15.8	15.5	14.6	13.9	12.5	14.7	16.1	15.5
Commercial Sector	11.3	9.5	11.0	10.6	11.1	10.9	11.7	10.5	10.5	12.3	10.7
Industrial Sector	14.0	12.7	12.5	10.7	9.2	8.8	9.8	10.1	9.7	9.7	9.6
Transportation Sector	69.3	68.5	72.0	72.9	61.1	62.3	64.3	56.7	58.3	58.9	58.1
Electric Power Sector	19.3	18.3	19.4	18.7	14.6	17.7	15.6	14.8	14.4	16.7	17.9
Total	130.6	123.2	131.0	128.8	111.6	114.3	115.3	104.5	107.7	113.7	111.9

Electric Power Emissions in New Jersey



Emissions by Sector in New Jersey



RGGI Price Auction History

Data Source[343]

Date	Auction Number	Offering	Quantity Offered	Quantity Sold	Clearing Price	Total Proceeds	Count
9/25/08	Auction 1*	Current	12,565,387	12,565,387	$3.07	$38,575,738.09	41
12/17/08	Auction 2	Current	31,505,898	31,505,898	$3.38	$106,489,935.24	40
3/18/09	Auction 3	Current	31,513,765	31,513,765	$3.51	$117,248,629.80	39
6/17/09	Auction 4	Current	30,887,620	30,887,620	$3.23	$104,242,445.00	38
9/9/09	Auction 5	Current	28,408,945	28,408,945	$2.19	$66,278,239.35	37
12/2/09	Auction 6	Current	28,591,698	28,591,698	$2.05	$61,587,120.90	36
3/10/10	Auction 7	Current	40,612,408	40,612,408	$2.07	$87,956,944.56	35
6/9/10	Auction 8	Current	40,685,585	40,685,585	$1.88	$80,465,566.78	34
9/10/10	Auction 9	Current	45,595,968	34,407,000	$1.86	$66,437,340.00	33
12/1/10	Auction 10	Current	43,173,648	24,755,000	$1.86	$48,224,220.00	32
3/9/11	Auction 11	Current	41,995,813	41,995,813	$1.89	$83,425,588.47	31
6/8/11	Auction 12	Current	42,034,184	12,537,000	$1.89	$25,477,200.00	30
9/7/11	Auction 13	Current	42,189,685	7,487,000	$1.89	$14,150,430.00	29
12/7/11	Auction 14	Current	42,983,482	27,293,000	$1.89	$51,583,770.00	28
3/14/12	Auction 15	Current	34,843,858	21,559,000	$1.93	$41,608,870.00	27
6/6/12	Auction 16	Current	36,426,008	20,941,000	$1.93	$40,416,130.00	26
9/5/12	Auction 17	Current	37,949,558	24,589,000	$1.93	$47,456,770.00	25
12/5/12	Auction 18	Current	37,563,083	19,774,000	$1.93	$38,163,820.00	24
3/13/13	Auction 19	Current	37,835,405	37,835,405	$2.80	$105,939,134.00	23

[343] RGGI 2018: https://www.rggi.org/auctions/auction-results

6/5/13	Auction 20	Current	38,782,076	38,782,076	$3.21	$124,490,463.96	22
9/4/13	Auction 21	Current	38,409,043	38,409,043	$2.67	$102,552,144.81	21
12/4/13	Auction 22	Current	38,329,378	38,329,378	$3.00	$114,988,134.00	20
3/5/14	Auction 23	Current	18,491,350	23,491,350	$4.00	$93,965,400.00	19
6/4/14	Auction 24	Current	18,062,384	18,062,384	$5.02	$90,673,167.68	18
9/3/14	Auction 25	Current	17,998,687	17,998,687	$4.88	$87,833,592.56	17
12/3/14	Auction 26	Current	18,198,685	18,198,685	$5.21	$94,815,148.85	16
3/11/15	Auction 27	Current	15,272,670	15,272,670	$5.41	$82,625,144.70	15
6/3/15	Auction 28	Current	15,507,571	15,507,571	$5.50	$85,291,640.50	14
9/9/15	Auction 29	Current	15,374,294	25,374,294	$6.02	$152,753,249.88	13
12/2/15	Auction 30	Current	15,374,274	15,374,274	$7.50	$115,307,055.00	12
3/9/16	Auction 31	Current	14,838,732	14,838,732	$5.25	$77,903,343.00	11
6/1/16	Auction 32	Current	15,089,652	15,089,652	$4.53	$68,356,123.56	10
9/7/16	Auction 33	Current	14,911,315	14,911,315	$4.54	$67,697,370.10	9
12/7/16	Auction 34	Current	14,791,315	14,791,315	$3.55	$52,509,168.25	8
3/8/17	Auction 35	Current	14,371,300	14,371,300	$3.00	$43,113,900.00	7
6/7/17	Auction 36	Current	14,597,470	14,597,470	$2.53	$36,931,599.10	6
9/8/17	Auction 37	Current	14,371,585	14,371,585	$4.35	$62,516,394.75	5
12/6/17	Auction 38	Current	14,687,989	14,687,989	$3.80	$55,814,358.20	4
3/14/18	Auction 39	Current	13,553,767	13,553,767	$3.79	$51,368,776.93	3
6/13/18	Auction 40	Current	13,771,025	13,771,025	$4.02	$55,359,520.50	2
9/5/18	Auction 41	Current	13,590,107	13,590,107	$4.50	$61,155,481.50	1

RGGI effect on emissions

While New Jersey was in RGGI from 2008 (beginning with Auction 2, 12/17/2008) through 2011 (ending with Auction 14, 12/6/2011), the price of RGGI ranged between \$1.86/ton CO_2 to \$3.51/ton CO_2. Since then, its maximum price has been only \$7.50/ton CO_2, much below the minimum price of \$40- 80/ton CO_2 needed by 2020 to achieve the Paris Agreement.[344]

During that time period, New Jersey electric power emissions fell from 18.7 million tons of CO_2 to 15.6 million tons of CO_2, or about 17%. During this time, total New Jersey emissions fell from 128.8 million tons of CO_2 to 115.3 million tons of CO_2, or about 10%. Of the total emissions decrease, electric power made up about 23%. New Jersey's electric power emissions made up 14.5% of total emissions in 2008 and 13.5% by 2011.

Thus, while a significant amount of CO_2 emissions decrease may be attributable to RGGI, it does not represent even a majority of total emissions decrease because it only impacts electric power emissions. A higher carbon price would be needed to incentivize larger emissions reductions.

For more information on New Jersey allowances please see:
https://www.rggi.org/docs/NJ_Proceeds_by_Auction.pdf

[344] CPLC 2017: https://www.carbonpricingleadership.org/report-of-the-highlevel-commission-on-carbon-prices/

New Jersey Primary Energy Usage

The following lists estimates of New Jersey energy consumption as of 2015.[345]

Category	New Jersey Energy Consumption Estimates (Trillion Btu)	Percentage of Total Energy Consumption
Coal	22.9	1.0
Natural Gas	778.8	35.6
Motor Gasoline excl. Ethanol	455.5	20.8
Distillate Fuel Oil	172	7.9
Jet Fuel	220.6	10.1
LPG	7.0	0.3
Residual Fuel	23.4	1.1
Other Petroleum	0	0
Nuclear Electric Power	347.9	15.9
Hydroelectric Power	0.1	0
Biomass	63.6	2.9
Other Renewables	21.6	1.0
Net Interstate Flow of Electricity	72.0	3.3
TOTAL, fossil fuels	1680.2	76.9
TOTAL,	85.3	3.9

[345] EIA 2017: https://www.eia.gov/state/?sid=NJ#tabs-1

renewables (not nuclear)		
TOTAL, non-fossil fuel (including nuclear)	505.2	23.1
TOTAL	2185.4	100

New Jersey Natural Gas Utilities

All four natural gas companies have headquarters in New Jersey, although the parent company of Elizabethtown Gas, Southern Company, is based in Atlanta, GA. However, Elizabethtown Gas will soon be sold to South Jersey Industries, which is based in New Jersey.[346]

Table 1: Gas Utilities in New Jersey, ordered by customer number

Gas	Customers	HQ	Parent Company	Service Area	Employees
PSE&G	1,800,000	Newark, NJ	PSE&G (Newark, NJ)	Northern, Central Jersey (Passaic, Bergen, Hudson, Essex, Morris, Hunterdon, Somerset, Union, Middlesex, Mercer, Monmouth, Ocean, Burlington, Camden, Gloucester)	13,100
New Jersey Natural Gas	525,000	Wall, NJ	New Jersey Resources	Northern, Eastern Jersey (Morris, Sussex, Middlesex, Monmouth, Ocean, Burlington)	1100
South Jersey Gas	381,000	Folsom, NJ	South Jersey Industries (Folsom, NJ)	South Jersey (Burlington, Camden, Gloucester, Salem, Atlantic, Cumberland, Cape May)	Not found
Elizabethtown Gas	286,000	Union, NJ	Southern Company Gas (Atlanta, GA), in the third quarter of 2018 to be sold to South Jersey Industries	Northern, Central Jersey (Sussex, Warren, Hunterdon, Morris, Mercer, Union, Middlesex)	Not found

[346] Southern Co. 2017: https://www.southerncompany.com/newsroom/2017/oct-2017/southern-company-gas-to-sell.html

Table 2: Sources for Table 1

PSE&G	New Jersey Natural Gas	South Jersey Gas	Elizabethtown Gas
-https://www.pseg.com/family/index.jsp.	-https://www.njng.com/about/ -http://www.njresources.com/about/careers/index.asp	-https://www.sjindustries.com/	-https://www.elizabethtowngas.com/about-us -http://www.aglresources.com/about/distribution_eli.aspx -https://www.southerncompany.com/newsroom/2017/oct-2017/southern-company-gas-to-sell.html -http://www.njcleanenergy.com/main/public-reports-and-library/links/gas-utilities-territory-map

Effect on High-Emissions Facilities

Below we list facilities with high carbon emissions in New Jersey. This was downloaded from the 2016 EPA Flight Data.[347] These facilities should be engaged as stakeholders in the design of the vulnerable business rebate, especially if they cannot pass their increased costs along to consumers for out-of-state competition, legal, or nonprofit reasons.

Chemicals						
FACILITY NAME	REPORTED ADDRESS	PARENT COMPANIES	CITY NAME	COUNTY NAME	GHG QUANTITY (METRIC TONS CO2e)	$30 fee ($m)
MERCK SHARP & DOHME CORP. - RAHWAY	126 EAST LINCOLN AVENUE	MERCK & CO INC (100%)	RAHWAY	UNION	59620	1.7886
BRISTOL MYERS SQUIBB INC	ONE SQUIBB DRIVE	BRISTOL-MYERS SQUIBB CO (100%)	NORTH BRUNSWICK	MIDDLESEX COUNTY	56358	1.69074
DSM NUTRITIONAL PRODUCTS LLC	205 MACKS ISLAND DRIVE	DSM HOLDING CO INC (100%)	BELVIDERE	WARREN	54543	1.63629

[347] EPA 2017, accessed 1/30/2018: https://ghgdata.epa.gov/ghgp/main.do

E R SQUIBB & SONS LLC	3551 LAWRENCE RD	BRISTOL-MYERS SQUIBB CO (100%)	LAWRENCEVILLE	MERCER COUNTY	37334	1.12002
CIP II/AR BRIDGEWATER HOLDINGS LLC	1041 ROUTE 202-206	CIP II/AR BRIDGEWATER HOLDINGS LLC (100%)	BRIDGEWATER	SOMERSET	26819	0.80457
NOVARTIS PHARMACEUTICALS CORPORATION	59 Route 10	NOVARTIS US (100%)	EAST HANOVER	MORRIS COUNTY	20421	0.61263
CHEMOURS CHAMBERS WORKS	67 Canal Road, PO Box 9001	THE CHEMOURS CO (100%)	DEEPWATER	SALEM COUNTY	1836	0.05508
PRAXAIR INC	554 SHELL RD	PRAXAIR INC (100%)	CARNEYS POINT	SALEM COUNTY	704	0.02112

Metals						
FACILITY NAME	REPORTED ADDRESS	PARENT COMPANIES	CITY NAME	COUNTY NAME	GHG QUANTITY (METRIC TONS CO2e)	$30 fee ($m)
McWane Ductile-New Jersey	183 SITGREAVES ST.	MCWANE INC (100%)	PHILLIPSBURG	WARREN COUNTY	38407	1.15221
GERDAU AMERISTEEL - SAYREVILLE	NORTH CROSSMAN ROAD	GERDAU USA INC (100%)	SAYREVILLE	MIDDLESEX	35513	1.06539

Minerals						
FACILITY NAME	REPORTED ADDRESS	PARENT COMPANIES	CITY NAME	COUNTY NAME	GHG QUANTITY (METRIC TONS CO2e)	$30 fee ($m)

DURAND GLASS MANUFACTURING CO INC	901 SOUTH WADE BOULEVARD	DURAND GLASS MANUFACTURING CO INC (100%)	MILLVILLE	CUMBERLAND COUNTY	71089	2.13267
Ardagh Glass Inc.	443 S EAST AVE	ARDAGH GROUP (100%)	BRIDGETON	CUMBERLAND COUNTY	40417	1.21251
NATIONAL GYPSUM	1818 RIVER ROAD	NEW NGC INC (100%)	BURLINGTON	BURLINGTON COUNTY	32855	0.98565
Ardagh Glass Inc.	83 GRIFFITH ST	ARDAGH GROUP (100%)	SALEM	SALEM	1416	0.04248

Other						
FACILITY NAME	REPORTED ADDRESS	PARENT COMPANIES	CITY NAME	COUNTY NAME	GHG QUANTITY (METRIC TONS CO2e)	$30 fee ($m)
RUTGERS UNIVERSITY BUSCH - LIVINGSTON CAMPUS	27 RD 1	RUTGERS THE STATE UNIVERSITY OF NEW JERSEY (100%)	PISCATAWAY	MIDDLESEX COUNTY	93700	2.811
TRUSTEES OF PRINCETON UNIVERSITY	DEPT OF ENGINEERING MACMILLAN BLDG ELM DR	PRINCETON UNIVERSITY (100%)	PRINCETON	MERCER	75179	2.25537
Rutgers Health Science Campus at Newark	30 Bergen Street ADMC #2 Suite 207	RUTGERS THE STATE UNIVERSITY OF NEW JERSEY (100%)	Newark	ESSEX	73595	2.20785
NESTLE USA INC	61 JERSEYVILLE AVENUE	NESTLE USA INC (100%)	FREEHOLD	MONMOUTH COUNTY	48361	1.45083

Mars Chocolate, Hackettstown	700 HIGH STREET	MARS INC (100%)	HACKETTSTOWN	WARREN COUNTY	45989	1.37967
Montclair State University	1 Normal Avenue	MONTCLAIR STATE UNIVERSITY (100%)	Montclair	ESSEX COUNTY	35797	1.07391
THE COLLEGE OF NEW JERSEY	2000 PENNINGTON ROAD	THE COLLEGE OF NEW JERSEY (100%)	EWING	MERCER	31788	0.95364
PASSAIC VALLEY SEWER COMM	600 WILSON AVENUE	PASSAIC VALLEY SEWERAGE COMMISSIONERS (100%)	NEWARK	ESSEX COUNTY	25374	0.76122
ROWAN UNIV	201 MULLICA HILL ROAD	ROWAN UNIVERSITY (100%)	GLASSBORO	GLOUCESTER	23993	0.71979
ANHEUSER-BUSCH, INC. NEWARK BREWERY	200 US HIGHWAY ONE	ANHEUSER-BUSCH INBEV (100%)	NEWARK	ESSEX COUNTY	20598	0.61794
SOLVAY SPECIALTY POLYMERS USA, LLC	10 LEONARDS LN	SOLVAY SPECIALTY POLYMERS USA LLC (100%)	THOROFARE	GLOUCESTER	15474	0.46422
Sunoco, Inc. (R&S) Eagle Point Facility	ROUTE 130 AND I 295 SOUTH	SUNOCO PARTNERS MARKETING & TERMINALS LP (100%)	WESTVILLE	Gloucester	14714	0.44142
HOFFMANN LA ROCHE INC	340 KINGSLAND STREET	PB Nutclif Master, LLC (100%)	NUTLEY	ESSEX	11317	0.33951
HUNTERDON COGENERATION LIMITED PARTNERSHIP		NORESCO (100%)	CLINTON	HUNTERDON	4915	0.14745
MERCK SHARP & DOHME	1011 MORRIS AVE	MERCK & CO INC (100%)	UNION	UNION	4202	0.12606

CORP.-UNION						

Petroleum and Natural Gas						
FACILITY NAME	REPORTED ADDRESS	PARENT COMPANIES	CITY NAME	COUNTY NAME	GHG QUANTITY (METRIC TONS CO2e)	$30 fee ($m)
TGP Station 325 Sussex	164 Libertyville Rd	KINDER MORGAN INC (100%)	Sussex	SUSSEX COUNTY	55382	1.66146
Hanover (AGT) Station	45 Airport Road	Spectra Energy (100%)	Morristown	MORRIS	33632	1.00896
Lambertville Station	1325 Hwy 179	Spectra Energy (100%)	Lambertville	HUNTERDON COUNTY	23878	0.71634
Hanover (TE)		Spectra Energy (100%)	Florham Park	MORRIS COUNTY	18631	0.55893

Power Plants						
FACILITY NAME	REPORTED ADDRESS	PARENT COMPANIES	CITY NAME	COUNTY NAME	GHG QUANTITY (METRIC TONS CO2e)	$30 fee ($m)
Linden Generating Station	WOOD AVE SOUTH	PUBLIC SERVICE ENTERPRISE GROUP INC (100%)	LINDEN	Union	2511175	75.33525

Linden Cogeneration Facility		AEIF LINDEN SPV LLC (50%); HIGHSTAR LINDEN PRISM/IV-A INTERCO LLC (15.8754%); HIGHSTAR LINDEN CIV A LLC (11.5443%); HIGHSTAR LINDEN CIV B LLC (11.5443%); HIGHSTAR LINDEN MAIN INTERCO LLC (11.036%)	LINDEN	Union	2372291	71.16873
Red Oak Power LLC	832 RED OAK LANE	THE CARLYLE GROUP (100%)	SAYREVILLE	Middlesex	2319626	69.58878
Bergen	VICTORIA TERRACE	PUBLIC SERVICE ENTERPRISE GROUP INC (100%)	RIDGEFIELD	Bergen	2043945	61.31835
West Deptford Energy Station	3 Paradise Road	LS POWER GROUP (100%)	West Deptford	GLOUCESTER COUNTY	1796680	53.9004
Woodbridge Energy Center	1070 Riverside Drive	CPV SHORE LLC (100%)	Keasbey	MIDDLESEX COUNTY	1607512	48.22536
Newark Energy Center, LLC	955 Delancy Street	EIF NEC LLC (100%)	Newark	ESSEX	1585402	47.56206

Carneys Point	500 SHELL RD	Calypso Energy Holdings LLC (60%); Epsilon Power Partners, LLC (Atlantic Power Generation) (40%)	CARNEYS POINT	Salem	1095215	32.85645
Logan Generating Plant	76 ROUTE 130	CALYPSO ENERGY HOLDINGS LLC (100%)	SWEDESBORO	Gloucester	694706	20.84118
Bayonne Energy Center	401 Hook Road	BAYONNE ENERGY CENTER (100%)	Bayonne	Hudson	586680	17.6004
Lakewood Cogeneration	123 ENERGY WAY	ESSENTIAL POWER LLC (80%); OSAKA GAS ENERGY AMERICA CORP (20%)	LAKEWOOD	Ocean	513599	15.40797
North Jersey Energy Associates, A LP	601 JERNEE MILL ROAD	NEXTERA ENERGY RESOURCES (50%); SUEZ ENERGY GENERATION NORTH AMERICA INC (50%)	SAYREVILLE	Middlesex	422886	12.68658
Eagle Point Power Generation	1250 Crown Point Road	ROCKLAND CAPITAL LLC (100%)	WESTVILLE	Gloucester	349415	10.48245
Kearny Generating Station	HACKENSACK AVE	PUBLIC SERVICE ENTERPRISE GROUP INC (100%)	KEARNY	Hudson	301575	9.04725

Hudson Generating Station	DUFFIELD AND VAN KEUREN AVE	PUBLIC SERVICE ENTERPRISE GROUP INC (100%)	JERSEY CITY	Hudson	224991	6.74973
Bayonne Plant Holding, LLC	10 HOOK ROAD	TALEN ENERGY CORP (100%)	BAYONNE	Hudson	215907	6.47721
Ocean Peaking Power, LP	123 ENERGY WAY	ESSENTIAL POWER LLC (100%)	LAKEWOOD	Ocean	195044	5.85132
Newark Bay Cogen	414 462 AVE P	TALEN ENERGY CORP (100%)	NEWARK	Essex	174543	5.23629
Camden Plant Holding, LLC	570 CHELTON AVE	TALEN ENERGY CORP (100%)	CAMDEN	Camden	144775	4.34325
B L England	900 NORTH SHORE ROAD	ROCKLAND CAPITAL LLC (100%)	MARMORA	Cape May	94456	2.83368
Pedricktown Cogeneration Plant	143 HIGHWAY 130	TALEN ENERGY CORP (100%)	PEDRICKTOWN	Salem	80340	2.4102
Howard M Down	211 N WEST AVE	CITY OF VINELAND (100%)	VINELAND	Cumberland	76050	2.2815
E F Kenilworth, Inc.	2000 GALLOPING HILL RD BLDG K-14	ATLANTIC POWER CORP (100%)	KENILWORTH	Union	75741	2.27223
Clayville	4087 S. Lincoln Ave.	CITY OF VINELAND (100%)	Vineland	CUMBERLAND COUNTY	67943	2.03829
Cumberland Energy Center	4001 EAST MAIN ST	CALPINE CORP (100%)	MILLVILLE	Cumberland	60182	1.80546
Sewaren Generating Station	751 CLIFF ROAD	PUBLIC SERVICE ENTERPRISE GROUP INC (100%)	SEWAREN	Middlesex	58583	1.75749

Mercer Generating Station	LAMBERTON ROAD	PUBLIC SERVICE ENTERPRISE GROUP INC (100%)	HAMILTON	Mercer	53057	1.59171
Marina Thermal Facility	1077 Absecon Blvd	SOUTH JERSEY INDUSTRIES INC (100%)	Atlantic City	ATLANTIC	44483	1.33449
Mid-Town Thermal Center	1825 Atlantic Ave	DCO ENERGY (100%)	Atlantic City	ATLANTIC COUNTY	43629	1.30887
Gilbert Generating Station	315 RIEGELSVILLE RD RTE 627	NRG ENERGY INC (100%)	MILFORD	Hunterdon	36450	1.0935
Sherman Avenue	ORCHARD ROAD	CALPINE CORP (100%)	VINELAND	Cumberland	34483	1.03449
Burlington Generating Station		PUBLIC SERVICE ENTERPRISE GROUP INC (100%)	BURLINGTON	Burlington	34286	1.02858
Veolia Energy Trenton, L.P.	320 S. Warren Street	VEOLIA ENVIRONMENT NORTH AMERICAN OPERATIONS INC (100%)	Trenton	MERCER COUNTY	31701	0.95103
Carlls Corner Energy Center	BURLINGTON ROAD	CALPINE CORP (100%)	UPPER DEERFIELD TWP	Cumberland	26242	0.78726
EFS Parlin Holdings, LLC	790 WASHINGTON ROAD	GENERAL ELECTRIC CO (100%)	PARLIN	Middlesex	24216	0.72648
Elmwood Park Power - LLC	15 RIVER ROAD	TALEN ENERGY CORP (100%)	ELMWOOD PARK	Bergen	17333	0.51999
Essex	155 RAYMOND BOULEVARD	PUBLIC SERVICE ENTERPRISE GROUP INC (100%)	NEWARK	Essex	11461	0.34383

Edison	164 SILVER LAKE AVE	PUBLIC SERVICE ENTERPRISE GROUP INC (100%)	EDISON	Middlesex	1789	0.05367

Pulp and Paper						
FACILITY NAME	REPORTED ADDRESS	PARENT COMPANIES	CITY NAME	COUNTY NAME	GHG QUANTITY (METRIC TONS CO2e)	$30 fee ($m)
MARCAL MANUFACTURING, LLC.	1 MARKET ST	MARCAL MANUFACTURING LLC (100%)	ELMWOOD PARK	BERGEN COUNTY	59379	1.78137

Refineries						
FACILITY NAME	REPORTED ADDRESS	PARENT COMPANIES	CITY NAME	COUNTY NAME	GHG QUANTITY (METRIC TONS CO2e)	$30 fee ($m)
Paulsboro Refining Company LLC	800 BILLINGSPORT ROAD	PBF ENERGY CO LLC (100%)	PAULSBORO	Gloucester	1198397	35.95191
Phillips 66 BAYWAY REFINERY	1400 PARK AVE	PHILLIPS 66 (100%)	LINDEN	UNION	911623	27.34869
PAULSBORO ASPHALT REFINERY	4 PARADISE RD.	AXEON SPECIALTY PRODUCTS (100%)	PAULSBORO	GLOUCESTER	133594	4.00782

Waste						
FACILITY NAME	REPORTED ADDRESS	PARENT COMPANIES	CITY NAME	COUNTY NAME	GHG QUANTITY (METRIC TONS CO2e)	$30 fee ($m)

ESSEX COUNTY RESOURCE RECOVERY FACILITY	183 RAYMOND BLVD	COVANTA ENERGY (100%)	NEWARK	ESSEX	350684	10.52052
UNION COUNTY RESOURCE RECOVERY FACILITY	1499 US RT 1 & 9 NORTH	COVANTA ENERGY (100%)	RAHWAY	UNION	198375	5.95125
CAMDEN COUNTY RESOURCE RECOVERY ASSOC	600 MORGAN BOULEVARD	COVANTA ENERGY (99%); CAMDEN COUNTY ENERGY RECOVERY ASSOCIATES LP (1%)	CAMDEN	CAMDEN	122574	3.67722
COVANTA WARREN ENERGY RESOURCE CO	218 MOUNT PISGAH ROAD	COVANTA ENERGY (100%)	OXFORD	WARREN	64143	1.92429
WHEELABRATOR GLOUCESTER COMPANY, L.P.		ENERGY CAPITAL PARTNERS LLC (100%)	WESTVILLE	GLOUCESTER COUNTY	61129	1.83387
BURLINGTON COUNTY RESOURCE RECOVERY COMPLEX	21939 COLUMBUS ROAD	BURLINGTON COUNTY (100%)	COLUMBUS	BURLINGTON	912	0.02736
MONMOUTH COUNTY RECLAMATION CENTER	6000 ASBURY AVE	MONMOUTH COUNTY BOARD OF CHOSEN FREEHOLDERS (100%)	TINTON FALLS	MONMOUTH	202	0.00606
OCEAN COUNTY LANDFILL	2498 STATE HWY 70	OCEAN COUNTY LANDFILL CORP (100%)	MANCHESTER	OCEAN COUNTY	171	0.00513

ATLANTIC COUNTY LANDFILL	6700 Delilah Road	ATLANTIC COUNTY UTILITIES AUTHORITY (100%)	EGG HARBOR TOWNSHIP	ATLANTIC COUNTY	163	0.00489
Middlesex County Landfill	53 Edgeboro Rd	MIDDLESEX COUNTY UTILITIES AUTHORITY (100%)	East Brunswick	MIDDLESEX	137	0.00411
CUMBERLAND COUNTY IMPROVEMENT AUTHORITY SWC	169 JESSE BRG RD	CUMBERLAND COUNTY IMPROVEMENT AUTHORITY (100%)	MILLVILLE	CUMBERLAND COUNTY	122	0.00366
NJMC 1-E Landfill	100 Baler Boulevard	NEW JERSEY MEADOWLANDS COMMISSION (100%)	North Arlington	BERGEN COUNTY	55	0.00165
GLOUCESTER COUNTY SOLID WASTE COMPLEX	493 MONROEVILLE ROAD (C.R. 694)	GLOUCESTER COUNTY IMPROVEMENT AUTHORITY (GCIA) (100%)	SWEDESBORO	GLOUCESTER COUNTY	53	0.00159
INTERSTATE WASTE REMOVAL PARKLANDS RECLM SLF	1070 ROUTE 206	WASTE MANAGEMENT INC (100%)	BORDENTOWN	BURLINGTON	37	0.00111
Pennsauken Sanitary Landfill	9600 RIVER ROAD	POLLUTION CONTROL FINANCING AUTHORITY (100%)	PENNSAUKEN	CAMDEN	26	0.00078

Income Distribution of NJ Households[348,349]

Household Income Level Bracket (in thousands of dollars)	Count of Households In Bracket (in thousands)	Percentage of Households Within Bracket	Cumulative Sum: Percentage of Households Within Bracket	Approximate Quintiles	Mean Household Income of Actual Quintile (in thousands of dollars)
<10	171	5.37	5.37	Bottom	15.3
10-15	121	3.79	9.16		
15-20	132	4.16	13.32		
20-25	126	3.96	17.28		
25-30	126	3.95	21.23		
30-35	126	3.96	25.19	Second	41.7
35-40	114	3.59	28.78		
40-45	115	3.61	32.39		
45-50	110	3.45	35.84		
50-60	221	6.94	42.78		
60-75	291	9.13	51.91	Third	72
75-100	413	13	64.91		
100-125	324	10.2	75.11	Fourth	112.8
125-150	225	7.06	82.17		
150-200	271	8.51	90.68	Top	244.3

[348] U.S. Census 2010: https://www.census.gov/
[349] Statistical Atlas 2017: https://statisticalatlas.com/state/New-Jersey/Household-Income#figure/household-income-percentiles

>200	300	9.41	100.09		
Total:	3186	100.09	100.9		

List of Past and Ongoing NJ Climate Policies

Clean Storm Water/Flood Defense Acts (A2694/S1073)[350,351]
Description: Authorization for authorities, counties, and municipalities to form Stormwater Utilities to manage stormwater; taxes impermeable surface to fund projects to reduce floods and clean stormwater
Year Introduced: 2018
Status: Active
House/Senate

Clean Renewable Energy Bill (A3723)[352]
Description: Goal to achieve 100% clean energy by 2050. Establishment and improvements of existing solar, offshore wind, and energy storage/efficiency programs. Increased investment into community solar programs.
Policy Category: Coastal Resiliency, Energy Efficiency/Retrofits
Year Introduced: 2018
Status: Active
House/Senate

Bill S2313[353]
Description: Sets up zero-emissions certificate program for nuclear energy plants
Policy Category: Energy Efficiency/Retrofits
Year Introduced: 2018
Status: Active
House/Senate

Executive Order no. 28[354]
Description: Requires state agencies to update their Energy Master Plan (EMP) to work towards 100% renewable energy by 2050.

[350] New Jersey State Legislature: https://www.njleg.state.nj.us/bills/BillView.asp?BillNumber=A2694
[351] New Jersey State Legislature: https://www.njleg.state.nj.us/bills/BillView.asp?BillNumber=S1073
[352] New Jersey State Legislature: https://www.njleg.state.nj.us/bills/BillView.asp?BillNumber=A3723
[353] New Jersey State Legislature: https://www.njleg.state.nj.us/bills/BillView.asp?BillNumber=S2313
[354] The State of New Jersey: https://nj.gov/infobank/eo/056murphy/pdf/EO-28.pdf

Policy Category: Coastal Resiliency, Energy Efficiency/Retrofits
Year Introduced: 2018
Status: Active
Executive Order by Governor Murphy

Hoboken Climate Action Plan[355]
Description: Carbon neutrality in Hoboken by 2050; reduce emissions below Paris Accords standards; achieve NJ Gold Star in energy
Policy Category: Carbon Fee/Tax, Coastal Resiliency, Energy Efficiency/Retrofits
Year Introduced: 2019
Status: Active
Executive Order in Hoboken by Mayor Ravi S. Bhalla

Transport and Climate Initiative (TCI)[356]
Description: Regional effort to encourage public transport, expand electric car usage, increasing green jobs, reducing traffic, improve existing transit infrastructure; shift toward clean transportation
Policy Category: Energy Efficiency/Retrofits, Household Dividends/Cashback
Year Introduced: NJ joined in 2018 under Governor Murphy

2007 Global Warming Response Act[357]
Description: Reduce GHG emissions to below 1990 levels by 2020; 80% below 2006 levels by 2050
Policy Category: Energy Efficiency/Retrofits
Year Introduced: 2007
House/Senate

CO_2 Budget Trading Program (N.J.A.C. 7:27C and 7:27D)[358]
Description: Set up how CO2 auctions under RGGI would work; funds redistributed
Policy Category: Carbon Fee/Tax, Household Dividends/Cashback
Year Introduced: 2007
House/Senate

[355] The City of Hoboken: https://www.hobokennj.gov/resources/greenhouse-gas-emissions-inventory-and-climate-action-plan
[356] Transportation and Climate Initiative: https://www.transportationandclimate.org/content/about-us
[357] The State of New Jersey Dept. of Environmental Protection: https://www.state.nj.us/dep/aqes/sggi.html
[358] New Jersey Business and Industry Association: https://www.njbia.org/njbia-comments-to-co2-budget-trading-program-rules-n-j-a-c-727c-and-global-warming-solutions-fund-n-j-a-c-727d/

Global Warming Solutions Fund Act[359]
Description: Implements market-based CO_2 trading under RGGI
Policy Category: Carbon fee/tax, Household dividends/cashback
Year Introduced: 2008
House/Senate

Executive Order no. 7[360]
Description: Directs NJ to re-enter RGGI; set up guidelines for distribution of CO2 auction funds
Policy Category: Carbon Fee/Tax, Household Dividends/Cashback
Year Introduced: 2018
Status: Active
Signed by Governor Murphy

Executive Order no. 8[361]
Description: Develop offshore wind program; generate 3,500 megawatts of wind energy by 2030; create Offshore Wind Strategic Plan w/input of stakeholders; general goal to fully implement Offshore Wind Economic Development Act (OWEDA)
Policy Category: Coastal Resiliency, Energy Efficiency/Retrofits
Year Introduced: 2018
Status: Active
Signed by Governor Murphy

Offshore Wind Energy Development Act (OWEDA)[362]
Description: Creates certificate program for offshore wind energy; NJEDA can allocate tax credits to certified wind energy facilities
Policy Category: Coastal Resiliency, Energy Efficiency/Retrofits, Household Dividends/Cashback
Year Introduced: 2010
Status: Active; amended by Exec. Order no. 8
House/Senate

NJ Smoke-Free Air Act (NJSA 26:3D-55 - 26:3D-59)[363]
Description: Prohibits smoking in indoor public areas as well as workplaces

[359] New Jersey State Legislature: https://www.njleg.state.nj.us/2006/Bills/PL07/340_.PDF
[360] The State of New Jersey: https://www.nj.gov/infobank/eo/056murphy/pdf/EO-7.pdf
[361] The State of New Jersey: https://nj.gov/infobank/eo/056murphy/pdf/EO-8.pdf
[362] The State of New Jersey: https://www.nj.gov/dep/aqes/offshorewind.html
[363] New Jersey Global Advisors on Smokefree Policy: http://www.njgasp.org/wp-content/uploads/2014/05/sfaa_2010_w-ecigs.pdf

Year Introduced: 2004
Status: Active
House/Senate

NJSA 2252/NJSB 4819[364]
Description: Sets up initiative and programs to shift toward more widespread use of electric vehicles.
Policy Category: Energy Efficiency/Retrofits
Year Introduced: 2018
Status: Active
Senate

[364] New Jersey State Legislature: https://www.njleg.state.nj.us/2018/Bills/A5000/4819_I1.HTM