A Proposal for a Carbon Fee and Dividend in New Jersey

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1. Abstract

We describe a comprehensive, politically feasible proposal for a Carbon Fee and Dividend (CF&D) policy in the state of New Jersey (USA). This proposal is informed by conversations with over 80 state stakeholders, including legislators, academics, and representatives from environmental, labor, and business groups. We propose a rising fee beginning at $30/ton of carbon dioxide (CO_2), with 70% to a household dividend and 30% to energy-intensive businesses, vulnerable communities, climate change adaptation, and low-carbon technology investments. We analyze the potential economic effects of this policy, including the positive effect on NJ renewables, changes in energy prices, impacts on households by size and income level, impacts on vulnerable economic sectors, and overall macroeconomic effects. We suggest avenues for sustainable investment, and address potential legal barriers including the Motor Fuels Tax Act. Finally, we discuss the political feasibility of the policy, including public opinion and the results of our stakeholder conversations. We conclude that a statewide CF&D policy is a politically feasible way to reduce emissions without significantly harming New Jersey's economy.

2. Introduction

2.1 Motivation for a Carbon Fee and Dividend Policy

A strong causal relationship has been established between greenhouse gas (GHG) emissions and climate change (Stips et al. 2016), which poses a major threat to New Jersey. Sea-level rise is projected to place 174,000 - 482,000 state residents at risk of inundation by 2100, and factoring in population growth increases this figure substantially (Hauer et al. 2016). The economic and social costs associated with climate change include increased extreme weather, damages to fisheries, decreased crop yields, more severe droughts and floods, heat-related illnesses, and increased insect-borne disease rates (EPA 2016). Even an individual state's actions to fight carbon emissions can yield effects; in the US and Western Europe, each ton of reduced CO_2 emissions is associated with health co-benefits of $30-600 (West et al. 2013). Effective solutions should ensure that costs are fairly allocated, and must not harm New Jersey's economy. We propose a CF&D policy as a simple, efficient method for reducing carbon emissions, establishing New Jersey as a leading state for US climate policy while promoting the economic welfare of most citizens and businesses.

2.2 Existing CF&D or Carbon Tax Programs

National carbon taxes currently exist in Chile, Costa Rica, Denmark, Finland, France, Iceland, Ireland, Japan, Mexico, Norway, Sweden, Switzerland and the UK (World Bank 2014). Carbon taxes have also been implemented at the sub-national level, for instance in British Columbia. We examine the policies in Denmark, Ireland, and British Columbia because they are well-documented and share similarities with our proposal.

2.2.1 Denmark

The tax was introduced in 1992 and is currently DKr ~170/tCO_2e (~$27/t$CO_2$e[1]), with 60% percent of the revenue dedicated to industry and 40% to environmental programs. From 1990-2012, Denmark's CO_2 emissions fell by 14% (World Bank 2017).

2.2.2 Ireland

The tax was implemented in 2010 on oil and gas consumption to increase revenues and reduce GHG emissions. This rate was increased in stages to €20/tCO_2e (~$23.50/t$CO_2$e) in 2012, and the tax has been extended to all fossil fuels. Tax revenues flow to the government's budget (World Bank 2017).

2.2.3 British Columbia (BC)

A revenue-neutral carbon tax was introduced in 2008 on emissions-generating fuels, covering the sources of about 70% of BC's total GHG emissions. The tax rose by C$5 per year from its initial rate of C$10/t$CO_2$e to reach C$30/tCO_2e (~$23/t$CO_2$e) in 2012, which remains the current rate. All of the revenue generated by the tax is returned to businesses and households through tax deductions and credits (World Bank 2017).

2.3 Our Policy Proposal

This paper describes the mechanics and feasibility of a state-level New Jersey CF&D policy. This policy appeals to both the progressive priority of protecting low-income households and the conservative preference for market-based policy. Considerable economic simulations and research, combined with case studies of similar implementations in other locations, find that a CF&D policy can reduce emissions without economic blowback.

[1] Currency conversions performed on 9/25/2018.

3. Methods

3.1 Economic Analyses (Section 6)

To assess the economic effects of our proposed CF&D policy, we study the economic effects of previous CF&D implementations, as well as models of similar policies in other US states. Because limited economic studies were available specifically for NJ, we assume that New Jersey would be sufficiently similar to these other cases. We provide more specific descriptions of individual analyses in Section 6.

3.2 Conversations with Stakeholders (Section 7)

To gauge political feasibility, we presented our proposal to 83 stakeholders between December 2017 and June 2018. These stakeholders typically held key leadership roles within relevant interest groups, including environmental groups, research groups, government officials, and business/trade/energy companies or coalitions. Our conversations helped us form relationships with stakeholders and exchange ideas and resources, in order to develop and strengthen our eventual policy proposal.

We attempted a quantitative analysis of the stakeholders' responses to our proposal. A thorough analysis of our notes generated three main categories of data for each stakeholder (whenever possible):

1) A "rating" between -2, denoting strong opposition, and 2, denoting strong support, of the stakeholder's overall views on the proposal.
2) A "rating" between -2 and 2 of the stakeholder's preference for how to use the revenue generated by our proposal (2 denotes strong preference for a revenue-neutral policy in which all revenue is used for the "dividend"; -2 denotes strong preference for greater investment in additional environmental priorities).
3) A categorization (42 categories) and record of the concerns, then-unanswered questions, objections, and any additional considerations, legislative preferences, ideas, and suggestions raised by each stakeholder.

We strove to conduct an impartial, objective, and honest analysis. However, there are imperfections: the ratings and the categorization rely on an extrapolation of the stakeholder's stance from our notes, and the stakeholders who were willing to meet might not accurately represent broader stakeholder opinions in NJ. We classify stakeholders into 5 categories:

- "Environmental groups": any organized group with an explicit environmental activism orientation, including student groups, faith groups, environmental justice groups, and miscellaneous advocacy groups for which environment-related activism work is either at the core of or a branch of the organization's work. This is a particularly diverse stakeholder category, composing over half of our total stakeholder sample size.
- "Academia": professors and researchers employed by a university.
- "Government": anyone currently serving as or working in the office of a public servant, or otherwise involved in a coalition of or collaboration between government officials.

- “Manufacturer/business group”: any lobbyist group, advocacy group, or association representing the interests of industries, manufacturers, and/or businesses.
- “Research/consultant”: any non-academia researchers and consultants.

4. CF&D Fee Structure

4.1 Overview

Our proposal would price CO_2-containing fuels at the first point of entry into New Jersey. The rising fee would reduce the relative price of non-polluting alternative sources of energy, and thus incentivize actors across the economy to pursue low-carbon options. Because energy providers are likely to pass down much of the price increase to consumers, the majority of collected revenue will be returned to households and to vulnerable businesses in the form of dividends to help them adjust. Depending on legal issues and political will, a portion of the collected fees may also be used to support green investments and adaptation initiatives.

4.2 Qualifying Fuels and Fee Schedule

We propose a fee on all CO_2 emitting fuels, proportional to their estimated CO_2 content. These would include marine fuels, natural gas used by utilities for home heating, and all fuels covered by the Motor Fuels Tax Act, including gasoline, diesel, petroleum blends and aviation fuel (NJ Dept. of Treasury 2010). We consider 3 different scenarios, for a Low (\$10/tCO_2), Moderate (\$30/tCO_2), and High (\$50/tCO_2) initial fee:

Table 1: Low, Medium and High Fee Scenarios

Fee Scenario	**2019 Price (per ton CO_2)**	**Annual Rate of Increase**	**2024 Price (per ton CO_2)**
Low	\$10	\$5	\$35
Medium	\$30	\$5	\$55
High	\$50	\$5	\$75

In each scenario, the fee rises by \$5 per year for 5 years, before the price is re-evaluated. For context, the High-Level Commission on Carbon Prices states that a global carbon price of \$40-80/tCO_2 by 2020 would be consistent with the goals of the Paris Climate Agreement (CPLC 2017). The decision of which scenario to adopt would be determined by lawmakers, based on political feasibility and statewide ambition. However, we recommend the Medium Fee Scenario because it is more ambitious than the Low Scenario, yet more politically feasible than the High

Scenario. For the sake of simplicity in this proposal, our calculations are based on the Medium Fee Scenario unless otherwise specified.

4.3 Relationship to RGGI: Fees for Electric Power

This CF&D policy should complement the Regional Greenhouse Gas Initiative (RGGI), which New Jersey will be re-joining as per Governor Phil Murphy's 2018 Executive Order (NJ DEP 2018). RGGI places a carbon cap-and-trade system on electric power plants that use fossil fuels with a capacity of over 25 MW, with the aim of reducing the power sector's GHG emissions (Ramseur 2017). Our proposed policy can optionally apply to electricity; specifically, to imported electricity and to fossil fuels used for producing electricity. Evidently, applying the fee to the electric sector without any adjustments for power plants that are already targeted by RGGI would lead to them being double taxed. We define two main options for applying our policy to electricity and, consequently, our policy's relationship with RGGI:

1. Apply the fee to all sectors, and rebate the electric sector for RGGI prices. The downside of this option is that rebating all concerned electric power plants for their carbon allowances, which are dependent on the new RGGI price, makes this option complex to implement. In addition, this would essentially negate New Jersey's RGGI participation since the effective carbon price is the one our policy sets.
2. Apply the fee to all sectors other than the electric sector. This option would work with RGGI by preserving RGGI's electricity price and imposing our fee on the remaining sectors. The downside of this option is that it will require diligent monitoring of imported fuels to verify whether or not they are being used to generate electric power.

We recommend pursuing the first option (impose the fee on companies affected by RGGI and rebate their RGGI fees), because it will have a higher effective carbon price for companies involved. RGGI's price has historically remained well under \$10/tCO_2 (RGGI, 2018), which is much lower (and therefore less impactful on emissions) than our \$30/tCO_2 scenario. This option does increase the risk of emissions leakage, as external power will be relatively cheaper.

4.4 Point of Assessment & Collection Mechanism

The carbon fee would be applied to entities purchasing fuel for electricity production or electricity for household distribution, and at the first point of in-state transfer of motor fuels. This criterion is important for the fee's application to electricity, since three of New Jersey's four investor-owned utility companies have parent companies headquartered out-of-state (the exception being PSE&G). The fee on imports of fuels for electricity generation (including coal, natural gas and crude oil), wholesale electricity, and natural gas would be charged upon their first entry into New Jersey.

According to current protocols, the fee on fuels unrelated to electricity production, electricity distribution or natural gas distribution, should be charged upon entry into the terminal transfer system, defined as “the fuel distribution system consisting of refineries, pipelines, vessels and terminals” by the New Jersey tax code §54:39-102.

For New Jersey, a small state with many terminals just outside of state lines, provision §54:39-118 allows importing motor fuels suppliers to treat the removal of fuels from extraterritorial terminals as though they are within the state. Applying the fee at such a midstream “choke point” ensures widespread coverage of carbon emissions without involving too many actors in the fee collection process, as would be the case in a downstream approach (Ramseur et al. 2013).

The New Jersey Division of Taxation, which already administers comparable fees and taxes, should administer this fee. The CF&D policy would be administered via the same framework as the Motor Fuels Tax (NJ Dept. of Treasury 2010), removing the need to create a new collection mechanism.

4.5 Pricing of Other Greenhouse Gases

Our analysis focuses on CO_2, since it accounted for 81% of US GHG emissions in 2016 (EPA 2016). Other GHGs, especially methane (CH_4) and nitrous oxide (N_2O), do play a considerable role in global warming. Ideally, if a non-CO_2 GHG is released directly into the atmosphere, then a separate fee—the baseline fee for CO_2 emissions multiplied by the gas’s Global Warming Potential (GWP), estimated at a 100 year timeframe—would be applied. We chose the 100 year timeframe over the 20 year timeframe because it is more widely used, and is more focused on the long-run. Table 2 summarizes the fee scenarios for methane and nitrous oxide, which have 100-Year GWPs of 28 and 265, respectively (Myhre et al. 2013).

Table 2: Theoretical Fee Scenarios for Different Pollutants (First Year of Implementation)

Fee Scenario	**Initial 2019 Price ($/t$CO_2$)**	**Initial 2019 Price ($/t$CH_4$)**	**Initial 2019 Price ($/t$N_2O$)**
Low	$10	$280	$2,650
Medium	$30	$840	$7,950
High	$50	$1,400	$13,250

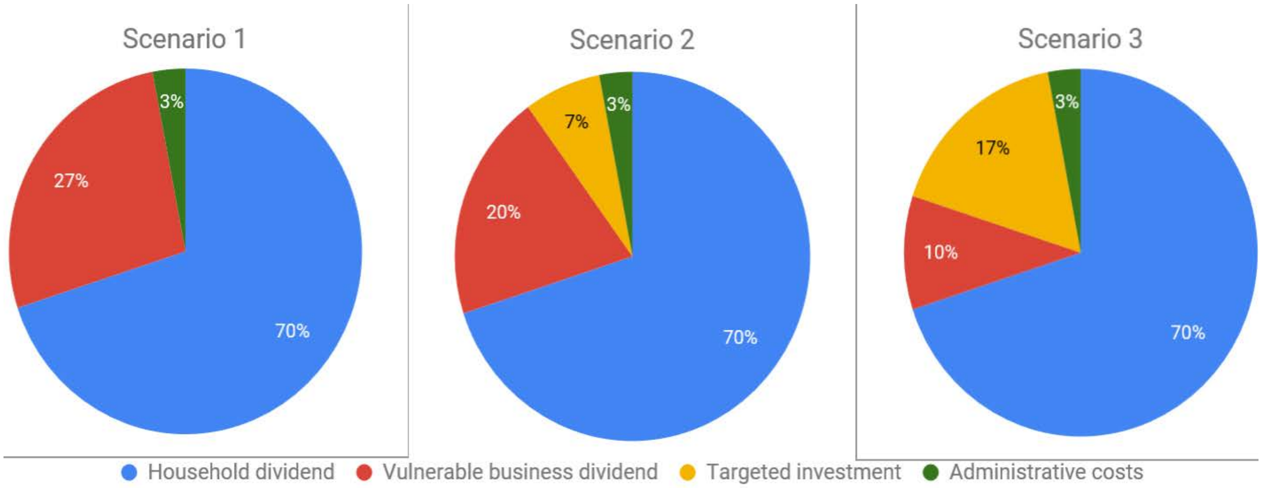
We also would ideally price other air pollutants, such as PM2.5. For each air pollutant, we would estimate its social cost, compare that social cost to the social cost of carbon, and scale the fee on the pollutant accordingly. Due to the high uncertainties surrounding the social costs of many pollutants, 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 air pollutants.

5. Revenue Usage

5.1 Structure

Several revenue allocation options are shown below:

Figure 1: Revenue Distribution Scenarios



We chose to allocate 70% of the revenue to households, to ensure that the three lowest income quintiles experience a net benefit on average from our policy (see Section 6.8). We support Scenario 3 because it allows for more targeted investment, which could fund low-carbon technologies and resiliency measures, especially in vulnerable communities (see Section 5.4).

5.2 Rebate Format

A carbon fee would lead to increased electricity and fuel prices, affecting citizens and businesses significantly. As such, a large portion of the revenue should be directly returned to the affected agents. We explore two options for this rebate: a refundable tax credit or a check-in-the-mail dividend.

The advantages of a refundable tax credit are largely through cost savings. Unlike dividends, tax credits do not qualify as taxable income; they are simply removed from the amount of taxes one has to pay (the refundable aspect would allow those who are not liable for taxes to benefit). This means that individuals would receive a larger proportion of the fee's revenue with a tax credit than they would with a dividend. In addition, many people may automatically qualify for tax credit deductions when filing taxes. Because tax credits use existing tax structures, they are easy and cheap to administer, reducing the overall implementation costs of the policy. The material and administrative costs of a check in the mail are much higher.

On the other hand, a check-in-the-mail dividend is very visible and serves as a tangible indication of benefit. Also, unlike tax credits which can only be administered annually, dividends can be distributed on a quarterly or monthly basis, making it easier for individuals to manage rising energy costs. Furthermore, tax credits could potentially exclude people who are unemployed or who do not file W-4 forms, which would require implementing a refund application process to allow such individuals to receive their rebate. Given these reasons, we currently support the dividend option.

5.3 Business Rebates

The portion of the fee that is redistributed to vulnerable businesses should be designed to help them to deal with increased costs in the short-term, while incentivizing them to improve energy efficiency in the long run. We would identify businesses that are

a) Energy intensive: energy and transportation make up a significant part of costs. This is the case for many construction, manufacturing, and mining companies (see Sections 6.4 and 6.5). This would not apply to companies directly involved in the production or distribution of fossil fuels.
b) Face significant out-of-state competition with which a pollution fee would put them at a considerable cost disadvantage. This would mainly apply to small and medium-sized businesses; according to the New Jersey Business and Industry Association, 86% of businesses that are vulnerable to tax increases earned less than $10 million in net allocated income (NJBIA 2018).

As the fee increases each year, we would simultaneously decrease the dividend for these vulnerable businesses, to encourage the adoption of low-carbon energy sources. It is important to ensure that the rebate does not disincentivize energy-intensive businesses from shifting to more efficient systems.

5.4 Targeted Investment

Many stakeholders have suggested that investment should be made to fund sustainability initiatives that decrease emissions and help vulnerable communities adapt to climate change impacts. This section explores some potential investment avenues.

Some sectors still lack committed state action in support of adaptation to climate change. The New Jersey Climate Adaptation Alliance (NJCAA) identifies several areas where state action remains insufficient, including developing cost-effective methods to control weeds and vectors, improving stormwater runoff management, and creating “incentive programs to preserve, increase, or improve climate-resilient agricultural land” (NJCAA 2014a). In addition, the NJCAA recommends educating healthcare professionals about how the field of public health is changing due to the negative consequences of climate change, and increasing studies of flood impacts on the spread of contaminated soil (NJCAA 2014b).

Electric vehicles are another investment option that are becoming an increasingly viable solution to reducing transportation emissions, which account for over half of NJ's total carbon emissions (EIA 2018a). Electric vehicle use can be incentivized through higher gas prices, which increase their competitiveness relative to other vehicles, and by installing charging stations. The latter strategy was tested through the 2016 Workplace Charging Grant Program, which funded employers to install charging stations in their parking lots; however, this project ran out of funding as of January 2017, and applications are currently being waitlisted (Smart Solution, 2018).

Due to the abundance of investment options, we suggest that policymakers and their staff decide where to allot the revenue. Regardless, we recommend that the revenue distribution be publicly accessible if possible, since transparency would increase public support of this policy.

6. Economic Effects

6.1 Effect on Renewable Energy & Fossil Fuels

By increasing the relative price of fossil fuels, a carbon fee should incentivize investment in low-carbon technologies, including renewable energy such as wind and solar. Under New Jersey's renewable portfolio standard (RPS), 50% of the energy sold in-state must come from renewables by 2030 (NJDEP 2018). However, current NJ utility portfolios only have 5-16% renewables.[2] 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.

Existing carbon fees often coincide with increased renewables; Denmark and Ireland have two of the world's highest shares of electricity from variable renewable energy (IEA 2017). More broadly, both countries saw a decline in overall CO_2 emissions after their carbon taxes were implemented, as did British Columbia until it froze the tax rate in 2013 (World Bank 2017).

6.2 Effect on Energy Prices

A carbon fee reduces emissions by increasing the relative cost of carbon-intensive processes. To calculate this cost increase, we use the EPA Greenhouse Gas Equivalencies Calculator (on average CO_2 emissions of gasoline and natural gas, and the maximum carbon content of NJ utilities for electricity (see below)). As shown in Table 3a, electricity and 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 (Fig. 2). Considering that the average gasoline price in NJ fluctuated between \$2.42/gallon to \$3.01/gallon in the most recently analyzed 365-day span, ("Historical Gas Price Charts",

[2] Utility portfolio data from the most recent (2017) statements: PSEG, Jersey Central Power & Light, Atlantic City Electric, and Rockland.

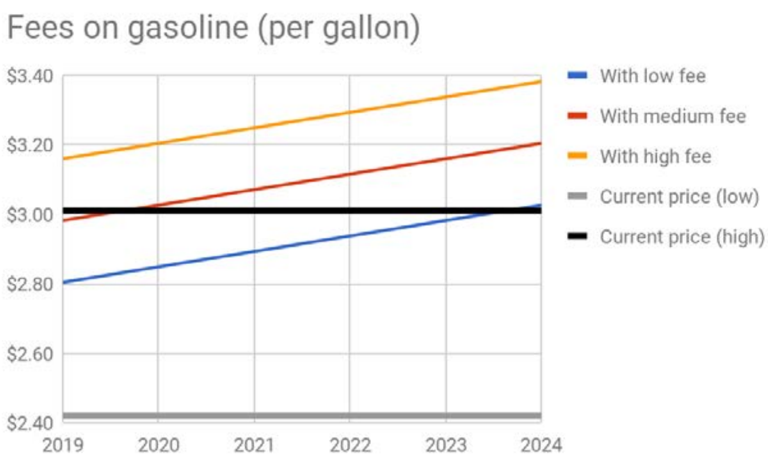
2018), a 27-cent increase would not be unheard of. Nevertheless, the household dividend is crucial for protecting consumers from these higher rates.

Because the energy sources used by New Jersey utilities have different carbon contents, a carbon fee would impact their electricity prices differently (Table 3b). PSE&G has the least carbon-intensive energy sources, so a carbon fee would have a 40% lower effect on its rates than on Jersey Central Power & Light's.

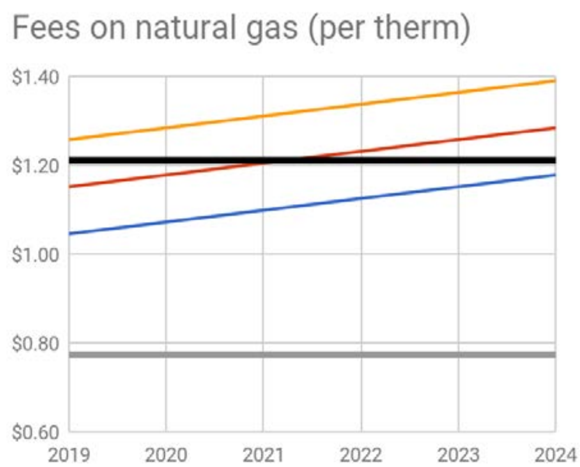
Table 3a: Effect of Proposed Carbon Fee on Energy Prices

Fuel	Initial Increase from $30/tCO_2$ Fee	Relative Increase[3]
Gasoline	$0.267 per gallon	8.9% – 11.0%
Natural Gas	$0.159 per therm	13.1% – 20.5%
Electricity	$0.015 per kWh	9.2% - 10.0%

Figure 2: Effect of Rising Carbon Fee on Energy Prices Over Time



[3] To calculate relative values, the price increases were divided by the average NJ cost for gasoline, residential natural gas, and residential electricity in the most recent 12-month span with data (accessed 9/23/18).



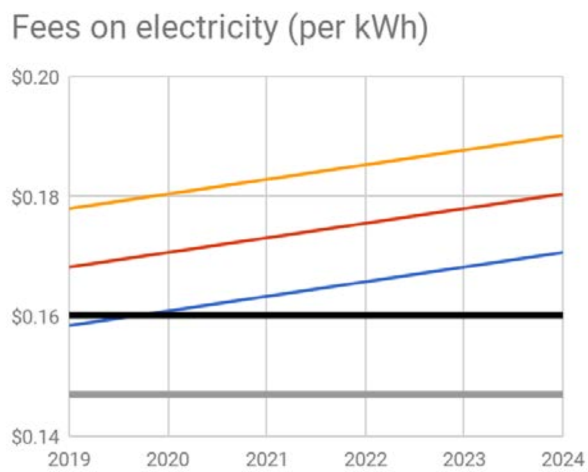


Table 3b: Effect of Proposed $30/tCO$_2$ Fee by Utility

Electric Utility	**Carbon Content[4] (tCO$_2$ per MWh)**	**Price Increase (per kWh)**	**Relative Increase[5]**
PSE&G	0.344	$0.010	6.3%
Jersey Central Power & Light	0.488	$0.015	11.0%
Atlantic City Electric	0.462	$0.014	8.0%
Rockland	0.416	$0.012	7.4%

6.3 Effect on Employment

No NJ-specific employment model was available for our use. However, Regional Economic Modeling, Inc. (REMI) has modelled state CF&D policies in Arkansas, Massachusetts, Rhode Island, Vermont, and Washington 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). A 2014 REMI model of a national, revenue-neutral CF&D policy estimated that 2.1 million jobs

[4] Using utility data on fuel portfolios, the maximum carbon content of each utility was calculated with the EPA data (Greenhouse Gas Equivalencies Calculator) on CO$_2$ emissions by fuel type as well as EIA maximum heat rates (EIA 2018c).

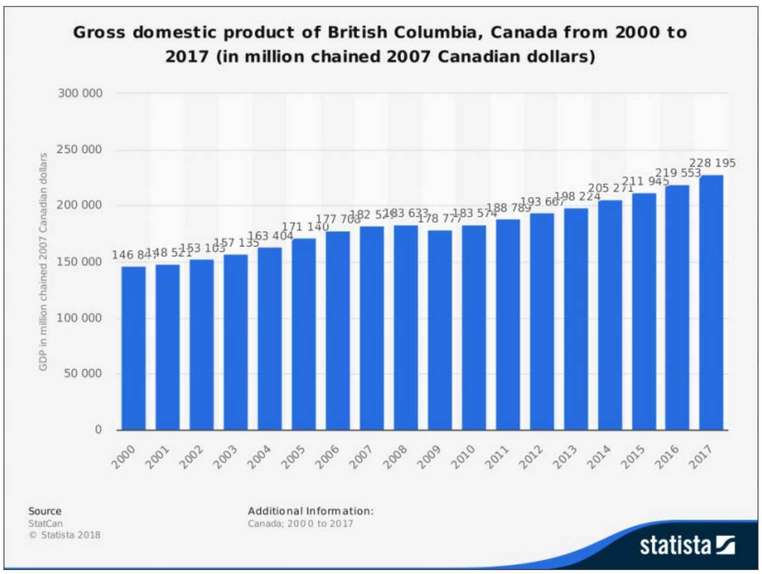
[5] Relative to electricity price range from https://www.eia.gov/electricity/sales_revenue_price/pdf/table6.pdf, accessed 9/23/2018. Table 6, 2016 Utility Bundled Retail Sales - Residential. The residential prices were chosen to demonstrate the effect of a carbon fee on a residential consumer's energy bill.

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). Assuming a similar response in New Jersey, we would expect a CF&D policy to result in a slight increase in NJ's long-term employment.

6.4 Effect on Overall Economy

Because no CF&D policy has yet been implemented in a US state, we use British Columbia's 2008 carbon tax as the closest analog. As shown in Figure 3, 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 to a CF&D policy as British Columbia's did to a carbon tax, we would expect our policy to have a negligible effect on New Jersey's overall GDP.

Figure 3: British Columbia's GDP, 2000-2017



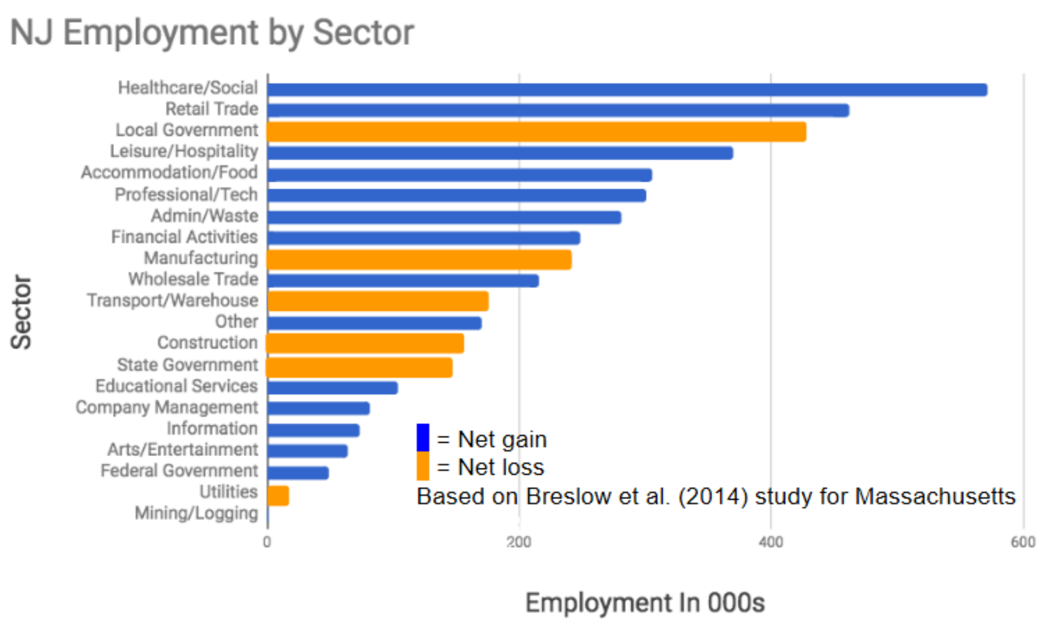
6.5 Effect on Vulnerable Sectors

To assess a carbon fee's economic impact on each sector of the economy, we study the Massachusetts Department of Energy Resources report, which analyzes a $10/tCO_2$ fee that increases $5 each year until it reaches $30, and then gradually increases to $75 after another 20 years. The report finds that most industries benefit from or are unaffected by a CF&D policy that features a uniform rebate to all industries and a mixed household and business rebate (Fig. 4). Although employment increases on net (Breslow et al. 2014), a small but significant portion of sectors which account for 28% of New Jersey's employment are projected to see decreased employment: Local Government (10.2% of NJ employment), Manufacturing (5.9%), Construction (3.8%), State Government (3.5%), Transportation (3.3%), Utilities (0.35%), and Mining (0.03%) (NJ Dept. of Labor 2018).

We next analyzed REMI's National Carbon Fee and Dividend study, which assumed a \$10/tCO_2 fee rising \$10 per year, with all revenues returned to households. Out of the 70 NAICS (North American Industry Classification System) sectors in the Mid-Atlantic region (New Jersey, Pennsylvania, New York), 9 sectors see decreased employment over the time frames studied: 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. 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).

To conclude, although overall employment in New Jersey may increase, a minority of sectors are projected to lose jobs. These should be taken into account when designing the vulnerable business rebate.

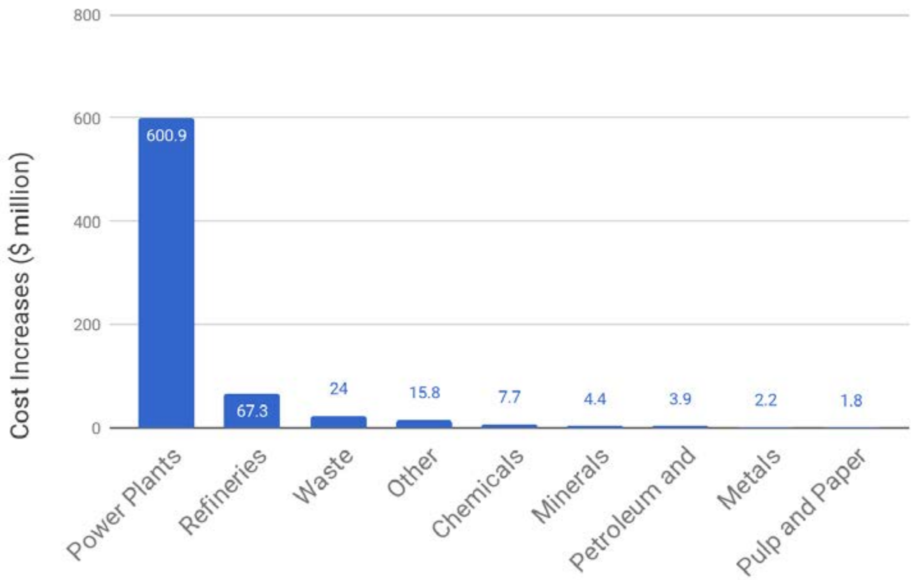
Figure 4: Effect of Carbon Price on Employment by Sector



(Source: 2016 Employment Data (Annual Average))

Facilities with especially high emissions should also be taken into account. To identify the most impacted facilities and sectors, we analyzed a list of 90 high CO_2-emitting facilities in New Jersey from the EPA FLIGHT database. 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). Figure 5 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. Power plants would face the most costs by far, followed by refineries and waste industries. Details for individual facilities can be found in Appendix A (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.

Figure 5: Cost of \$30/tCO_2 Fee for High-Emitting Facilities, by Sector[6]



6.6 Effect on Energy Demand

A price on carbon can decrease energy demand, which we can estimate by using energy price elasticities. 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 tax 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. The high uncertainty associated with estimating elasticities complicates matters; to understand the outcome range, we examine the effects on consumption for a low elasticity scenario (-0.15) and a high elasticity scenario (-0.60) in Table 4, based on the percent changes from Table 3a. Because the calculated changes in energy consumption are short-term estimates, they might not accurately reflect the response in energy demand.

[6] Costs are proportional to emissions of each sector, which are taken from the EPA FLIGHT database (2016).

Table 4: Change in Energy Consumption for Low and High Elasticity Scenarios

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%
Electricity	1.4-1.5%	5.5-6.0%

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). We therefore expect a CF&D policy to cause a small yet non-negligible decrease in NJ's energy demand.

6.7 Leakage

One potential problem with the policy's implementation is carbon emissions leakage, which has been a significant concern for past carbon pricing schemes. Leakage is defined as "the increase in CO_2 emissions outside the countries [or states] taking domestic mitigation action divided by the reduction in the emissions of these countries" (IPCC AR4 2007), and usually entails the movement or outsourcing of economic activity to cheaper states, preventing the fee from decreasing carbon emissions and causing statewide job loss. Any proposal to implement a CF&D policy must take measures to prevent leakage.

California shows how leakage between US states could be addressed after the passage of the 2006 California Global Warming Solutions Act (Assembly Bill 32). A 2015 study by Caron et al. estimated that California's out-of-state emissions would have increased by 45% if its cap and trade policy did not apply to imported electricity. The leakage drops to 9% when imported electricity is included (Caron et al. 2015). This demonstrates that an out-of-state adjustment can minimize leakage involved with the movement of energy production, provided that such a policy is uniformly applied. 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 ("AAA Gas Prices", 2018). As a rough calculation for this potential leakage, we compare gas prices in each border county of NJ, DE, PA, and NY. To find the maximum distance from the NJ border where it would be cost-effective to refuel out-of-state (Table 5), 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*

Table 5: Maximum Distance from NJ Border Where Refueling Out-of-State is Cost-Effective

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

It is always cost-effective to cross the border in counties bordering Delaware for a compact car (16 US Gal, 30mpg), 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.

Finally, a carbon fee could incentivize carbon-intensive industries and manufacturers to relocate to neighboring states, which could have 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.

6.8 Effect on Households by Size and Income

Note: The calculations in this section are undergoing final review.

New Jersey emitted 112 MMTCO_2 in 2015 (EIA 2015). In our calculations, we converted BTUs of different sources of consumption to emissions using their CO_2 emission rates (EIA 2017), excluding emissions of asphalt and road oil (which we did not classify as a "fuel"), and found 106.5 MMTCO_2 in total emissions. With the fee placed on those total emissions, a \$30/tCO_2 fee would raise approximately \$3.2 billion annually. Allocating 70% of this revenue to

New Jersey’s 8.95 million residents (World Population Review 2018), with children counting as half an adult when calculating dividend shares, yields ~$280 per adult.

Based on the mean New Jersey household energy usage and associated emissions, we estimate an average annual household cost of $383. One should note that this is only an average, and the effects will vary significantly by residents’ energy usage.

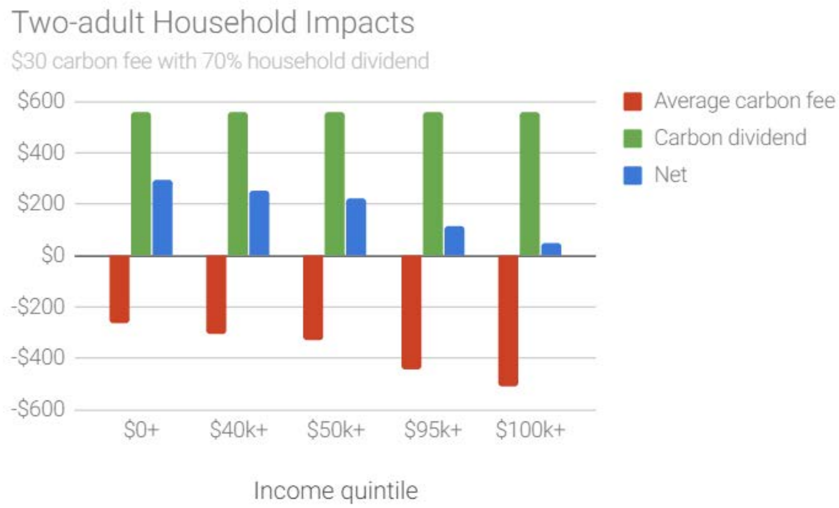
By combining household fuel use microdata from the Energy Information Administration’s Residential Energy Consumption Survey and gasoline expenditure microdata from the Bureau of Labor Statistics’ 2015 Consumer Expenditures survey, we estimate financial impacts on households of varying income levels and familial composition. We further assume that all fuels consumed by the electric power sector are exempted (in case overlap with RGGI is not possible), which reduces the annual dividend to $234.81 per adult (EIA 2016).

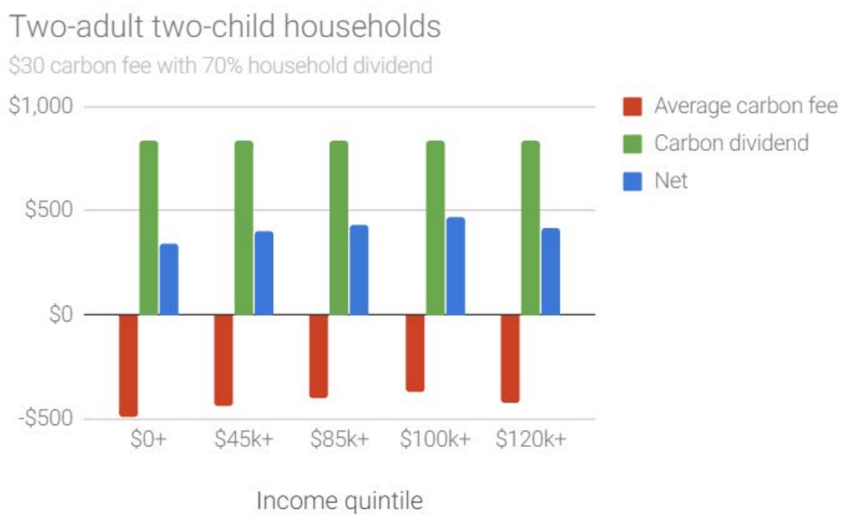
Each household composition (single adult, two adult, and two-adult two-child households) in NJ is divided into income quintiles, as shown in Figure 6. For each quintile, we calculated the average carbon fee paid due to direct household use of electricity, heating fuels, and gasoline. We excluded households with retired members, due to income not reflecting wealth in those households.

We then added the carbon dividend to the average carbon fee amount. Figure 6 represents the impact of the carbon dividend on all example household incomes and quintiles.

The lowest 3 quintiles of families are expected to benefit on net from a carbon fee with a 70% household dividend. This was one of our key objectives, as we wanted to ensure that lower income households gain a net benefit from the policy.

Figure 6: Effect of Carbon Fee on Households by Size and Income Quintile





7. Political Feasibility

7.1 Public Polling Evidence

Support for climate change action and fossil fuel regulation is strong in New Jersey as well as nationally. According to a 2016 study by the Yale Program in Climate Change Communication, 65% of adults in NJ are worried about global warming, 84% support funding research into renewable energy sources, and 80% support regulating CO_2 as a pollutant (Marlon et al. 2016). A January 2015 survey conducted by political scientists at Stanford University and Resources for the Future concluded that there is substantial national support for carbon pricing policies. Roughly 61% of Americans support taxing carbon-emitting companies, and 67% favor a tax that provides rebates to American households (RFF 2015).

Furthermore, a CF&D policy has appeal on both sides of the political aisle. Republicans such as Senator Lindsey Graham, former Secretaries of State James Baker III and George Shultz, and former EPA Director and former Governor of New Jersey Christine Todd Whitman have taken supportive stances towards a carbon tax (Worland 2017, Baker et al. 2017, Ruckelshaus et al. 2013). Democrats such as New Jersey Senator Cory Booker, Hawaii Senator Brian Schatz, and former President Barack Obama have also voiced support for carbon pricing policy (Friedman 2013, Friedman 2017, Lehmann 2015). Nationally, 49% of self-identified Republicans support a revenue-neutral carbon tax (Leiserowitz et al. 2016).

A key political challenge is that the implementation of our policy will involve an increase in gas prices. According to the most recent Rutgers-Eagleton Poll on gas taxes (March 2016), 56% of New Jersey residents opposed a gas tax increase, while 42% supported the increase (Rutgers-Eagleton 2016). In 2015, a Fairleigh-Dickinson University poll found that the two main reasons people oppose a tax increase are concerns that the tax is already too high, and doubts that the money will go where it is intended (FDU 2015). However, 54.5% of New Jersey voters approved the 2016 constitutional amendment channelling all revenue obtained from the state Motor Fuels Tax and the tax on gross receipts from petroleum products sales to the Transportation Trust Fund (Public Question Results 2016). Therefore, if carbon fee revenues can be guaranteed to be used for their intended purpose, support may increase.

7.2 Stakeholder Analysis

Table 6: Level of Proposal Support by Stakeholders

Overall rating (2 to -2)	2	1	-1	-2	No rating inputted
Number of stakeholders	35	17	2	2	27

In our conversations, the vast majority of stakeholders somewhat supported or strongly supported our proposal. Only four stakeholders opposed the policy, of which three were environmental groups who saw our proposal as too weak in addressing climate change. The fourth stakeholder was a manufacturing/business group concerned that our policy may hurt business by not returning a large enough portion of the policy's revenue to businesses (i.e. proportional to energy consumption). This frames our proposal as a compelling candidate for a bipartisan, unifying, and politically feasible carbon pricing policy for New Jersey.

Stakeholders who discussed options for revenue usage expressed, on average, a preference for dividends to vulnerable businesses and targeted investment (as opposed to household dividends). A common concern was the projected impact of the carbon pricing policy on the transportation sector and potential leakage to other states. Many were also concerned that funds could be diverted from their intended use without a constitutional amendment.

8. Legal Issues

There are a number of legal issues specific to the state of New Jersey that must be considered to ensure that the proposal is compatible with current federal and state constitutional law. In addition, it is necessary to consider the potential legal safeguards that can be implemented to prevent the CF&D revenue from being reallocated to other areas.

8.1 Interstate Commerce Clause:

The Dormant Commerce Clause is an implicit part of the US Constitution which prevents states from regulating commerce in favor of in-state businesses (U.S. Const. art. I, § 8). The potential for legal conflict arises upon consideration of how New Jersey obtains its energy supply. New Jersey imports its crude oil, natural gas and coal from neighboring states (particularly New York and Pennsylvania) because it does not produce any of these fuels (EIA 2018b). Consequently, the carbon fee will almost exclusively apply on imported fossil fuels.

The carbon fee, however, does not violate the Dormant Commerce Clause because it is applied at the first point of in-state sale. This practice is no different, from a legal standpoint, from the common practice of placing a sales tax on goods sold in-state but produced out-of-state. The legal interstate commerce issue is avoided because the fee is not applied at the interstate level; however it could not be applied to fuels being transported through New Jersey (Morris et al. 2016).

If the CF&D policy were to be challenged under the terms of the Dormant Commerce Clause, it would meet the legal requirements for waiving the clause. In *Pike v. Bruce Church, Inc.* (1970), the Supreme Court ruled that "Where the statute regulates 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" (Justicia, 1970). The magnitude of the carbon fee depends on the fuel's carbon content, not the location of energy production, so our policy treats in-state and out-of-state entities the same. The intention of the CF&D is to improve public health and environmental outcomes, both of which are in the "local public interest." Assuming that one considers that said benefits outweigh the strain on interstate commerce, our proposed CF&D policy stands up to legal tests established by the U.S. Supreme Court and meets the requirements of the Dormant Commerce Clause.

8.2 Motor Fuels Tax Amendment:

A public referendum in 2016 approved a state constitutional amendment to dedicate all revenue from the Motor Fuels Tax and the Petroleum Products Gross Receipts Tax to the Transportation Trust Fund (TTF), whose capital is used to maintain and develop the state's transportation system. This poses a challenge for our proposal because it would prevent us from using much of the revenue as a household dividend.

Although carbon fee revenues could be directed to the TTF for green transportation projects such as NJ Transit improvements, the scope of said projects would be limited by the agencies' decisions, and the loss of dividend revenue could have regressive effects on consumers. Exempting CF&D from the TTF requirement would be preferable, allowing the fee revenue to go towards household dividends. According to correspondence with Professor Robert Williams from Rutgers University's Center for State Constitutional Studies, this distinction could potentially be accomplished if the carbon fee were legally classified as a regulatory fee and not as a tax. New Jersey has judicial precedent stating that a specific fee can be classified as a regulatory fee, provided that its primary purpose is not to raise general revenue, and that it is proportional to the cost of the action it prohibits. 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,* have upheld this standard. Provided that its primary objective is to tackle health and environmental concerns instead of raising government revenue, and that it is accurately priced to offset the harmful effects of carbon emissions, a carbon fee can satisfy both classification requirements (Henchman 2013).

8.3 Annual Appropriations Bill:

The New Jersey Supreme Court ruled in *Burgos v. New Jersey* that "each year's appropriations act will reflect the present legislative and executive judgment as to the budgetary priority" and therefore can supersede statutory legislation. This means that annual appropriations bills in New Jersey can reallocate funds away from their original purpose. In effect, during Chris Christie's tenure, approximately $1.5 billion was diverted from the Clean Energy Fund to balance the budget, appropriating revenue initially intended for energy efficiency programs (Johnson 2017). Fund appropriation was the most commonly expressed concern among the stakeholders we talked with, as seven groups voiced this as their primary concern.

It is likely that a constitutional amendment to dedicate funds to a specific purpose would need to be passed alongside a CF&D policy, to protect funds destined for rebates or sustainable investment from appropriations raiding. Although such amendments require substantial political will and public support, there exists recent precedent: the 2017 amendment dedicating settlement funds from environmental contamination lawsuits to either the case's costs or conservation and cleanup projects, as well as the 2016 Motor Fuels Tax amendment, are both good examples (NJ TTF 2018).

9. Conclusion

9.1 Lessons for Carbon Pricing Advocacy

Our stakeholder outreach has established that engagement with existing political and advocacy groups is critical. Several carbon pricing initiatives, such as the 2016 ballot measure in Washington state, failed in part due to opposition from environmental groups, whose input was not accounted for in the design of the policy. A robust discussion process that incorporates the priorities of state stakeholders can solve this issue. Based on our conversations, our proposal has changed from a 100% dividend to a 70% dividend and 30% investment model. In addition, policymakers' main concerns are the household impacts, so a core point of our research is that low- and moderate-income households benefit on average. It is advisable to supplement carbon pricing with low-emissions alternatives, such as public transportation or electric vehicles. Government assistance may be needed to assist low-income households that cannot cope with the large upfront cost of many alternatives.

9.2 CF&D Policy Viability

We conclude that a CF&D policy is a politically feasible method of reducing carbon emissions in NJ without harming the state's economy. It is important to note that many of the specific policy details may be subject to change as we present our proposal to lawmakers. Areas of future research include extending the fee to other greenhouse gases (notably methane and nitrous oxide), and potentially other air pollutants.

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11. Figures

Figure 3: Statista (2018). GDP of British Columbia, Canada 2000-2017. Retrieved from: https://www.statista.com/statistics/577563/gdp-of-british-columbia-canada/

12. Appendix A: High Emitting Facilities (see Section 6.5)

Chemicals						
FACILITY NAME	REPORTED ADDRESS	PARENT COMPANIES	CITY NAME	COUNTY NAME	GHG QUANTITY (METRIC TONS	$30 tax ($m)

					CO2e)	
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
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)	$30 tax ($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)	$30 tax ($m)
DURAND GLASS MANUFACTURIN G CO INC	901 SOUTH WADE BOULEVAR D	DURAND GLASS MANUFACTURIN G 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%)	BURLINGTO N	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)	$30 tax ($m)
RUTGERS UNIVERSITY BUSCH - LIVINGSTON CAMPUSE	27 RD 1	RUTGERS THE STATE UNIVERSITY OF NEW JERSEY (100%)	PISCATAWAY	MIDDLESEX COUNTY	93700	2.811
TRUSTEES OF PRINCETON UNIVERSITY	DEPT OF ENGINEERIN G 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%)	HACKETTSTOW N	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 PENNINGTO N 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 CORP.-UNION	1011 MORRIS AVE	MERCK & CO INC (100%)	UNION	UNION	4202	0.12606

Petroleum and Natural Gas

FACILITY NAME	REPORTED ADDRESS	PARENT COMPANIES	CITY NAME	COUNTY NAME	GHG QUANTITY (METRIC TONS CO2e)	$30 tax ($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)	$30 tax ($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 Delaney 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 Cogeneratio n	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	KEARNY	HUDSON	301575	9.04725

		(100%)				
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 Cogeneratio n Plant	143 HIGHWAY 130	TALEN ENERGY CORP (100%)	PEDRICKTOW N	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	Vineland	CUMBERLAND COUNTY	67943	2.03829

		(100%)				
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	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)	$30 tax ($m)
MARCAL MANUFACTURING, LLC.	1 MARKET ST	MARCAL MANUFACTURING LLC (100%)	ELMWOOD PARK	BERGEN	59379	1.78137

Refineries						
FACILITY NAME	REPORTED ADDRESS	PARENT COMPANIES	CITY NAME	COUNTY NAME	GHG QUANTITY (METRIC TONS CO2e)	$30 tax ($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)	$30 tax ($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 CNTY 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 CAPITOL PARTNERS LLC (100%)	WESTVILLE	GLOUCESTER COUNTY	61129	1.83387
BURLINGTON CNTY RESOURCE RECOVERY COMPLEX	21939 COLUMBUS ROAD	BURLINGTON COUNTY (100%)	COLUMBUS	BURLINGTON	912	0.02736
MONMOUTH COUNTY RECLAMATIO N 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