A Carbon Tax for New York State

Sara Hsu, Assistant Professor, SUNY New Paltz

Acknowledgements: I am grateful to Mark Dunlea, Andrew Ratzkin, Jannette Barth, Steve Breyman, Barbara Warren, Gary Rucinski, Yoram Bauman, Jeff Renfro, Shi-Ling Hsu, Deirdre Henderson, Evan Gallo, Kevin Cahill, Cary Krosinsky, Christine Kosmider, and Mimi Reichenbach for their comments and support.

Summary: We propose a carbon tax of $180 per metric ton of carbon emissions to be phased in on fossil fuel production and distribution in New York State, to be in part returned to consumers and producers via tax refunds and in part spent on supporting the transition to 100% clean energy in New York State, supporting mass transit to reduce carbon emissions, and improving climate change adaptation. The tax will greatly reduce New York State's carbon footprint.

I. Overview

In New York State, Assembly members Kevin Cahill and Barbara Lifton and Senators Kevin Parker and Liz Krueger introduced a carbon tax bill in August 2015. The proposed carbon tax policy places a tax on fossil fuels produced or distributed in New York State, based on how many metric tons of carbon, or carbon-equivalent content (in terms of climate impact, often denoted as CO_2e), are emitted into the atmosphere. The purpose of the policy is to send a price signal to consumers and producers that includes the cost of pollution, thereby changing consumer and producer behavior via economic incentives.

The bill would implement a carbon tax that would start at $35 per metric ton of carbon dioxide and increase in $15 increments annually up to $180 per metric ton. The bill also proposes to refund 60% of its revenues to the poorest and lower middle income classes, and utilize the other 40% of revenues for supporting the transition to clean energy in New York State, augmenting mass transit to reduce carbon emissions, and improving climate change adaptation.

Carbon taxes provide market signals to consumers and producers to utilize fossil fuels more conservatively. For example, an upstream carbon tax levies a tax according to the amount of carbon dioxide, or carbon-equivalent, emitted by each fossil fuel. The cost of the tax is then passed along to consumers and producers as fossil fuels and energy intensive goods and services become more costly. The subsequent increase in prices drives consumers to goods or services on the market that are relatively less expensive. If the carbon tax is effective, goods and services which are less energy intensive will become more affordable than those which release larger quantities of carbon dioxide into the atmosphere.

Reduced use of fossil fuels is possible at this time, as renewable energy becomes lower-priced and more efficient. Prices for solar panels have steadily fallen since 2008, decreasing 15% in 2013 alone (SEIA 2014). Still, natural gas eclipses solar as the country's largest source of new electricity generation sources. New York comes in ninth in the country for its number of solar panel installations, and is fifth in the country in solar energy job creation. The implementation of a carbon tax will spur job creation in the renewables sector, innovation, and accountability from producers and consumers for their carbon footprint. Carbon taxes provide ways in which markets can appropriately price in pollution and comprise a complete plan to combat climate change.

Further, other states have made proposals for their own carbon tax efforts. These include Washington, Oregon, and Massachusetts. Oregon recommends a carbon tax of between $10 and $150 per metric ton of CO_2, with revenues used for tax reductions, targeted low-income support, and targeted investment. Massachusetts recommends a carbon tax of $30 per metric ton of CO_2 with revenues redistributed through tax cuts or rebates.

British Columbia in Canada set a precedent for a carbon tax in North America. Its carbon tax, implemented in 2008, has returned revenue gained from the tax and has reduced greenhouse gas emissions while maintaining a net neutral impact on the economy. The BC tax began at $10 in per metric ton of carbon dioxide emitted and has increased by $5 /ton annually. In US dollars and converted from metric to short ton, the cost as of 2012 is $25 USD per short ton of CO_2.The BC carbon tax is revenue neutral, in that all carbon tax revenues are returned to taxpayers through personal and business income tax cuts. Additionally, the legislation issues a low-income tax credit in quarterly increments, as to offset the cost of the carbon tax for low-income individuals (British Columbia 2013).

Since the enactment of the carbon tax in 2008, fuel consumption in British Columbia has fallen by 4.5%, more than in any other Canadian province, and the province's income tax is the lowest in the country. It is also important to note that the carbon tax implemented by British Columbia has not acted as a drag on economic growth. In fact, British Columbia's GDP per capita growth rate has outpaced that of the rest of Canada on average since the carbon tax was implemented.

Many economists, including many conservative economists, have publicly supported a carbon tax for the sake of economic efficiency. These include Alan Blinder at Princeton, Edwin Glaeser at Harvard, Greg Mankiw at Harvard, Kevin Hassett at the American Enterprise Institute, Arthur

Laffer of the Free Enterprise Fund, and Henry Jacoby at MIT. For example, in an Op-ed piece published by *The Wall St Journal*, Dr. Blinder asserts his confidence in a carbon tax, as low as $8 per short ton of carbon dioxide, as an effective method of decreasing the US foreign deficit by diminishing the country's reliance on foreign oil as the carbon tax motivates consumers to rely on green energy alternatives (Blinder 2011). Blinder says, "Everyone also knows that CO2 emissions are the major cause of global climate change, that climate change poses a clear and present danger to our planet, and that the U.S. contributes a huge share of global emissions." This decrease in imports of oil, coupled with job creation in the green sector, would grow the domestic economy. Economists agree that pricing in the negative externalities of fossil fuel use will make individuals and corporations more accountable for emissions and encourage behavioral changes toward energy efficient practices (Mankiw 2013).

In New York State, carbon taxes are supported by R. Glenn Hubbard at Columbia University, Mark Gertler at NYU, Thomas Sargent at NYU, Michael Grossman at CUNY, Raquel Fernandez at NYU, Graciela Chichilnisky at Columbia University, Laura Veldkamp at NYU, Sean MacDonald at CUNY, Robert Frank at Cornell University, Marco Battaglini at Cornell University, Kaushik Basu at Cornell University, Ben Ho at Vassar College, Mona Ali at SUNY New Paltz, Gary Fields at Cornell University, Willi Semmler at the New School, Gerald Marschke at SUNY Albany, Duncan Foley at the New School, and Simin Mozayeni at SUNY New Paltz.

Nordhaus (2009) makes the case for a carbon tax, which performs the following functions:

- Provides price signals to consumers, raising the price for carbon-intensive goods;
- Provides signals to producers, raising the cost of carbon-intensive inputs;
- Provides signals to inventors to stimulate design of low-carbon products;
- Reduces information requirements to incorporate all of these pricing signals.

To date, a number of politicians, citizens' groups, and economists within New York State have supported a carbon tax. In 2007, Mayor Michael Bloomberg of New York City supported a revenue-neutral carbon tax that would result in payroll tax cuts. Bloomberg asked for an honest look at long-term costs and benefits, and an analysis of economists' studies rather than just playing short term "politics". Citing the beneficial transparency of a carbon tax in comparison to a cap and trade system, Bloomberg wanted America to not, "wait for others to act," but rather to, "lead by example," exclaiming, "This is the United States of America!... We lead!" (Chan 2007). Kathleen Rice and Gregory Meeks, both Congressional Representatives in New York State, also support a carbon tax.

Professor Robert Frank, of the Samuel Curtis Johnson Graduate School of Management at Cornell University, as well as Antonio Bento, of the Charles H. Dyson School of Applied

Economics and Management at Cornell, both support a carbon tax. Bento and Frank support a carbon taxation system that would result in a corresponding tax cut. Frank has emphasized the ease of application and straightforward results stemming from carbon taxation, explaining that "rich firms pollute because it's cheaper than filtering the stuff out. When you charge them for (pollution), they filter them out. It works." Jim Hansen of the Columbia University Earth Institute supports a carbon tax that would increase annually to allow for a gradual adjustment to the new fee, along with revenue neutrality so that every dollar raised would be distributed to taxpayers through a tax cut. In October of 2014, Hansen was quoted in the Des Moines Register explaining the "certain disaster" of climate change- including "ice melt, sea level rise and superstorms"- and the necessity of a carbon tax. Hansen emphasized, "It's a tragedy if we don't do it," referring to a carbon tax, explaining that, "the solution is not that painful" (Koons 2013).

Equally importantly, New York residents have also underscored the fact that climate change must be addressed, as was made clear in the People's Climate March in September 2014 in New York City. Over 1,500 organizations participated in the event, drawing 400,000 people to the march.

The proposed New York State carbon tax will play an important role in following national climate change policies. President Obama's Climate Action Plan from June 2013 focuses both on reduction of carbon emissions and preparation for the impacts of climate change (White House 2013). Among other action items, the Plan directs the Environmental Protection Agency to complete carbon pollution standards for new and existing power plants, accelerates clean energy permitting and expedites federal agency review processes for approval of electric grid expansion proposals. President Obama aims to reduce carbon emissions to 26-28% below their 2005 level by 2025 (White House 2014). While the role of carbon pricing remains unclear under this plan, a state-level carbon tax may be a way to comply with the Clean Power Plan.

In this White Paper, we discuss the State of New York's energy use, the proposed New York State carbon tax, and the economic and climate impacts of the policy. We then map out the way forward.

II. The State of New York's Energy Use

New York State is committed to improving the environment, and has a history of advocating for environmental protection. For example, in the mid-1880s, the campaign for forest protection resulted in the creation of the Forest Preserve. The conservation movement roared in the early 1900s and picked up swing in the 1920s when many New Yorkers began to tour the countryside in their automobiles (Edmonson 2002). Today, New York is home to hundreds of environmental organizations, and New Yorkers are increasingly concerned about the issue of climate change.

In fact, New York State Executive Order Number 24, laid out by New York Governor David Paterson in 2009, sets forth the goal to reduce greenhouse gas emissions in the state by 80% of 1990 levels by the year 2050. New York State's 1990 CO_2 emissions weighed in at 204.60 million metric tons, so that 80% below this level would amount to about 40 million metric tons. CO_2 levels reached 187.57 million metric tons in 2010 (NYSERDA 2014). This was achieved to some degree by the phasing out of outdated coal-burning power plants. Yet New York State will in fact not reach a level of CO_2 emissions 80% below 1990 levels by 2050 if the state does not continue to take serious action.

The Environmental Protection Agency reports that US emissions of CO_2 have increased 5% between 1990 and 2012, despite our awareness of the dangerous effects that the overabundance of carbon dioxide has on our environment. In New York State, the overall potential impacts of climate change include shifting growing seasons for farmers, the encroachment of invasive species, which affects the populations of native plant and animal species, and the occurrence of extreme weather events.

Serious consequences of climate change are predicted by scientists for New York State, and have been reported under the ClimAID project commissioned by NYSERDA (Rosenweig, Solecki and DeGaetano 2014). Higher temperatures will result in a higher number of heat waves and stress on materials in the water, energy, transportation and telecommunications sectors, as well as cause stress on animals and plants, impact production and distribution of key crops, and result in a higher number of heat-related deaths. Increased annual precipitation and heavy precipitation events will result in higher water pollution levels, deterioration in vulnerable geographies such as floodplains and wetlands, flooded transportation channels, and sea level increases. Large parts of New York City and coastal Long Island are under 10 feet above sea level and are especially vulnerable to flooding.

Climate models of New York State show that temperatures across New York State will, on average, increase by 1.5-3.0° F by the 2020s, 3.0-5.5° F by the 2050s, and 4.0-9.0° F by the 2080s (Rosenweig, Solecki and DeGaetano 2014). This is far faster than the 0.6° F per decade increase since 1970 that New York State has experienced so far. The sea level and Hudson River rise are projected at 1-5 inches by the 2020s, 5-12 inches by the 2050s, and 8-23 inches by the 2080s. Broken down by region, temperature and precipitation projections are as follows:

Baseline Climate and Mean Annual Changes for Seven ClimAID Regions

Region	Indicator	Baseline, 1971-2000	2020s	2050s	2080s
Buffalo, Rochester, Geneva Fredonia	Temperature	48ºF	+1.5 to 3.0ºF	+3.0 to 5.5ºF	+4.5 to 8.5º F
	Precipitation	37 in	0 to +5%	0 to +10%	0 to +15%
Mohonk Lake, Port Jervis, Walton	Temperature	48º F	+1.5 to 3.0ºF	+3.0 to 5.0ºF	+4.0 to 8.0º F
	Precipitation	48 in	0 to +5%	0 to +10%	+5 to 10%
Elmira, Cooperstown, Binghamton	Temperature	46º F	+2.0 to 3.0ºF	+3.0 to 5.5ºF	+4.5 to 8.5º F
	Precipitation	38 in	0 to +5%	0 to +10%	+5 to 10%
New York City, Reiverhead, Bridgehampton	Temperature	53º F	+1.5 to 3.0ºF	+3.0 to 5.0ºF	+4.0 to 7.5º F
	Precipitation	47 in	0 to +5%	0 to +10%	+5 to 10%
Utica, Yorktown Heights, Saratoga Springs, Hudson Correctional Facility	Temperature	50º F	+1.5 to 3.0ºF	+3.0 to 5.5ºF	+4.0 to 8.0º F
	Precipitation	51 in	0 to +5%	0 to +5%	+5 to 10%
Boonville, Watertown	Temperature	44º F	+1.5 to 3.0ºF	+3.5 to 5.5ºF	+4.5 to 9.0º F
	Precipitation	51 in	0 to +5%	0 to +10%	+5 to 15%
Wanakena, Indian Lake, Peru	Temperature	42º F	+1.5 to 3.0ºF	+3.0 to 5.5ºF	+4.0 to 9.0º F
	Precipitation	39 in	0 to +5%	0 to +5%	+5 to 15%

Source: Rosenweig, Solecki and DeGaetano 2014

Economic inequality will heavily impact responses to climate change. Within New York State, areas that have access to larger water systems will be less vulnerable to drought than the 1.9 million residents who depend on well water and small public water systems (Leichenko et al 2014). Economic capacities to respond to droughts and floods vary between small and large communities, while among individuals, elderly and disabled residents face larger challenges to floods and droughts. Coastal populations in New York City and Long Island generally are more affluent than the average, but small areas of poverty exist along coastal plains. Tourism-dependent communities, such as the Adirondacks region, may suffer as ecosystems are threatened. Smaller farms may also be more vulnerable to climate change, as they have less capital to use for adaptation. The transportation, telecommunications, and public health sectors may experience interruptions and/or increased burdens, having disproportionate impacts on the population.

While New York residents are affected by environmental degradation and resulting climate changes, the polluter is often not held accountable for the costs of such pollution. In economic theory, this is defined as a negative environmental externality, and therefore a market failure, because the costs of pollution are not reflected in the final prices of the goods and services created using carbon-intensive processes. The potential impact of such negative externalities in New York State was prominently exemplified by the highly destructive Hurricane Sandy, which the US Department of Commerce estimates cost the New York over $40 billion in reconstruction costs and tourism revenue loss (Richter 2014); while individual weather events are generally difficult to attribute to climate change, the growing frequency and force of such events are consistent with predicted impacts of a warming climate [CITE] . In order to correct market failures and include the cost of climate change in the prices of goods and services, the government must intervene by way of regulations or market-based instruments to influence the decision-making processes of producers and consumers.

New York State is moving gradually in the right direction. Like many other states around the US, New York has seen the retirement of outdated coal fired power plants. This has led to a reduction in coal usage and subsequently to lower carbon emissions from utility companies in New York State. The overall trend is positive—substitution of “dirtier” sources of energy for “cleaner” sources of energy—and has been caused by economic forces.

Policy has also played a role in shifting away from excessive reliance on higher-emitting sources of fuel. New York State already has in place the Regional Greenhouse Gas Initiative, which places restrictions on power plant carbon emissions. The Regional Greenhouse Gas Initiative (RGGI) encompasses nine states, including Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island and Vermont, which set a limit on total CO_2 emissions from electric generation plants in the region. The cap was initiated in 2005 and has narrowed over time to 91 million tons in 2014. Larger power plants hold one tradable emissions allowance for each ton of CO_2 emitted. Proceeds from the emissions auctions go to enhancing end-use energy efficiency. New York State has invested its proceeds toward energy audits, energy efficiency measures, and cleaner energy sources.

While RGGI has played an important role in reducing carbon emissions, focusing on expansion of RGGI in place of a carbon tax is not practical. This is because cap-and-trade policies are difficult to administer to the transportation and residential sectors; setting up a carbon auction system for these sectors would be particularly onerous. A carbon tax is far easier to administer, as carbon emissions can be priced into the cost of fuels. In addition, the cap-and-trade price of carbon is often lower than the price necessary to reduce CO_2 emissions by the target amount; this is true of RGGI as well, as the price of CO_2 emissions was $5 per metric ton in 2013 (Ramseur 2014), far below the price of $30 we propose.

Existing economic and policy forces have had a positive impact on energy usage in New York State, but they can and should go further if New York will reach its emissions goal of 40 million metric tons of CO_2 by 2050. Major economic agents responsible for the shift include the electric power sector and the industrial sector. Sectors that require additional incentives to reduce carbon emissions include the residential, commercial, and transportation sectors, in particular.

The main reason that higher levels of CO_2 persist is that the cost of pollution is not factored into the price of fossil fuels. This results in overuse of these resources, even given a decline in their use due to other factors. In effect, a CO_2 fee would greatly help to reduce the use of "dirty" energy sources that produce higher CO_2 emissions and move New York State closer to its emissions target.

III. Proposed Carbon Tax

Carbon dioxide is by far the most prevalent greenhouse gas emitted in the United States. Carbon emissions, a by-product of the combustion of fossil fuels, create externalities relating to environmental degradation and global warming since they are not properly priced into purchases of fossil fuels. In order to address this serious issue, we propose a carbon tax policy that would place taxes on carbon sales in New York State.

The New York State carbon tax policy would complement the existing Regional Greenhouse Gas Initiative, which has sharply reduced power plant CO_2 emissions through a cap-and-trade system. A carbon tax imposed on crude oil and gasoline in New York State, at a rate equivalent to $180 per metric ton of carbon dioxide emitted, would generate revenue while addressing climate change. A tax of $180 per ton of carbon dioxide imposed on crude oil and gasoline at the level of production or distribution would provide approximately over $14 billion a year in new net state tax receipts.

A New York State carbon tax would be imposed on the carbon content of crude oil and gasoline, applying to fuels extracted in New York State or elsewhere and sold to end users in New York

State who combust the fuel here or elsewhere. The carbon content of fossil fuels extracted in New York State and exported for combustion outside the state would not be taxed, so as to avoid penalizing in-state exporters of energy and to preclude possible inter-state conflicts over ownership of the tax revenues.

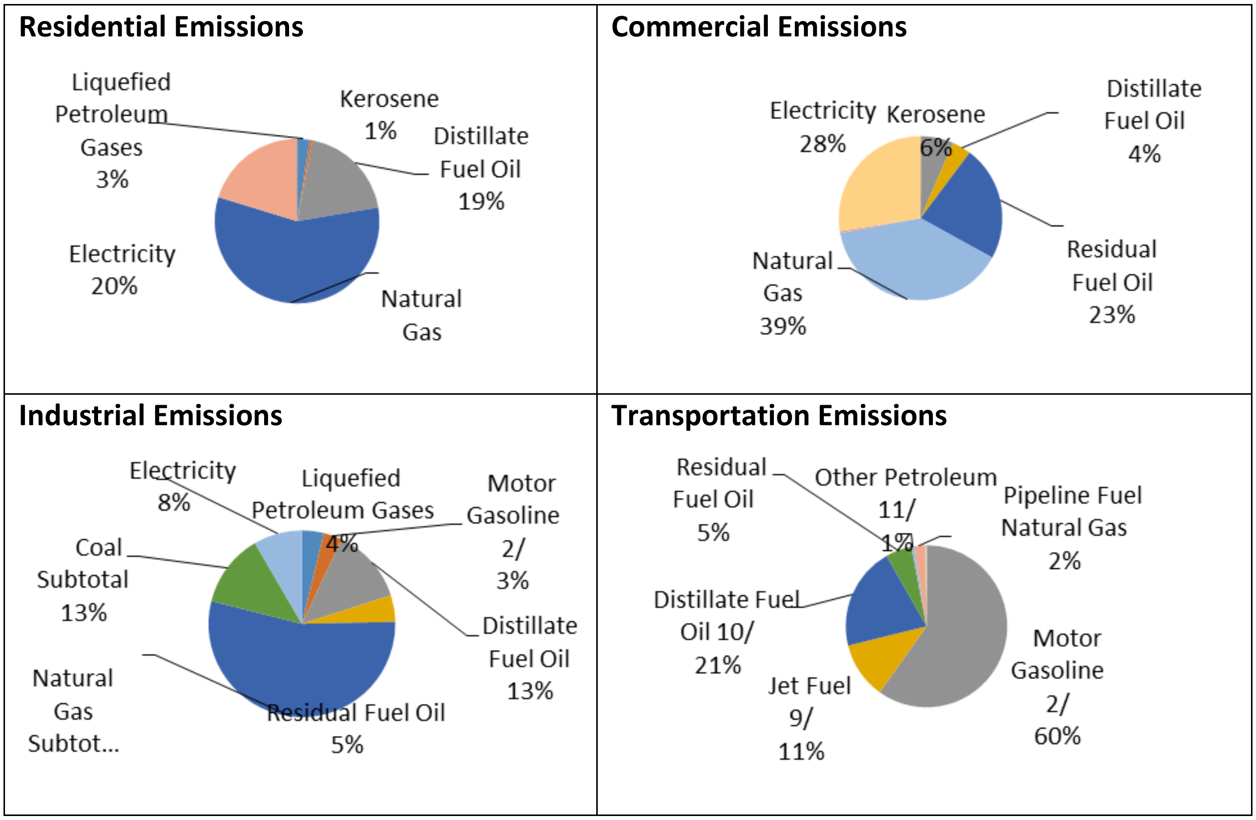
Fees would be levied on the purchase of fossil fuels at the wholesale level; for those not covered under this area, fees would be levied carrying fuel into the state for own use or for use by another principal. A database on producers and distributors would be necessary to avoid double taxation. Additional stipulations of how to treat the taxation of fuels in a cascading manner are spelled out in British Columbia's Carbon Tax Act of 2008 which treats fossil fuel taxation in a manner similar to that in which we analyze it here.

The tax would be implemented at the wholesale level for fossil fuels to be used in New York State. The tax will be implemented incrementally in order to allow the economy to have some time to adjust to the new measures. The tax will be implemented uniformly across New York State. The total projected energy consumption without the tax is expected to decline as a result of the tax.

With regard to the RGGI, the electric utilities which are currently subject to the cap on emissions will be taxed for the emissions per the carbon tax; the quantity quota measure is different from the carbon tax itself in that the cost of the carbon tax can be passed on to the consumer. Costs can be passed on to the final consumer of the fossil fuel according to the distributor's own estimation of how much consumers are willing to pay.

New York State baseline emissions from 2011, broken down by sector and specific type of fuel, are as follows.

Baseline Emissions for New York State, 2011



Source: Energy Information Administration, CTAM, and Author's Calculations

As can be seen from the figures, fuel oil, natural gas, and motor gas are major contributors of CO_2 emissions in New York State. We next examine how a New York State carbon tax policy would help to reduce these emissions.

IV. Economic and Climate Impacts of the CO_2 Tax and Refund

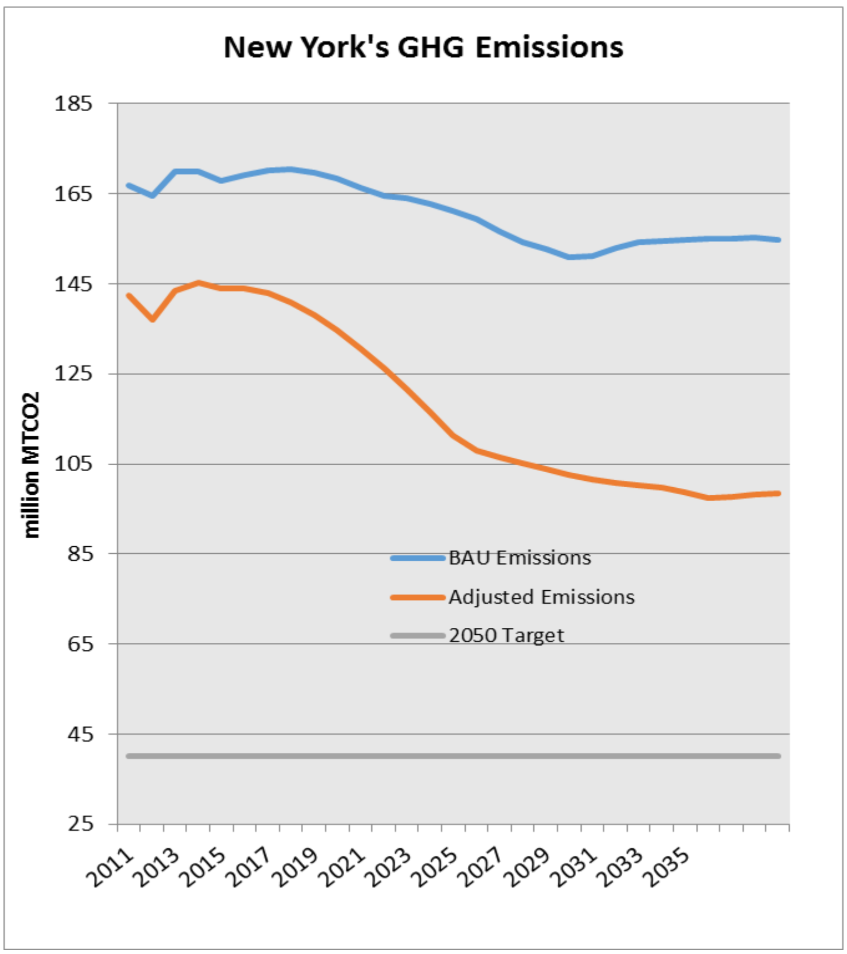
We use the Carbon Tax Analysis Model (CTAM) created by Keibun Mori for Washington State to determine the impact of a carbon tax on greenhouse gas emissions and revenues, then input revenue numbers from CTAM into New York State data via the IMPLAN input-output economic model to estimate the impact of a carbon tax on output and employment.

The Carbon Tax Analysis Model is an Excel model that incorporates proposed carbon tax rates by energy source, price elasticities of demand of fuel sources, and energy prices and demands forecasted by the US Energy Information Administration (EIA). The calculation method is straightforward, and is basically:

Adjusted Demand = Baseline Demand * % Price Change * Price Elasticity of Demand + Baseline Demand as presented in Mori (2011). As Mori points out, the CTAM model is simple since the EIA baseline forecast already contains the most complex components to determine future consumption of fossil fuels.

Using CTAM, we implement a carbon tax that begins at $35/metric ton CO2 and moves up annually $15 per year, reaching $180 per year after eleven years and come up with the following results: a large decline in greenhouse gas emissions and an increase in revenue collected from the tax. Greenhouse gas emissions would fall from 153 million tons CO_2 in 2040 under the baseline scenario to 98 million tons CO_2 in 2040 under the CO_2 Tax and Refund system.

New York State's Greenhouse Gas Emissions



Source: CTAM and Author's Calculations

The New York State carbon tax will help New York State to get closer to reaching its goal of emitting 40 million metric tons of CO_2 per year by 2050. Additional measures, such as those that promote renewable energy and increase energy efficiency, will also help New York State to attain this goal. The aim in working toward carbon emissions reduction is not only to reduce greenhouse gas emissions, but to do so in a way that prevents a sudden economic shock to households, corporations, and other organizations. Ensuring that climate change mitigation is carried out in a way that is equitable and positively impacts the economy is essential to ensure social and economic viability.

The tax impact on various types of fossil fuels are illustrated in the following chart:

Tax Impact at $180 per ton on fossil fuel prices

Fuel Type	CO_2 Emission Factor
Bituminous Coal	Lbs/short ton 5,086.36
Anthracite Coal	Lbs/short ton 5,675.29
Natural Gas	Lbs/ft^3 0.120
otor Gasoline	Lbs/gallon 19.37
Residential Fuel Oil	Lbs/bbl 1,081.42
Source: EPA, http://www.epa.gov/cpd/pdf/brochure.pdf	

$$\frac{Carbon\ tax}{Short\ ton\ CO_2} \times \frac{Short\ ton\ CO_2}{Short\ ton\ fuel} \times \frac{Short\ ton\ fuel}{Lbs\ or\ Gallons}$$

$180/mton CO_2 tax = $163.26 short ton
1 Short ton = 2000 Lbs
1 Short ton = 240 Gallons
1 Cubic foot = 7.48052 Gallons
1 Bbl = 42 Gallons

Bituminous Coal: $\frac{\$163.26}{1\ \text{St CO2}}\ x\ \frac{5{,}086.36\ \text{Lbs CO2}}{1\ St\ Coal}\ x\ \frac{1\ St\ CO2}{2000\ Lbs\ CO2} = \$415{,}20/$1 Short ton Coal
(compare to price of short ton bituminous coal, $57.64)

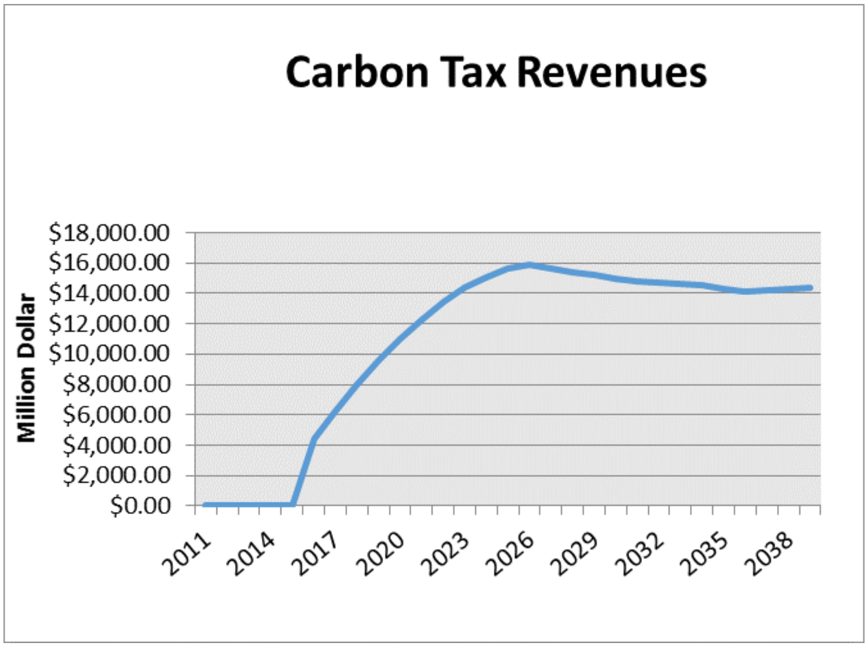
Anthracite Coal: $\frac{\$163.26}{1\ \text{St CO2}}\ x\ \frac{5{,}675.29\ \text{Lbs CO2}}{1\ St\ Coal}\ x\ \frac{1\ St\ CO2}{2000\ Lbs\ CO2} = \$463.23/$1 Short ton Coal
(compare to price of short ton anthracite coal, $70.99)

Natural Gas: $\frac{\$163.26}{1\ \text{St CO2}}\ x\ \frac{0.120\ Lbs\ CO2}{1\ ft3\ Gas}\ x\ \frac{1\ St\ CO2}{2000\ Lbs\ CO2} = \$0.009796/$ft3 Nat Gas
(compare to price of ft3 natural gas, $0.01713)

Motor Gas: $\frac{\$163.26}{1\ St\ CO2}\ x\ \frac{19.37\ Lbs\ CO2}{1\ Gall\ gas}\ x\ \frac{1\ St\ CO2}{2000\ Lbs\ CO2} = \$1.58/$Gallon Motor Gas
(compare to price of gallon motor gas, $3.48)

Residential Fuel Oil: $\frac{\$163.26}{1\ St\ CO2}\ x\ \frac{1{,}081.42\ Lbs\ CO2}{1\ Bbl\ Oil}\ x\ \frac{1\ St\ CO2}{2000\ Lbs\ CO2}\ x\ \frac{1\ Bbl\ Oil}{42\ Gall\ Oil} = \$\ 2.11/$Gallon Oil
(compare to price of gallon res fuel oil, 3.48)

Projected Carbon Tax Revenues



Source: CTAM and Authors' Calculations

Carbon tax revenues would amount to over $14 billion by 2040, rising even above that already by 2020. These revenues are to be returned to households, corporations, and other organizations via preexisting channels. In Year One of implementation, carbon tax revenues would amount to $4.4 billion, in Year Two, $6.2 billion, in Year Three, $7.9 billion, in Year Four, $9.5 billion, and in Year Five, $11 billion. At the last point, revenue would amount to $14.3 billion in 2040.

These revenue figures are inputted into IMPLAN, the economic impact software, using IMPLAN data for New York State. According to CTAM, the revenue collected from the residential sector would equal $2.2 billion. Revenues from the commercial sector weigh in at $1.5 billion in 2020 and those from the industrial sector measure in at $2.3 billion. Those from the transportation sector amount to $5 billion in 2020.

We group the sectors together for the sake of simplicity, assuming that all carbon taxes are eventually passed on to the households. The total carbon tax revenue in 2020 amounts to $11 billion. If 60% is returned to lower and low-middle income households in the amount of $6.6 billion and 40% is invested in construction of mass transit, climate change adaptation structures, and renewable energy in the amount of $4.84 billion, assuming quite reasonably that households spend the refund on other consumer goods and services, the total net effect is to generate $7 billion when we account for the negative income impact on households, the decline in household spending on energy, the positive household spending impact after refunds are returned, and the positive impact of government spending on mass transit, climate change adaptation, and renewable energy. In other words, the carbon tax generates output by shifting spending away from low employment sectors to high employment sectors. The tax policy would also generate 61,000 jobs in the state and increase labor income.

We assume households that receive a refund spend evenly in the top 20 largest non-fossil fuel related household industries, which include the following sectors: Securities, commodity contracts, investments, and related activities, Real estate establishments, Wholesale trade businesses, Private junior colleges, colleges, universities, and professional schools, Funds, trusts, and other financial vehicles, Lessors of nonfinancial intangible assets, Imputed rental activity for owner-occupied dwellings, Monetary authorities and depository credit intermediation activities, Employment and payroll only (state & local govt, non-education), Private hospitals, Food services and drinking places, Insurance carriers, Legal services, Offices of physicians, dentists, and other health practitioners, Employment and payroll only (state & local govt, education), Management of companies and enterprises, Telecommunications, Advertising and related services, Private junior colleges, colleges, universities, and professional schools, and Funds, trusts, and other financial vehicles. Results are as follows:

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	41,662.2	$2,536,456,098	$805,397,633	$3,425,189,763
Indirect Effect	12,991.2	$1,287,633,830	$1,807,869,551	$2,588,588,665
Induced Effect	6,906.7	$413,093,469	$715,247,500	$1,052,739,341
Total Effect	61,560.2	$4,237,183,396	$3,328,514,684	$7,066,517,769

Some caveats: the model used is a static model (IMPLAN) and is not broken out by household, commercial, industrial, and transportation sectors. Additional analysis must be performed to better understand how households in particular will react to the carbon tax, and whether experience in other countries can confirm the assumption that businesses pass on the cost of the carbon tax to consumers. Furthermore, if particular fossil fuels are more intensive in other greenhouse gases that are not priced out or down by the carbon tax (ie, natural gas), those greenhouse gases should be included in the analysis. Long-term dynamics of the carbon tax also need to be explored.

Although it may seem counterintuitive to impose a tax that is partly rebated to households, the major impact is to reorient economic behavior toward environmentally sustainable activities. The New York State carbon tax policy is aligned with these goals and will reduce carbon dioxide emissions while creating jobs and increasing output overall.

V. Additional Study Needed

New York State activists and researchers have pointed out that additional research is necessary to fully evaluate the impact of a carbon tax. This can be accomplished under funding from the state government and/or private sources. Major considerations should include the dynamic impacts of a carbon tax as consumers shift not only spending but also employment into jobs created directly or indirectly by the carbon tax policy, the impact of the tax on households and firms given different tax pass-through scenarios, and the role of methane as a major greenhouse gas pollutant.

The impact of a carbon tax that refunds some of the tax to low and low-middle income households and spends the other share on climate change-related, job-creating programs is quite complex. This is because demand elasticity for fossil fuels may change as alternative energy fuels become more available and as the economic structure at the state level changes, because assumptions of employment creation may follow different pathways as alternatives in both the short-run and the long-run, and because the indirect impact of new job creation and shifts in spending ripple throughout the economy. A major drawback of the IMPLAN software used in this study is that effects are examined within a static framework rather than a dynamic framework.

The impact of a tax on households and firms must also be further studied. The first question that must be asked is, how much of the tax will indeed be passed on to households by firms? What evidence can be found from other nations that have already implemented this tax to support this assertions? Secondly, how will firms respond to the tax in their consumption and production patterns, and how will households act in turn?

Finally, it has been strongly recommended that we incorporate methane into a carbon tax bill and rename the bill a “greenhouse gas” tax proposal. The reason for this is, while methane comprises 9% of greenhouse gas emissions in the United States, the impact of methane as a heat-trapping gas per molecule is far greater than that of carbon dioxide. Life-cycle studies of greenhouse gas emissions during fossil fuel production is especially important with respect to the generation of methane, which is released extensively during the production of natural gas.

VI. The Way Forward

New York State is already attempting to transform its energy sector by focusing on the following goals as part of its New York State Energy Plan for 2014: increasing energy affordability, enhancing private sector energy financing, strengthening the power grid, increasing customer control over energy use, and meeting energy innovation with market demand (New York State Energy Planning Board 2014). Clean energy strategies are promoted via public-private partnerships, while rate and economic incentives are encouraged to promote energy efficiency. Fossil fuel alternatives, especially for heating buildings, are to be promoted. The New York State carbon tax policy on fossil fuels will help to further shift the energy landscape.

One can contrast the impact of a carbon tax on the economic impact of Hurricane Sandy alone. While a carbon tax is predicted to generate revenue, switching spending from capital-intensive fossil fuel industries to labor-intensive consumer industries, failing to implement economic policies to reduce the impact of climate change will have serious economic consequences. During Hurricane Sandy, the New York City metro area lost 32,000 jobs in the immediate aftermath of the storm, particularly in the utilities, chemicals, food, transportation equipment and computers and electronic products sectors (US Department of Commerce 2013). Post-hurricane Sandy, Governor Andrew Cuomo was quoted in the New Yorker stating that, "Climate change is a reality… it is a reality that we are vulnerable."

The next step for the proposed New York State carbon tax policy is to educate and build support across demographic groups, political parties, and legal entities. Implementation of a New York State carbon tax policy would render New York State a leader in climate change policies and set an example for the rest of the United States. To join the coalition, please contact Sara Hsu, at hsus@newpaltz.edu.

References

1. Blinder, Alan S. "The Carbon Tax Miracle Cure." The Wall St. Journal. 31 January, 2011. http://www.wsj.com/articles/SB10001424052748703893104576108610681576914
2. British Columbia 2014. "Low Income Climate Action Tax Credit." 2.gov.bc.ca. Web. 2013. http://www2.gov.bc.ca/gov/topic.page?id=E9258ADE1AE3423080A1B2674F4EAABD
3. California EPA 2014. "Assembly Bill 32 Overview." Arb.ca.gov. Web. 05 August, 2014. http"//www.arb.ca.gov/cc/ab32/ab32.htm
4. Chan, Sewell. 2007. Bloomberg Calls for Tax on Carbon Emissions. The New York Times. The New York Times Company, 02 Nov. 2007. Web. 09 Jan. 2015. <http://cityroom.blogs.nytimes.com/2007/11/02/bloomberg-calls-for-tax-on-carbon-emissions/>.
5. Edmonson, Brad. 2001. Environmental Affairs in New York State: An Historical Overview. New York State Archives Publication Number 72.
6. EDF 2014. "California Cap and Trade Updates." EDF.org. Web. 2014. http://www.edf.org/california-cap-and-trade-updates

7. EPA. 2014a. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2012 (April 2014): EPA Report, http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html.
8. EPA. 2014b. "Climate Change Indicators in the United States." *EPA.gov*. United States Environmental Protection Agency, 02 July 2014.
9. Koons, Jennifer. 2013. Economists Call on Washington to Enact Carbon Tax | Cornell Chronicle. Cornell Chronicle. Cornell University, 5 Mar. 2013. Web. 08 Jan. 2015. <http://www.news.cornell.edu/stories/2013/03/economists-call-washington-enact-carbon-tax>.
10. Leichenko, Robin, Yehuda Klein, Marta Panero, David C. Major, and Peter Vancura. 2014. Equity and Economics. ClimAID report. http://www.nyserda.ny.gov/climaid
11. Mankiw, Gregory N. "A Carbon Tax that America Could Live With." The New York Times. 31 August, 2013. http://nytimes.com/2013/09/01/business/a-cabon-tax-that-america-could-live-with.html?_r=0
12. Mori, Keibun. 2011. Washington State Carbon Tax: Fiscal and Environmental Impacts. http://www.commerce.wa.gov/Documents/Washington-State-Carbon-Tax.pdf.
13. New York State Energy Planning Board. 2014. Shaping the Future of Energy: New York State Energy Plan. http://energyplan.ny.gov/Plans/2014.aspx
14. NYSERDA. 2014. New York State Greenhouse Gas Inventory 1990-2011 and Forecast 2012-2030. *http://www.Nyserda.ny.gov*.
15. Ramseur, Jonathan L. 2014. The Regional Greenhouse Gas Initiative: Lessons Learned and Issues for Policy Makers. Congressional Research Service Report R41836.
16. Richter, Danny. 2014. Summary of 'The Economic, Climate, Fiscal Power, and Demographic Impact of a National Fee and Dividend Carbon Tax' By REMI and Synapse." Citizens' Climate Lobby, 01 August 2014.
17. Rosenweig, Cynthia, William Solecki and Arthur DeGaetano. 2014. ClimAID: Integrated Assessment for Effective Climate Change Adaptation Strategies in New York State. ClimAID report. http://www.nyserda.ny.gov/climaid
18. SEIA 2014. "Solar Market Insight Report 2013 Year in Review." Seia.org. Web. 2014. http://www.seia.org/research-resources/solar-market-insight-report-2013-year-review
19. US Department of Commerce. 2013. Economic Impact of Hurricane Sandy. Report prepared by the staff of the Office of the Chief Economist, Economics and Statistics Administration, U.S. Department of Commerce, http://www.esa.doc.gov/sites/default/files/reports/documents/sandyfinal101713.pdf.
20. White House. 2013. The President's Climate Action Plan. Washington, DC: The White House.
21. White House. 2014. U.S.-China Joint Announcement on Climate Change. Washington, DC: The White House.