Caiazza Comment on Draft Scoping Plan Benefits

Summary
The Climate Leadership and Community Protection Act Scoping Plan claims that "The cost of inaction exceeds the cost of action by more than $90 billion". However, the benefit claims are poorly documented, misleading and the largest benefit is dependent upon an incorrect application of the value of carbon. These comments address the Scoping Plan benefit claims and explain how the value of carbon is used incorrectly.

The Scoping Plan claims net benefits range from $90 billion to $120 billion. The Plan describes health benefits totaling $165 to $170 billion due to improvements in air quality, increased active transportation ($39.5 billion), and energy efficiency interventions in LMI homes ($8.7 billion). The benefit claims are not documented well enough to confirm those estimates but they appear to be biased high. The claimed benefits for the avoided cost of GHG emissions range between $235 and $250 billion. However, Climate Act guidance incorrectly calculates avoided GHG emissions benefits by applying the value of an emission reduction multiple times. If the multiple-counting error is corrected, the avoided carbon damage benefits range from negative $74.5 to negative $49.5 billion. These errors should be corrected in the Final Scoping Plan.

The Scoping Plan air quality improvement benefits range between $100 billion and $103 billion for the low values and the high values range between $165 billion and $172 billion. These benefits are due to an air quality improvement for $PM_{2.5}$ of 0.35 µg/m^3 that is supposed to "avoid tens of thousands of premature deaths, thousands of non-fatal heart attacks, thousands of other hospitalizations, thousands of asthma-related emergency room visits, and hundreds of thousands of lost workdays". However, the modeled impacts rely on a linear no-threshold model. The observed $PM_{2.5}$ reduction in New York City since 2005-2007 is 5.6 µg/m^3 and that is 16 times higher than the projected decrease due to the Climate Act. Using the linear no-threshold model that means that we should be able to observe sixteen times tens of thousands of premature deaths, sixteen times thousands of non-fatal heart attacks, sixteen times thousands of other hospitalizations, sixteen times thousands of asthma-related emergency room visits, and sixteen times hundreds of thousands of lost workdays. When the Climate Action Council and Final Scoping Plan verifies that these reductions have been observed I will accept these benefits.

The Scoping Plan admits that the health benefits from increased active transportation "should be considered a first-order approximation of the benefits of increased active transportation". The active transportation health theory claims that as people are forced out of their personal vehicles some will switch to walking and biking. Those activities are healthier so there is a benefit. However, the analysis was conducted at the state level, rather than modeling changes in walking and biking activity due to changes in vehicle miles traveled within counties or individual communities. Because the actual number of places where this strategy could actually encourage more walking and bicycling to work is small relative to the state as a whole, the $39.5 billion health benefit claim is far too high. The Final Scoping Plan active transportation benefits should be revised to take into account the number of places where this might work.

The majority of the health benefits from energy efficiency interventions in Low and Middle Income (LMI) homes are the result of "non-energy interventions". The Climate Act intends to transform the energy

sector so it is disingenuous to claim health benefits not directly related to energy efficiency programs themselves. Of the $8.7 billion in benefits claimed $3 billion is due to reduction in asthma-related incidents resulting from better ventilation not directly due to energy efficiency. The $2.4 billion in benefits from reduced trip or fall injuries and reduced carbon monoxide poisoning benefits are non-energy interventions and should not be claimed as benefits for GHG emission reduction programs. The "non-energy interventions" benefits should not be included in the Final Scoping Plan.

The Scoping Plan claims that 2020-2050 societal benefits are greater than societal costs by between $90 and $120 billion. The largest proposed benefits come from avoided GHG emission impacts on climate change due to emission reductions. The Climate Act Scoping Plan manipulates the emissions, the emissions accounting, and calculation of social cost of carbon benefits to inflate these benefits to claim that there are net benefits. In order to maximize the benefits from emission reductions the Scoping Plan uses non-conventional assumptions to contrive increased emission estimates that are 1.9 times higher in 1990 and 2.3 times higher in 2019 than conventional, or UNFCCC, format for emissions accounting used by other jurisdictions. New York's Value of Carbon guidance chooses a lower discount rate that places lower value on immediate benefits relative to higher delayed benefits received in the future. The combined effect of the higher emissions and lower discount rate means that New York's societal benefits of GHG emission reductions are 4.5 times higher for 1990 emissions and 5.4 times higher for 2019 emissions than other jurisdictions. Most importantly, it is inappropriate to claim the benefits of an annual reduction of a ton of greenhouse gas over any lifetime or to compare it with avoided emissions. The Value of Carbon guidance incorrectly calculates benefits by applying the value of an emission reduction multiple times. If you lost five pounds five years you cannot claim that you lost 25 pounds but that is what the Draft Scoping Plan is doing. Using that trick and the other manipulations results in New York societal benefits more than 21 times higher than benefits using everybody else's methodology. When the over-counting error is corrected, the total societal benefits range between negative $74.5 billion and negative $49.5 billion. The Final Scoping Plan should only take credit for societal climate change benefits based on total emission reductions from the baseline, the maximum observed total emissions or the most recent total emissions.

Scoping Plan Cost Benefit Findings

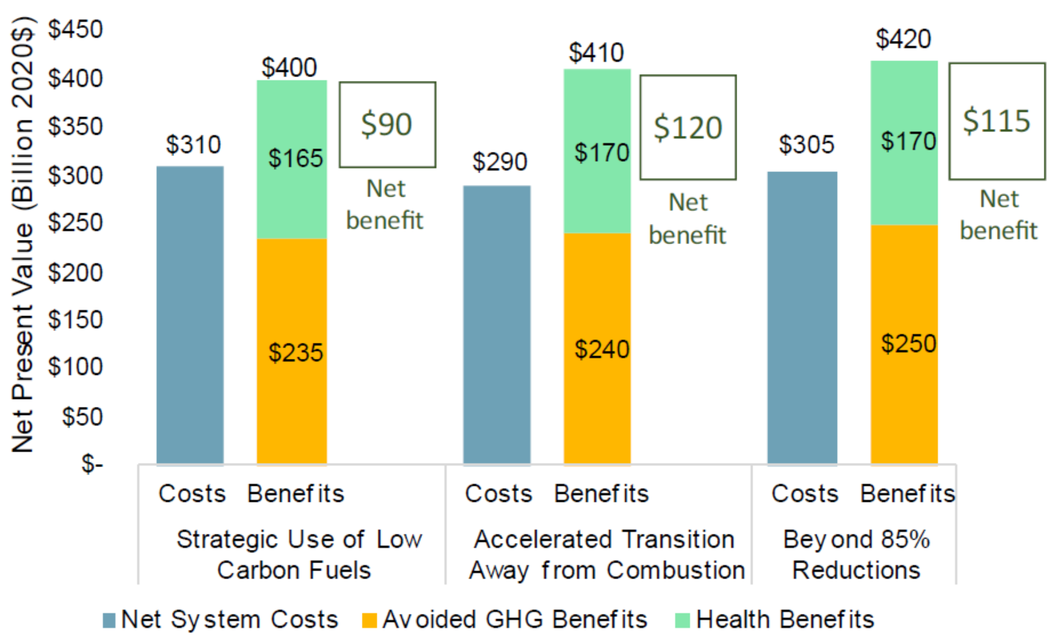
Section 10.3 in the Scoping plan states:

> The integration analysis assessed the benefits of avoided GHG emissions, health co-benefits, and resource costs for Scenario 2: Strategic Use of Low-Carbon Fuels, Scenario 3: Accelerated Transition Away from Combustion, and Scenario 4: Beyond 85% Reduction (Figure 12). There are three key findings from this assessment:
>
> - The cost of inaction exceeds the cost of action by more than $90 billion. There are significant investments required to achieve Climate Act GHG emission limits, accompanied by even greater external benefits and the opportunity to create hundreds of thousands of jobs.
> - Net benefits range from $90 billion to $120 billion. Improvements in air quality, increased active transportation, and energy efficiency interventions in LMI homes generates health benefits ranging from approximately $165 billion to $170 billion. Reduced GHG emissions avoids the economic impacts of damages caused by climate change equaling approximately $235 to $250 billion. The combined benefits range from approximately $400 billion to $420 billion.

- Net direct costs are small relative to the size of New York's economy. Net direct costs are estimated to be 0.6% to 0.7% of GSP in 2030, and 1.4% of GSP in 2050.

This document addresses the benefits claims in Figure 12. In a separate comment I documented that the net present value relative to Reference Case caveat in the title makes all the difference. Whenever the claim is made to the public without mentioning this condition it is a deliberate deception used to convince the public that benefits out-weigh costs. In short, the Reference Case includes "already implemented programs" that deletes legitimate Climate Act costs by mis-categorizing initiatives such as the 2035 zero-emission vehicle mandate, offshore wind, and energy storage that would not be implemented were it not for the Climate Act.. As a result, Reference Case costs are higher than a business-as-usual case so the costs relative to it are smaller. In order to address that problem, the Final Scoping Plan should describe all the control measures, provide the assumptions used for the strategies, and list the expected costs and expected emission reduction for each measure for the Reference Case, the Advisory Panel scenario and the three mitigation scenarios so the public can decide for themselves which costs associated with "already implemented" program are appropriate.

Figure 12. Summary of Benefits and Costs (Net Present Value Relative to Reference Case)



Scoping Plan Benefits

The Scoping Plan estimates societal health benefits and avoided economic damages caused by climate change as a result of GHG emission reductions. Improvements in air quality, increased active transportation, and energy efficiency interventions in low- and middle-income homes generates health benefits ranging from approximately $165 billion to $170 billion. Reduced GHG emissions avoids the economic impacts of damages caused by climate change equaling approximately $235 to $250 billion. The combined benefits range from approximately $400 billion to $420 billion.

Sectoral Coverage For Cost

Cost Category	Description
Electricity System	Includes incremental capital and operating costs for electricity generation, transmission (including embedded system costs), distribution systems, and in-state hydrogen production costs.
Transportation Investment	Includes incremental capital and operating expenses in transportation (e.g. BEVs and EV chargers)
Building Investment	Includes incremental capital and operating expenses in buildings (e.g. HPs and building upgrades)
Non-Energy	Includes incremental mitigation costs for all non-energy categories, including agriculture, waste, and forestry
Renewable Gas	Includes incremental fuel costs for renewable natural gas and imported green hydrogen
Renewable Liquids	Includes incremental fuel costs for renewable diesel and renewable jet kerosene
Negative Emission Technologies (NETs)	Includes incremental costs for direct air capture of CO2 as a proxy for NETs
Other	Includes other incremental direct costs including industry sector costs, oil & gas system costs, HFC alternatives, and hydrogen storage
Fossil Gas	Includes incremental costs spent on fossil natural gas (shown as a negative for cases when Gas expenditures are avoided compared with the Reference Case)
Fossil Liquids	Includes incremental costs spent on liquid petroleum products (shown as a negative for cases when liquids expenditures are avoided compared with the Reference Case)
Other Fuel	Includes incremental costs spent on all other fossil fuels

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Air Quality Health Benefits

The primary health benefits are associated with improvements in air quality due to reduced combustion and associated emissions. According to Scoping Plan Appendix G: Section II, 1.1 Health Analyses Approach Overview:

> The air quality analysis applied EPA's CO Benefits Risk Assessment (COBRA) Health Impacts Screening and Mapping Tool, customized with detailed inputs specific to New York State and the scenarios analyzed, to evaluate air quality and ensuing public health outcomes at the county level. COBRA evaluates ambient air quality based on emissions of direct fine particulate matter ($PM_{2.5}$) and its precursors (sulfur dioxide (SO2), volatile organic compounds (VOC), and nitrogen oxides (NOX)) and the ensuing changes in annual average total $PM_{2.5}$ concentrations. The results include 12 different health outcomes, such as premature mortality, heart attacks, hospitalizations, asthma exacerbation and emergency room visits, and lost workdays.

The following paragraph from Scoping Plan Appendix G: Section II summarizes the fundamental assumption for the health impacts:

> Nevertheless, the health impact functions included in COBRA were developed from a specific population exposed to specific levels and compositions of $PM_{2.5}$, and conditions in NYS have changed since these functions were developed. For example, the health impact function from the Krewski study was based on examining mortality impacts from 500,000 people in 116 U.S. cities between 1980 and 2000. The levels and compositions of $PM_{2.5}$ have decreased substantially since 2000, as discussed above, with sharp declines in ammonium sulfate, making ammonium nitrate and secondary organic aerosols relatively more important components of $PM_{2.5}$ However, the synthesis of the research into $PM_{2.5}$ impacts on public health conducted for EPA's draft Integrated Science Assessment for Particulate Matter indicates that the literature provides evidence that the health impact functions may be linear with no threshold below which reductions in exposure to $PM_{2.5}$ provides no benefits. In other words, even though $PM_{2.5}$ concentrations have been reduced in NYS in the time since the health impact functions were developed, the evidence suggests that the functions can adequately estimate changes in health impacts even at relatively low levels of $PM_{2.5}$ Similarly, EPA's draft Integrated Science Assessment finds that the literature is unclear as to whether changes in the composition of secondary $PM_{2.5}$ species results in differential changes to health impacts. For this reason, this health analysis, along with most other similar benefits analyses, uses the total change in $PM_{2.5}$ concentrations to evaluate health impacts rather than looking separately at impacts by the different $PM_{2.5}$ species.

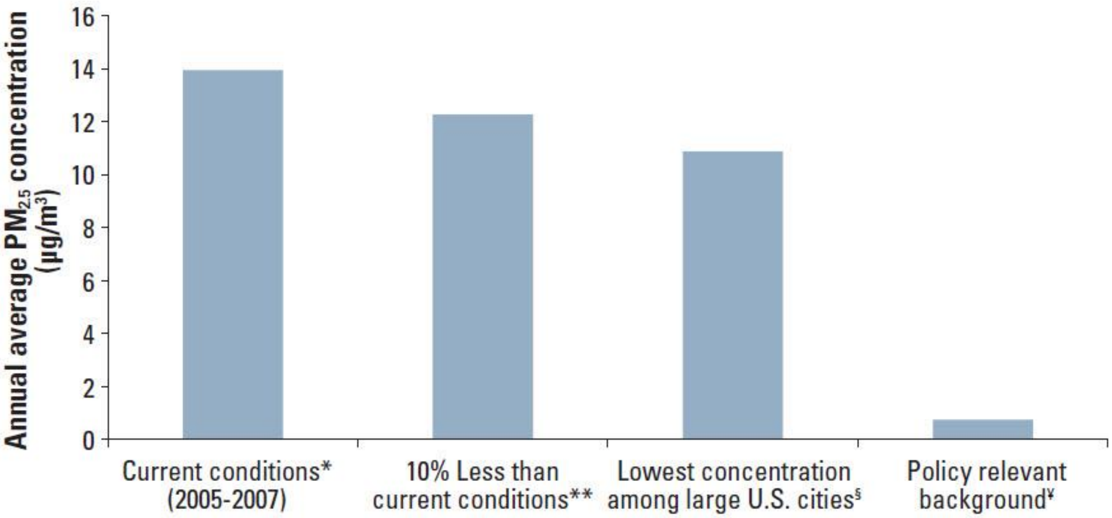
In brief, the Scoping Plan air quality health assessment depends on a linear no-threshold model. Originally used for radiation assessment, it suggests that each time radiation is deposited in the susceptible target there is a probability of tumor initiation. Note, however, that its use in radiation assessment is controversial. In my opinion, I don't think it has been verified well enough for air quality benefits to justify its use here.

In particular, because there has been significant reduction in ambient concentrations of inhalable particulates it could be verified if in fact the relationship is correct. For example, I have analyzed claims of inhalable particulates impacts in New York City. The New York City Department of Health and Mental Hygiene's (DOHMH) Air Pollution and the Health of New Yorkers report is often referenced and provides a typical and consistent health benefit estimate from inhalable particulates using the linear no-threshold model. The DOHMOH report concludes: "Each year, $PM_{2.5}$ pollution in [New York City] causes more than 3,000 deaths, 2,000 hospital admissions for lung and heart conditions, and approximately 6,000 emergency department visits for asthma in children and adults." These conclusions are for average air pollution levels in New York City as a whole over the period 2005-2007.

The DOHMOH report specified four scenarios for comparisons (DOHMOH Figure 4) and calculated health events that it attributed to citywide $PM_{2.5}$ (DOHMOH Table 5). Based on their results the report notes that:

> Even a feasible, modest reduction (10%) in $PM_{2.5}$ concentrations could prevent more than 300 premature deaths, 200 hospital admissions and 600 emergency department visits. Achieving the PlaNYC goal of "cleanest air of any big city" would result in even more substantial public health benefits.

Figure 4. Baseline annual average $PM_{2.5}$ levels in New York City (2005-2007) and levels in comparison scenarios.



$PM_{2.5}$=particulate matter

* Current conditions=annual average PM2.5 concentrations, 2005-2007 Source: United States Environmental Protection Agency Air Quality System (AQS)

** 10% Less than Current Conditions=2005-2007 Annual average concentrations reduced by 10%, calculated from USEPA AQS

§ Lowest concentration among large US Cites: Lowest 2005-2007 annual average concentrations among the 9 US cities with greter than 1.000.000 residents.

¥ Policy relevant background – Annual average $PM_{2.5}$ concentrations in U.S. Northeast assuming no anthropogenic emissions from sources within the U.S., as predicted by the Community Multiscale Air Quality Modeling System (CMAQ) and the Goddard Earth Observing System (GEOS)-Chem model Source: EPA 2009

Table 5. Annual health events attributable to citywide $PM_{2.5}$ levels and the health benefits of reduced $PM_{2.5}$ levels.

			Annual Health Events Attributable to Current $PM_{2.5}$ Compared to Background Levels			Annual Health Events Prevented: $PM_{2.5}$ Levels Reduced 10%			Annual Health Events Prevented: $PM_{2.5}$ Levels Reduced to Cleanest Air of Any Large City		
	Health Effect	Age Group	Number of Events (95% CI)*	Rate per 100,000 people	Percent (%) of Events**	Number of Events (95% CI)	Annual Rate per 100,000 people	Percent (%) of Events**	Number of Events (95% CI)*	Annual Rate per 100,000 people	Percent (%) of Events**
$PM_{2.5}$	Premature mortality	30 and older	3,200 (2200,4100)	65	6.4	380 (240,460)	7.1	0.7	760 (520,1000)	16	1.5
$PM_{2.5}$	Hospital admissions for respiratory conditions	20 and older	1,200 (460,1900)	20	2.6	130 (50,210)	2.1	0.3	280 (109,460)	4.7	0.6
$PM_{2.5}$	Hospital admissions for cardiovascular conditions	40 and older	920 (210,1630)	26	1.1	100 (20,170)	2.8	0.1	220 (50,380)	6.0	0.3
$PM_{2.5}$	Emergency department visits for asthma	Under 18	2,400 (1400,3400)	130	5.6	270 (160,370)	14	0.6	580 (340,810)	30	1.3
$PM_{2.5}$	Emergency department visits for asthma	18 and older	3,600 (2200,4900)	57	6.1	390 (240,550)	6.3	0.7	850 (520,1200)	14	1.5

$PM_{2.5}$=particulate matter
* CI=Confidence Interval
** Percent of certain citywide health events attributable to $PM_{2.5}$ in the specified age range.

The NYS DEC air quality monitoring system has operated a $PM_{2.5}$ monitor at the Botanical Garden in New York City since 1999 which provides inhalable particulate trends for New York City. I compared the data from that site for the same period as the DOHMOH analysis relative to the most recent data available (Table 1). The Botanical Garden site had an annual average $PM_{2.5}$ level of 13 μg/m^3 for the same period as the report's 13.9 μg/m^3 "current conditions" city-wide average (my estimate based on their graph). The important thing to note is that the latest available average (2018-2020) for a comparable three-year average at the Botanical Garden is 7.4 μg/m^3 which represents a 43% decrease. That is substantially lower than the PlaNYC goal of "cleanest air of any big city" scenario at an estimated city-wide average of 10.9 μg/m^3.

Based on years of developing and using models I prefer observed results any time as opposed to model projections. In this instance I will have reservations regarding the Scoping Plan air quality health benefits until such time that the projections are verified by comparing the observed health impacts associated with the observed 43% decrease in inhalable particulate concentrations observed. Note that the reduction in $PM_{2.5}$ annual average concentrations in the Strategic Use of Low Carbon Fuels scenario predicts at most a reduction in $PM_{2.5}$ of 0.35 μg/m^3. The observed reduction in New York City since 2005-2007 is 5.6 μg/m^3.

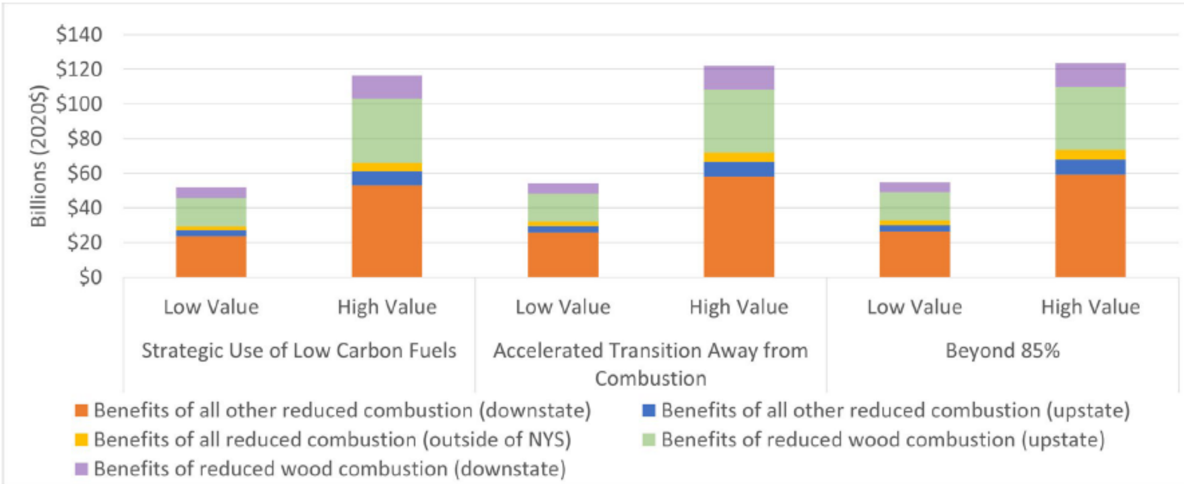
The Scoping Plan states: In all scenarios, air quality improvements can avoid tens of thousands of premature deaths, thousands of non-fatal heart attacks, thousands of other hospitalizations, thousands of asthma-related emergency room visits, and hundreds of thousands of lost workdays. The value of the benefits by scenario are presented in Figure 3. The low values range between $100 billion and $103 billion and the high values range between $165 billion and $172 billion. The plan notes that the vast majority of benefits would occur within New York but that some benefits occur downwind. Also note that "A large portion of the projected benefits would result from reduced wood combustion". The text goes on to explain that "While the reduced wood combustion represents a small amount of the total reduced fuel combustion, it has an outsized impact on particulate matter emissions, resulting in substantially high benefits."

Table 1: Data from Figure 4. Baseline Annual Average PM2.5 Levels in New York City (2005-2007) and DEC Measurement Levels in Comparison Scenarios

DOHMOH Air Pollution and the Health of New Yorkers report

Departments of Health and Mental Hygiene	Averaging Period	Annual Average PM2.5 (ug/m3)		
Current conditions	2005-2007	13.9	Source: United States Environmental Protection Agency Air Quality System (AQS)	
10% less than current	2005-2007	12.5	Annual average concentrations reduced by 10%, calculated from USEPA AQS	
Lowest US Cities	2005-2007	10.9	Lowest annual average concentrations among the 9 US cities with greater than 1.000.000 residents.	
Background		1.0	Concentrations in U.S. Northeast assuming no anthropogenic emissions from sources within the U.S.	
NYSDEC Monitoring				
Botanical Garden	2005-2007	13.0	Site ID: 36-005-0083/0133	NYS DEC air quality monitoring system
Botanical Garden	2016-2018	8.1	Site ID: 36-005-0083/0133	NYS DEC air quality monitoring system
Botanical Garden	2018-2020	7.4	Site ID: 36-005-0083/0133	NYS DEC air quality monitoring system

Figure 3. Total Projected Ambient Air Quality Health Benefits (Net Present Value, 2020–2050)



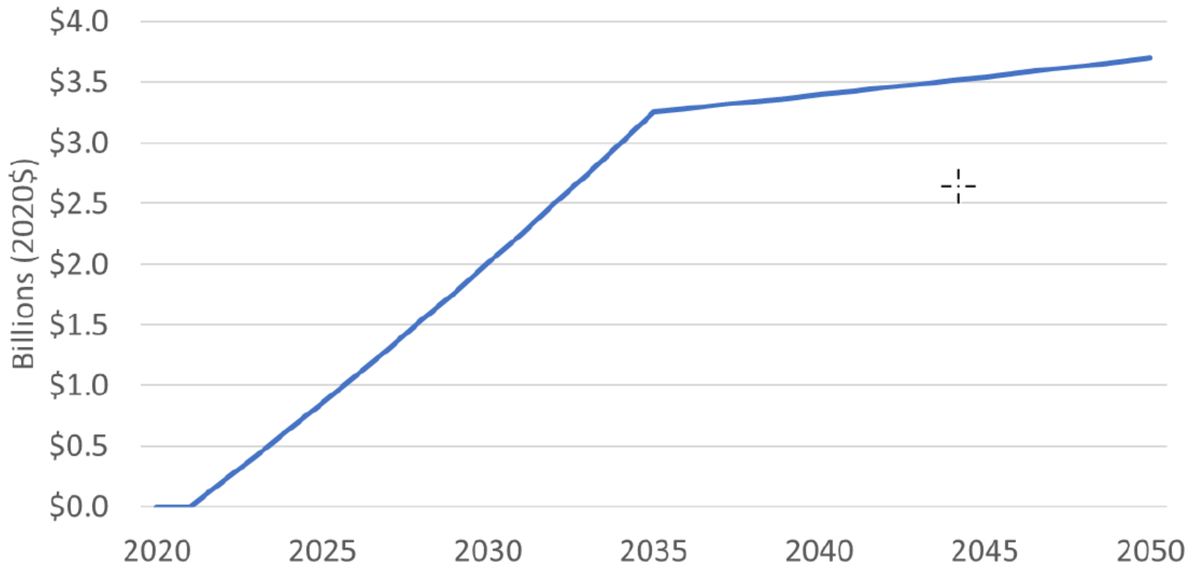
Until such time that the Scoping Plan bases its $PM_{2.5}$ health benefits on the observed health outcome benefits observed from the reductions that have occurred, then I do not accept the health benefits suggested in the Integration Analysis. Consider that the reduction in $PM_{2.5}$ annual average concentrations in the Strategic Use of Low Carbon Fuels scenario predicts at most a reduction in $PM_{2.5}$ of 0.35 $\mu g/m^3$ and this is supposed to "avoid tens of thousands of premature deaths, thousands of non-fatal heart attacks, thousands of other hospitalizations, thousands of asthma-related emergency room visits, and hundreds of thousands of lost workdays". The observed reduction in New York City since 2005-2007 is 5.6 $\mu g/m^3$ and that is 16 times higher than that projected due to the Climate Act. Using the linear no-threshold model that means that we should be able to observe sixteen times tens of thousands of premature deaths, sixteen times thousands of non-fatal heart attacks, sixteen times thousands of other hospitalizations, sixteen times thousands of asthma-related emergency room visits, and sixteen times hundreds of thousands of lost workdays. I doubt that there has been this large an improvement in lost workdays. In order to prove the case for these benefits the Final Scoping Plan must document the alleged benefits using observed data over the period that ambient concentrations have decreased.

Active Transportation Health Benefits

According to Scoping Plan Appendix G: Section II, 2.3 Health Benefits of Increased Active Transportation:

> The potential value of the net reduction in the number of deaths, including the decrease in deaths from increased physical activity and the increase in deaths from traffic collisions, is estimated to be a NPV of $39.5 billion (2020 to 2050). As presented in Figure 22, the values increase over the years as walking and cycling increases with the introduction of infrastructure and other measures to encourage the use of these modes. Note that the projected decrease in premature deaths from physical activity far outweighs the potential increase in deaths from traffic collisions. Active transportation benefits are the same for the Low-Carbon Fuels and Accelerated Transition scenarios.

Figure 22. Potential Annual Value of Public Health Benefits from Increased Active Transportation



The Scoping Plan admits that "the results of this analysis should be considered a first-order approximation of the benefits of increased active transportation". It is difficult to determine exactly how the analysis conjured up $39.5 billion in benefits because the documentation is so sparse. A primary source of documentation is a Power Point presentation to the Transportation Advisory Panel. The presentation lacks information and context. We do know that the analysis was conducted at the state level, rather than modeling changes in walking and biking activity due to changes in VMT within counties or individual communities. This is a major flaw because smart planning changes to walking and biking are a specific community outcome. In my opinion, the actual number of places where this strategy could actually encourage more walking and bicycling to work is very small so their benefits are too high.

One of the missing pieces of documentation is an update for the preliminary results of the New York Clean Transportation Roadmap that was used as a primary reference. The following slide from the Camus April 9, 2021 presentation incudes the Complete Streets simulated policy that appears to directly address increased walking and biking to work. However, the Scoping Plan does not explain how these policies are related to the active transportation programs in its plan. Moreover, there are numerical inconsistencies in the components of the policy. For example, assuming that the New York City region has 12.1% employees who walk or bike to work and that all the other regions have 0.7% who do so, then the state-wide percentage is 5.6% which exceeds the 2050 goal for Mitigation Scenario 1. In addition, it is not clear how the Figure 22 health benefits relate to the actual number of commuters affected by the policies. There simply is not enough documentation available to reconcile the health benefit claims. I recommend that the Final Scoping plan provide that documentation.

Scenario Approach | Mitigation Scenarios (2/2)

Simulated Policies	Baseline	Mitigation 1	Mitigation 2	Mitigation 3	Mitigation 4
		Electrification Emphasis		Mixed Emphasis	
		Moderate VMT/Mode Shift Policies	*Agressive VMT/Mode Shift Policies*	*Moderate VMT/Mode Shift Policies*	*Agressive VMT/Mode Shift Policies*
Smart growth	2050 Reference Case value for fraction of HH in mixed-use neighborhoods ranges from 4 to 74% across MSAs; 2050 Reference Case value for transit service level increases by 34%	20-25% increase in HH in mixed-use neighborhoods; 100% increase in transit service level	25-30% increase in HH in mixed-use neighborhoods; 200% increase in transit service level		
Complete Streets	Start value for % walking or biking to work ranges from 0.7% to 12.1% across counties	5% of workers walk, bike, and take e-bikes by 2050*	10% of workers walk, bike, and take e-bikes by 2050*	Same as M1	Same as M2
Employer telework + TDM measures	Start value ranges from 2 to 65% across counties		Share of workers and households participating in TDM programs increases by 35 percentage points in each county by 2050		

*E-bikes includes electric scooters, ebikes, bikes, shared bikes, electric skateboards

Energy Efficiency Health Benefits

According to Scoping Plan Appendix G: Section II, 2.4 Health Benefits of Residential Energy Efficiency Intervention:

> Health benefits in residential energy efficiency interventions are expected to result from several factors listed in Table 1. These do not include all the potential benefits, but rather only those for which sufficient study of benefits per intervention was available to apply to the New York scenarios. Not included, for example, are benefits of indoor air quality associated with reduced indoor combustion of gas for cooking. Indoor air quality improvements can be achieved during such interventions by ensuring appropriate ventilation (often in cases where ventilation and existing conditions were not appropriate prior to the intervention) combined with heat recovery where needed. Crucial to this benefit is ensuring appropriate ventilation when tightening building envelopes.

Table 1. Health Benefits Included in the Analysis of Residential Energy Efficiency Interventions

Health-Related Measure	Causes for each Benefit	Low-Income Single Family	Low-Income Multifamily
Reduced thermal stress – heat and cold	Building envelope tightening, appliance replacements	☑	☑
Reduced asthma-related incidents or reduced asthma symptoms	Improved ventilation	☑	*
Reduced trip or fall injuries	Removal of trip hazards, roofing improvements, lighting improvements	☑	☑
Reduced carbon monoxide poisonings	Appliance replacements, carbon monoxide monitors	☑	Not available

* This was studied but no significant difference was detected.

In many cases, benefits occur due to programs ensuring that associated measures are taken at the same time, such as ensuring that carbon monoxide monitors are available where needed and that weatherization does not happen prior to fixing existing conditions such as mold caused by excess moisture in building envelopes and water leaks. Other indoor air quality considerations not related to energy efficiency interventions may include humidity control and filtration where appropriate.

The analysis was undertaken at high-level, applying the number of homes to average benefits from the existing studies. Benefits were estimated only for LMI homes. There are likely also benefits for higher income homes, but data to estimate those benefits is not available.

Benefits would be highly dependent on the structure of the interventions. Energy efficiency programs differ based on whether they include appliance replacement, building shell retrofits, or other non-energy interventions (such as installing carbon monoxide detectors).

Following the current practice in NYSERDA's energy efficiency programs, the analysis assumes that a range of non-energy measures would be included as appropriate in each case.

According to this description, the health-related co-benefits from energy efficiency interventions are associated with associated measures and the structure of the interventions. The Climate Act intends to transform the energy sector. It is disingenuous to claim the health benefits in the following table from GHG emission reduction programs when the reality is that benefits include "non-energy interventions".

There are five health-related measures for energy efficiency but only two are directly related to the energy efficiency. Reduced thermal stress due to heat and cold account for $3.4 billion of the $8.7 billion benefits claimed. The reduction in asthma-related incidents ($3 billion in benefits) is due to better ventilation not directly due to energy efficiency. The $2.4 billion in benefits from reduced trip or fall injuries and reduced carbon monoxide poisoning benefits are non-energy interventions and should not be claimed as benefits for GHG emission reduction programs. These benefits should not be included in the Final Scoping Plan.

Table 2. Potential Public Health Benefits of Energy Efficiency Intervention (2020–2050) Strategic Use of Low Carbon Fuels

Health-Related Measure	LMI Single Family (billion $)	LMI Multifamily (billion $)	Total (billion $)
Reduced asthma-related incidents or reduced asthma symptoms	$3.0	Not available	$3.0
Reduced trip or fall injuries	$1.4	$0.5	$1.9
Reduced thermal stress - cold	$0.4	$0.9	$1.2
Reduced thermal stress - heat	$0.6	$1.5	$2.2
Reduced carbon monoxide poisonings	$0.5	Not available	$0.5
Total	**$5.8**	**$2.9**	**$8.7**

Inventory Games

One way to increase Scoping Plan benefits is to increase the emissions inventory thereby creating more "value" when they are reduced. This inventory does two and possibly three things that increase emissions relative to all other jurisdictions: it includes upstream emissions and it changes the global warming potential time period. Obviously if upstream emissions are included then the total increases but at the same time it makes the inventory incompatible with everybody else's inventory. Global warming potential (GWP) weighs the radiative forcing of a gas against that of carbon dioxide over a specified time frame so that it is possible to compare the effects of different gases. Almost all jurisdictions use a 100-year GWP time horizon but the Climate Act mandates the use of the 20-year GWP. I am not comfortable with the third inventory manipulation. While it is clear that New York's emission factors for upstream methane emissions are higher than a recent National Renewable Energy Laboratory (NREL) estimate, I am not comfortable saying that they are 40 times higher which is my current estimate.

The DEC inventory report does not break out the effects of these metrics on emissions so that the New York inventory can be compared to the inventories developed by other jurisdictions. However, some insight on the effect of upstream emissions is provided in the recently released New York State Oil and Gas Methane Emissions Inventory: 2018-2020 Update that includes a couple of tables describing emissions that are a component of the DEC inventory. One update in this report is a revision to use more recent Intergovernmental Panel on Climate Change emission factors from report AR5 rather than AR4. Table 18 in the report compares AR4 and AR5 GWP100 and GWP20 values. Using the GWP20 instead of GWP100 increases methane emissions by a factor of 3.

Table 18. Comparison of AR4 and AR5 GWP_{100} and GWP_{20} Values Applied to the 2018, 2019 and 2020 Emissions from the Oil and Natural Gas Sector ($MTCO_2e$)

	AR4 GWP_{100}	AR4 GWP_{20}	AR5 GWP_{100}	AR5 GWP_{20}
CH_4 GWP (CO_2e)	**25**	**72**	**28**	**84**
2018 Oil and Gas CH_4 ($MMTCO_2e$)	3,744,730	10,784,823	4,194,098	12,582,293
2019 Oil and Gas CH_4 ($MMTCO_2e$)	3,753,499	10,810,076	4,203,919	12,611,756
2020 Oil and Gas CH_4 ($MMTCO_2e$)	3,708,353	10,680,057	4,153,356	12,460,067

Tables 11 through 13 in the methane inventory update list emissions by source category from 1990 to 2020. I summed the emissions to get totals for representative years for upstream, midstream and downstream emissions. It appears that the DEC inventory adds on the order of 10% for upstream emissions.

Tables 11-13. CH4 Emissions by Source Category in NYS from 1990 to 2020 (MTCO2e; AR5 GWP20)

	1990	2016	2017	2018	2019	2020
Total Upstream	1,784,833	1,441,972	1,280,681	1,171,232	1,311,098	1,228,290
Total Midstream	5,255,044	6,079,968	6,071,633	6,057,280	6,059,781	6,066,603
Total Downstream	8,442,135	5,712,298	5,567,443	5,353,779	5,240,878	5,165,175
State Total	15,482,012	13,234,238	12,919,757	12,582,291	12,611,757	12,460,068

According to the DEC GHG report: "Total statewide gross emissions in 2019 were 6% below 1990 and 17% below 2005 levels, when assessed using CLCPA accounting". Figure ES.1 in the DEC GHG inventory shows the annual statewide emissions from 1990 to 2019. Table 2 lists the data used for this figure. In 1990 total GHG emissions were 402.54 (million metric tonnes CO2e AR5 20-year GWP) and in the last year that data were available (2019) GHG emissions were 379.43. The maximum emissions since 1990 were 463.42 in 2000.

Figure ES.1: NYS Statewide Greenhouse Gas Emissions by Gas, 1990-2019 (mmt CO_2e GWP20)

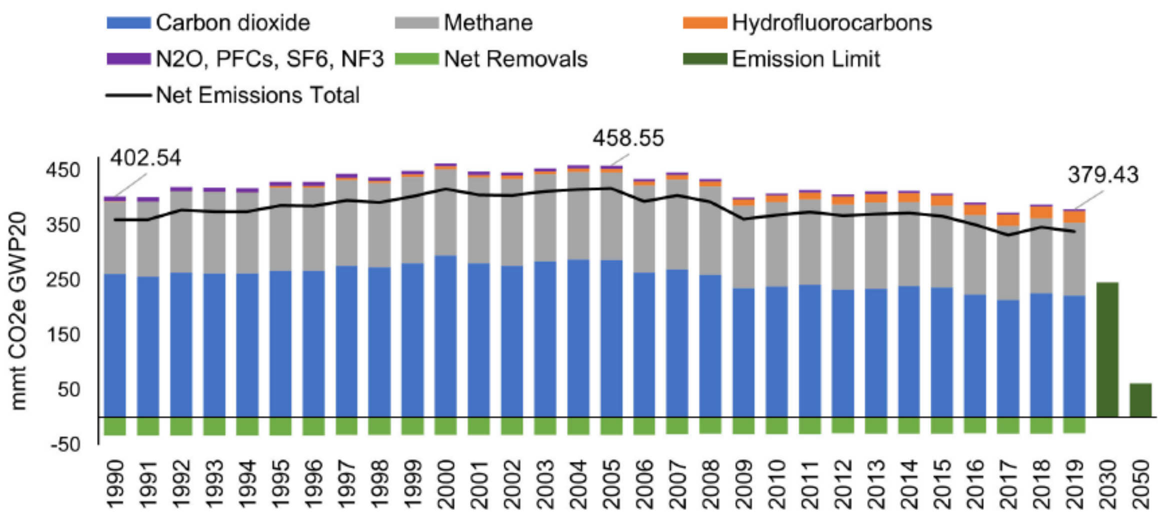


Table 2: Statewide Greenhouse Gas Emissions: Beginning 1990

https://data.ny.gov/Energy-Environment/Statewide-Greenhouse-Gas-Emissions-Beginning-1990/5i6e-asw6

	Greenhouse Gas (MMT CO2e AR5 20 yr)									Greenhouse Gas (MMT CO2e AR4 100 yr)								
Year	**CO2**	**N2O**	**Biogenic CO2**	**CH4**	**HFCs**	**NF3**	**PFCs**	**SF6**	**Total**	**CO2**	**N2O**	**Biogenic CO2**	**CH4**	**HFCs**	**NF3**	**PFCs**	**SF6**	**Total**
1990	252.08	3.69	9.13	132.66	0.04	0.00	0.90	4.02	402.54	252.08	3.96	9.13	39.48	0.02	0.00	1.36	5.24	311.28
1991	248.53	3.57	8.78	136.29	0.11	0.00	0.75	3.84	401.87	248.53	3.83	8.78	40.56	0.04	0.00	1.13	5.01	307.88
1992	254.76	3.72	9.65	147.12	0.11	0.00	0.68	3.80	419.85	254.76	3.99	9.65	43.79	0.05	0.00	1.03	4.96	318.22
1993	251.25	3.67	11.02	148.33	0.12	0.00	0.66	3.68	418.72	251.25	3.93	11.02	44.14	0.05	0.00	1.00	4.79	316.18
1994	251.93	3.81	10.70	147.27	0.36	0.00	0.59	3.45	418.12	251.93	4.07	10.70	43.83	0.14	0.00	0.89	4.49	316.06
1995	256.04	3.67	10.80	152.57	2.27	0.00	0.59	3.15	429.08	256.04	3.92	10.80	45.41	0.87	0.00	0.88	4.10	322.03
1996	255.41	3.43	12.02	151.76	3.05	0.00	0.62	2.88	429.18	255.41	3.70	12.02	45.17	1.17	0.00	0.93	3.76	322.16
1997	259.96	3.56	15.86	157.31	3.60	0.00	0.56	2.66	443.50	259.96	3.83	15.86	46.82	1.40	0.00	0.84	3.46	332.16
1998	259.10	3.63	14.15	154.20	3.98	0.00	0.47	2.25	437.78	259.10	3.90	14.15	45.89	1.56	0.00	0.71	2.93	328.24
1999	266.60	3.73	14.49	157.45	4.38	0.00	0.46	2.33	449.44	266.60	4.00	14.49	46.86	1.73	0.00	0.69	3.03	337.41
2000	279.67	3.60	15.48	157.34	4.69	0.00	0.45	2.19	463.42	279.67	3.88	15.48	46.83	1.86	0.00	0.68	2.85	351.25
2001	270.22	3.53	10.60	156.59	4.96	0.00	0.20	2.09	448.21	270.22	3.80	10.60	46.60	1.97	0.00	0.31	2.72	336.23
2002	265.65	3.46	10.16	159.31	5.57	0.01	0.31	1.96	446.42	265.65	3.71	10.16	47.41	2.22	0.01	0.46	2.56	332.19
2003	273.85	3.47	10.62	158.14	6.05	0.01	0.23	1.84	454.20	273.85	3.72	10.62	47.07	2.43	0.01	0.35	2.39	340.44
2004	275.51	3.59	12.69	159.50	6.43	0.01	0.20	1.73	459.67	275.51	3.85	12.69	47.47	2.60	0.01	0.30	2.25	344.69
2005	276.78	3.45	10.10	159.59	6.80	0.01	0.20	1.62	458.55	276.78	3.70	10.10	47.50	2.77	0.01	0.31	2.11	343.27
2006	253.38	3.47	10.49	158.84	7.43	0.01	0.18	1.19	435.00	253.38	3.71	10.49	47.28	3.05	0.01	0.27	1.55	319.75
2007	258.74	3.38	11.42	163.45	8.20	0.01	0.27	0.87	446.34	258.74	3.62	11.42	48.65	3.38	0.02	0.41	1.13	327.36
2008	247.05	3.33	12.29	160.92	9.22	0.01	0.20	0.57	433.58	247.05	3.56	12.29	47.89	3.82	0.02	0.31	0.74	315.67
2009	227.12	3.03	8.56	150.84	10.59	0.01	0.13	0.42	400.70	227.12	3.24	8.56	44.89	4.38	0.01	0.20	0.55	288.96
2010	229.20	3.22	9.34	154.08	11.70	0.01	0.15	0.29	407.99	229.20	3.44	9.34	45.86	4.81	0.02	0.22	0.38	293.26
2011	232.13	3.59	9.96	155.10	13.20	0.01	0.34	0.23	414.56	232.13	3.86	9.96	46.16	5.40	0.01	0.52	0.31	298.33
2012	223.15	3.50	9.59	154.14	14.41	0.00	0.42	0.22	405.43	223.15	3.75	9.59	45.88	5.99	0.00	0.64	0.29	289.28
2013	224.41	3.46	10.35	156.96	15.60	0.00	0.41	0.21	411.41	224.41	3.71	10.35	46.71	6.58	0.00	0.62	0.27	292.66
2014	228.76	3.46	10.41	153.34	16.79	0.01	0.14	0.21	413.13	228.76	3.71	10.41	45.64	7.15	0.01	0.21	0.28	296.17
2015	224.89	3.42	12.04	148.46	18.12	0.01	0.05	0.17	407.16	224.89	3.67	12.04	44.19	7.76	0.01	0.07	0.22	292.84
2016	212.57	3.38	11.22	144.33	19.23	0.01	0.05	0.16	390.94	212.57	3.62	11.22	42.96	8.21	0.01	0.07	0.20	278.86
2017	203.28	3.33	11.05	135.52	19.86	0.01	0.06	0.14	373.25	203.28	3.57	11.05	40.33	8.62	0.01	0.10	0.18	267.13
2018	215.10	3.36	11.65	136.93	20.42	0.01	0.09	0.13	387.68	215.10	3.60	11.65	40.75	8.99	0.01	0.13	0.17	280.40
2019	210.09	3.35	11.79	133.07	20.89	0.01	0.10	0.13	379.43	210.09	3.58	11.79	39.60	9.32	0.01	0.15	0.17	274.73

Avoided Cost of GHG Emissions Benefits

The largest benefit for the Climate Act is claimed for avoided societal costs from GHG emissions. For the three mitigation scenarios in the Scoping Plan these benefits range from $235 billion to $250 billion. Because this concept is so complex I have documented in detail how the societal benefits are estimated and how the Scoping Plan calculated these estimates.

The Social Cost of Carbon (SCC) or Value of Carbon is a measure of the avoided costs from global warming impacts out to 2300 enabled by reducing a ton of today's emissions. This is a complicated concept and I don't think my explanations have successfully described it well. Fortunately, I believe that Bjorn Lomborg does a very good job explaining it. I highly recommend his 2020 book *False Alarm - How Climate Change Panic Costs Us Trillions, Hurts the Poor, and Fails to Fix the Planet* (Basic Books, New York, NY ISBN 978-1-5416-4746-6, 305pp.). The following is an excerpt from his chapter "What is Global Warming Going to Cost Us?"

> We need to have a clear idea about what global warming will cost the world. so that we can make sure that we respond commensurately. If it's a vast cost, it makes sense to throw everything we can at reducing it. If it's smaller, we need to make sure that the cure isn't worse than the disease.
>
> Professor William Nordhaus of Yale University was the first (and so far, only) climate economist to be awarded the Nobel Prize in economics in 2018. He wrote one of the first ever papers on the costs of climate change in 1991 and has spent much of his career studying the issue. His studies have helped to inspire what is now a vast body of research.
>
> How do economists like Professor Nordhaus go about estimating the costs of future climate change impacts? They collate all the scientific evidence from a wide range of areas, to estimate the most important and expensive impacts from climate change, including those on agriculture, energy, and forestry, as well as sea-level rises. They input this economic information into computer models; the models are then used to estimate the cost of climate change at different levels of carbon dioxide emissions, temperature, economic development, and adaptation. These models have been tested and peer reviewed over decades to hone their cost estimates.
>
> Many of the models also include the impacts of climate change on water resources, storms, biodiversity, cardiovascular and respiratory diseases, vector-borne diseases (like malaria), diarrhea, and migration. Some even try to include potential catastrophic costs such as those resulting from the Greenland ice sheet melting rapidly. All of which is to say that while any model of the future will be imperfect, these models are very comprehensive.
>
> When we look at the full range of studies addressing this issue, what we find is that the cost of climate change is significant but moderate, in terms of overall global GDP.
>
> Figure 5.1 shows all the relevant climate damage estimates from the latest UN Climate Panel report, updated with the latest studies. On the horizontal axis, we can see a range of temperature increases. Down the vertical axis, we see the impact put into monetary terms: the

net effect of all impacts from global warming translated into percentage of global GDP. The impact is typically negative, meaning that global warming will overall be a cost or a problem.

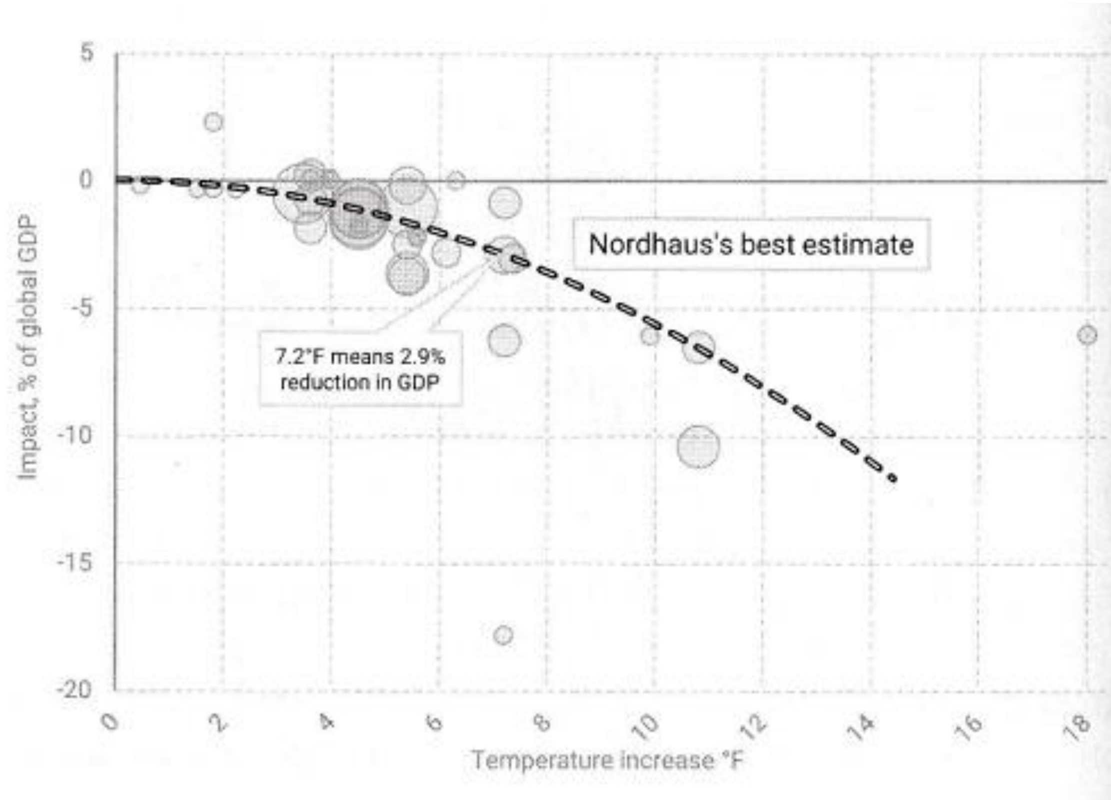


FIGURE 5.1 Impact of temperature rise. Total impact as percentage of global GDP of a given temperature rise, based on thirty-nine published estimates in the literature. Larger circles are better studies. This is an update of the UN's overview (IPCC 2014a,690, SM10-4) Size of circles shows the weight of the individual studies (larger circles for latest estimates, using independent and appropriate methods; smaller circles for earlier estimates, secondhand studies, or less appropriate methods). The black dashed line is Nordhaus's best estimate, based on median quadratic weighted regression.

Right now, the planet has experienced a bit less than 2°F global temperature increase since the industrial revolution. This graph shows us that it is not yet clear whether the net global impact from a 2°F change is positive or negative; there are three studies that show a slight negative impact, and one showing a rather large benefit. As the temperature increase grows larger, the impact becomes ever more negative. The dashed line going through the data is Nordhaus's best estimate of the reduction in global GDP for any given temperature rise.

We should focus on the temperature rise of just above 7°F, because that is likely to be what we will see at the end of the century, without any additional climate policies beyond those to which governments have already committed. At 7.2°F in 2100, climate change would cause negative impacts equivalent to a 2.9 percent loss to global GDP.

Remember, of course, that the world will be getting much richer over die course of the century. And that will still be true with climate change -we will still be much richer, but slightly less so than we would have been without global warming.

In summary, models are used to project the benefits of reducing GHG emissions on future global warming impacts including those on agriculture, energy, and forestry, as well as sea-level rises, water resources, storms, biodiversity, cardiovascular and respiratory diseases, and vector-borne diseases (like malaria), and diarrhea. Richard Tol describes the value of greenhouse gas emission reductions thusly: "In sum, the causal chain from carbon dioxide emission to social cost of carbon is long, complex and contingent on human decisions that are at least partly unrelated to climate policy. The social cost of carbon is, at least in part, also the social cost of underinvestment in infectious disease, the social cost of institutional failure in coastal countries, and so on."

Social Cost of Carbon Caveats

There are some important caveats in this approach. For example, Lomborg does not mention the fact that the models estimate those impacts out to the year 2300 and that the largest impacts are predicted to occur towards the end of the modeling period. All of these economic models simplify the relationship between emissions and potential global warming impacts and they all presume a high sensitivity to those impacts from greenhouse gases but recent studies suggest that the models are overly sensitive. Finally, keep in mind that there is no attempt to consider advantages of greenhouse gases much less balance them in their projected benefit costs.

Advocates for the Climate Act often say we need to act on climate change for our children and grandchildren. However, if a generation is 25 years long, then the avoided cost of carbon societal benefit is applied to 11 generations out to 2300. One of the points that Lomborg makes in *False Alarm* is that the costs of global warming will only reach 2.6% of GDP by 2100 but that global GDP will be so much higher at that time that this number is insignificant.

New Yorkers also need to be aware that benefits mostly accrue to those jurisdictions outside of New York. To this point those jurisdictions are more vulnerable because there is under-investment in resilient agriculture, energy, and forestry; their society is not rich enough to address sea-level rises like Holland has done for centuries; adaptation for water resources, storms, and biodiversity is not a priority because of poverty; and underfunding for cardiovascular and respiratory diseases, vector-borne diseases (like malaria), and diarrhea makes the impacts of those diseases worse than in New York.

Importantly, if total global greenhouse gas emissions continue to rise as developing countries improve their resiliency to weather events and health care system using fossil fuels then there will not be <u>any</u> actual societal benefits from New York's emission reductions. The benefits argument devolves into claiming that the value of New York's avoided greenhouse gas emissions reductions is that impacts would have been even worse without them. New York's share of global GHG emissions is 0.45% in 2016, the last year when state-wide emissions consistent with the methodology used elsewhere are available, so the Scoping Plan can only claim only less than half a percent worse because that is New York's share of total emissions today.

New York Avoided Cost of Carbon Estimates

In order to claim that the Climate Act emission reductions provide societal benefits the Social Cost of Carbon (SCC) or Value of Carbon is used. The metric is a measure of the avoided costs from global warming impacts out to 2300 caused by reducing a ton of GHG emissions. The benefit is calculated by multiplying the New York values of carbon times the number of tons of carbon reduced. I believe that the societal benefit for Climate Act reductions should use one and only one of the three values in Table 2. Using the maximum rather than the baseline makes sense if you want to get credit for New York's biggest impacts and using the most recent value could be argued as appropriate because it represents the actual value of the Climate Act itself.

The following table lists the societal benefits for the three different discount rates listed in New York's Value of Carbon guidance. Note that New York's emissions estimates using upstream emissions and unconventional assumptions increase emission estimates to 1.9 times higher in 1990 and 2.3 times higher in 2019 than emissions accounting used by other jurisdictions. The state recommends using the 2% discount rate which gives societal benefits ranging between $46.7 billion and $56.4 billion using the 2021 values depending on which historical emission value is used. However, consider that most other jurisdictions, including the Federal government are using conventional, or UNFCCC, format for governmental accounting and the 3% discount rate. That drops the social benefits to $8.6 for 2019 emissions to $10.9 billion for 2019 emissions. In 1990 New York's emissions accounting increases the benefits to $20.9 billion and for 2019 emissions the accounting increases the benefits to $19.7 billion.

The discount rate value is a measure of trading off the welfare of the present generation for the benefit of future generations. This is entirely a value judgement and the Climate Act chooses a lower discount rate that places lower value on immediate benefits relative to higher delayed benefits received in the future. The combined effect of the higher emissions and lower discount rate means that New York's societal benefits of GHG emission reductions are 4.5 times higher for 1990 emissions and 5.4 times higher for 2019 emissions.

Societal Benefits of New York GHG Emission Reductions and Scooping Plan Scenarios

	Year	NYS GHG Emissions mmT CO2e	Recommended Range of Discount Rates			Societal Benefit of Climate Act ($millions)		
			3%	2%	1%	3%	2%	1%
Climate Act	1990	402.54	$ 52	$ 123	$ 409	$20,932	$ 49,512	$164,639
	2005	458.55	$ 52	$ 123	$ 409	$23,845	$ 56,402	$187,547
	2019	379.43	$ 52	$ 123	$ 409	$19,730	$ 46,670	$155,187
Everybody Else	1990	210.43	$ 52			$10,942		
	2019	165.46	$ 52			$ 8,604		

	Scenario	Scenario Description	Societal Benefit of Climate Act		
Scoping Plan	2	Strategic Use of Low Carbon Fuels		$235,000	
	3	Accelerated Transition Away from Combustion		$240,000	
	4	Beyond 85% Reductions		$250,000	

New York's Flawed Avoided Cost of Carbon Benefits Methodology

Despite all the machinations the societal benefits in the Scoping Plan are not large enough to claim positive net benefits. The Scoping Plan relies on flawed DEC Value of Avoided Carbon Guidance to make that claim. The Guidance includes a recommendation how to estimate emission reduction benefits for a plan or goal. I believe that the guidance approach is wrong because it applies the social cost multiple times for each ton reduced. It is inappropriate to claim the benefits of an annual reduction of a ton of greenhouse gas over any lifetime or to compare it with avoided emissions. The social cost calculation that is the basis of the Scoping Plan carbon valuation sums projects benefits for every year for some unspecified lifetime subsequent to the year the reductions. As shown above, the value of carbon for an emission reduction is based on all the damages that occur from the year that ton of carbon is reduced out to 2300. Clearly, using cumulative values for this parameter is incorrect because it counts those values over and over. I contacted social cost of carbon expert Dr. Richard Tol about my interpretation of the use of lifetime savings and he confirmed that "The SCC should not be compared to life-time savings or life-time costs (unless the project life is one year)".

There are other problems with the DEC Guidance approach. I asked Dr. Tol another question about using the social cost of methane and he pointed out that "the social cost of carbon is an efficiency concept" so it is inappropriate to use social costs in the way that New York is doing. He said that "If a cap is set, you should not use the social cost of carbon. A cap violates efficiency." I am not an economist and honestly cannot claim to understand this argument but it is pretty clear that New York is pushing the envelope in its interpretation of the social cost of carbon calculations.

This section shows how the State has contrived higher estimates for societal greenhouse gas emission benefits to the point where their valuation is around five times higher than other jurisdictions using conventional methodology. I also showed that this manipulation was not sufficient to "prove" that societal benefits were greater than the costs for the Scoping Plan mitigation scenarios so they relied on state guidance that mistakenly over counts the benefits. That gamesmanship results in New York societal benefits more than 21 times higher than benefits using everybody else's methodology.

I prepared this comment because the Draft Scoping Plan benefits are biased over-estimates designed to "prove" that the benefits are greater than the costs. I have written extensively on implementation of the Climate Act because I believe the ambitions for a zero-emissions economy outstrip available renewable technology such that it will adversely affect reliability and affordability, risk safety, affect lifestyles, will have worse impacts on the environment than the purported effects of climate change in New York, and cannot measurably affect global warming when implemented. The opinions expressed in this document do not reflect the position of any of my previous employers or any other company I have been associated with, these comments are mine alone.

Roger Caiazza
Pragmatic Environmentalist of New York
NYpragmaticenvironmentalist@gmail.com
Liverpool, NY