Documentation for Caiazza Comments at Public Hearing in Syracuse on April 26, 2022

Introduction

This submittal documents the comments I presented at the Syracuse public hearing on April 26, 2022. Because public comments were limited to two minutes, I could not document my statements. The following section lists the comments presented and documentation follows. Because the documentation is detailed and long, the text includes internal links to the relevant documentation highlighted in red. External links are highlighted in traditional blue.

Public Comments Verbally Presented on April 26, 2022

I am going to summarize the written comments I submitted on April 22 to the Council. I don't think the Council, much less the public, appreciates the Draft Scoping Plan's claimed benefits, costs, threats to reliability, or effect of the proposed reductions on global climate change. [Introduction Documentation]

The scoping plan claims that "The cost of inaction exceeds the cost of action by more than $90 billion". That statement is inaccurate and misleading. The plan claims $235 billion societal benefits for avoided greenhouse gas emissions. I estimate those benefits should only be $60 billion. The Scoping Plan gets the higher benefit by counting benefits multiple times. If I lost 10 pounds five years ago, I cannot say I lost 50 pounds but that is what the plan says.
[Benefits Documentation]

The cost estimates are poorly documented but I have determined that they misleadingly exclude the costs in the transportation investments category needed to make the necessary reductions. The semantic justification is that the program is already implemented. Adding $700 billion for that and using the correct avoided cost of carbon means that costs are at least $760 billion more than the benefits.
[Costs Documentation]

Reliability will be risky. When buildings are 100% electric and transportation relies on electric vehicles, what happens when there is an ice storm? There are many similar "what if" scenarios not considered.
[Reliability Documentation]

New York emissions are <u>less</u> than one half of one percent of total global emissions. Global emissions have been increasing on average by <u>more</u> than one half of one percent per year. [Emissions Context Documentation]

Anything we do will be displaced in a year, cost a lot of money and risk catastrophic blackouts. The plan must be revised to one based on technically achievable incremental steps that maintain current standards of affordability and reliability. [Conclusion Documentation]

Introduction Documentation

My name is Roger Caiazza. In my verbal comments I summarized these written comments. I don't think the Council, much less the public, appreciates the Draft Scoping Plan's claimed benefits, costs, threats to reliability, or effect of the proposed reductions on global climate change.

The only way to eventually eliminate greenhouse gas emissions is by a plan that is technically possible, maintains reliable energy systems and is affordable to those who have to pay for it, in this case the citizens of New York. The Draft Scoping Plan put forth by the Climate Action Council is technologically incomplete and does not address important reliability requirements. The costs are not clearly identified anywhere. I estimate that cost will be measured in trillions of dollars.

New Yorkers are entitled to understand the full nature of the changes proposed to be imposed on them and must be fully supportive of making the expenditures required by the plan. The Scoping Plan should be based on technically achievable incremental steps that are affordable and, most importantly, that New Yorkers fully support. The Council has an important task and New Yorkers are depending upon them to prepare a realistic and affordable plan. The work to date is incomplete at best.

Documentation for the Health Benefits Comments

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. In order to maximize the alleged benefits, the Integration Analysis inflates the GHG emissions inventory. Furthermore, the analysis claims that GHG emissions reductions to the avoided economic impacts of damages caused by climate change equal approximately \$235 to \$250 billion. The combined benefits range from approximately \$400 billion to \$420 billion. I will address each of these benefit claims in turn and discuss the contrived emissions estimates used to increase the benefits of control even further.

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.

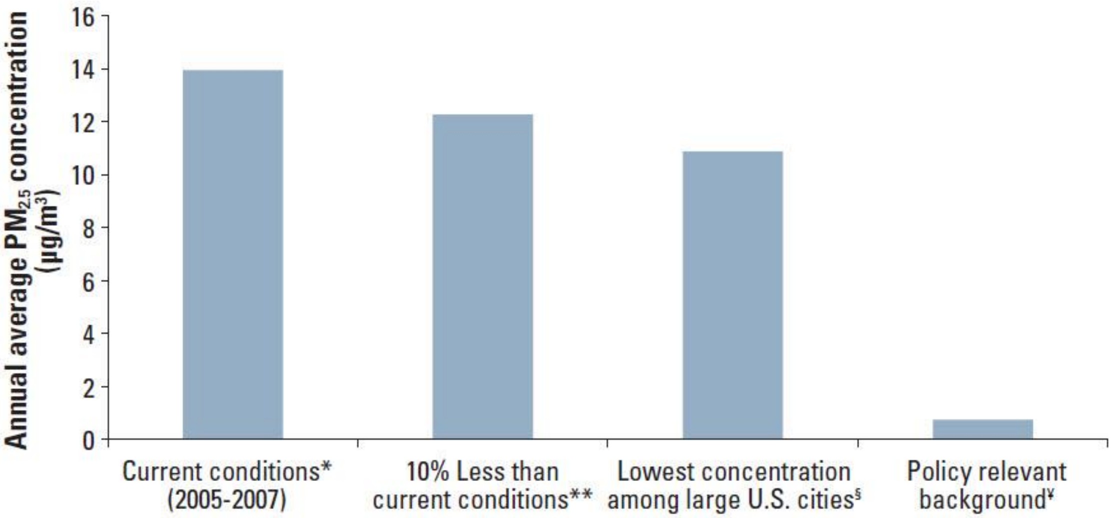
In brief, the Scoping Plan air quality health assessment depends on a linear no-threshold model. Originally used for radiation assessment, in that context it suggests that each time radiation is deposited in the susceptible target there is a probability of tumor initiation. Note, however, that its use in radiation assessment is controversial.

In my opinion, I don't think it has been verified well enough to justify its use in the Draft Scoping Plan. 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 did a post on 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
	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
	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
	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
	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 personal experience 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.

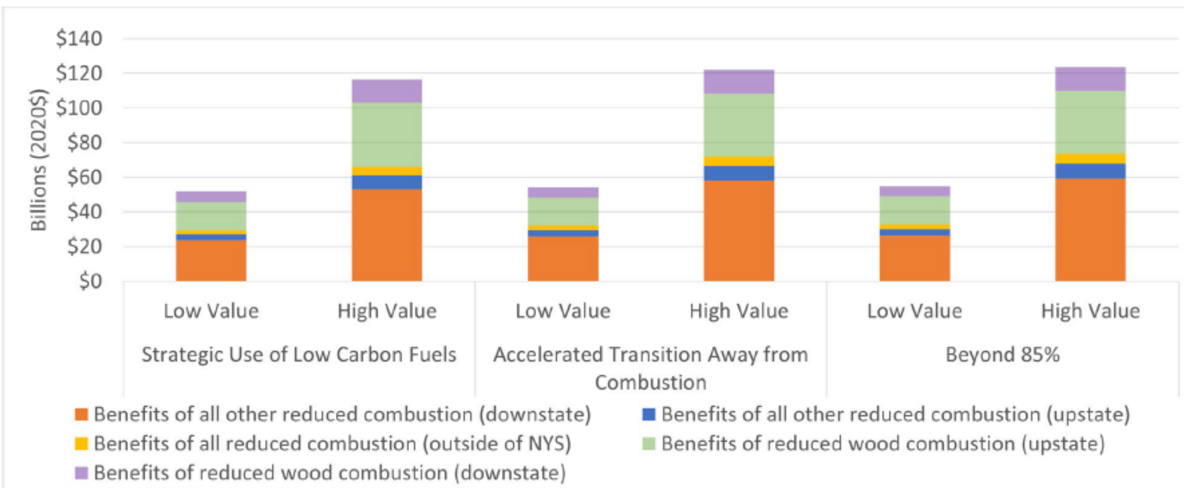
Table 1: Data from Figure 4. Baseline Annual Average PM2.5 Levels in New York City (2005-2007) and DEC Measurement Levels in Comparison Scenarios

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

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."

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



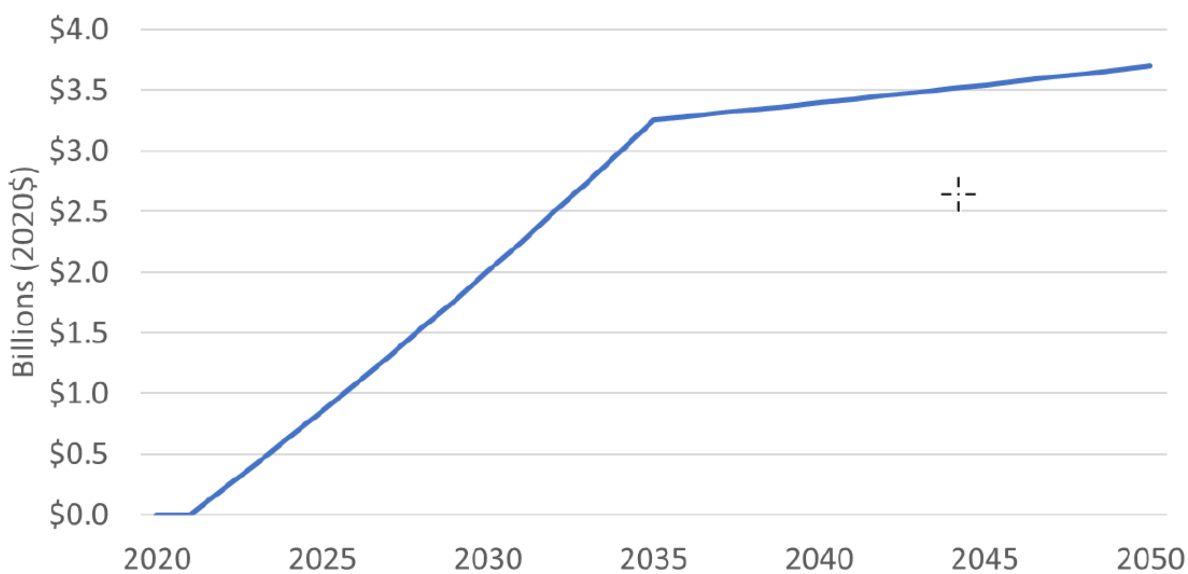
Until such time that the Scoping Plan bases its $PM_{2.5}$ health benefits on the observed health outcome benefits observed from the reductions that have occurred, I do not accept the health benefits suggested in the Integration Analysis. Consider that the reduction in $PM_{2.5}$ annual average concentrations in the Strategic Use of Low Carbon Fuels scenario predicts at most a reduction in $PM_{2.5}$ of 0.35 µg/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 µg/m^3 and that is 16 times higher than the projected reduction 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. The Climate Action Council must prove their thesis that these benefits have occurred.

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 the proposed 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 Cadmus 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.

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 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 improvements. 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 Climate Act GHG emission reduction programs.

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 emissions 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 game. 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 how much higher.

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

Table 2, Statewide Greenhouse Gas Emissions: Beginning 1990, lists the 1990 through 2019 GHG emissions using the CLCPA accounting approach and the IPCC accounting approach all other jurisdictions use. 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". Using the IPCC methodology, total statewide gross emissions in 2019 were 17% below 1990 and 20% below 2005 levels. The CLCPA accounting methodology is 38% higher than the IPCC approach.

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)									GWP20 GHG - GWP100 GHG (MMT CO2e)						
Year	CO2	N2O	Biogenic CO2	CH4	HFCs	NF3	PFCs	SF6	Total	CO2	N2O	Biogenic CO2	CH4	HFCs	NF3	PFCs	SF6	Total	N2O	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	-0.27	93.18	0.03	0.00	-0.46	-1.22	91.26
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	-0.26	95.73	0.06	0.00	-0.38	-1.16	93.99
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	-0.27	103.34	0.07	0.00	-0.35	-1.15	101.63
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	-0.26	104.18	0.07	0.00	-0.34	-1.11	102.54
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	-0.26	103.44	0.22	0.00	-0.30	-1.04	102.05
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	-0.26	107.16	1.40	0.00	-0.30	-0.95	107.05
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	-0.26	106.60	1.87	0.00	-0.31	-0.87	107.02
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	-0.27	110.49	2.20	0.00	-0.28	-0.80	111.33
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	-0.27	108.31	2.42	0.00	-0.24	-0.68	109.54
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	-0.27	110.59	2.65	0.00	-0.23	-0.71	112.03
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	-0.28	110.51	2.83	0.00	-0.23	-0.66	112.17
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	-0.26	109.99	2.99	0.00	-0.10	-0.63	111.98
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	-0.26	111.90	3.34	0.00	-0.16	-0.59	114.23
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	-0.26	111.07	3.62	0.00	-0.12	-0.56	113.76
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	-0.25	112.03	3.83	0.00	-0.10	-0.52	114.98
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	-0.25	112.09	4.03	0.00	-0.10	-0.49	115.27
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	-0.24	111.57	4.38	0.00	-0.09	-0.36	115.25
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	-0.24	114.81	4.81	0.00	-0.14	-0.26	118.97
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	-0.23	113.03	5.40	0.00	-0.10	-0.17	117.92
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	-0.21	105.95	6.21	0.00	-0.07	-0.13	111.75
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	-0.22	108.22	6.89	0.00	-0.08	-0.09	114.73
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	-0.27	108.94	7.80	0.00	-0.17	-0.07	116.22
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	-0.26	108.27	8.42	0.00	-0.22	-0.07	116.15
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	-0.25	110.25	9.03	0.00	-0.21	-0.06	118.75
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	-0.25	107.71	9.64	0.00	-0.07	-0.06	116.95
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	-0.25	104.28	10.36	0.00	-0.02	-0.05	114.31
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	-0.24	101.37	11.02	0.00	-0.02	-0.05	112.08
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	-0.23	95.18	11.24	0.00	-0.03	-0.04	106.12
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	-0.24	96.18	11.43	0.00	-0.05	-0.04	107.28
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	-0.24	93.47	11.57	0.00	-0.05	-0.04	104.70

Documentation for the Avoided Cost of GHG Emissions Benefits Comments

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 complex, I have documented in detail how the societal benefits are estimated, caveats for these calculations, how the Scoping Plan calculated these estimates, and finally describe a flaw in the New York State methodology.

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, but 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.

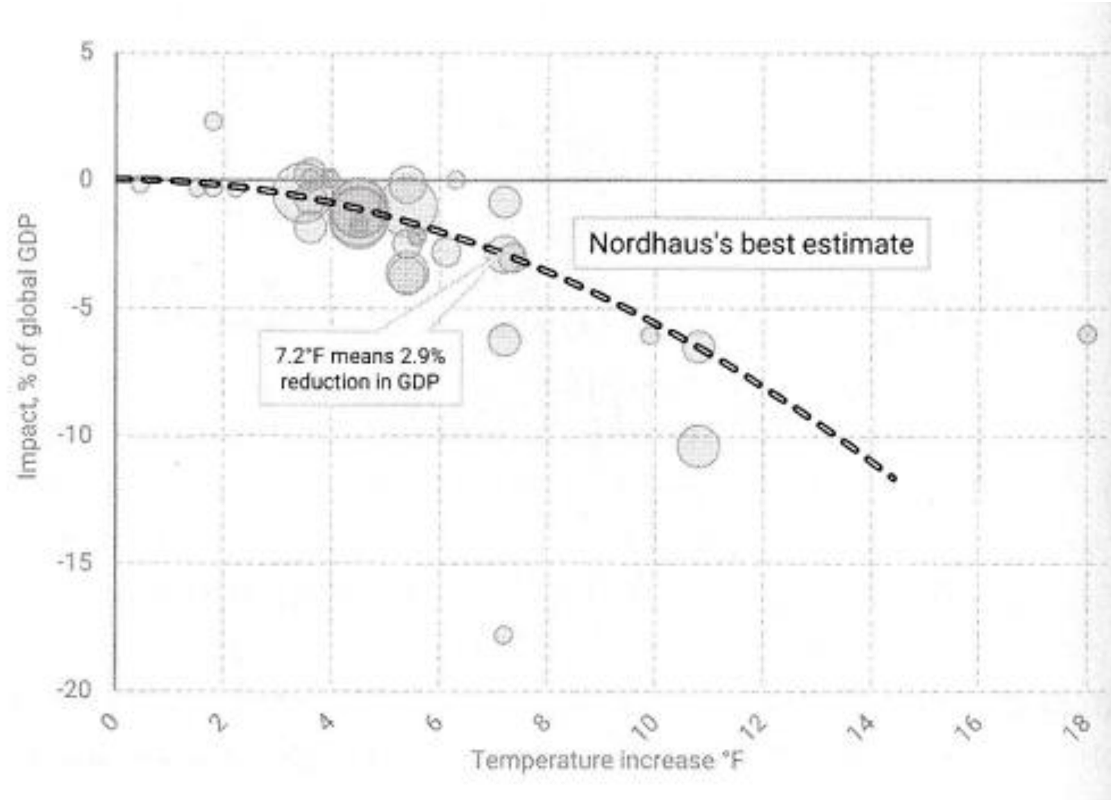


FIGURE 5.1 Impact of temperature rise. Total impact as percentage of global GDP of a given temperature rise, based on thirty-nine published estimates in the literature. Larger circles are better studies. This is an update of the UN's overview (IPCC 2014a,690, SM10-4) Size of circles shows the weight 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, 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 to value the projected benefits of avoided GHG emissions. 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 at 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 which is entirely consistent with the Climate Act's presumed impacts. However, Dr. Judith Curry writes "Recent analyses from the International Panel on Climate Change (IPCC) and the International Energy Agency (IEA) indicate that the extreme tail risks from global warming, associated with very high emissions and high climate sensitivity, have shrunk and are now regarded as unlikely if not implausible. 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. In the first place the benefits of avoided emissions are very low over those two generations. Moreover, 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. 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 where 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 any 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 they 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. In order to calculate the benefit, the New York values of carbon is multiplied by the number of tons of carbon reduced. I believe that the societal benefit for Climate Act reductions should use one and only one of three historical emissions values: baseline (1990), maximum, or most recent. 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 billion for 2019 emissions and $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 for the 3% discount rate.

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. Given that most of the benefits accrue in the last century of the projections this is a biased judgement. 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 those projected by other jurisdictions.

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 these machinations the societal benefits in the Scoping Plan are not large enough to claim positive net benefits without additional cooking of the books. The Scoping Plan relies on flawed DEC Value of Avoided Carbon Guidance. The Guidance includes a recommendation 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. I maintain that 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)".

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.

The Scoping Plan claims that 2020-2050 societal benefits are greater than societal costs by between $90 and $115 billion. However, the flawed Climate Act guidance incorrectly calculates benefits by applying the value of an emission reduction multiple times. The Strategic Use of Low Carbon Fuels scenario is estimated to have $310 billion in net direct costs, avoided carbon damage benefits of $235 billion, and health co-benefits of $165 billion so that the net benefit is $90 billion. However, when the over-counting error is corrected, the avoided carbon damage benefit is only $70.5 billion so there is a negative net benefit of $74.5 billion. The Accelerated Transition Away from Combustion scenario ends up with a negative net benefit of $49.5 billion and the Beyond 85% Reductions scenario has a negative net benefit of $64.5 billion.

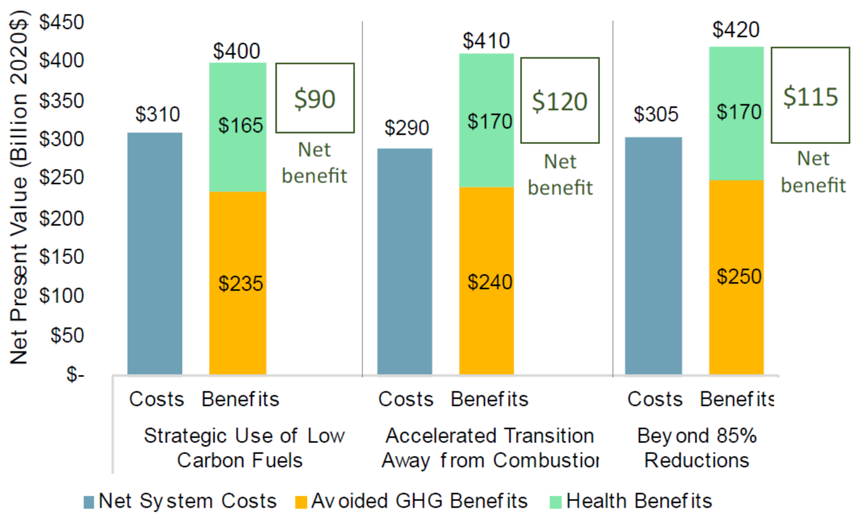
Documentation for the Cost Comments

Appendix G Figure 51. Net Present Value of Benefits and Costs relative to Reference Case, Including GHG benefits, Health Benefits, and Net Direct Costs (2020 – 2050) on page 69 is the primary documentation for the assertion that the "cost of inaction exceeds the cost of action by more than $90 billion". Note that three scenarios are shown: "Strategic use of low carbon fuels", "Accelerated transition away from combustion", and "Beyond 85% Reductions". The $90 billion number is the net benefit difference between the net system costs and the total benefits. My first impression was that these numbers represented the total costs for New York State to meet the net-zero mandate. I should have known better.

In order to understand the real costs, it is necessary to unpack the title language. Firstly, the numbers are the "net present values". Note that the costs listed are "net direct costs". Finally, the values are listed "relative to the reference case".

According to the Draft Scoping Plan the integration analysis included calculations for three cost metrics: net present value (NPV) of net direct costs, annual net direct costs, and system expenditures. The Plan defines NPV of Net Direct Costs as the levelized costs in a given scenario incremental to the Reference Case from 2020 through 2050 using a discount rate of 3.6% and including incremental direct capital, investment, operating expenses, and fuel expenditures. The annual Net Direct Costs are defined as the levelized costs in a given scenario incremental to the Reference Case for a single year snapshot and include incremental direct capital investment, operating expenses, and fuel expenditures. I don't have the background to comment on the impact of these definitions relative to the acceptability of the projections.

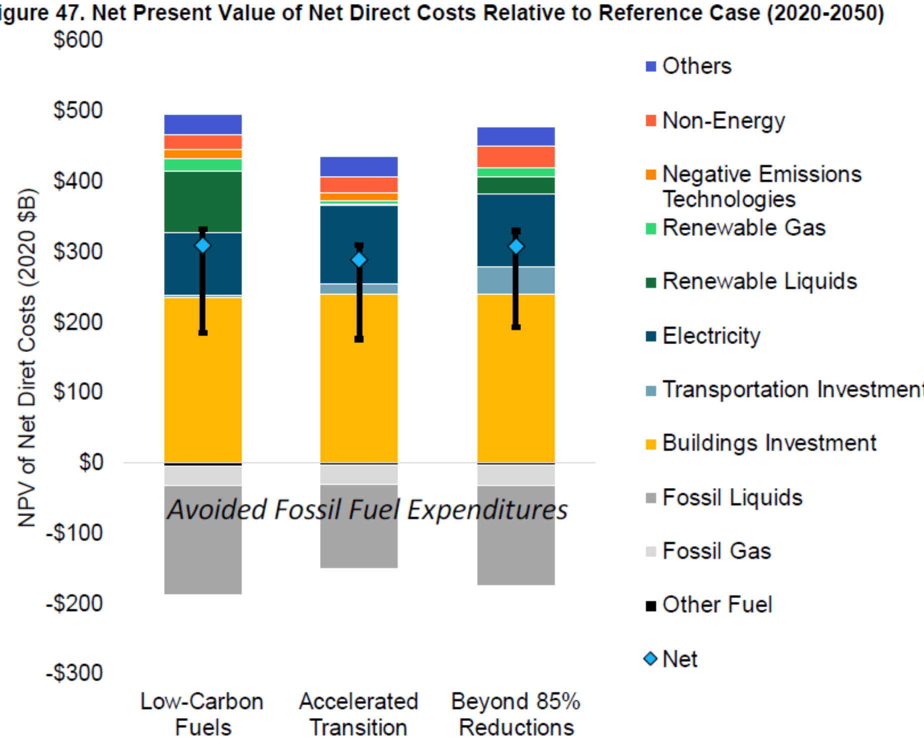
Figure 51. Net Present Value of Benefits and Costs relative to Reference Case, Including GHG benefits, Health Benefits, and Net Direct Costs (2020 – 2050)



Net Direct Costs

Appendix G Figure 47 lists the NPV of net direct costs relative to the reference case. This illustrates what is meant by the net direct costs label. In each of the mitigation scenarios there are avoided fossil fuel expenditures that are subtracted from the total costs of the implementation strategies to get the ~$300 billion <u>net</u> direct costs.

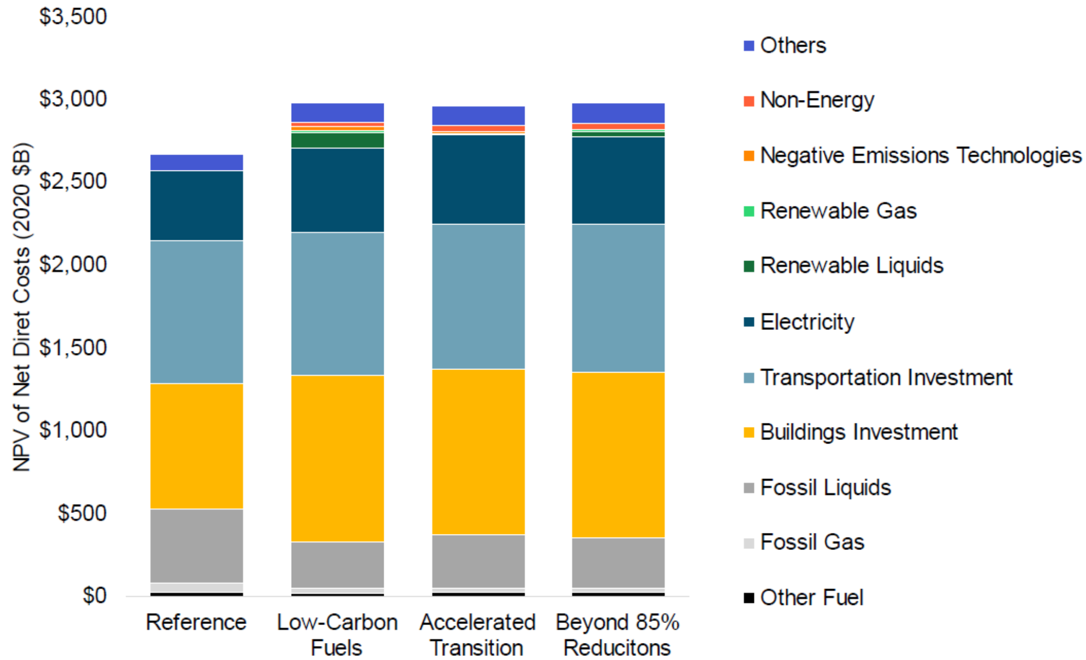
Figure 47. Net Present Value of Net Direct Costs Relative to Reference Case (2020-2050)



System Expenditures

System Expenditures are defined as an estimate of absolute direct costs (not relative to the Reference Case) and do not reflect direct costs in some sectors that are represented with incremental costs only. Appendix G Figure 48, New Present Value of System Expenditures in Reference Case and Scenarios 2-4 (2020-2050) shown below describes these costs. Figure 48 is important because other than a text mention that the Reference Case is $2.7 trillion, it is the only documentation for Reference Case values. It looks like the scenarios are all approximately $3 trillion consistent with the difference relative to the Reference Case ~$300 billion costs in Figure 51.

Figure 48. Net Present Value of System Expenditures in Reference Case and Scenarios 2-4 (2020-2050)



An important aside: the Climate Act requires the Climate Action Council to "[e]valuate, using the best available economic models, emission estimation techniques and other scientific methods, the total potential costs and potential economic and non-economic benefits of the plan for reducing greenhouse gases, and make such evaluation publicly available" in the Scoping Plan. This figure and the others included represent most of the cost documentation. For example, the component costs in the reference case in this figure are not included in any supporting documentation. There are spreadsheets that document other non-cost figures in the Draft Scoping Plan with the data tables used to generate the figures but I have been unable to find this information for any of the cost figures. I submit that the Council will not have fulfilled the "publicly available" requirement until the costs for each measure considered, each component cost, and the total costs of each scenario are publicly documented.

Costs Relative to the Reference Case

Recall that Figure 51 notes that the values listed are relative to the Reference Case. In order to determine what is included I searched the Draft Scoping Plan and the technical supplements for the phrase "Reference Case" for the analysis. The best description of the Reference Case contents was in

Appendix G, Section I on page 12 in a footnote for Figure 4: Gross Greenhouse Gas Emissions by Mitigation Scenario:

> The Reference Case is used for evaluating incremental societal costs and benefits of GHG emissions mitigation. The Reference Case includes a business as usual forecast plus implemented policies, including but not limited to federal appliance standards, energy efficiency achieved by funded programs (Housing and Community Renewal, New York Power Authority, Department of Public Service, Long Island Power Authority, NYSERDA Clean Energy Fund), funded building electrification, national Corporate Average Fuel Economy standards, a statewide Zero-emission vehicle mandate, and a statewide Clean Energy Standard including technology carveouts. For more details see Chapter 5.3.

The Integration Analysis documentation does not describe the costs associated with the implemented policies or include a cost component breakdown that would enable readers to determine whether the components of the reference case are a reasonable estimate of the costs without the Climate Act. In my opinion many of the programs apparently included should not be in the Reference Case. Looking at the bar chart the four biggest cost components are electricity, transportation investment, buildings investment and fossil liquids. Note that the transportation investment (~700 billion per my eyeball) does not vary much between the Reference Case and the three mitigation scenarios. Keep that in mind.

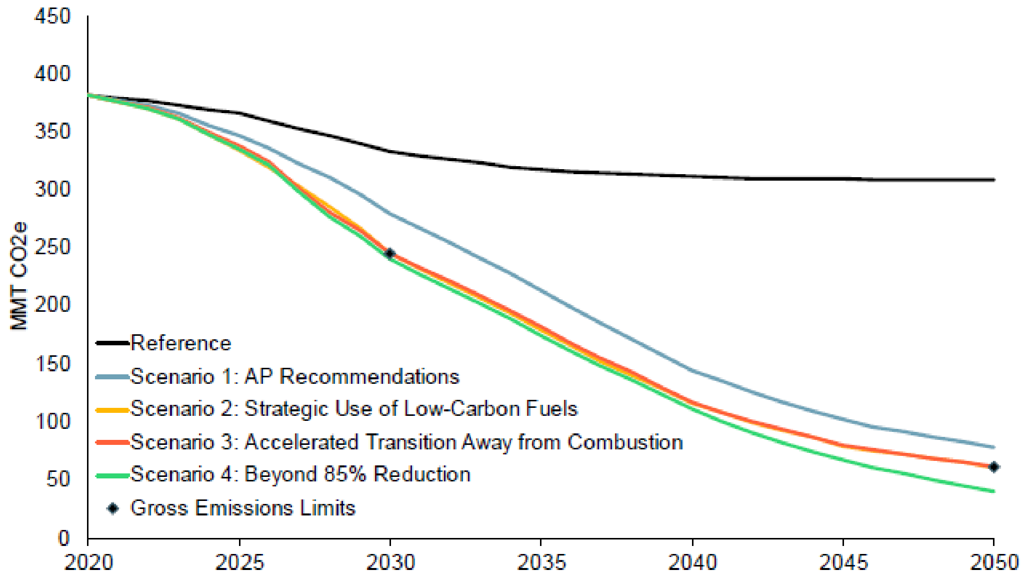
In Figure 47 the cost categories for the net direct costs relative to the Reference Case are listed. Note that the highest transportation investments costs listed are no more than $30 billion for the scenario, “Beyond 85%”. My original impression of Figure 51 was that it represented all the costs necessary for New York to get to net-zero. Clearly $30 billion is nowhere near the cost to replace all the approximately 10 million vehicles in New York with electric vehicles that use batteries or fuel cells. The total cost has to be higher to include the cost for personal electric charging stations and public electric chargers, at least.

It is apparent that the true cost to electrify New York transportation is included in the Reference Case. The system expenditures listed in Figure 48 suggest the transportation investment component cost is around $700 billion which at least makes some sense for total costs. Going to back to footnote 6 above, the justification to put those costs in the Reference case is a bit of semantic sleight of hand. The footnote says that the Reference Case includes a “business as usual forecast plus implemented policies”. Obviously, most of the costs of vehicle electrification are considered costs associate with “implemented policies”. New York passed legislation setting a goal for all new passenger cars and trucks sold in New York State to be zero-emissions by 2035 in April 2021 so this is technically true.

However, suggesting that this “implemented policy” should not be included in the Climate Act implementation costs is disingenuous at best. The press release announcing that the Governor signed the legislation states: “The actions announced today in advance of Climate Week 2021 support New York's ambitious goal of reducing greenhouse gas emissions by 85 percent by 2050, as outlined in the Climate Leadership and Community Protection Act.” It goes on to quote Governor Hochul: "New York is implementing the nation's most aggressive plan to reduce the greenhouse gas emissions affecting our climate and to reach our ambitious goals, we must reduce emissions from the transportation sector, currently the largest source of the state's climate pollution”. I think that these statements pretty well represent any dispassionate observer’s belief that the only reason for the law is to support the Climate Act. As such those costs are not legitimate Reference Cases costs.

In my opinion, this is part of a pre-determined plan to make sure the benefits are greater than the costs for the mitigation scenarios. Not including all the category and control measures costs in the Integration Analysis supporting spreadsheet documentations is one sign of a cover-up. Hiding the Reference Case definition is another sign. The following figure shows where this reference is found. Look closely. The footnote reference is not connected to a caption for Figure 4. The only way you can find this if you are reading every word on every page or if you search for the phrase "reference case".

Figure 4. Gross Greenhouse Gas Emissions by Mitigation Scenario



[6]

- **Scenario 1: Advisory Panel Recommendations**: Representation of the Advisory Panel recommendations,[7] which provide a foundation for all scenarios through rapid electrification of buildings and transportation, decarbonization of the power sector, and ambitious reductions in non-

[6] The Reference Case is used for evaluating incremental societal costs and benefits of GHG emissions mitigation. The Reference Case includes a business as usual forecast plus implemented policies, including but not limited to federal appliance standards, energy efficiency achieved by funded programs (Housing and Community Renewal, New York Power Authority, Department of Public Service, Long Island Power Authority, NYSERDA Clean Energy Fund), funded building electrification, national Corporate Average Fuel Economy standards, a statewide Zero-emission vehicle mandate, and a statewide Clean Energy Standard including technology carveouts. For more details see Chapter 5.3.

The following table compares the costs in Figure 51 to revisions to the inaccurate benefits and misleading costs presented in the Scoping Plan. This invalidates the claim that the benefits are greater than the costs. Approximately $700 billion should be added to the net system costs column in the revised section of the table and the avoided GHG benefits should be only $60 billion. The costs are greater than the benefits by at least $760 billion instead of benefits of at least $90 billion.

Revisions to Figure 51 Data After Correcting Benefit Error and Cost Trick

Draft Scoping Plan Figure 51 Data	Net System Costs	Avoided GHG Benefits	Health Benefits	Net Benefit Benefit
Strategic Use of Low Carbon Fuels	$310	$235	$165	$90
Accelerated Transition Away from Combustion	$290	$240	$170	$120
Beyond 85% Reduction	$305	$250	$170	$115

Revised Figure 51 Data	Net System Costs	Avoided GHG Benefits	Health Benefits	Net Benefit Benefit
Strategic Use of Low Carbon Fuels	$1,010	$60	$165	-$785
Accelerated Transition Away from Combustion	$990	$60	$170	-$760
Beyond 85% Reduction	$1,005	$60	$170	-$775

Benefits Relative to the Reference Case

I described all the benefits above. I have been unable to find any indication that the benefits calculated excluded costs from the Reference Plan "already implemented" categories. For example, the health benefits of residential energy efficiency intervention were presented despite the fact that the Reference Case includes implemented policies for "energy efficiency achieved by funded programs (Housing and Community Renewal, New York Power Authority, Department of Public Service, Long Island Power Authority, NYSERDA Clean Energy Fund)". Clearly the Draft Scoping Plan claim that the benefits are greater than the costs is not accurate. More concerning is the overt coverup. What else is buried away because the documentation is so inadequate.

Before I address New York reliability issues I want to call attention to a recent article by I Kevin Kilty. He has taught engineering thermodynamics for twenty years and his article about energy storage raises some fundamental issues vis-à-vis the feasibility of the energy storage necessary for a reliable zero-emissions electric grid:

> Whenever I read about some new or improved scheme to store energy, I ponder two things about it. These are two ubiquitous Achilles heels: 1) What limitations does the second law of thermodynamics place on it, and 2) what are the other constraints that would limit its usefulness in a system? I focus on the second law because the first law just refers to conservation of energy itself, and this is not where most limitations on the use of energy, or in fact limitations on any human activity, come from.

He explains that any energy storage system must lose energy as it is stored and then again as it comes out of storage. This limits the viability of every storage system. He goes on to explain that there are system issues that further limit specific technological availability. For example, pumped storage hydro is a proven technology but it requires specific terrain characteristics.

After describing how those issues affect a couple of "breakthrough" energy storage technologies he describes energy storage time scales, how the current grid addresses those problems, and then briefly talks about potential solutions for a future zero-emissions grid.

> One of the most serious systems problems for renewable energy to solve is the various time-scales of response required to make a reliable grid. There is first the very short time scale of

fractions of a second needed for automatic control systems to keep frequency and voltage within prescribed limits. Next there is a daily time scale of response needed to handle the daily variations in load. Following this is an unknown amount of storage to handle outages resulting from weather that may last for 10 days or more. Finally, there is the issue of seasonal shifting of energy supply which requires either a large overbuilding of generation or massive long-term storage, or some hybrid in between.

> The present grid handles the very short time scale problem by relying on the rotational KE of its turbomachinery which stores several seconds worth of demand in spinning mass.[9] All other time-scales are covered by using stored fossil fuels on site right up to 95% capacity factor of the plant. It is not overly complex and we have nearly a century of systems engineering experience making this system 99.9% or more reliable.

> Wind plants have very little rotational energy to aid in the very short time scale stability issue and solar has none. One remedy is to add "synchronous condensers" into a renewables grid to act as an analog to the rotating turbomachinery of thermal plants. These solutions are parasitic which only consume energy in exchange for short term stability. Solutions to the longer-term system problems rely on cascading elements of diverse energy storage and conversion schemes that require lots of mass, lots of ground space, exotic materials, transmission utilities, embodied energy, excess generating capacity, and so forth. Not only are such elements unproven themselves, but we have zero systems engineering experience with them. Could they be made to work? Who knows? Have a look at their heels.

I recommend the entire article.

Documentation for the Reliability Comments

It is very difficult to provide meaningful comments in the two minutes allowed for speakers. As a result, the only thing I could say about New York reliability in my presentation was that it is a complicated concept and should be a real concern. When everything is electrified any extreme weather that knocks the power off for an extended period is going to be a disaster.

I intend to submit a comment that directly addresses the reliability issues before the end of the comment period. I have published blog posts addressing various aspects of reliability feasibility that will form the basis of those comments. Even though this issue was not addressed in any detail in my comments because of time constraints, I will summarize some of the issues raised in my blog posts because they are so important.

I outlined the scope of the New York reliability problem here. The Integration Analysis recognizes that the future New York electric grid will be more vulnerable to cold weather. When electricity is universally used for heating, cooking, hot water, and transportation, then the peak loads will occur in winter. It is also accepted that solar energy resources will be reduced in the winter, if for no other reason the days are shorter, and that multi-day wind lulls mean that there will be periods when wind and solar resource availability will essentially be zero.

I provided an overview of grid reliability here. In brief, the electric grid is the world's biggest machine. Generating units from the East Coast to the Great Plains are all synchronized and work together. New York Independent System Operator (NYISO) employees match load with generation constantly. NYISO is responsible for grid daily operations and long-term planning. Current operation relies on dispatchable generators that can be adjusted as needed. This system has evolved over decades of research, analysis, and responses to blackouts.

In February 2021, the Texas electric grid failed when needed most. Why there were insufficient generating resources may be debatable, but there is no questioning that Texas generators could not provide sufficient power to match the load. Russell Gold's article "One year after the deadly blackout, officials have done little to prevent the next one—which could be far worse" does an excellent job describing what happened when frigid air behind an intense winter storm blanketed the state and the electric gird operators had to start dealing with resulting problems. I recommend the article also because the description how the blackout unfolded gives some indication of electric grid operational challenges.

At the September 13, 2021 meeting of the Climate Action Council a requirement to consider carbon reduction measures in other jurisdictions was discussed. The fact is that the situation in Europe this winter is a harbinger of things to come in New York. The Draft Scoping Plan considers control measures in isolation and ignores the ramifications observed elsewhere for the measures.

There are serious challenges for the transition to a zero-carbon grid that have not been adequately addressed by the Draft Scoping Plan. I think that the biggest issue is intermittency of wind and solar. In order to address those times when the wind is not blowing at night, for example, energy storage is required. As Kilty explained, energy storage must be available for different conditions on different time scales. He mentioned the very short time periods when some service in the electric grid has to address fluctuations in voltage and frequency. There is another short-term variation issue. Imagine a variably windy day that is partly cloudy. In order to have a stable load not much storage is needed but it will be used much of the time. In a system that has a large amount of solar capacity, there has to be a moderate amount of storage that will be used on a daily basis. The ultimate problem is that there are multi-day renewable resource drought periods when the wind resource is low and, especially in the winter, solar resources will also be low. It is especially concerning because those periods can coincide with the highest expected future loads after homes and cars are electrified. The amount of storage needed for those conditions is large but it won't be used much. In order to help meet these requirements a generating type called Dispatchable Emission-Free Resource (DEFR) has been identified. Finally, Kilty pointed out that the seasonal variation of wind and solar requires either a large overbuilding of generation or massive long-term storage, or some hybrid in between. Long-term storage is another technology that does not exist.

At a recent NYISO meeting, three DEFR build types were addressed:

- Low Capital, High Operating – needed to handle the short-term fluctuations of renewable output.
- Medium Capital, Medium Operating – needed for the daily generation vs. solar load capacity problem
- High Capital, Low Operating – needed to supply power over the multi-day low renewable resource

I assume that the low capital, high operating DEFR build type are represented by the 3,000 MW mandate for energy storage systems in the Climate Act. At this time those energy storage systems typically provide four hours of energy. The medium capital, medium operating build type could use multiple batteries to provide longer periods of energy availability. It is possible that batteries that could provide 12-hour storage could be developed and used by 2040. The high capital, low operating DEFR is a problem. There is nothing currently available that meets the need for the large amount of energy needed for the multi-day renewable resource drought periods or the seasonal variation of wind and solar output. Importantly there are physical, economic, and technological constraints on any of the alternatives proposed as described by Kilty. Until such time that a commercially proven affordable resource is available for these requirements, there should be no decommissioning of existing systems.

In addition, there are other considerations for an electric grid that relies on as much wind and solar as expected in New York. Both resources are diffuse so additional transmission will be required. There are no technological issues associated with transmission but siting is always an issue that delays permitting and construction. Ancillary services refer to other things that are needed to keep the transmission system operating. Recall that all the generators on the massive grid are synchronized with each other. Spinning turbines in the existing system help provide that service but wind and solar electricity is asynchronous so another piece of equipment is needed to provide synchronous service. Kilty mentions that "One remedy is to add "synchronous condensers" into a renewables grid to act as an analog to the rotating turbomachinery of thermal plants". That adds another layer of complexity and cost. When someone says that wind or solar are cheaper than fossil-fired generators they are not including all the energy storage and ancillary services necessary to get power to where it is needed when it is needed. When those costs are included wind and solar are not, and probably never will, be cheaper than fossil fuels.

New York system reliability standards are very high because we have had problems in the past. After every blackout, improvements were made to prevent re-occurrence. There is a continuing process in place to maintain and refine reliability standards. However, in my opinion, the shift from dispatchable resources to intermittent resources introduces so many new variables that I fear some set of unanticipated situations will cause a blackout.

According to a Gothamist summary of the Climate Act: "Seggos, the DEC commissioner, said the draft plan is meant to generate a framework and solicit input on how the state can meet its climate goals, not provide a policy-by-policy cost estimate." With all due respect to the commissioner, I believe it is inappropriate to rely on a "framework" to claim that renewable energy resources can provide adequate and reliable electric service affordably. The reality is that the integration analysis does not provide enough detail to be considered a cost and technology feasibility study that guarantees that power will be available and affordable in the worst-case conditions.

On August 2, 2021, the New York State Energy Research and Development Authority (NYSERDA) held a Reliability Planning Speaker Session to describe New York's reliability issues to the advisory panels and Climate Action Council. Importantly, this briefing was held after the Power Generation Advisory Panel provided its recommendations for the Integration Analysis and there has been no indication that the findings were incorporated into the Integration Analysis. All the speakers but one made the point that today's renewable energy technology will not be adequate to maintain current reliability standards and that a "yet to be developed technology" will be needed. The NYISO and the New York State Reliability Council have reliability planning responsibilities. The Climate Action Council must reconcile the generating resource requirements defined by those organizations with the resource capacities proposed in the Draft Scoping Plan.

Documentation for the New York Emissions in Context Comments

Ultimately, New York's emissions and economy should be considered relative to other countries. Climate Act advocates frequently argue that New York needs to take action because our economy is large. The 2020 Gross State Product (GSP) ranks ninth if compared to the Gross Domestic Product (GDP) of countries in the world. However, when New York's GHG 2016 emissions are compared to emissions from other countries, New York ranks 35th. More importantly, a country's emissions divided by its GDP is a measure of GHG emission efficiency. New York ranks third in this category trailing only Switzerland and Sweden. We are already doing a good job.

There is no question that New York is rich but is not a major player in global GHG emissions. In fact, 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. In 1990 New York's share of global GHG emissions was 0.77% so the state's programs to reduce emissions have been working.

Despite the fact that the ostensible rationale for GHG emission reduction policies is to reduce global warming impacts, the Draft Scoping Plan continues an unbroken string for the State not reporting the effects of a policy proposal on global warming. The reason is simple. The change to global warming from eliminating New York GHG emissions is simply too small to be measured, much less have an effect on any of the purported damages of greenhouse gas emissions. I have calculated the expected impact on global warming as only 0.01°C by the year 2100 if New York's GHG emissions are eliminated.

It is also important to consider how New York GHG emissions relate to global emission increases. I found CO2 and GHG emissions data for the world's countries and consolidated the data in a spreadsheet. I found that on average global emissions are increasing by more than one half of one percent per year. New York's share of global GHG emissions is 0.45% in 2016 so this means that global annual increases in GHG emissions will displace all of our emissions in a year.

Documentation for the Conclusion Comments

In the verbal comments I presented I concluded that: "Anything we do will be displaced in a year, cost a lot of money and risk catastrophic blackouts. The plan must be revised to one based on technically achievable incremental steps that maintain current standards of affordability and reliability".
I have documented the futility, affordability and reliability issues above.

At the top of the list of changes that have to be made is to make the schedule contingent upon availability of DEFR and long-term energy storage technology that meets reliability and affordability criteria. The Climate Action Council should focus its efforts on developing those acceptability criteria instead of discussing specific components of the plan related to the personal interests and agendas of its members. In order to address reliability, the Council has to start listening to the organizations responsible for New York grid reliability. Thomas Sowell said "It is hard to imagine a more stupid or more dangerous way of making decisions than by putting those decisions in the hands of people who pay no price for being wrong". That is exactly what the Climate Action Council will be doing if they do not listen to the experts.

Biography

I am a retired air pollution meteorologist. I have bachelors and master's degrees in meteorology, was certified as consulting meteorologist, worked for EPA consulting firms for five years, and then worked in the electric generating business for over 40 years. In my time in the electric generation business, I analyzed energy and environmental regulations that could affect operations among other responsibilities.

In January 2017 I started a blog called Pragmatic Environmentalist of New York to address New York environmental issues from a practical and rational viewpoint. Pragmatic environmentalism is all about balancing the risks and benefits of both sides of issues. Last July I published the 300th article on the blog. Because New York's Climate Act is the major energy and environmental issue affecting the state I have published over 190 articles on it.

I prepared this comment because I think Climate Action Council and pubic understanding of the costs and benefits of the proposed action is needed to determine the value of this plan. Jim Shultz writes that "The plan is a true masterpiece in how to hide what is important under an avalanche of words designed to make people never want to read it". Unfortunately, it is worse. My evaluation shows that the cost-benefit analysis itself was developed to support the idea that the benefits of the Climate Act are greater than the costs. In order to do that the Draft Scoping Plan inaccurately applies the social cost of carbon metric and misleadingly accounts for implementation costs and benefits.

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. I have summarized my analyses for non-technical readers at Citizens Guide to the Climate Act. 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