Caiazza Personal Comment Electric Vehicles

Summary
I prepared this comment because I found that the Integration Analysis is simply making assumptions about future zero-emissions transportation implementation strategies without providing adequate referenced documentation. There are numerous recommendations for additional documentation in these comments so that New Yorkers can understand what will be expected and how much it will cost.

The Integration Analysis projections for electric vehicle costs start in 2020. The observed data is not consistent with the projections. The final Scoping Plan should address those discrepancies. In addition, it may also be necessary to revise the Integration Analysis.

As far as I can tell, the electric vehicle costs are based entirely on new vehicle sales. There is no acknowledgement that the used car market will likely change because of the cost of battery replacement. Sellers will likely get less relative to new cars in the battery electric vehicle market. Buyers may get a relative deal but will lose in the end when the batteries have to be replaced.

A common theme in the Draft Scoping Plan is that any doubts that the public has about any aspect of the net-zero transition can be simply addressed by convincing them with appropriate information. This is also evident in the zero-emissions vehicle presentation. The problem is that the draft Scoping Plan only tells one-side of the story instead of presenting all the issues and making a case for their preferred approach. Simply put, that is propaganda and it has no place in the Scoping Plan.

There is no bigger disconnect between the ZEV proposed strategy and reality than the ZEV charging infrastructure requirements. The biggest problem is that millions of cars will have to rely on chargers that cannot be dedicated for the owner's personal use because the owners park on the street or in parking lot. In order to provide a credible ZEV strategy, the final Scoping Plan has to describe a plan how this could possibly work. It is not enough to simply say it will work.

There is another disconnect between the public and the Climate Action Council when it comes to grid-interactive assets. This refers to using electric vehicle batteries as storage for the grid at times when the grid needs the power. I cannot imagine widespread public acceptance when told that their vehicles will be grid-interactive assets and that means that they will lose control of their vehicle's range because someone, somewhere decides that the power they have stored in their car for their use is needed somewhere else.

The Draft Scoping Plan assumes without documented analysis that zero-emissions trucks will be viable alternatives to current equipment. Moreover, there is no recognition that the trucking industry is nation-wide. If the proposed zero-emissions technologies costs are cheaper and don't impose marked changes to operations then everyone will convert because it is a better solution. However, if it is not a better, cheaper solution that drives adoption of zero-emissions vehicles everywhere what is the plan for out-of-state vehicles? I cannot imagine that trucks will have to meet New York registration requirements if they are just passing through the state. If deliveries to New York must use zero-emissions vehicles that would mean swapping the motive power and that would markedly increase

costs. Because of its importance to the viability of the Integration Analysis the final Scoping Plan should account for these issues.

My comments analyzed the Integration Analysis spreadsheet documentation. The analysis presumes an unprecedented adoption rate for light-duty electric vehicles but provides no reason why this is possible. The biggest problem in the analysis is that the device costs for zero-emissions charging technology and the vehicles themselves is presumed to decrease significantly over time. Home EV chargers and battery electric vehicles both are claimed to go down 18% between 2020 and 2030. The overall cost decreases are so large that the total costs for the zero-emissions vehicles adoption is cheaper than using existing technology. I cannot accept this optimistic assessment of future cost reductions without documentation that addresses at least the potential for battery supply chain issues.

There are many specific issues with zero-emissions vehicles that are not addressed in the Draft Scoping Plan. As the United Kingdom implements their own EV mandates electric system upgrade costs have become obvious. California is leading New York in EV adoption but there are warning signs that implementation is not working out as expected. None of the apparent unintended consequences are addressed. Safety issues related to fires are becoming an issue but the Draft Scoping Plan does not recognize the issue.

Introduction

One of the biggest short-comings of the Draft Scoping Plan is that only one side of the issues associated with the Climate Act net-zero transition are presented. Deliberately only presenting certain information is propaganda and that has no place in the Draft Scoping Plan. Propaganda is defined as material disseminated by the advocates of a doctrine or cause. There are many propaganda techniques including "card stacking". This technique is common in the Draft Scoping Plan:

> It involves the deliberate omission of certain facts to fool the target audience. The term card stacking originates from gambling and occurs when players try to stack decks in their favor. A similar ideology is used by companies to make their products appear better than they actually are.

These comments highlight issues with electric vehicles that are not addressed in the Draft Scoping Plan and should be included in the final Scoping Plan. I will highlight feasibility issues that must be addressed in the final Scoping Plan.

Zero Emission Vehicle Strategies

In Section 11.2, page 101 in the Draft Scoping Plan, two zero-emission vehicle (ZEV) strategies are listed under the theme "Transitioning to ZEVs and Equipment": light-duty ZEV adoption and adoption of zero-emission trucks, buses, and non-road equipment.

The introduction to this section gives a basic overview:

> Transitioning the transportation sector to zero-emission technologies is central to achieving the State's GHG emission reduction requirements. In most cases this means replacing existing vehicles that run on gasoline or diesel fuel with either battery electric, hydrogen fuel cell or future zero-emission propulsion technologies. Zero-emission vehicles and their related infrastructure present an economic development opportunity as well, offering a chance to build

> on New York's robust historical involvement in manufacturing and supplying vehicles and vehicle components. Other advanced clean fuels will play a role in decarbonizing hard-to-electrify segments of the transportation sector.

All of these items sound good in theory but in practice there are issues. The goal of the authors was to develop scenarios to meet the emissions targets. There was no consideration of feasibility despite the reliance on some technologies that are not available at commercial scale. The final Scoping Plan must include a feasibility analysis for these proposed strategies.

Light-Duty Zero Emission Vehicle Adoption

In order to meet the Climate Act targets, strategy T1. Light-Duty Zero Emission Vehicle Adoption states:

> There are approximately 9 million LDVs in New York, which make the emissions from LDVs the largest component of transportation emissions.155 Since 2010, sales of light-duty ZEVs have increased and in 2021 account for more than 3% of all LDV sales and about 1% of all LDVs on the road. Light-duty ZEVs have come down in price compared to their petroleum-fueled counterparts but are still comparatively more expensive; they are expected to reach price parity from a total cost of ownership perspective in the next two to four years and from a purchase price perspective later in the 2020s. Most light-duty ZEVs are expected to be battery electric, but hydrogen fuel cell vehicles are emerging into this market, primarily in California. A key challenge is that most of these vehicles are owned by individuals, who will each have to make their own purchase decisions if the State is to meet its Climate Act requirements and goals.

What is the basis of the claim that light-duty ZEVs "are expected to reach price parity from a total cost of ownership perspective in the next two to four years and from a purchase price perspective later in the 2020s"? It is not sufficient to make such a bold claim without referenced documentation. The cost estimates in the Integration Analysis Appendix 2 Key Drivers reflect this presumption and lead to the ludicrous claim that over the period from 2020 to 2050 that mitigation scenario costs will be lower by between $44 and $38 billion than the Reference Case.

Consider an alternate view of the current situation not reflected in the analysis:

> The average electric vehicle cost $65,977 as of March, compared to an average price of $45,927 across the entire industry, and a much lower price of $26,052 for a compact car, meaning going electric will cost a frugal family over 250% more than opting for a small car mainstay like a Toyota Corolla or Honda Civic. Even if you have the funds and are willing to spend them, *Politico* reported last weekend that most models are sold out until next year. Ford and Volkswagen both anticipate no new vehicles being available until 2023. Tesla's least expensive model won't be available until December, and Rivian, a new entry in the market, was forced to cut production in half this year due to supply chain issues.

The final Scoping Plan should prevent detailed evidence supporting its claims or change the Integration Analysis cost estimates.

The plan to implement the strategy is generally described as follows:

> Achieving the aggressive transition in this market will require a mix of regulations, incentives (which will require identifying new sources of funding), and removal of market barriers and depends on industry greatly accelerating the expansion of production capacity for these

vehicles. Incentives for EVs and charging stations are expected to be needed primarily over the next five to 10 years, as the market for ZEVs reaches maturity. Enhanced incentives for LMI consumers will help achieve the air quality benefits of these vehicles in Disadvantaged Communities. Incentives for hydrogen fuel cell vehicles may be needed for longer, as they are expected to take longer to enter the market in significant quantities.

The Draft Scoping Plan does a terrible job quantifying costs for the strategies proposed. What are the control measure cost components proposed and how much GHG emission reductions are expected from each? References should be provided that document the claim that incentives will only be needed for the next 5 to 10 years. The costs for the expected incentives needed should also be provided.

Six components of the Strategy are described in the text.

- **Adopt California's Advanced Clean Cars 2 Regulations**: California is currently developing the Advanced Clean Cars 2 regulations that are expected to require 100% light-duty ZEV sales by 2035. DEC should adopt these regulations once they are finalized in California. California is also pushing to electrify for-hire vehicles through a clean-miles standard, which the State could also adopt or take other approaches to electrifying these vehicles, such as providing targeted incentives for fleet ZEV purchases and charging/fueling stations.

No comment

The description of purchase incentives is a list of aspiratinal theories with no history of successful implementation.

- **Provide enhanced ZEV purchase incentives**: ZEVs are approaching price parity with petroleum-fueled vehicles and the price of battery EVs is expected to eventually fall below that of their petroleum equivalents. Offering strategic incentives will accelerate ZEV production, price parity, and purchases. New York should enact legislation to establish a "feebate" program that would offer direct rebates for ZEV purchases supported by imposing a fee on purchases of fossil fuel vehicles. The fee and rebate levels should be dynamic in response to market conditions and ambition levels. Such a program can be designed to be revenue-neutral and can incorporate other policy goals, such as higher rebates for LMI customers and exemptions from the fee for lower priced vehicles purchased largely by LMI consumers. Feebates should be applied to new car sales, but there should be an additional rebate for used ZEVs targeted toward LMI customers, which could be paired with affordable financing options. Although each scenario under consideration relies heavily on LDV electrification, the scenario that relies more heavily on expedited electrification will require the establishment of additional incentives to retire internal combustion vehicles early.

At the top of the list of my concerns is the emphasis on new car purchases. Why does the Draft Scoping Plan ignore the size of the used car market? Although the text acknowledges that there should be an additional rebate for used ZEVs for LMI households, there is no acknowledgement that there will always be a premium for used ZEVs because of the cost of battery replacement. How are used cars costs incorporated into the Draft Scoping Plan costs? The total ZEV costs should reflect the used car market in the final Scoping Plan.

A common theme in the Draft Scoping Plan is that any doubts that the public has about any aspect of the net-zero transition can be simply addressed by convincing them with appropriate information.

Funding consumer engagement activities to increase consumer interest fits right into that approach but in my personal situation I cannot imagine what additional information is going to be able to convince me that a BEV will fulfill my needs. Furthermore, I have no clue, why anyone would expect that direct-to-consumer sales will increase availability and sales. It seems to me that if this was a viable market then dealers would be entering the market to provide sales but that is inconsistent with this strategy.

- **Enhance ZEV awareness and reduce sales barriers:** New York should enact legislation to expand direct-to-consumer sales of ZEVs by manufacturers, which can serve to increase the availability and sales of ZEVs in the State; the State should provide dealer incentives for franchise car dealers to sell ZEVs; and NYSERDA should partner with industry participants and stakeholders to fund consumer engagement activities to increase consumer interest in ZEVs.

One example of current consumer engagement activities is a NYSERDA email titled "Considering an electric vehicle (EV)? Here are four reasons you should". It also is available in a weblink. The question for the final Scoping Plan is whether it is realistic to assume that this sort of engagement activity will actually make anyone change their mind.

> There's no denying that over the past several years the demand for electric vehicles (EV) has increased. In New York State, driving electric is a great opportunity for vehicle owners to make a positive environmental impact, lowering their carbon footprint while helping the State reach its ambitious clean energy and climate action goals.
>
> Transportation accounts for 42% of New York State's greenhouse gas emissions, meaning that every EV that replaces a gas-powered vehicle will help make a difference.
>
> Making the switch to an electric vehicle is a big decision. The more knowledge you have, the more informed your choices will be. If you're still on the fence about making the switch, here are four additional things to consider:
>
> 1: Electric vehicles will save you time and money.
> Compared to gasoline-powered cars, EVs are more energy efficient and cost about 50 to 70% less to operate per mile. EV motors don't need oil changes, you'll be making fewer visits for regular maintenance and repairs. And since your car will run on electricity, not gas, you won't need to make trips to the gas station.
>
> 2: Electric vehicles are clean, quiet, and fun to drive.
> There is no loud engine, but electric vehicles deliver fast acceleration and surprising pick up that make them exceptionally fun to drive. EVs also boast a variety of different technological advantages, including the ability to preheat your car without garage emissions, or to turn up the bass on your speakers without engine distortions.
>
> 3: There are tax credits and rebates available to help you purchase your EV.
> With an electric car charger provided by your vehicle's manufacturer, you can simply plug into a standard home outlet to charge your car. You can also upgrade your home to a Level 2 charger,

which requires an electrician to install but increases the speed of charging up to 10x compared to a standard outlet. And if you need to charge your EV while you're out and about, rest easy: there are thousands of available charging stations throughout the State that are easy to find through mobile apps and through the NYSERDA website.

4: There are tax credits and rebates that can be put toward purchasing an EV.
Use the Drive Clean Rebate to take up to $2,000 off the price of an electric car at the time of purchase. You can also combine that rebate with the existing federal tax credit for electric cars, which provides up to $7,500 for the purchase of a new electric car.

This is a good example of electric vehicle propaganda. I will address the propaganda in the components of the NYSERDA email below. My comments will rely heavily on Dr. Jay Lehr's excellent overview of the many reasons that electric vehicles will never replace the internal combustion engine.

NYSERDA claims that electric vehicles will save you time and money because they are "more energy efficient and cost about 50 to 70% less to operate per mile" than gasoline powered vehicles. This ignores the fact that electric vehicles are significantly more expensive than comparable internal combustion automobiles. There also are buried assumptions about the costs of electricity relative to gasoline that can be used to game the answers to provide this rationale. Another claim is that "since your car will run on electricity, not gas, you won't need to make trips to the gas station". What happens when you want to take a trip that exceeds the battery range is ignored. A gasoline powered car can re-fuel in a matter of minutes whereas an electric vehicle charger takes hours if you can find a charging station that is not being used. Lehr also points out that the cost of battery replacement and lack of a used car market should also be considered when comparing costs.

Electric vehicle proponents love to claim that they are clean, quiet, and fun to drive. Although electric vehicles have lower emissions the life-cycle emissions and supply chain implications of the batteries also need to considered for this claim. NYSERDA claims that "electric vehicles deliver fast acceleration and surprising pick up that make them exceptionally fun to drive". Reality is that most people use their vehicles as a tool and having fun is a low priority. The email goes on to claim that they "boast a variety of different technological advantages, including the ability to preheat your car without garage emissions, or to turn up the bass on your speakers without engine distortions". The first claim about garage emissions suggests this was written by someone who has a garage. Based on my neighborhood more than half the cars are not stored in a garage in the winter. The final claim is absurd. Who in the world decides to buy a car based on being able to turn up their bass speakers?

One of reasons that electric vehicle ownership is more expensive is the desirability of a charging system that can provide a full charge in a short time. The third component notes that you can choose between the electric car charger provided by your vehicle's manufacturer that uses a standard home outlet to or upgrade your home to a Level 2 charger, "which requires an electrician to install but increases the speed of charging up to 10x compared to a standard outlet". Another notable observation in my neighborhood is the number of vehicles per home. Most have at least two and anyone with adult children living at home has more. Of course, the concern about where to charge at home in my suburb pales in comparison to any city where car owners have to park on the street. NYSERDA goes on to claim that "if

you need to charge your EV while you're out and about, rest easy: there are thousands of available charging stations throughout the State that are easy to find through mobile apps and through the NYSERDA website". I believe it is fair to say that European electric vehicle implementation is ahead of New York so the "horror trip" of a retired German couple who needed 26 hours to make a 765 Km or 475 mile trip in an electric vehicle makes me leery of this NYSERDA claim.

Finally, NYSERDA notes that you can use the Drive Clean Rebate to take "up to $2,000 off the price of an electric car at the time of purchase" and that you can also combine that rebate with the existing federal tax credit for electric cars, which provides up to $7,500 for the purchase of a new electric car. There are around 9.4 million light-duty vehicles registered in New York. If every one of those vehicles were to be replaced, this subsidy it would cost $18.9 billion so I have to wonder if this money will be available for everyone. In order to provide New Yorkers with the complete story of vehicle electrification these issues should be addressed in the final Scoping Plan.

There is no bigger disconnect between the ZEV proposed strategy and reality than the ZEV charging infrastructure requirements. According to the most recent New York vehicle registration information there are a total of 11,100,413 motor vehicles registered in the state. The final Scoping Plan has to answer the question how many of these will have to be charged on the street or in parking lots. In New York City there are over 2 million vehicles and I guess the majority park on the street. My point is that millions of cars will have to rely on chargers that cannot be dedicated for the owner's personal use. In order to provide a credible ZEV strategy, the final Scoping Plan has to describe a plan how this could possibly work. It is not enough to simply say it will work.

- **Invest in and remove barriers for ZEV charging and fueling infrastructure**: To support the level of ZEV adoption anticipated by 2030, New York must quickly increase the number of EV charging stations and hydrogen filling stations in the State. New York should fund rebates or investment in EV charging stations and hydrogen filling stations, either directly through programs run by NYSERDA and/or NYPA or through market-based mechanisms like a clean fuel standard that would generate resources for ZEV infrastructure. All financing and ownership models should be considered. As part of the State's focus on investments in Disadvantaged Communities, programs in this area should focus on charging at multi-unit dwellings and convenient urban fast charging, especially in areas with less access to home charging, Strategies should also prioritize fast charging along travel corridors and support, and market segments that have been slow to attract private investment, including hydrogen fueling stations for appropriate applications. DOS should incorporate EV charging into building codes to ensure new construction is EV-ready.

I have no comments on the utility rate design changes proposed. However, there is another disconnect between the public and the Climate Action Council when it comes to grid-interactive assets. I cannot imagine public acceptance when told that grid-interactive assets and storage devices means that they will lose control of their vehicle's range because someone, somewhere decides that the power they have stored for their use is needed somewhere else. How will the final Scoping Plan explain this concept and its ramifications?

- **Enact utility rate design changes:** The PSC should direct utilities, as appropriate, to implement programs that offer lower rates for or otherwise encourage off-peak charging

and/or controlled, managed charging. The PSC should further examine the effectiveness of its per plug incentive program to determine if it offers sufficient opportunities to reduce operating costs that support the near-term build-out of public and fleet charging infrastructure to make this type of charging more cost effective when utilization is low or whether a change should be considered in the structure of demand chargers that is cost-based and nondiscriminatory. The PSC and NYSERDA should also consider how to maximize the value of ZEVs as grid-interactive assets and storage devices, which could potentially lower electric grid upgrade costs and generate revenue for ZEV owners, and whether any policy changes are required to enable these use cases. These changes will be relevant to both LDVs and MHD vehicles.

It is very easy for the State to announce that the state vehicle fleet will be fully zero emissions. However, the reality is that it might not be appropriate for the state police or forest rangers to convert to vehicles with range and re-fueling limitations. What feasibility criteria for public safety vehicles have to be established before this can be implemented will be included in the final Scoping Plan?

- **State fleet:** Procurement targets, with appropriate funding allocated, should be established to operationalize the State's announced November 2021 commitment to a fully zero emission State fleet of passenger vehicles by 2035. DEC should continue supporting municipal ZEV acquisition by providing rebates under the Climate Smart Communities program.

Adoption of Zero-Emission Trucks, Buses, and Non-Road Equipment

In order to meet Climate Act targets strategy T2. adoption of zero-emission trucks, buses, and non-road equipment the text states:

> Converting New York's trucks, buses, and non-road equipment (including construction and farm equipment) to zero-emissions technologies plays a dual role of both reducing GHG emissions from a major source and reducing local air pollution from one of the most significant sources of poor air quality and adverse health impacts. Trucks and buses and non-road equipment are just starting to transition from diesel fuel to electricity as more options become available, but electric trucks, buses, and equipment are still much more expensive than their diesel counterparts. The transition to ZEVs for this subsector will entail a mix of battery electric and hydrogen fuel cell vehicles, which are just beginning to emerge into the market. Achieving the aggressive transition in this market will require a mix of regulations, incentives (which will require identifying new sources of funding), and removal of market barriers and depends on industry greatly accelerating the expansion of production capacity for these vehicles. Incentives for EVs and charging stations are expected to be needed primarily over the next 10 to 15 years, as the market for ZEVs reaches maturity. Incentives for hydrogen fuel cell vehicles may be needed for longer, as they are expected to take longer to enter the market in significant quantities.

The text states that the "transition to ZEVs for this subsector will entail a mix of battery electric and hydrogen fuel cell vehicles" but admits the technologies are "just beginning to emerge into the market". The Draft Scoping Plan presumes that implementation is just a matter of political will. The text says "Achieving the aggressive transition in this market will require a mix of regulations, incentives (which will require identifying new sources of funding), and removal of market barriers and depends on

industry greatly accelerating the expansion of production capacity for these vehicles". The final Scoping Plan must include a feasibility analysis to prove that these strategies are viable.

The Draft Scoping Plan assumes without documented analysis that zero-emissions trucks will be viable alternatives to current equipment. It is crucial that the final Scoping Plan explain how this is supposed to happen in enough detail for New Yorkers to determine themselves whether this is feasible.
In addition, there is no recognition in the Draft that the trucking industry is nation-wide. If the proposed zero-emissions technologies costs are cheaper and don't impose marked changes to operations then everyone will convert because it is a better solution. However, if, for example, the range is shortened and the charging time is much longer than current re-fueling times, then the shipping times could increase so much that the operational limitations exceed the value of the allegedly cheaper truck. In that instance, then trucks not registered in New York will not be be zero-emissions vehicles so what is the plan? I cannot imagine that trucks will have to meet New York zero-emissions requirements if they are just passing through the state. Theoretically, there could be limitations on trucks that make deliveries to the state. Practically that would mean swapping the motive power and that would markedly increase costs. The Draft Scoping Plan does not address this nuance and the likely added costs. Because of its importance to the viability of the Integration Analysis the final Scoping Plan should account for all these issues.

The Climate Act mandates zero emissions using technology that does not exist. Because of this mandate the State ignores the potential to address the described air quality problems using existing technology (compressed natural gas vehicles) or hybrid technology that is much closer to widespread deployment. As a result, the problems identified in the following paragraph will be an issue for longer and may not be resolved.

> Diesel trucks and port equipment are one of the largest sources of local air pollution in Disadvantaged Communities. Although they comprise only a small portion of total vehicles in the State, diesel trucks and buses are responsible for 30% of total PM and NOX emissions from mobile sources. Replacing diesel trucks and port equipment with ZEV trucks and equipment would have a substantial impact on improving air quality statewide, especially in Disadvantaged Communities.

Five components are identified for this strategy in the Draft Scoping Plan.

- Adopt California's Advanced Clean Trucks regulations: In 2020 California promulgated the Advanced Clean Trucks regulations that require an increasing percentage of new zero-emission MHD truck sales annually through 2035. In September 2021, DEC proposed to adopt the Advanced Clean Trucks regulation under 6 NYCRR Parts 200 and 218.156 In accordance with the legislation signed by Governor Hochul, DEC should finalize the adoption of these regulations. DEC should also consider adopting additional regulations, such as California's proposed Advanced Clean Fleets regulation currently under development, that would provide a regulatory framework for 100% MHD ZEV sales by 2045 or earlier (e.g., Advanced Clean Fleets would require 100% MHD ZEV sales by 2040). These regulations could be targeted to the type of fleets operating in overburdened communities and, like California, exclude smaller fleets largely operated by small businesses. In accordance with the legislation signed by Governor Hochul cited above, DEC should consider regulatory

options, consistent with federal law, for requiring 100% ZEV sales for non-road vehicles by 2035.

Most of this text is simply wishful thinking. It says we hope that California's proposed Advanced Clean Fleets regulation currently under development might work. A bigger concern is that the non-road vehicles category includes farm vehicles. Has the Integration Analysis determined whether it is feasible to mandate farm vehicle electrification without extensive upgrades to rural electric distribution networks? Another question is how will non-road construction vehicles be charged when working away from the electric grid?

There is no apparent attempt to reconcile potential incentives to the amount of money needed:

- Provide enhanced ZEV purchase incentives: ZEV trucks, buses, and non-road vehicles are significantly more expensive than diesel equivalents today. While the cost of ownership is becoming more cost-competitive, targeted incentives will be needed to facilitate the transition to emerging ZEV technologies. The State should fund direct incentives supporting the purchase of ZEV trucks and buses, with a focus on fleets operating in LMI and overburdened communities, small fleets, and school buses, as well as non-road vehicles and equipment such as airport ground support equipment, port cargo handling equipment, construction, and farm equipment. The State should also provide incentives or offer buybacks for small engines, including electric yard and garden equipment and small marine vessels, and encourage local electrification requirements.

Since the publication of the Draft Scoping Plan Governor Hochul announced fiscal year 2023 investments in clean energy infrastructure, climate resiliency and preservation that included an electric school bus requirement. It is instructive to compare the generalities of this description advocating direct incentives for the purchase of electric school buses relative to reality. According to the press release:

> In order to improve air quality for school-age New Yorkers, the State Budget requires that all new school bus purchases be zero-emissions by 2027 and all school buses on the road be zero-emissions by 2035. The State Budget will provide $500 million through the Environmental Bond Act to support school districts in purchases of zero-emission buses and related charging infrastructure including charging stations. Additionally, the State Budget authorizes school districts to lease or finance zero-emission buses for 12 years, more than double the current five-year limitation for diesel buses, in order to help districts meet this goal, and ensures Transportation Aid is provided on zero-emission buses and related charging infrastructure.

I prepared an article describing an interview with a bus electrification expert and found a series of webinars on electric school buses put together by the Center for Transportation and the Environment (CTE). They are a "member-supported 501(c)(3) nonprofit organization that develops, promotes, and implements advanced transportation technologies, vehicles, and fuels that reduce environmental pollution and fossil fuel dependency". "In partnership with the U.S. Departments of Defense, Energy, Interior, and Transportation, the U.S. Armed Services, and NASA, among many others", CTE and its 89 member companies work together to improve transportation technologies and fuels while reducing their environmental impacts. Despite the fact that CTE's primary interest is foisting their "zero-

emission" transportation vision on us all, the webinars (Bus Technology, Charging Infrastructure, and Program Funding) are a useful overview of the technology needed for zero-emissions school buses.

Jeff Sweet is an engineer at the Niagara Frontier Transportation Authority (NFTA). His last task before retirement is to get the first electric buses and charging infrastructure operational for NFTA. He has a lot of experience making buses work for their customers and, importantly, working with Metro Rail light rail vehicles in the NFTA. Over the past couple of years, NFTA has begun the process to add battery-electric buses (BEB) to their fleet. The article was based on our talk about the challenges of bus electrification using the CTE webinar slides as a guide.

NFTA took the position that converting the 323 buses currently in operation to battery electric vehicles should not lower the bar. The BEBs need to achieve diesel bus efficiencies and standards of performance. The more I think about that approach the more I approve. Why should we have to accept lower performance standards especially given that New York's GHG emissions are lower than the average annual increase in global emissions over the last 30 years.

The first webinar includes a slide that explains why electric school buses are being considered now:

- Zero criteria emissions around vulnerable populations
- Quiet operation
- Lower Greenhouse Gas emissions
- Funding availability
- Lower fuel and maintenance costs
- Vehicle availability

There are issues with each of these points. Zero emissions at the point of release ignores the environmental impacts of the materials needed for battery technology. Most of the time quiet operation is an advantage but it also means pedestrians might not hear them coming. The decrease in GHG emissions when total life cycle emissions are compared is pretty small. Current funding availability only works when someone, somewhere else is paying the bill. The last two claims, lower costs and availability, are frequently pointed out by advocates. Sweet explained that electric buses don't have transmissions so that reduces maintenance. However, he noted that the lower day-to-day maintenance costs advantage can disappear when it comes time for battery replacement. Ultimately, when everything is considered, these advantages are not as big as they appear at first glance.

The bus technology CTE presentation includes a good overview description of electric vehicle batteries. A couple of good points were made. In a series of slides the limitations of the nameplate capacity were discussed. It turns out that buses won't move unless they have more than 5% charge, below 10% they have derated performance and that charging them over 90% reduces longevity. In other words, actual battery capacity is down 20% from the get go. In addition, there are many factors that cause batteries to age that also reduce performance. Among the factors are age since production; charging rates and number of cycles; discharging rates and number of cycles; high temperatures; cyclic depth of discharge; sitting at high state of charge; and sitting at low state of charge.

Sweet explained that those battery considerations are not the only things that school districts will have to plan for when they switch to electric buses. The specifications for buses must consider the duty cycle. It is not just range but also the bus route terrain. If the buses have routes with many hills that will affect battery use. Specifications must also consider how they will be used: how many stops, location and terrain are factors. Based on his experience NFTA is planning to use traction motors like the ones used in their trolley buses.

In order for this all to work the school districts must have specifications for the life and usage of their buses to have the batteries meet the duty cycle. Financing is another practical consideration. Sweet explained that given their high rate of use when a bus is leased there is no residual value of the bus at the end of the lease. On the other hand, car leases can have lower rates because the cars have residual value and can be sold at lease end. Ultimately, he thinks the leases will be a financing scheme for batteries.

The issue of charging is an important consideration for school districts. There are different kinds of chargers and there is a premium cost for faster charging. There also different types of charging connections. Cables are cheaper but pantograph chargers are more flexible. In addition, the power requirements must be considered. We agreed that most school district bus garages would need to upgrade their electric service to a higher capacity. For a large district getting sufficient power could mean upgrades not only to the service to the bus garage but the serving utility might also have to make changes to the electric distribution system. What does the Integration Analysis assume for these charging requirements?

My primary concern is how school bus electrification will affect New York's Climate Act implementation. In the second CTE set of slides there is a presentation titled "White Plains Electric School Bus Vehicle to Grid (V2G) Project" that describes a pilot study with Consolidated Edison. The utility's main concern is charging equipment. The presentation notes that it needs to meet bus needs, funding constraints, and "charge management platform compatibility". It goes on to explain that school buses will use a mix of AC and DC charging:

- AC, Level 2 (most, but not all school buses) Slower charging, up to 22kW, cheaper, smaller
- DC, Level 3 (becoming more common) Fast charging, 50-60kW typ., expensive, big, better vehicle to grid

The relevant Draft Scoping Plan question is how much money will be needed and how much is available in the Governor's announced plan. The presentation states that in New York State the plan is to cover up to $120K of the cost of a Type C school bus. A commentary advocating for more funding claims that there are 45,000 school buses in New York and that the Senate budget plan proposes $1 billion for school and transit bus electrification. The following table combines that information with the costs for school buses and the costs for charging infrastructure to estimate how much money will be needed. Depending on the types of chargers used there will be a funding shortfall of between $3 and $5 billion to replace 45,000 diesel school buses.

New York State School Bus Conversions

		NYS Funding Available
		CTE Webinar "Charging Infrastructure"
	45,000	Number of school buses
$	120,000	NYS will cover up to $120k of a Type C school bus.
$	1,000,000,000	Environmental bond act transit and school buses
$	6,400,000,000	State funding available
		School Bus Costs
		How much does a school bus cost
$	90,000	Diesel
$	98,000	Propane
$	120,000	CNG
$	290,000	Electric
		Delta Electric minus other fuel
$	200,000	Diesel
$	192,000	Propane
$	170,000	CNG
		CTE Webinar "Charging Infrastructure"
$	6,000	AC level 2 $5k to $7k
$	60,000	DC Level 3 $50K to $70K
		Cost to Upgrade over Different Bus Fuel Types
	45,000	Number of school buses
$	9,000,000,000	Diesel
$	8,640,000,000	Propane
$	7,650,000,000	CNG
		Cost for Charging Infrastruture
$	270,000,000	AC level 2 $5k to $7k
$	2,700,000,000	DC Level 3 $50K to $70K
		Total Upgrade Cost for Diesel Buses
$	9,270,000,000	AC level 2 $5k to $7k
$	11,700,000,000	DC Level 3 $50K to $70K
		Funding Shortfall for Diesel Bus Replacement
$	2,870,000,000	AC level 2 $5k to $7k
$	5,300,000,000	DC Level 3 $50K to $70K

The costs of electric buses are significantly higher than diesel buses and there is insufficient money available in Hochul's program to cover those higher costs. There is no documentation available in the Draft Scoping Plan to compare the Integration Analysis cost estimates with this analysis. As a result, the electric bus conversion is an unfunded mandate to New York schools of at least $3 billion. The final Scoping Plan should provide sufficient detailed information so that New Yorkers can compare costs themselves. Furthermore, Sweet's impression is that the manufacturers and many of the consultants don't have the practical experience necessary to keep school districts from avoiding potential pitfalls that will further increase costs. The final Scoping Plan should address the funding and incentive requirements as part of a feasibility analysis.

The strategy for the notes that the funding requirements should be established. I agree.

- State fleet: Procurement targets, with appropriate funding allocated, should be established to operationalize the State's November 2021 commitment to a zero-emission State fleet of medium and heavy-duty vehicles, where technically feasible, by 2040.

Setting standards for ZEV use for state contractors sounds like a Climate Action Council idea that was conjured up by a member of the Council who is long on ideology and short on technical expertise. Everything hinges on availability and cost. The following text throws in an availability caveat but who determines the threshold for availability? It also includes the idea that certain facilities will be limited to ZEVs by a certain date. Who chooses that date? This is another instance where a feasibility analysis should be a prerequisite for thresholds and deadlines that establishes affordability and reliability standards.

- Require ZEV equipment use for State contractors and at targeted facilities: To further encourage ZEV adoption, New York should enact legislation that establishes procurement and contracting rules to increase the percentage of zero-emission equipment and vehicles used for State-funded projects to be ZEVs (including contractors and subcontractors), based on production and availability, to align with New York's November 2021 commitment to converting 100% of public medium- and heavy-duty fleet (where technically feasible) to ZEVs by 2040. DEC should also adopt regulations similar to California's Advanced Clean Fleets proposal that require MHD trucks in use at, or accessing, certain types of facilities such as ports or intermodal railyards to be ZEVs by a set date. The date should be determined based on truck vocation, product, and related infrastructure availability.

I seriously doubt that the authors of the ZEV charging and fueling infrastructure understand the ramifications of these requirements on the trucking industry. As it stands now a truck can take 30 minutes to get enough fuel for well over a thousand miles of travel. Charging a battery truck will take much longer and get much less range. How has the Draft Scoping Plan incorporated the labor costs when travel times increase?

- Invest in ZEV charging or fueling infrastructure: Similar to LDV infrastructure, the State should provide rebates or direct investment in EV charging stations and hydrogen filling stations, where market support is needed. Preference for investments would be provided to fleets adversely impacting LMI communities that have been disproportionately burdened by the impacts of air pollution. DPS should continue to work with the utilities to plan for expected service levels needed to support the electrification of MHD fleets, especially in Disadvantaged Communities where such depots tend to cluster.

Integration Analysis spreadsheet IA-Tech-Supplement-Annex-2-Key-Drivers-Outputs
Electric Vehicles

The Annex 2: Key Drivers and Outputs Spreadsheet, Tab: Scenario Definitions table lists specific programs in the Reference Case. Table 1 extracts assumption data from that spreadsheet so that the Reference Case and mitigation scenarios can be compared.

Table 1 Transportation Sector Scenario Summary

Light duty vehicles transition to battery electric technology

Parameter	Year	Reference	Scenario 2	Scenario 3	Scenario 4
ZEV New Sales	2030	19%	90%	98%	98%
	2035	27%	100%	100%	100%
Early Retirements	2030			10%	10%
ZEV Stocks	2030	5%	21%	26%	26%
	2050	34%	95%	95%	95%

Medium and heavy-duty vehicles are slower to transition, and rely on a combination of battery electric and hydrogen fuel cell technologies

Parameter	Year	Reference	Scenario 2	Scenario 3	Scenario 4
MDV New Sales	2030	7%	40%	50%	50%
	2045	27%	100%	100%	100%
HDV New Sales	2030		DNR	40%	40%
	2045		DNR	100%	100%
BEV & HFCV Split	MDV	DNR	50/50	75/25	75/25
	HDV	DNR	25/75	50/50	50/50
ZEV MHDV stocks	2030	1%	7%	9%	9%
	2050	17%	76%	85%	85%

Reduction in vehicle miles travelled due to greater ambition in transit, transportation demand management, telework, mixed-use development, and complete streets policies drives emission reductions

Parameter	Year	Reference	Scenario 2	Scenario 3	Scenario 4
VMT Reduction	2035	DNR	6%	DNR	5%
	2050	DNR	6%	DNR	5%

Aviation

Parameter	Year	Reference	Scenario 2	Scenario 3	Scenario 4
Electric short-haul	2050	DNR	DNR	DNR	16%
Hydrogen aviation	2050	DNR	DNR	DNR	50%

Consider the light duty vehicle strategies. For all motor vehicle registrations in New York in May 2022 there are only 62,123 electric vehicles statewide. The Integration Analysis projects that there will be 138,156 light-duty electric vehicles in 2025 in the Reference case. Scenario 2 projects 257,718 LDEV in 2025 and both Scenarios 3 and 4 project 275,417. In order to reach those levels, there will have to be a significant increase in electric vehicle sales. The unprecedented buildout proposed in these Draft Scoping Plan scenarios has to be documented to be considered viable.

Although the primary emphasis of these comments is on electric vehicles the Aviation sector Scenario 4 strategies need to be called out. An article by aircraft Airbus notes some of the challenges to widespread aviation hydrogen adoption:

> Hydrogen is increasingly considered as one of the most promising zero-emission technologies for future aircraft. However, despite the fact that hydrogen has an energy-density-per-unit mass

that is three times higher than traditional jet fuel, a variety of challenges must be addressed before widespread adoption can happen.

From the technical side, aeronautical engineers will need to take the technologies developed in the automotive and space industries and make the technology compatible with commercial aircraft operations, notably by bringing the weight and cost down. One specific challenge is how to store hydrogen on board the aircraft. Today, liquid hydrogen storage is among the most promising options, while storing hydrogen as compressed gas poses challenges with current aircraft weight and volume requirements.

In addition, the aviation industry will need to achieve the same or better safety targets than what has been achieved with existing commercial aircraft. Indeed, extensive safety precautions are currently taken into account in the design and operation of today's kerosene-powered aircraft. This stringent approach has ensured the industry's consistent safety record throughout the years. Future hydrogen-propulsion systems will thus need to achieve equivalent or better safety levels before hydrogen-powered aircraft can take to the skies.

In my opinion the idea that a colorless, odorless, explosive gas that is difficult and energy intensive to store could support 50% of the aviation needs at anytime is unlikely. Importantly, widespread adoption will only occur if it is cost-effective and that seems extremely unlikely. If there isn't widespread adoption then where will New Yorkers fly?

EV Charging

The LDV charger cost comparison table extracts data from the IA-Tech-Supplement-Annex-2-Key-Drivers-Outputs spreadsheet related to charger systems. The Electric Vehicle Supply Equipment: Per-Vehicle Costs section at the top of the table lists cost directly from the Integration Analysis spreadsheet. In a previous article I found a reference bus charging infrastructure. The Center for Transportation and the Environment (CTE) Charging Infrastructure webinar listed costs between $5,000 and $7,000 for an AC level 2 charger and between $50,000 and $70,000 for a DC level 3 charger. There is an obvious disconnect between those numbers and the $24,000 value for 2020 in this table. More disturbing are the cost projections over time. The Integration Analysis projects a cost decrease of 18% for light duty vehicle battery chargers between 2020 and 2030, a 41% decrease between 2020 and 2040, and a 61% decrease between 2020 and 2050. The first ten years the price decreases by 18%, the second ten years the price decreases another 27% and the last ten years the price decreases another 34%. Sorry I am not buying this incredibly optimistic assessment of future cost reductions without documentation. The fact that the battery charging cost reductions are identical to the hydrogen fuel cell cost reductions suggests that some analyst simply made an assumption to get the emission reductions needed for the pre-conceived result.

The total costs of course reflect these optimistic charger costs. Assuming that every new car needs a new charger, I multiplied the number of new battery electric light duty vehicles by the charger cost. Relative to the Reference Case the projected costs of battery electric light duty vehicles are projected to

be $15 billion for Scenario 2 and $18.5 billion for Scenarios 3 and 4. Note that if the cost for chargers stays the same then the projected cost is $37 billion for Scenario 2 and $42 billion for Scenarios 3 and 4.

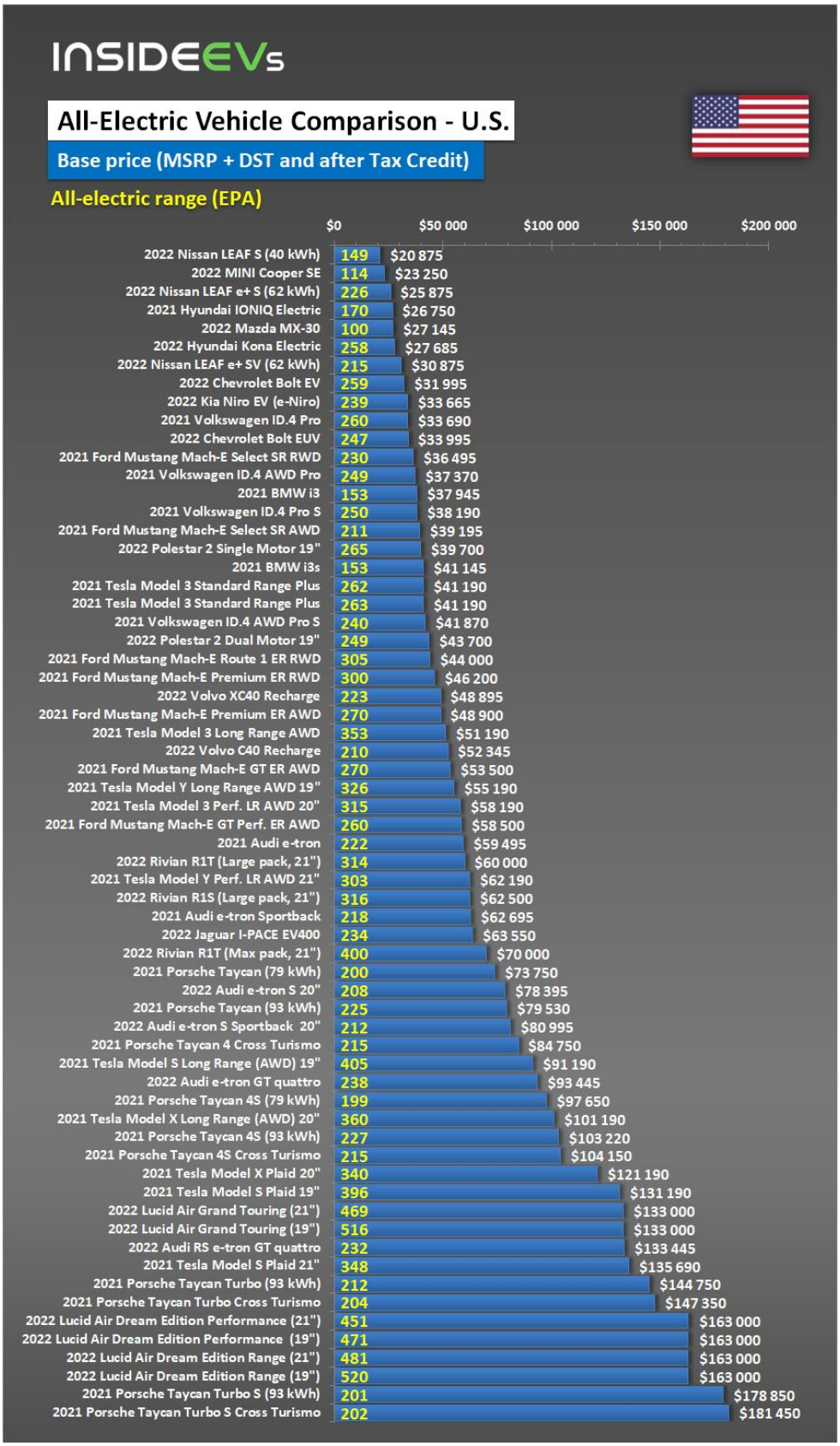
There is an associated issue that I could not address due to the poor documentation. The expected lifespan of an electric vehicle charging system is ten years. I don't know if the final costs in the Draft Scoping Plan incorporate the lifespan adjustment that is going to increase costs markedly. That adjustment means that the real charger cost has to account for all the cars in the New York fleet not just new ones. The final Scoping Plan should clarify whether those costs were included.

Light-Duty Vehicle Costs

The LDV Zero-Emission Vehicle Costs table extracts data from the IA-Tech-Supplement-Annex-2-Key-Drivers-Outputs spreadsheet related to the costs of light-duty vehicles themselves. The Transportation - Vehicle Cost by Technology: Reference Trajectory section at the top of the table lists cost directly from the Integration Analysis spreadsheet. Note the cost of zero-emissions battery electric $43,794 and hydrogen fuel cell vehicles $58,392. The following table from Inside EVs lists the costs of battery electric vehicles on September 18 2022. There are 63 car models listed and there are only 13 models less than the Integration Analysis estimate.

Similar to the car charging the cost projections over time are disturbing. The Integration Analysis projects a cost decrease of 35% for light duty battery electric vehicles between 2020 and 2030, a 42% decrease between 2020 and 2040, and a 44% decrease between 2020 and 2050. The first ten years the price decreases by 18%, the second ten years the price decreases another 11% and the last ten years the price decreases another 3.4%. Sorry I am not buying this optimistic assessment of future cost reductions without documentation.

I also calculated the total costs for vehicles over the period 2020 to 2050 in the LDV Zero-Emission Vehicle Costs table. The total cost for new vehicles in the Reference Case is $619.6 billion. Scenario 2, Strategic Use of Low-Carbon Fuels, total costs are $575.6 billion so the Draft Scoping Plan claims that converting to zero-emission vehicles will cost less than the Reference Case by $44 billion. The assumptions for Scenarios 3 and 4 must be identical because they both have a total cost of $581.8 billion or $37.8 billion less than the Reference Case. In those scenarios there are 6.4 million electric vehicles in 2050. The massive cost reductions projected for zero-emissions vehicles is most of the reason that converting to zero-emissions is cheaper. Note that the apparent difference between the scenarios is the use of hydrogen fuel cell vehicles in Scenario 2.



Source: https://insideevs.com/news/534027/electric-car-prices-us-20210918/

Another aspect that is not included in the Draft Scoping Plan battery electric costs is the cost of materials for batteries:

> For example, lithium is a primary component of modern batteries, but prices have risen a ridiculous 483% since last year and no one is expecting that number to decline anytime soon because we aren't mining nearly enough. Joe Lowry, the founder of Global Lithium explained it to Bloomberg this way, "you can build a battery factory in two years, but it takes up to a decade to bring on a lithium project. In a 2050 scenario, there's time for everything to happen that needs to happen. But in 2030, it just isn't going to happen. Just look at the mess we're in from a lithium supply standpoint with less than 10% EV penetration." Electric vehicles also require far more copper and nickel than traditional cars, but rather than approving new mines, the Biden Administration has been canceling them by declaring a 20 year ban on mining in Minnesota, where Chile-based Antofagasta had planned new operations for both metals.

Other Comments

It would be prudent for the Draft Scoping Plan to consider the results of similar programs in other jurisdictions. The economic and upgrades to the electric system costs for the United Kingdom needed to implement electric vehicles are enormous. Can the Scoping Plan provide any evidence that the experiences in other jurisdictions suggest that the Integration Analysis will work out as proposed?

Ronald Stein recently described California warning signs that should be considered in final Scoping Plan:

- The highly educated and financially well off are currently the primary owners of EV's.
- EV usage being slightly more than 5000 miles a year is a reflection that the EV is a second vehicle and not the family workhorse vehicle.
- The growing percentage of EV owners that are switching back to gasoline cars, is a message that may deflate EV growth projections.
- The larger and heavier gasoline driven SUVs are currently half of all the new car sales.

These warning signs suggest that the Integration Analysis presumptions need to be re-addressed.

The final Scoping Plan should address potential unintended consequences. The emphasis on battery electric vehicles over other technologies puts all our eggs in one basket. What about the ZEV downsides such as limited range, environmentally-damaging batteries and generally low energy efficiency? "Electrifying parts of our transportation system may result in incremental reductions in greenhouse gas emissions," Robert Bryce argues. "But a look at history, as well as an analysis of the supply-chain issues involved in manufacturing EVs, the resource intensity of batteries, and the increasingly fragile state of our electric grid – which is being destabilized by bad policy at the state and national levels – shows that a headlong drive to convert our transportation systems to run on 'green' electricity could cost taxpayers untold billions of dollars, increase greenhouse gas emissions, be bad for societal resilience, make the U.S. more dependent on commodity markets dominated by China, make us less able to respond to extreme weather events or attacks on our infrastructure, and impose regressive taxes on low and middle-income Americans in the form of higher electricity prices." The final Scoping Plan should address these caveats and explain why New Yorkers should not have to worry about them.

There also is a safety issue related to fires. Manufacturers have noted that EVs pose a fire risk and the General Motors recommendations for its Chevrolet Bolt electric vehicles do not inspire confidence. Also note that there are parking garages in Germany that will not allow electric vehicles because of the risk of

a fire that burns so hot that it cannot be extinguished before it does structural damage. How will these issues be addressed in the final Scoping Plan?

From a personal standpoint the transportation initiative does not mention recreational vehicles. Since my retirement I have traveled over 60,000 miles, visited 40 states and been on the road about 20% of the time with a motor coach. I don't see how that life-style will be possible in the net-zero world. Anyone who has driven I-95 in the winter has noticed a steady stream of campers headed south. Based on my experience many travel over 300 miles per day which I expect to be the limit of the battery electric technology. The batteries necessary for that operating range will undoubtedly reduce storage space which will not be popular. Finally, there are very few campgrounds that have any apparent surplus of electricity. Upgrading campgrounds is another hidden cost. How will this segment of the transportation sector be addressed in the final Scoping Plan?

I prepared this comment because I found that the Integration Analysis is simply making assumptions about future zero-emissions transportation implementation strategies without providing adequate referenced documentation. 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