

**ALTERNATIVE VEHICLES AND INFRASTRUCTURE REQUIREMENTS  
CONFERENCE**  
Final Report

Prepared for

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Contract Nos. 21146 / C-10-18

November 2011

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This report was funded in part through grant(s) from the Federal Highway Administration, United States Department of Transportation, under the State Planning and Research Program, Section 505 of Title 23, U.S. Code. The contents of this report do not necessarily reflect the official views or policy of the United States Department of Transportation, the Federal Highway Administration or the New York State Department of Transportation. This report does not constitute a standard, specification, regulation, product endorsement, or an endorsement of manufacturers.

## Technical Report Documentation Page

1. Report No.  C-10-18	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle  Alternative Vehicles and Infrastructure Requirements Conference	5. Report Date  November 2011		6. Performing Organization Code
	8. Performing Organization Report No.		
7. Author(s)  A. S. Mondschein and M. Lopez	9. Performing Organization Name and Address  Rudin Center for Transportation Policy and Management, New York University, 295 Lafayette Street, New York NY 10012		
12. Sponsoring Agency Name and Address  New York State Energy Research and Development Authority (NYSERDA), 17 Columbia Circle, Albany, NY 12203; New York State Department of Transportation (NYSDOT), 50 Wolf Road, Albany, NY 12232	10. Work Unit No.		11. Contract or Grant No.  NYSERDA 21146
	13. Type of Report and Period Covered  Final Report		14. Sponsoring Agency Code
	15. Supplementary Notes		
16. Abstract  A conference entitled "Alternative Fuel / Advanced Vehicles Technologies & Infrastructure Requirements: Bringing Innovation to Our Streets" was held in New York, NY at New York University on June 14, 2011. The conference addressed several of the key issues concerning the widespread adoption of low-carbon vehicles in New York state. Panel topics included (1) recent findings and developments in alternative fuels and vehicles, including electric, biofuel, natural gas, and advanced engine technology, (2) infrastructure needs for growth of a low-carbon transportation system, and (3) policy requirements. Panelists and attendees included academic researchers, representatives of the private sector, public agency staff, and advocacy group members. The information disseminated and ensuing discussion has helped build a community of individuals in New York State with the knowledge and motivation to increase adoption of low-carbon alternative vehicles and fuels by government, businesses, and the public. This report includes a summary of conference proceedings, as well as information on how to access a webcast of the event.			
17. Key Words  Alternative fuels, batteries, electric cars, sustainability, conference	18. Distribution Statement  No Restrictions		
19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages 10	22. Price
<b>Form DOT F 1700.7 (8-72)</b>			

## **ABSTRACT**

A conference entitled “Alternative Fuel / Advanced Vehicles Technologies & Infrastructure Requirements: Bringing Innovation to Our Streets” was held in New York, NY at New York University on June 14, 2011. The conference addressed several of the key issues concerning the widespread adoption of low-carbon vehicles in New York State. Panel topics included (1) recent findings and developments in alternative fuels and vehicles, including electric, biofuel, natural gas, and advanced engine technology, (2) infrastructure needs for growth of a low-carbon transportation system, and (3) policy requirements. Panelists and attendees included academic researchers, representatives of the private sector, public agency staff, and advocacy group members. The information disseminated and ensuing discussion has helped build a community of individuals in New York State with the knowledge and motivation to increase adoption of low-carbon alternative vehicles and fuels by government, businesses, and the public. This report includes a summary of conference proceedings, as well as information on how to access a webcast of the event.

## **ACKNOWLEDGEMENTS**

The members of the research team gratefully acknowledge sponsorship of this project by the New York State Energy Research and Development Authority (NYSERDA) and the New York State Department of Transportation (NYSDOT), under the direction of Joseph D. Tario of NYSEDA and John Zamurs of NYSDOT. We also acknowledge very generous support of Con Edison of New York for this conference.

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## INTRODUCTION

The Rudin Center for Transportation Policy and Management at New York University’s Robert F. Wagner Graduate School of Public Service was awarded a grant by the New York State Energy Research and Development Authority (NYSERDA) and the New York State Department of Transportation (NYSDOT) to develop and host a one day conference on low carbon, alternative-energy vehicles and the requirements for their use in New York State. In addition to support from NYSERDA and NYSDOT, funds for the conference were provided by Con Edison of New York.

The conference, entitled “Alternative Fuel / Advanced Vehicles Technologies & Infrastructure Requirements: Bringing Innovation to Our Streets,” was held on June 14, 2011 at the New York University Kimmel Center at 60 Washington Square South, New York, NY, from 8:30 am to 2:30 pm. A summary of the conference, including presenters, follows this introduction.

The following table lists the conference’s objectives and how they were accomplished.

<b>Conference Objectives</b>		
<i>Objective</i>		<i>Accomplishment</i>
Subject Matter	Low-carbon vehicle technology	The first panel of the conference addressed the latest research and information on fuels and vehicles. Presenters included Ann Schlenker (Argonne National Laboratory), Rich Kolodziej (Natural Gas Vehicles Association), Bruce Bunting (Oak Ridge National Laboratory), and Steve Weir (NYC Office of Fleet Administration).
	Provision of infrastructure to support widespread adoption of alternative vehicles	The second panel addressed infrastructure requirements for widespread adoption of alternative vehicles. Presenters included Caley Johnson (National Renewable Energy Laboratory), Stephen Schey (ECOTality North America), Brian Asparro (Green Charge Networks), and John Shipman (Con Edison).
	Policies	The third panel addressed how public officials and agencies might foster further adoption of low-carbon vehicles, technology, and infrastructure. The discussion included audience members, as well as panelists Richard Kassel (NRDC), Christina Ficicchia (Lower Hudson Valley Clean Cities Coalition), Ari Kahn (Mayor’s Office of Long Term Planning and Sustainability), and Rich Kolodziej (Natural Gas Vehicles Association).
Audience	Public agencies, private companies, researchers	The conference was attended by public officials, agency representatives, members of the transportation and planning community, industry and business leaders, and advocacy groups. In total approximately 150 individuals attended from across these groups.

The collection of expert panelists, combined with a large, diverse audience furthered the conference's fundamental goal of creating a community of individuals in New York State with the knowledge and motivation to increase adoption of low-carbon alternative vehicles and fuels by government, businesses, and the public.



## CONFERENCE SUMMARY

### **Welcoming Remarks**

*Mitchell Moss, Director, Rudin Center for Transportation, NYU Robert F. Wagner School of Public Service*

Professor Moss welcomed everyone to the conference. He emphasized the local, national, and global scales of the issues being addressed at the conference. He underscored the importance of future-focused transportation research, of which alternative and advanced vehicle technologies are a clear example. There are challenges in terms of the technologies, getting these vehicles to market, and getting consumers to purchase them. Professor Moss also thanked the sponsors of the event, Con Edison of New York, the New York State Energy Research and Development Authority, and the New York State Department of Transportation.

### **Keynote Address**

*Craig Ivey, President, Con Edison of New York*

Mr. Ivey placed new vehicle technologies in the context of their long history, including at Con Edison. We must learn to use new vehicle technology to save energy and protect the environment. The utility industry has a crucial role to play in new vehicle technologies. Recently, falling prices and improving technology have combined to make electric vehicles an attractive option for Americans. At Con Edison, more than 40% of their fleet is comprised of alternative fuel or advanced vehicles, reducing their greenhouse gas footprint. Demand for electric vehicles (EVs) will start slowly, but then increase rapidly. Con Edison is ready, and anticipating the challenges of charging vehicles on the existing grid. Vehicle fleets will likely be ahead of others in terms of adoption. Con Edison has been working with regulators to allow more flexibility in charging lower rates during off-peak hours. They are also working on new technology to enable vehicle owners to charge anywhere but pay for their electricity on single account.

### **Panel 1: Alternative Fuel Vehicle Technologies**

*Moderator: John Zamurs, Sustainability & Climate Change Section, Statewide Policy Bureau, NYSDOT*

New York State Department of Transportation (NYSDOT) has formed a new office of Sustainability and Climate Change, which handles alternative fuel policy. Close to 60% of NYSDOT's light duty fleet is already alternative-fueled. Still, that's not sufficient. The state is creating a new energy plan to further reduce reliance on petroleum via increased energy efficiency. The strategy also includes electrification of transportation sector, as well as increased adoption of alternative fuel vehicles.

*Ann M. Schlenker, Argonne National Laboratory*

The US Department of Energy (DOE) has ten national labs that do basic research, applied research, and engineering, in addition to deployment in the commercial sector. One of the key goals of DOE is to reduce greenhouse gases and energy use in the transportation sector, while

maintaining comparable performance to today. There are 240 million vehicles on road and roughly 11.5 million new vehicles come online each year. However, hybrid vehicles are only 3% of new vehicles, making current penetration of new technologies very minor. Yet, the reasons to adopt alternative vehicle technologies continue to coalesce, with major drivers being the foreign trade deficit, increasing greenhouse gases, and the need for energy security. Still, impediments to adoption include the fragile but recovering US auto industry, unpredictability in gas prices, new technology vehicle affordability, infrastructure readiness, reliability, and the need for government standards.

There is no “silver bullet” vehicle or fuel for every consumer. A plethora of technologies, whether advancements in internal combustion engines, hybrid-electric vehicles, plug-in hybrids, natural gas, battery-electric, or hydrogen fuel cells will be implemented. Every manufacturer has plans for an alternative fuel vehicle within some technology class. GM indicates an electric vehicle should cost about as much as a water heater in ongoing electricity costs. Still, there is a need to refine technologies and bring down costs through wider distribution. Research on batteries that improve upon the lithium-ion battery is ongoing, but there are significant challenges in terms of cost. Other technologies are coming on line, however. We are entering a decade of discovery for the vehicle and the grid. At least 50% of vehicle sales will be plug-in hybrids and EVs by 2050. Fuel cells are out on the roads today, and there has been a 30% reduction in costs. There is a four-year return on investment for plug-in hybrids, so there is some incentive to switch now. Battery technology and cost progress is the real enabler.

*Rich Kolodziej, Natural Gas Vehicles Association*

There is no one panacea to replace petroleum. There will be a plethora of options and fuels in different parts of the country. We’ll need to use them all. Petroleum vehicles themselves are getting more efficient and clean. How can we move to different fuels? Natural gas vehicles (NGVs) are an essential part of the broader move away from petroleum. Worldwide, there were 2.8 million NGVs in 2003 and 13.2 million today. All auto manufacturers are making NGVs. Much of the conversation on alternative fuels and vehicles focuses on light duty vehicles, but heavy duty diesel vehicles use a quarter of the petroleum in transportation, and there are few alternatives to diesel in the heavy truck sector. Eighteen-wheelers will not work with electric, due to their weight and range requirements. Natural gas is the best alternative to diesel for heavy trucks. Right now, there are only 250,000 NGVs in US. That’s a small number, but natural gas will emphasize the heavy duty market. Medium- and heavy-duty vehicles are Original Equipment Manufacturer (OEM) vehicles, rather than conversions. NGVs cost more because of their high-pressure, secured fuel tanks, but actual fuel costs and maintenance can be much lower, providing a good return on investment for fleets that adopt NGVs.

NGVs produce less of all the major pollutants, including 20% less greenhouse gases than diesel vehicles, well-to-wheels. Non-renewable natural gas is available in great supply, and estimates of supply keep increasing. NG fuel can also be made renewably from biomethane. Landfill gas can be used, thereby reducing greenhouse gas emissions from landfills by 90%.

*Bruce Bunting, Oak Ridge National Laboratory*

Dr. Bunting spoke about biofuels and advanced engine technologies. Oak Ridge Laboratory focuses on liquid fuels, infrastructure, and engines. Most of our biofuel in the US comes from corn, but there's a cap on corn-based ethanol, so we will need to replace corn starch ethanol production with cellulosic ethanol. While ethanol is a gasoline substitute, it currently cannot be transported through US pipelines. It could harm the existing infrastructure, corroding pipelines by bringing in water. However, ideally we could continue to use the existing petroleum infrastructure, both pipelines and refineries. Petroleum refineries have the most control over the quality and complexity of fuels. Unfortunately, biofuels can contaminate other fuels. Still, potential fixes are possible as demand for biofuels increase. Chemically making biofuels more resemble petroleum will help them be transported through the existing infrastructure. There are many technologies for creating biofuels. All have their challenges in terms of cost of the process or of the inputs. The simplest option is to supply a specific fuel to a specific consumer. Blending with petroleum-based fuels, as is already done, is another simple solution to overcoming some of the functional and supply problems with biofuels.

Dr. Bunting discussed advanced engine combustion technologies. There are many variations being tried, but all try to get the temperature and blending of fuel and oxygen just right for the cleanest, most complete combustion. By premixing and diluting the fuel, an engine can avoid the temperatures and blends that create either soot or nitrogen oxides. Advanced engines can balance inputs for a variety of fuels to optimize their combustion and their efficiency.

*Steve J. Weir, NYC Office of Fleet Administration, Department of Citywide Administrative Services*

The Office of Fleet Administration sees the use of alternative fuel vehicles as the right thing to do. Relying entirely on foreign petroleum is not a smart idea. Alternative fuels and vehicles are not as subject to cost fluctuations as gas and diesel. The City abides by Local Law 38, which required the purchase of the highest-rated vehicles "in terms of air quality" commercially available. The City also follows Local Law 55, which mandates the reduction of greenhouse gas emissions by 30% by 2030. The City is using electric, plug-in hybrid, CNG, and biodiesel vehicles, as well as right-sizing vehicles to job requirements. They have 4,000 alternative fuel vehicles today, including Chevy Volts. CNG is the fuel of the future for large vehicles. Mr. Weir said that he has not seen many problems in the operation of alternative fuel vehicles relative to traditional vehicles. Battery packs have been are robust, and CNG performance has been great. Still, the most reliable CNG vehicles are OEM, not retrofits. In terms of infrastructure, electric vehicles are problematic in that there are no charging stations on the streets.

## **Panel 2: Required Infrastructure Investments**

*Moderator: Rae Zimmerman, NYU Robert F. Wagner School of Public Service*

Prof. Zimmerman emphasized that alternative fuel vehicles are part of our national security objectives.

*Caley Johnson, Market Transformation Center, National Renewable Energy Laboratory*

The National Renewable Energy Laboratory works with multiple technologies to help displace petroleum in local economies. Mr. Johnson works to help groups decide which technologies are best for them. E85 (85% ethanol fuel) has been growing since its introduction, and will continue to grow. All of the gasoline in US is E10, so to increase ethanol usage, there will need to be more E85 vehicles. The natural gas infrastructure (in terms of NG stations) peaked in 1996 and decreased through 2006 before starting to grow again. However, while the number of CNG stations decreased, the overall volume of natural gas used for transportation has actually continued to increase. NGVs have refocused and are tied to vehicle fleets now. The primary driver for NGVs is that natural gas has a pretty reliable fuel savings per gallon. Also, natural gas is much more reliable in terms of cost fluctuations. It requires a larger up-front investment, but then that cost is paid for with fuel savings. The larger the CNG station, the quicker the payback will be. The more you compress the natural gas, the more expensive the station. Slow-fill (less compression) stations are fairly inexpensive, with fast-fill (highly compressed gas), and liquefied natural gas stations going up in cost. There are major advantages to clustering stations throughout an area. More and more CNG stations are open to the public, and there are advantages there, too. LNG is used in eighteen-wheelers with a range of over 500 miles. While these stations are at a much earlier stage of development, there will not need to be as many stations. Instead, stations can be spaced about 500 miles apart.

Methane wafts into the atmosphere, where it is 25 times worse than carbon dioxide in terms of its greenhouse effect. Thus, capturing methane from landfills, industrial farms, and wastewater treatment facilities can have a very positive impact on climate change. Right now, we are only capturing 2% of economically feasible methane from livestock operations. This methane can be used for vehicles, or for electricity generation.

Mr. Johnson concluded by emphasizing the importance of coordination among all of the industry and local groups focusing on alternative fuels and vehicles. Everyone can learn from the experiences, negative or positive, of a single group.

*Stephen Schey, ECOTality North America*

Mr. Schey focused on the electric vehicle (EV) infrastructure, and what ECOTality is doing to improve that infrastructure. They have been involved with every EV initiative since late 1980s. They test all types of alternative fuel vehicles but focus on electric vehicles. EVs are here already. There are multiple types of EV charging stations. They are designated as Levels 1 and 2 that deliver AC power to a vehicle, which then converts the AC to DC power, as well as DC fast-charging stations. The Chevy Volt and Nissan Leaf use a standard AC connector J1772, so one connector will fit all electric vehicles. Leaf also has a fast DC charge connector. Level 1 charging stations roughly provide enough energy for 3 miles of travel in 30 minutes. Level 2 charging stations are much faster charge, fully charging Nissan Leaf in 4 hours versus 20 hours at Level 1. A DC fast charger is better yet, taking just minutes to recharge a Leaf.

In terms of building the charging infrastructure, Level 2 chargers would make sense where people spend an hour or more. Charging is most likely to occur at first at home, second at work,

and then at places where people spend a relative long time, such as shopping centers. DC fast chargers should be built where people spend only short periods of time. Gas stations, convenience stores, and fast food stores are examples. Overall, we need to identify revenue sharing streams for the charging sites in order to encourage build-out. In 2009, DOE gave an award to ECOtality to do a charging infrastructure study. There are about 50 partners in the project. They will be installing about 14,000 Level 2 stations at homes and public facilities. In exchange for the charging station, ECOtality will collect and analyze information on usage. They are engaged in a planning effort to identify where chargers should go. It's important to look at the long range and make sure that 10 years from now, there will be infrastructure accessible to everyone and not just to today's high end users.

*Brian Asparro, Green Charge Networks*

Green Charge Networks focuses on systems, matching supply and demand. They started in 2007, based in Brooklyn. Green Charge is working with Con Edison on managing the grid as vehicle charging increases. One major area they are looking at is distributed energy storage. Lithium-ion batteries, located at charging stations, can be used to reduce strain on the grid. Right now, they are installing electric vehicle charging facilities at a variety of retail locations to assess potential issues. One of the key challenges is finding ways to conduct EV charging in a facility without creating electric congestion on the grid. Utilities need to understand where the problems and weak spots lie on the grid. Increased demand for EVs will only make the problems worse. The infrastructure is not cheap, and doing so before the demand comes means that companies and utilities have to consider future rewards. With battery-based energy storage at retail facilities, retailers can reduce overall energy costs with a return on investment in 3-5 years.

*John Shipman, Engineering & Planning, Con Edison*

Con Edison uses a 20% biodiesel blend for its entire heavy truck fleet. Mr. Shipman echoed that there is no silver bullet technology, and everyone must diversify their portfolio of vehicles by fuel and technology. Biodiesel has a low adoption cost, but the volatility of that fuel's cost, as a commodity, has become an issue. Still, diesel engines whether fueled with petroleum or biodiesel have improved tremendously in terms of pollution. CNG vehicles have come back after a contraction in the market when OEM stopped building CNG vehicles. The CNG infrastructure would have to be reinforced if everybody used it, but it will likely be only one component of the mix. Con Edison estimates there will be 100,000 to 150,000 EVs in New York area by 2020. They believe this will be manageable from a load perspective. That's less than 1/10 of 1% of total load. Their analysis indicated that only 2 to 6 percent of area substations would have to be upgraded to handle that load. Residential and local parking garage customers should be able to charge off peak. Those driving into the city may want to charge during peak hours, however. Fleets needing to constantly charge will also need more intensive load management. Still, Con Edison believes they can manage the peaks and make use of existing infrastructure to supply electricity for EVs.

### **Panel 3: Policies - Moving Towards Implementation**

*Moderator: Richard Kassel, Clean Vehicles Project, NRDC*

*Panelists:*

*Christina Ficicchia, Lower Hudson Valley Clean Cities Coalition*

*Ari Kahn, Electric Vehicles Program for the Mayor's Office of Long-Term Planning & Sustainability*

*Rich Kolodziej, Natural Gas Vehicles Association*

This session was a discussion among the panelists and audience on policies necessary for implementation of alternative fuels and vehicles to be successful. The following summary highlights key observations made during the discussion.

*Topic: Where Will Growth Occur?*

Christina Ficicchia: Even a couple of years ago, there were many barriers to fleet operators in terms of available technology. Those barriers are going away. On the CNG side, most of the heavy duty manufacturers have CNG options. Electric vehicle manufacturers are also starting to make medium- to heavy-vehicles available. Biodiesel is also making progress. People are testing and running all of the technologies. We also need to address the fact that battery technology needs to be coupled with other alternative fuels. Hybridized biofuel trucks are one such example.

Rich Kolodziej: Electric and natural gas vehicles are going to be the vehicle technologies that grow. They are less expensive to operate. Ethanol and biodiesel cost more for fuel, even though they are cheaper to start up. Unless ethanol and biodiesel can reduce costs, they will fall by the wayside. The subsidy for biodiesel is critical for people to use it. Trash trucks and buses are a fast growing market for CNG. Still, all these assumptions are based on gasoline vehicles staying the same as they are today, but they're going to continue to get more efficient and remain competitive.

Ari Kahn: The growth will be in the suburbs, where people have garages to charge. Indicators of potential EV adoption suggest that in New York City major adoption will begin in Downtown Brooklyn, Western Queens, and Manhattan. EV production has reached some maturity, but batteries are still incredibly expensive. We don't know whether EVs may just benefit from industrial process improvements, or a technological breakthrough in batteries will make them much more attractive.

*Topic: Policies for Implementation*

Ari Kahn: Most of the demand is from early adopters. We need to remove barriers to entry and improve education. We have to make sure people can have a charge in their garage at home or parking lot. The City can help with policies for off-peak charging, and getting second meters in home. There is the \$7,500 tax credit on electric vehicles, and a tax rebate for installation of EV infrastructure. Have they been effective enough? It's hard to say.

Rich Kolodziej: What can you do to make it more economically attractive? In other countries, the government sets the price of fuels. In Argentina, they make CNG 35% cheaper than gas, and therefore 15% of vehicles run on CNG. We encourage adoption with mandates, but they are a blunt policy instrument. Incentives are much better tools, and people can either choose to take advantage of them or not. We ought to tax gasoline and diesel more, and use those funds to support alternative fuels and technologies. Still, that's not going to happen in our political environment. Even the building of the Interstates had to be sold to Congress and the public, by putting it in a defense bill. We could change existing policies, though. For example, the Federal government pays 80% of transit bus costs. We could change the policy to 50% for diesel and 100% for CNG buses. That wouldn't change total cost of the subsidy, but it would change adoption rates for CNG buses. At the Ports of Los Angeles and Long Beach, they put a surcharge on cargo and use that to pay for alternative-fueled trucks. For airports, there is some funding for alternative-fueled tarmac vehicles, but that could be expanded to include hotel shuttles and other ground-based services.

Christina Ficicchia: The Federal government has to take some stance and create an overarching policy to move everyone towards adoption.

## CONFERENCE MATERIALS

In addition to the conference summary, a webcast of the event has been made available on the NYU Rudin Center website. This webcast consists of audio from the entire conference, in addition to all of the presentation slides from the conference. The webcast can be accessed under “Archived Events” at:

<http://wagner.nyu.edu/rudincenter/events/>