



University Transportation Research Center - Region 2

Final Report

Transportation Transformed: Advancing Eco-Friendly Mobility



Performing Organization: The City College of New York



August 2016



Sponsors:
New York State Energy Research and Development Authority (NYSERDA)
New York State Department of Transportation (NYSDOT)
University Transportation Research Center - Region 2

University Transportation Research Center - Region 2

The Region 2 University Transportation Research Center (UTRC) is one of ten original University Transportation Centers established in 1987 by the U.S. Congress. These Centers were established with the recognition that transportation plays a key role in the nation's economy and the quality of life of its citizens. University faculty members provide a critical link in resolving our national and regional transportation problems while training the professionals who address our transportation systems and their customers on a daily basis.

The UTRC was established in order to support research, education and the transfer of technology in the field of transportation. The theme of the Center is "Planning and Managing Regional Transportation Systems in a Changing World." Presently, under the direction of Dr. Camille Kamga, the UTRC represents USDOT Region II, including New York, New Jersey, Puerto Rico and the U.S. Virgin Islands. Functioning as a consortium of twelve major Universities throughout the region, UTRC is located at the CUNY Institute for Transportation Systems at The City College of New York, the lead institution of the consortium. The Center, through its consortium, an Agency-Industry Council and its Director and Staff, supports research, education, and technology transfer under its theme. UTRC's three main goals are:

Research

The research program objectives are (1) to develop a theme based transportation research program that is responsive to the needs of regional transportation organizations and stakeholders, and (2) to conduct that program in cooperation with the partners. The program includes both studies that are identified with research partners of projects targeted to the theme, and targeted, short-term projects. The program develops competitive proposals, which are evaluated to insure the most responsive UTRC team conducts the work. The research program is responsive to the UTRC theme: "Planning and Managing Regional Transportation Systems in a Changing World." The complex transportation system of transit and infrastructure, and the rapidly changing environment impacts the nation's largest city and metropolitan area. The New York/New Jersey Metropolitan has over 19 million people, 600,000 businesses and 9 million workers. The Region's intermodal and multimodal systems must serve all customers and stakeholders within the region and globally. Under the current grant, the new research projects and the ongoing research projects concentrate the program efforts on the categories of Transportation Systems Performance and Information Infrastructure to provide needed services to the New Jersey Department of Transportation, New York City Department of Transportation, New York Metropolitan Transportation Council, New York State Department of Transportation, and the New York State Energy and Research Development Authority and others, all while enhancing the center's theme.

Education and Workforce Development

The modern professional must combine the technical skills of engineering and planning with knowledge of economics, environmental science, management, finance, and law as well as negotiation skills, psychology and sociology. And, she/he must be computer literate, wired to the web, and knowledgeable about advances in information technology. UTRC's education and training efforts provide a multidisciplinary program of course work and experiential learning to train students and provide advanced training or retraining of practitioners to plan and manage regional transportation systems. UTRC must meet the need to educate the undergraduate and graduate student with a foundation of transportation fundamentals that allows for solving complex problems in a world much more dynamic than even a decade ago. Simultaneously, the demand for continuing education is growing – either because of professional license requirements or because the workplace demands it – and provides the opportunity to combine State of Practice education with tailored ways of delivering content.

Technology Transfer

UTRC's Technology Transfer Program goes beyond what might be considered "traditional" technology transfer activities. Its main objectives are (1) to increase the awareness and level of information concerning transportation issues facing Region 2; (2) to improve the knowledge base and approach to problem solving of the region's transportation workforce, from those operating the systems to those at the most senior level of managing the system; and by doing so, to improve the overall professional capability of the transportation workforce; (3) to stimulate discussion and debate concerning the integration of new technologies into our culture, our work and our transportation systems; (4) to provide the more traditional but extremely important job of disseminating research and project reports, studies, analysis and use of tools to the education, research and practicing community both nationally and internationally; and (5) to provide unbiased information and testimony to decision-makers concerning regional transportation issues consistent with the UTRC theme.

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Acknowledgements

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Thanks also to all of the speakers and moderators who volunteered to present during the conference and to the New York Institute of Technology for their support and generosity.

Background

UTRC responded to NYSDERDA PON 2881, **INSTITUTIONALIZING INTEGRATED SOLUTIONS SUPPORTING ACCESSIBLE MULTIMODAL TRANSPORTATION**, on May 29, 2014 as part of its mission to provide technology transfer and educate the public on new developments in the sector, particularly on topics pressing in our region. The PON category: was Education and Technology Transfer and the focus area was Active Transportation and Demand Management (ATDM).

UTRC received the award on September 5, 2014. The title of the proposal was *Implementing Eco-Driving in New York State: Opportunities and Challenges*.

The proposed format was a one day symposium to provide a forum to discuss all issues related to the eco-driving topic — what it is, new and developing applicable technologies, the benefits and associated challenges to implementing wide use of the technology and driving behavior.

The symposium was held on April 7, 2016 at the New York Institute of Technology in Manhattan. About 200 people were in attendance.

Introduction

The transportation sector is one of the largest sources of U.S. greenhouse gas (GHG) emissions. Between 1990 and 2013, GHG emissions in the transportation sector increased more in absolute terms than any other sector (i.e. electricity generation, industry, agriculture, residential, or commercial). ¹

But as awareness has increased regarding how our carbon footprint negatively impacts the environment, energy consumption, climate change, and our health, many innovations in transportation and other sectors have been or are being developed to help us perform better. In the transportation sector, adaptive signal control, which makes adjustments to traffic at stop lights based on traffic conditions; apps that provide directions based on current traffic flow and conditions and alternative fuel vehicles—are just some examples. It is now known that these existing technologies can be utilized to meet a variety of needs, including supporting eco-driving behavior. ² Research has demonstrated that strategies that can address individual behavior as well as assist driving behavior with technological

¹ <https://www3.epa.gov/otaq/climate/basicinfo.htm> - epa.gov

² UTRC NYSDERDA Pon 2881 Proposal: Implementing Eco-Driving in New York State

advancements such as V2V (vehicle to vehicle) and V2I (vehicle to infrastructure) technology, can reduce transportation-related emissions significantly.

Executive Summary/Planning for the Conference

We were aware of an earlier workshop on eco-driving that had been organized by UC Berkeley's Institute of Transportation Studies' Transportation Sustainability Research Center, UC Riverside's Center for Environmental Research and Technology, and the UC Davis Institute of Transportation Studies as part of the University of California Multi - Campus Research Program Initiative on Sustainable Transportation that had taken place on May 18, 2011 in Berkeley, California.³ Their event brought together experts to evaluate behavioral, technical, and policy issues associated with eco-driving.

As we began planning for the UTRC event, we envisioned a one-day symposium on the topic of eco-driving and thought about drawing upon some of the California expertise. We reached out to Karen Trappenberg Frick, Ph.D., (co-director of the University of California Transportation Center) to inquire about a possible partnership in sponsoring the event. Though this UTC did not ultimately co-sponsor the program, they were very helpful in recommending potential speakers and topic ideas for the UTRC event.

As we continued planning for the conference, however, several potential attendees called to our attention that they were interested in overall mobility that was eco-friendly, rather than on just a driving perspective. Therefore, in consultation with our co-sponsors NYSERDA and NYSDOT, we expanded the role of the conference and re-titled it *Transportation Transformed: Advancing Eco-friendly Mobility*. Though eco-driving does reduce GHG because the driving behavior maximizes fuel economy of existing cars while minimizing carbon emissions, eco- mobility encompasses a broader range of solutions. Eco-mobility includes environmentally-friendly travel options that are part of an integrated system. It often includes multi-modal solutions, car and bike sharing programs, active transportation demand management systems and enhanced V2V (vehicle to vehicle) and V2I (vehicle to infrastructure)communications technologies.

Because of the large environmental impact of the transportation sector, we felt that a good way to package a list of topics as varied as technological advances, academic research and findings, government programs, impacts on freight deliveries, behavioral influence, etc., would be to incorporate them under the umbrella of climate change and its impact on the global environment.

Through the assistance of members of WAFUNIF (World Association of Former United Nations Internes and Fellows) who UTRC staff were fortunate to meet when they reached

³ *Final Report of the Proceedings of the UC MRPI 2011 Eco-driving Workshop*, May 18, 2011, Berkeley, CA; Susan Shaheen, Ph.D., Matt Barth, Ph.D., Nelson Chan.

out to our center about a mutual interest in eco-driving, UTRC was able to secure Mr. Jamil Ahmad, Deputy Director of the United Nations Environmental Programme, New York City (UNEP), as our keynote speaker who focused on climate change as a complex challenge and noted that the way we handle the problem is a “test of human endurance.” He discussed our overextended ecological footprint, the extent of world poverty and the serious impacts of climate change on this population group; and that to encourage sustainable development — economic, developmental, and environmental dimensions must be integrated.

Mr. Ahmad also discussed the recent agreement developed at the COP21 meetings in Paris in December 2015, which included the development of the 2030 Agenda for Sustainable Development. He explained that the agenda was “guided by sustainable development goals (SDGs) [and] embraced all aspects of sustainable development: economic, social and environmental.” To be successful, he indicated that the “5Ps” must be considered: people, planet, prosperity, peace, and partnership. He also emphasized that the financing needed to realize the SDGs is substantial.

Gabe Pacyniak, the second keynote speaker, adjunct professor Georgetown Law School and Mitigation Program Manager of the Georgetown Climate Center (GCC), thanked Mr. Ahmad for helping to show the magnitude of the challenge ahead of us to achieve the Paris agreement’s goal of limiting global temperature increase to below 2° C, let alone the more ambitious target of 1.5° C. He explained that the Transportation and Climate Initiative, a group of 11 northeast and Mid-Atlantic States and the District of Columbia that GCC founded, works together to reduce energy use and GHG emissions from the transportation sector in the region. He acknowledged that the states have been leaders in this country in developing climate change initiatives and in informing federal policy. His talk focused on the states’ efforts in achieving a goal of 80% reduction from 2011 GHG emissions by 2050 and the challenges to do so.

Agenda:

After these keynote addresses, presentations were given on eco-mobility, grouped by five sessions.

The sessions were:

1. Technology for Eco-Mobility: concepts and unique approach for a TRANSNET project headed by NREL; Dash software, and autonomous taxis
2. Academic Research
3. Government Programs: City and State
4. Goods Movement and Eco-driving
5. Policy Session Panel

In addition, there was an afternoon keynote address given by Ray Martinez Administrator/Chairman, New Jersey Motor Vehicle Commission

The following chapters provide summaries of each of the speakers' presentations. More detail regarding these presentations can be found in the appendices to this report that include copies of the slide presentations that were shown at the event. The recordings of the complete symposium are available at:

https://www.youtube.com/channel/UCoLajZydhhuoONZRGzzfVQ?feature=em-share_playlist_user

Chapter 1: Welcome Remarks and Summaries of the AM Keynote Presentations

Speakers included:

Welcome Remarks, Camille Kamga, Ph.D., CCNY, Director UTRC

Mr. Jamil Ahmad, Deputy Director, UNEP, New York

Mr. Gabe Pacyniak, Adjunct Professor, Georgetown Law School and Mitigation Program Manager of the Georgetown Climate Center

Welcome Remarks: Dr. Camille Kamga, Ph.D., Director UTRC

After a brief hello and welcome was given on behalf of Dean Nada Anid of NYIT, welcoming the transportation community and expressing their pleasure at the opportunity to co-sponsor the event, Camille Kamga, Director of UTRC, gave welcome remarks.

He said that it was always a pleasure to come to NJIT and that UTRC always appreciated their hospitality. He also expressed appreciation to the agency sponsors, NYSERDA and NYSDOT and acknowledged their financial support.

Dr. Kamga referenced several innovations in technology that are helping the transportation sector to perform better such as transportation signal priorities, adaptive signal control, mobile apps and alternative vehicles. This technology can multi-task to help meet a variety of needs including eco-driving.

He explained that recent discussions have been about improvements in fuel usage and reductions in GHG from the transportation sector can be realized with better driving habits. The eco-friendly habits in conjunction with technology assistance can go a long way in reducing energy use, he said. He indicated that the conference would answer the question what eco-mobility was and identify some of the applicable technologies.

Dr. Kamga then acknowledged Elisabeth Lennon and Robert Ancar of NYSDOT for their role in the planning committee for this conference along with Joseph Tario of NYSERDA. He also gave thanks to Dr. Valdemar Prado and Lilliana Bucur from the United Nations World Association of Former Internes and Fellows, and Dr. Karen Frick of UC Berkeley for their extensive assistance in planning for the conference.

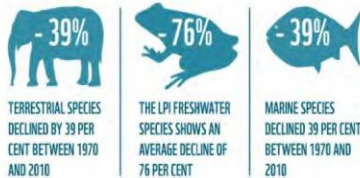
Lastly, of course, he thanked all of the speakers and moderators.

Mr. Jamil Ahmad, Deputy Director, UNEP, New York

“We are living in very challenging times. The challenges that we face are numerous, and complicated and complex. How we are going to handle these will be a test of our human endurance.” Mr. Jamil Ahmad began his talk on **Climate Change, Sustainability, and Eco-mobility** with these words, as he highlighted the “inextricable link between poverty and sustainable development” and the essential need to look at global environmental issues to meet the challenge that each person within our growing global population is entitled to “a life in dignity and promise of human well-being, while remaining within earth’s safe operating space.”

Mr. Ahmad continued by illustrating the situation with metrics—1.2 billion people out of the seven billion humans alive today are still living in extreme poverty on less than 1.25 cents per day and the ecological footprint of our combined lifestyle today uses a bio-capacity of 1.5 planets. He clearly emphasized that it will only be possible to successfully meet this very difficult challenge by pursuing solutions that integrate economic, social, and environmental dimensions of sustainability. He explained that the challenge is exasperated by currently observed changes, including unpredictable rises in global temperatures and sea levels, glacial melting, and ocean acidity, attributed to green-house gas emission increases. He listed additional human-induced changes such as extensive deforestation, land clearing for agriculture, urbanization as well as land degradation, “which all occur through the unsustainable use of human resources.” Moreover, efforts to slow the extent of change has only resulted in moderate success, he said, which have not reversed the adverse environmental impacts. He admonished that the human influence on climate is clear and that we “must decide whether to maintain business as normal or work together to improve the lives of people both in the developing and developed world.”

Current global environmental challenges



- **Earth system** provides basis for human societies and their economies
- Current **ecological footprint of 7 billion** already uses bio-capacity of 1.5 Earths
- All the while 1.2 billion live in extreme poverty
- The **great human challenge**: provide all with a life in dignity within Earth's safe operating space
- **Need for sustainable development**: integrating the economic, social and environmental
- **Changes to Earth system unprecedented**: climate change, land use changes and degradation, biodiversity loss

3

Mr. Ahmad also discussed the climate change agreement in Paris in December 2015 which “recognized the need to strengthen the global response to the threat of climate change through sustainable development and efforts to eliminate poverty. [A key point of the agreement was to] “Hold the increase in the global average temperature to below 2 °C from pre-industrial levels and pursue an even lower increase of only 1.5 °C.”⁴ The world needs to raise its level of ambition to meet and combat climate change, he said.

In addition to the Paris agreement, Mr. Ahmad discussed the 2030 Agenda for Sustainable Development that was adopted at the United Nations Sustainable Development Summit on September 25, 2015 in New York City. He said that the countries “adopted a universal, transformative, and integrated blueprint for development over the next 15 years.” A set of 17 Sustainable Development Goals (<http://www.un.org/sustainabledevelopment/sustainable-development-goals/>) is part of the agenda which integrates social, economic and environmental dimensions. “Choosing between development and sustainability is a false choice,” he said.

He continued that to reach the goal of carbon neutral and sustainable development, we must transform economies and societies. One instrument to do this is to promote the shift

⁴ http://unfccc.int/files/meetings/paris_nov_2015/application/pdf/paris_agreement_english.pdf

to a green economy. This is growth in income and employment driven by public and private investments that reduce pollution and carbon emissions, improves human well-being, social equity, while also reducing environmental risks and economic scarcities.

Mr. Ahmad also spoke about what this all means for transportation, a large contributor to Greenhouse Gas Emissions.

Mr. Ahmad concluded with a positive “We are moving in the right direction and all of us have a role to play. “ A major challenge, he pointed out though, is how to fund the new agenda.

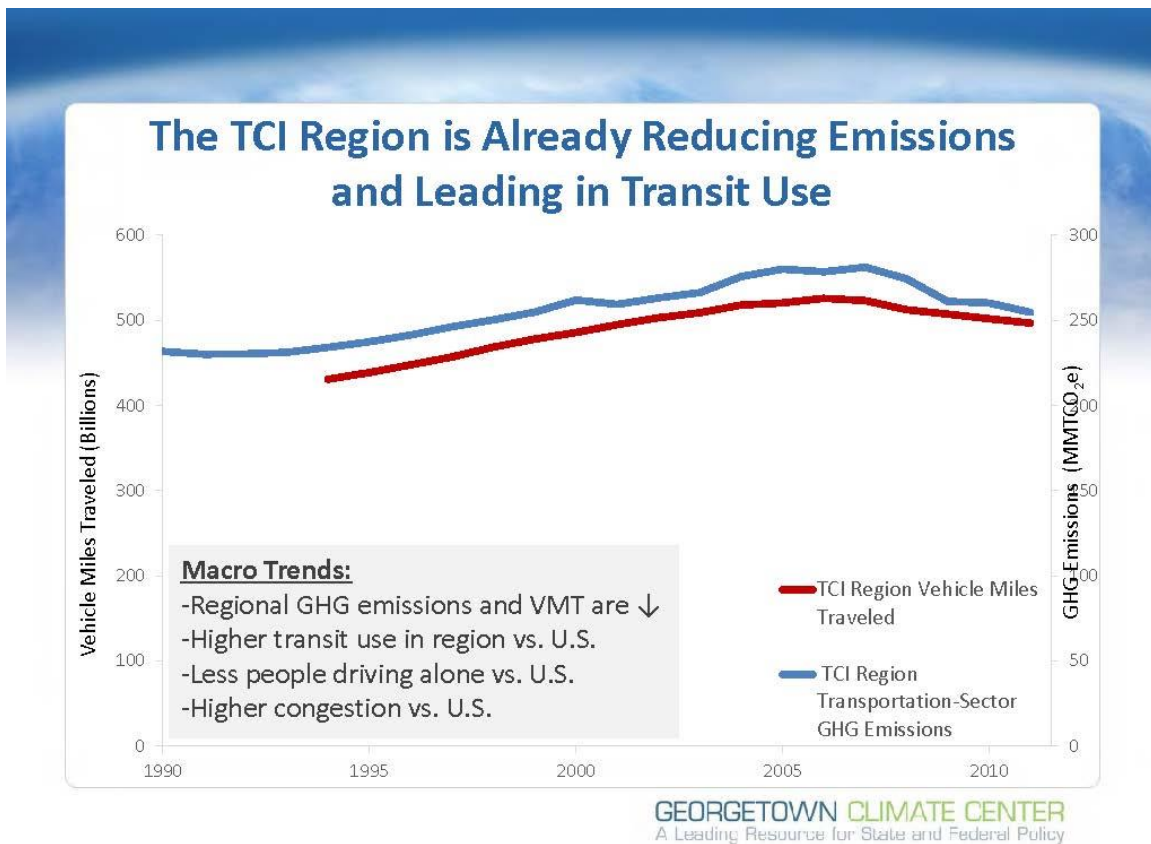
Mr. Gabe Pacyniak, Adjunct Professor, Georgetown Law School and Mitigation Program Manager of the Georgetown Climate Center (GCC)

After thanking Mr. Ahmad for pointing out the magnitude of the challenge ahead, Gabe began his presentation on ***Reducing GHG Emissions in Transportation and the Role of Eco-Mobility*** by noting that serious challenges also exist regarding transportation policy in the US, and specifically, for state policymakers. He indicated that since GCC was founded six years ago, two of the Center’s directors, who had been environmental heads at the state level, had become EPA administrators. In their federal positions, they were able to inform federal policy with lessons learned at the state level. In NY, specifically, Gabe pointed out that Governor Cuomo has been a strong leader, implementing a GHG reduction target of 40% by 2030. Though originally started to achieve discrete tasks such as launching the Northeast electrical vehicle program, TCI is now looking at a larger picture-- what the region can do as a whole to reduce emissions from the transportation sector and energy use. TCI is a collaboration of state transportation, energy, and environmental agency heads.

Mr. Pacyniak reiterated Mr. Ahmad’s point that the countries’ pledges for GHG reduction is not sufficient to reach the limit of a 2 C increase in global temperature, let alone the more ambitious and safer 1.5 C target. However, he believed it established a framework that the world can use to over time build up the level of ambition so that we can meet the targets. The essential mechanism to reach these targets is nationally determined contributions-- goals countries set for what they believe that can achieve. He stated that the US set a 17 percent reduction by 2020 from 2005 levels and a 26-28 percent reduction by 2025. The US also referenced a pledge made in Copenhagen a few years ago, that it wanted an 80 percent reduction by 2050, the target most people believe is needed to meet the 2 C. goal for global warming.

Mr. Pacyniak pointed out that the states have made their own target goals as well. Both the US and TCI states have set economy-wide GHG reduction goals. Most of the states have

long-term goals to 2050, and all converge to 80 percent by 2050. However the challenge is significant. He also noted that nationally, transportation is responsible for 27 percent of US emissions. The sector is also the single largest contributor to GHG in this region. He did indicate that there had been some recent reductions, most likely due to lower VMT (vehicle miles traveled) due to the recession and maybe there have been some behavioral changes. However, power sector emissions are going down at a much faster rate due to national market changes such as the switch from coal to natural gas and also due to policy leadership in this region. The region's governors are showing leadership with ambitious mid-term targets to get to 2050 goals. However, there are more questions about how to get the needed reductions from the transportation sector. Federal fuel economy standards for light-, medium- and heavy-duty vehicles are supporting significant emission reductions, 29%, and are still not sufficient to meet the 80% economy-wide reduction in emissions by 2050. There are challenges associated with some of the reduction solutions as well. While providing the potential for tremendous benefits, fuel economy standards, for example, have the effect of reducing revenue for transportation programs. This is because most funding for transportation programs are paid for through fixed federal and state gas taxes and so revenue decreases as the vehicle becomes more fuel – efficient due to the use of cleaner energy sources.



Ending with a positive opportunity, Mr. Pacyniak said that GCC is working with states to identify a portfolio of transportation policies to invest in and to set various levels of investment such as electric vehicle, bike, and transit infrastructure, and travel demand management systems –from which it has been estimated that a 30-40 percent reduction in GHG can be achieved, moving us closer toward the 80 percent target. Also, if you include pricing strategies to invest in clean transportation technologies, Mr. Pacyniak believes that we can more than make up for losses due to improved fuel economy.

Before ending, he raised some questions for the conference to think about. Some of these included:

How to promote market transformations, remove barriers and provide support to provide private market transformations?

What regulation policies can spur these changes?

Will they be real emission reductions?

Why this strategy vs. other strategies?

Is it ready for prime time?

Will it work in this context?

What are the benefits to residents?

What will it cost?

What are the policy mechanisms?

Will it reduce revenue?

Chapter 2: Session I, TRANSNET, DASH, Autonomous Taxis

Speakers included:

Moderator, Joseph Tario, NYSERDA

Dr. Stanley Young, Ph.D. NREL, Vassilis Papayannoulis, Ph.D., TRANSNET

Jamyn Edis, Ph.D. Adjunct Professor at NYU & CEO /Co-founder, Dash

DASH

Alain Kornhauser, Ph.D., Princeton University, Autonomous Taxis

TRANSNET, Stanley Young, Ph.D., National Renewable Energy Lab (NREL) and Vassilis Papayannoulis, Ph.D., Metropia

(Presentation given by Dr. Young)

Dr. Young began his talk, **TRANSNET**, by explaining the National Renewable Energy Lab's (NREL) traditional approach to improved energy efficiency in transportation was either through more efficient drivetrains, or through greener fuels such as low carbon fuels, electricity, and hydrogen. The TRANSNET project (an ARPA-E project) introduces a new approach, that of influencing traveler behavior. Within the past five years the influence of increased connectivity and automation, as well as the impact of ride and car sharing has pointed toward, "The coming revolution of transportation," in which the way people choose to consume mobility will fundamentally change. As a result, the way people choose to take trips (and influencing those trips to sustainable practices) is going to have a significant impact on energy intensity and Greenhouse Gases emissions.

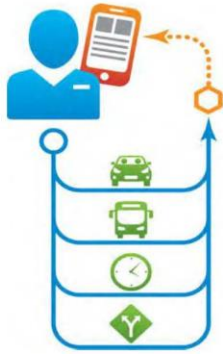
The NREL TRANSNET project is about the connected traveler. The project's emphasis is on incentivizing users via a smartphone interface toward sustainable mobility decisions. The NREL connected traveler project is one of five ARPA_E TRANSNET teams within the nation. The market opportunity for this project is both at the individual level, providing customized travel suggestions to optimize the individual trip, as well as collectively, providing travel options that simultaneously optimize the network, reducing the massive amounts of time, fuel and money wasted due to congestion in the urban areas. The project is centered about "incentivizing travel choices that optimize their travel experience, and marrying the incentive and feedback to eco-mobility so [the users] see the energy intensity impact that they have."

A key aspect of the connected traveler program is the "control architecture"—how the concepts of adaptive learning, refined incentives, and control strategies are incorporated to provide a high certainty of adoption. The control architecture will provide a broad range of choices as opposed to single dimensional route choices in Google Maps for example, that may provide just two different routes. Some choices could be change in departure time, carpooling, alternative routing, alternate destinations, or even elimination for the need for some of the trips. The user may also be provided with an indication of which choices may

be more sustainable as well as some incentives for taking the sustainable choice. Users are incentivized through the award of points which can be exchanged for a variety of products such as a coupon for Starbucks coffee. Incentives can be for services, transit passes, discounts, entry into concerts, charity, etc.

Metropia, a major partner on the NREL TRANSNET team, were among the first to market for some of the concepts in TRANSNET.. The Metropia business process includes a sophisticated smartphone app, combined with community engagement. This includes recruiting business partners, the local transportation jurisdiction, and the community, explaining their goal to improve “eco-mobility” through the Metropia platform. The incentives within the Metropia app is then tied to local communities and available services. Information from the application can support energy and GHG trip analysis, an area which NREL intends to apply its expertise. A new Metropia feature was tested in Tucson for social carpooling called “Drive up Occupancy” or DUO. DUO is designed for event management, to match event attendees to reduce vehicle at events with limited parking.

Connected Traveler Project Overview



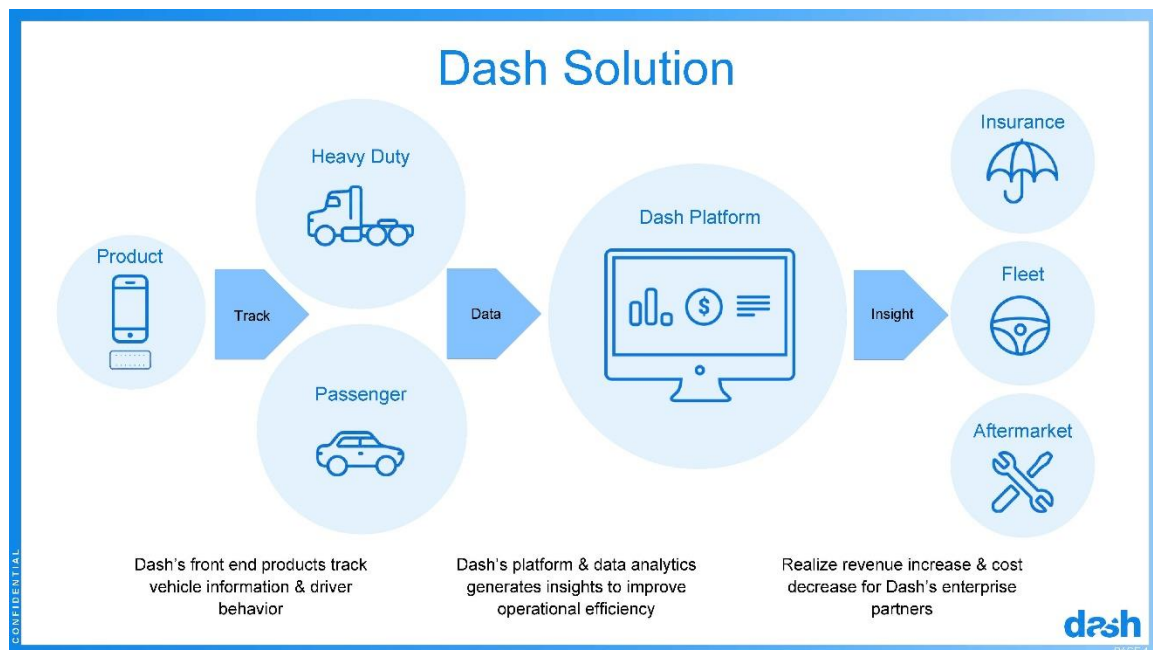
- Multi-disciplinary undertaking that will seek to validate potential for transformative transportation system energy savings by incentivizing efficient traveler behavior
- Control architecture will be developed that incorporates adaptive learning, refined incentives, and control strategies to provide high certainty of adoption
- Metropia platform will allow for real-world validation of traveler behavior and assist in refining incentives and control strategies
- NREL Transportation Secure Data Center and related tools will be used to determine individual energy consumption
- Individual energy impacts will be extrapolated to estimate transportation system energy consumption*

**Additional system model development may be required to refine this to a margin of error that can be used by transportation practitioners*

DASH SMART DRIVING APP, Jamyn Edis, Ph.D., Adjunct Professor at NYU & CEO /Co-founder, Dash

Jamyn Edis spoke about ***Dash's smart driving app***. He indicated that the company was started in 2012 and developed a technology solution that “makes any car a smart car.” His talk focused on some of the company’s products, “sweet smart-mobility products,” and with whom they partner. Basically, the technology connects the vehicle to a phone with a device called an onboard diagnostic reader. This enables all of the sensor readings to be downloaded and then analytics on fuel efficiency, improving safety, and what might be wrong with the car can be provided.

Their product stemmed from a viewpoint that cars are “four-ton mobile devices,” a computer with lots of available data that could be accessed. Dash is built on data. Excel software is used, which allows very complex forms of analysis and visualization to “bring in three, four, five dimensions to that data and really allow you to see patterns and insights that you wouldn’t [otherwise] be able to see.” Dr. Edis indicated that the company’s work involves both a hardware and software product and with the OBD devices, have been able to work with any vehicle in the U.S. since 1996, 1998 in Canada, and 2001 in Europe. Their focus uses mobility-based products, IOS and Android. Initially targeted at passenger vehicles, they now also work with commercial vehicles and trucking. The data can be harnessed from “everything to insurance, financial services, leasing, financing, to aftermarket, OEM, fleet, logistics –even billboard analytics, and hopefully, down the road, academia and also government agencies.”



One partner is the New York City Department of Transportation, (DASH is involved with the *Smart Drive* Program) which has about “a million cars” commuting into the City every day. He believes that this data collection can help—“If you know the origin point, maybe you can develop better routes, better systems to get them to this point without congestion.”

In 2014, DASH launched a consumer product. All trips can be tracked and the consumer can be given feedback while driving and a score out of 100. They can also share the trips on social media, which does give a “gamified” element. Post transit analysis can also be available. In addition to gathering data from the OBD, the product uses phone sensors and the GPS, barometers, a compass, accelerometers. If the driver registers as a user, demographic information can be made available. In addition, third-party APPs can provide ambient information such as weather, traffic, and road conditions. Dr. Edis concluded, “Over all of those four buckets, we are getting three to four hundred data points in real time – very rich in terms of depth and breadth. We are able to collate that data across OEM, across device, across user, across a hundred countries – and that really is the promise of what we are doing.”

Autonomous Taxis, Alain Kornhauser, Ph.D., Princeton University

“What else would I talk about?” joked Dr. Kornhauser in response to his introduction from the moderator, referring to his in-depth interest, research, and experience with the topic of autonomous vehicles. He began his talk on ***Autonomous Taxis*** by observing that autonomous vehicles today are really about safety. “Ultimately, though,” he said, “It really is about advanced mobility and that advanced mobility is a demand mobility for all, –so all those who do not currently have it.” He pointed out that this on-demand mobility is expected to be substantially lower in greenhouse gases and other pollutants, substantially more efficient and eventually could eliminate congestion. He indicated that you eventually get there “by taking the first step,” which has been done.

He referred to levels of autonomous vehicle implementation, levels 1, 2, 3, 4. Each level provides progressively more automation in terms of the function. “Levels one and two are basically your automated collision avoidance, which is getting available in cars nobody seems to be buying, which is really unfortunate,” Dr. Kornhauser pointed out. He also assumed that people are good drivers as long as they are paying attention, but cell phones have caused a lot of distraction...He feels autonomous vehicles, particularly at level 2, are all about safety, “some comfort and convenience, and in the end, it’s an insurance play.”

Dr. Kornhauser indicated that he calls a level three vehicle “a texting machine,” because “I’ll be able to text, and I’ll be able to watch Dash, and I’ll be able to do everything else because I won’t have to drive... And that is an enormous comfort play.” However, he pointed out that

person miles traveled could be increased with this because it will change how drivers perceive driving's utility vs. disutility.



Level 4, however, changes everything according to Dr. Kornhauser because it is completely driverless and can drive around empty. He stated that empty vehicle repositioning would be a real gain and would move vehicles around without "any strains on the environment." He asserts that an autonomous taxi eliminates the cost of transit, the labor cost in transit. By eliminating the labor costs for transit companies, they would reduce their expenditures and then they "might be able to put a vehicle out there that is basically small enough and frequent enough and in demand enough that somebody might want to use it." This could provide massive opportunities and significantly raise the market share for transit. He also said that ride sharing raises the average vehicle occupancy and then the fuel consumption metric goes down because it is a divisor of the average vehicle occupancy, so pollution is cut by half. Some of this information is based on an analysis that Dr. Kornhauser did to simulate the use of autonomous taxi stands within a quarter mile maximum walk to everyone in New Jersey. He found out also, that "in the peak hour, peak direction in New Jersey," according to his simulation, "the average vehicle occupancy goes up to 3.54" Therefore, out of every 4 cars not shared, you take three of them out by sharing and that eliminates congestion, he concluded.

Chapter 3: Session 2, Academic Research

Speakers included:

Moderator: Elisabeth Lennon, NYSDOT

Angela Sanguinetti Ph.D., UC Davis, A Behavioral Review of Eco-driving

Kanok Boriboonsomsin, Ph.D., UC Riverside, Evaluating Real World Impacts of Eco-driving

Rae Zimmerman, Ph.D., NYU, Issues of Connectivity and Eco-Mobility

Angela Sanguinetti, Ph.D., Institute of Transportation Studies, U. California, Davis

In her presentation, *A Behavioral Review of Eco-driving*, Dr. Sanguinetti shared her perspective as a behavioral scientist on the current state of academic research on eco-driving. Her first assignment as a Post-Doc at UC Davis was to “conduct a review of the literature on eco-driving to assess the degree to which it could be enhanced by integrating strong behavioral theory and research methods.” As a first step, she searched the literature for a good operational definition of eco-driving. As it turned out, there was little consistency among existing definitions, which also lacked precision and comprehensiveness in terms of delineating all the behaviors that constitute eco-driving.

Some definitions were limited to driving operations (e.g., use of pedals and gears), while others included maintenance practices, equipment purchases, and even choice of vehicle. Therefore, Dr. Sanguinetti’s team set out to develop a definition that was more comprehensive and more precise. They first bounded the concept by limiting eco-driving to “those behaviors that are assumed away and excluded from the CAFÉ standard’s fuel economy estimates posted on every new car”, which are accompanied by the caveat, “actual mileage will vary for many reasons.” The behaviors that contribute to this variability are the target of eco-driving. After drawing this boundary, Dr. Sanguinetti synthesized definitions of eco-driving from academic research, popular media, and vehicle experts to identify the following categories of eco-driving behavior: accelerating, cruising, decelerating, waiting, parking, cabin comfort, maintenance, load management, trip planning, and fueling. This typology provides a framework to think about how to most effectively target different types of eco-driving behavior.

The second step in Dr. Sanguinetti’s literature review was to assess the potential impact of eco-driving on fuel economy and GHG emissions. As a framework, she adapted an equation suggested by psychologist Paul Stern to determine the impact of any action to mitigate climate change (see below). She considered how existing estimates of the impact of eco-driving are either based on technical potential only (not accounting for behavioral plasticity), or on an incomplete set of eco-driving behaviors. For example, in-vehicle feedback interventions to promote eco-driving indicate an average effect of about 6%

improvement in fuel economy, but they only target a subset of eco-driving behaviors; therefore, the total impact of eco-driving could be larger.

What is the potential impact of eco-driving?

$$I = \sum_k (t_k * pn_k)$$

I = impact
 t = technical potential (savings impact of the behavior)
 p = behavioral plasticity: proportion of population that can be induced to take the action
 n = total population that could possibly take the action
 k = each eco-driving behavior

After defining the target behaviors and considering how to evaluate their impact, the next step was to consider interventions to promote eco-driving. The most common eco-driving intervention has been in-vehicle feedback. Dr. Sanguinetti and her team reviewed 27 academic peer-reviewed studies of in-vehicle feedback interventions. They noted an extremely wide range of effectiveness, from no effect (or decreases in fuel economy) to up to 18% increase in fuel economy.

Multiple factors may contribute to this variation in the effectiveness of eco-driving feedback interventions, but one likely culprit is the similarly wide range of variability in the types of feedback provided in different studies. In order to lay the foundation for more systematic research, Dr. Sanguinetti's team developed a typology of in-vehicle feedback. They identified 15 types of in-vehicle feedback. This typology will enable investigations into the features and types of feedback that are most effective for particular eco-driving behaviors.

The next project that Dr. Sanguinetti's team will undertake is a meta-analysis of eco-driving feedback studies. This statistical method of aggregating findings from multiple discrete studies will provide the best estimate to-date of the impact of eco-driving. It will also allow for the identification of characteristics of eco-driving feedback interventions that contribute to their effectiveness.

Kanok Boriboonsomsin, Ph.D., College of Engineering, Center for Environmental Research and Technology, UC Riverside

Dr. Boriboonsomsin's presentation, *Evaluating Real World Impacts of Eco-driving*, focused on the technical potential of eco-driving and how it can be evaluated in the real-world. He indicated that "Before and After" studies have frequently been used to evaluate eco-driving impacts because they are simple and convenient ways to conduct an analysis. However, he said that these studies often do not address the temporal changes that can occur at each point. Things that can vary include mileage, extra weight that is carried during each test period, travel pattern, etc. Kanok's research assessed how to account for these temporal changes during the before and after periods of data collection. Basically, statistical adjustments allow every variable to be kept constant except the ones that vary with behavior, e.g. acceleration. The process normalizes a lot of factors that were not controlled in the real world and analyzes the impact of each driving behavior on fuel consumption as if the vehicle was subject to the same operating pattern during each real-world observation.

He provided results for one test subject, which used a charter bus that picked up and dropped off passengers similar to paratransit. Fuel Economy was originally low at seven miles per gallon. After collecting the data based on the eco-driving feedback, it was found that the improvement was only 2.4%. However, after the appropriate statistical adjustment, the adjusted fuel economy actually showed that the improvement was 4.2%. In other words, the 2.4% result had not yet been adjusted to account for factors that can affect vehicle fuel economy beyond just driving behavior.



Results for Example Vehicle

	Baseline	Feedback	% Change
Distance (mi)	2,863	3,920	
Fuel consumption (gal)	405	541	
Fuel economy, FE (mpg)	7.08	7.25	2.4%
FE adjusted for acceleration & braking (mpg)	6.21	6.29	1.4%
FE adjusted for acceleration, braking, & idling (mpg)	7.00	7.30	4.2%

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Rae Zimmerman, Ph.D. NYU Wagner Graduate School of Public Service

Dr. Zimmerman addressed eco-mobility in her talk on *Issues of Intermodal Connectivity and Eco-Mobility* in terms of connectivity among modes. She described trends by mode and made the point that according to U.S. Census, U.S. EPA and Oak Ridge National Labs data, driving alone has been the dominant mode of travel between 1980 and 2010.⁵ She then described road transportation usage compared with road capacity from U.S. DOT, FHWA highway statistics report data. Dr. Zimmerman indicated that to a large extent, those trends show that vehicle miles traveled is generally tracking motor fuel usage.

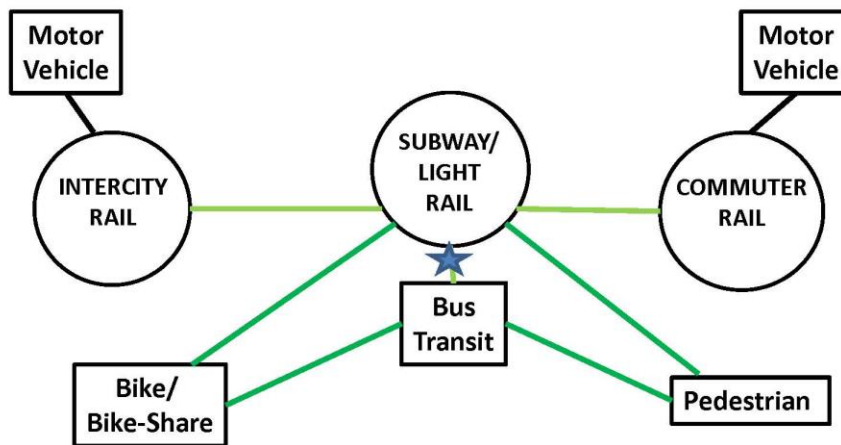
Regarding public transit in 2011, trends from the American Public Transportation Association 2013 report show the dominance of bus, heavy rail, and commuter rail usage. By city, New York dominates in terms of use of sustainable transportation.⁶ Overall, Dr.

⁵ U.S. EPA (2013) Our Built and Natural Environments: A Technical Review of the Interactions among Land Use, Transportation, and Environmental Quality, Second edition. Washington, D.C.: EPA <http://www.epa.gov/dced/pdf/b-and-n/b-and-n-EPA-231K13001.pdf>, p. 29

⁶ Source: New York City (September 2010) Inventory of NYC Greenhouse Gas Emissions, p. 7.

Zimmerman pointed out that biking as a non-auto form of travel is increasing, but still only accounts for a small proportion of trips as does walking according to U.S. DOT FHWA 2010 statistics.⁷

Multimodal Connectivity: A Framework to Move from Gray to Green – Bring Them Closer



She also discussed trends in energy use and transportation. Basically, Dr. Zimmerman reported that the transportation sector accounted for about 72% of petroleum usage reflecting numbers until the late 2000s.⁸ In addition, citing U.S. Energy Information Administration (EIA) data the absolute amount of petroleum consumption by transportation dropped between 2007 and 2008 often attributed to economic conditions, but the share still increased. Also, the U.S. Energy Information Administration (EIA) reports that only 4% of the energy used in the transportation sector is from renewable energy sources⁹ another energy statistic that Dr. Zimmerman pointed to was Greenhouse Gas emissions of which, 70% of these emissions was due to urban transport choices in the

⁷ U.S. DOT FHWA (2010) The National Biking and Walking Study: 15 Year Status Report, pp. 5, 6.

⁸ Summary from R. Zimmerman (2012) Transport, the Environment and Security. Making the Connection, Cheltenham, UK and Northampton, MA: Edward Elgar Publishing, Ltd., http://www.e-elgar.com/bookentry_mainUS.lasso?id=13884 based on U.S. Energy Information Administration data.

⁹ EIA Annual Energy Review 2011, p 44

U.S. and there is a 90% growth in emissions from transport systems in lower income countries.¹⁰

Zeroing in on connectivity, 72% of heavy rail connectivity in New York City is associated with bus transit and this is true for many cities.¹¹ Moreover, bus travel is high in New York City, but is lower to a large extent in New Jersey, which were the two areas Dr. Zimmerman and her research team evaluated in the UTRC report referenced earlier.

Her research team also reported on poorer areas and whether they have as many buses stopping and as many subway stops, compared to other areas.¹² Her research team did find that the number of buses stopping at subway stations was less in areas with higher percentages of the population within a census tract below the poverty line as defined by the federal government.

Another connectivity factor Dr. Zimmerman looked at in that same UTRC report was the level of buses available at the end of subway lines and found that a relatively larger number of buses stopped at the end of these lines relative to other stations in the system.

The use of multiple modes of travel leads to a lot of competition on streets and nearby sidewalks. She noted an issue related to the attempt to manage multi-modal travel that she observed in Arizona where walk-only zones exist in some areas at certain times of the day and bikes and skateboards are not allowed from 8AM – 4:00 PM. Dr. Zimmerman made the point that not only do the modes themselves allow for inter-connectivity, but also integrating the modes on the street network is necessary.

Her concluding point was that eco-mobility is good in terms of responding to disruptions. It is resilient and can redistribute modes, such as buses, for special purposes.

¹⁰ Rosenzweig C., W. Solecki, P. Romero-Lankao, S. Mehrotra, S. Dhakal, T. Bowman, and S. Ali Ibrahim (December 2015). ARC3.2 Summary for City Leaders. Urban Climate Change Research Network. Columbia University. New York. P. 16. <http://uccrn.org/files/2015/12/ARC3-2-web.pdf>.

¹¹ R. Zimmerman, C.E. Restrepo, J. Sellers, A. Amirapu, and Theodore R. Pearson (2014) Promoting Transportation Flexibility in Extreme Events through Multi-Modal Connectivity, U.S. Department of Transportation Region II Urban Transportation Research Center, New York, NY: NYU-Wagner. This is based on calculations using the U.S. DOT Intermodal Transportation Database.

¹² R. Zimmerman, C.E. Restrepo, H.B. Kates and R. A. Joseph (2016) Suburban Poverty, Public Transit, Economic Opportunities, and Social Mobility,” U.S. Department of Transportation Region II Urban Transportation Research Center, New York, NY: NYU-Wagner. Final report. <http://www.utrc2.org/sites/default/files/Final-Report-Surburban-Poverty-Public-Trans-Eco-Opportunities.pdf>

Chapter 4: Session 3, Government Programs

Speakers Included:

Moderator: Frank Mongioi, Jr., Senior Manager, ICF International

Brenda Dix, ICF International, San Francisco Bay Area Sustainability Programs

Alex Keating, NYCDOT, DriveSmart

John Lyons, MetroPool

Brenda Dix, ICF International

Brenda Dix began her talk on ***Bay Area Sustainability Programs*** at the Metropolitan Transportation Commission (MTC) by explaining that she was able to continue her work from MTC, while in her new position at ICF International. The MTC region covers all nine counties in the Bay area, including San Francisco, Silicon Valley, Oakland, up to the Wine Country, and Gilroy. The MPO has many programs, but Brenda focused on Smart Driving and the Climate Initiative Programs, which have several elements and for which \$80 Million had been allocated. This allocation funded the Smart Driving and Innovative Climate Programs. The latter included Transportation Demand Management, Parking Pricing, Ridesharing, Bicycle Projects, and Electric Vehicle Deployment.

The Smart Driving techniques include many eco-driving behaviors already discussed in this report. They include the in-vehicle driver experience, as well as things done before or after driving, such as vehicle maintenance.

Prior to engaging in the eco-driving project, MTC conducted a literature review and evaluated other eco-driving programs in several locations, including UC Davis (already discussed in this report) and Drive Clean Texas. As a result, MTC launched the pilot program, half of which was managed by ICF International, half of which was run out of UC Davis. UC Davis' portion was a phone app that showed real-time miles per gallon, fuel savings, and CO₂ savings. The other pilot was a plug-in OBD device that measures real-time fuel efficiency with a bar ranging from green to red. The pilot was able to record before-and-after driver behavior information to capture the effectiveness of the devices. MTC then moved forward with the smart driving public campaign.

Phase 2: Public Smart Driving Program

- **Two primary components:**

- Education campaign
- Automatic device giveaway



- **What is Automatic?**

- Smart phone app and connected car adapter

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Brenda noted that the campaign, Drive Smart Bay Area, was launched in February 2016, so results were not available at the time of the presentation. One component of the program was focused on public education about smart driving strategies with information on the website and also about how anyone could track their driving without an OBD device. The program also offered a discount on the Automatic device (<https://www.automatic.com/home/>). This provides auditory cues while driving for accelerating too hard, decelerating too hard or speeding. It avoids distracted driving because the driver does not have to look at the screen. After the trip, the driver can look up scores compared to other trips. Other programs funded through the \$80M grant included transportation demand management strategies, parking-pricing strategies, and bicycle projects. Another innovative grant that she mentioned was the “Cold in Place Recycling Program” which saves the local government money while reducing emissions. It involves grinding up what is in place on the roadway surface and then laying the surface back down to produce a new, smooth driving surface that reduces embedded material greenhouse gas emissions.

Alex Keating, NYCDOT

Alex began by saying that the **DriveSmart** program is one of NYCDOT's special projects and is looking at how to "change behaviors on the roads, improve safety and save money.". The program is trying to produce a platform that powers private sector innovations and apps that are already out there. They are trying to harness data that is already available and find new insights on how to manage the system.

This project is funded by a federal VPPP – Value Pricing Pilot Program Grant. The "in-market" time is one year and there are about 400 individuals in New York participating now. Participants must drive at least four times per week. Alex emphasized that this is a pilot program, a demonstration project. More will be learned from the program at the end, next summer. In addition to saving the drive time and money, the drive is greener because the driver feedback app is included along with the routing apps.

Program Goals

About Drive Smart

Drive Smart is a new technology pilot program from the New York City Department of Transportation (NYCDOT) that will help participants:



SAVE TIME: Tired of getting stuck in the same traffic every day? Drive Smart can help you find a better route to the office - and reward you for taking it.



SAVE MONEY: Owning a car in New York City is expensive, but Drive Smart can tell you exactly how much you're spending on driving, give you tips on how to save, and help you save money on your car insurance.



DRIVE MORE SAFELY: Drive Smart will help you be a safer driver by giving you in-vehicle feedback and a "safe driver score" all while never taking your eyes off the road.



DRIVE GREENER: Help us clear the air - Drive Smart will give you pointers on how to be a more eco-friendly driver and even plant a tree or two every time you reach a milestone.

Contribute to Vision Zero goals:

- Provides input and incentives for safe drivers and contributes unique focus on "near misses."
- New probe data source to manage network and reduce crashes.

Evaluate impact of information and services on driver behavior, safety, and congestion:

- Impact will be evaluated based on 12 months of aggregated driver performance + before and after surveys

For DOT, Alex said that the project "dovetails nicely with the larger framework of Vision Zero and improving safety because we're getting lots of information, not just on how people are driving, but on things we don't really see like 'near misses' where people are

jamming on their brakes or accelerating or hard turning events – data we’re not usually collecting from the private driver...”. He added that this data set also complements what is being collected through the existing yellow taxi GPS (that also comes from green cabs now, and along with MTA Bus Time data, the entire network can be evaluated.

Another point he made was that one partner is Allstate (in addition to DASH and METROPIA already discussed). Allstate made a specific snapshot program that is powered on the DriveSmart device that incentivizes drivers.

For DOT, the data is in two “buckets.” One gives actual GPS driving results so you can see where each individual is driving. They also have a bin of data that is linked to the user’s ID when they sign up and it provides aggregate, broad-brush data on how they are driving, their total VMT, the average driving speeds, etc.

John Lyons, MetroPool

In 2014, the City of Yonkers launched eco-driving training workshops for City employees. In his talk, John Lyons provided a snapshot of this program, which was created by Eco-Driving Solutions in Arizona, a MetroPool partner. He explained that Eco-Driving Solutions’ background was with safety training, near and around the racecar industry and later progressed to the environmental piece when gas prices rose. He explained that Eco-Driving Solutions’ theory was that the greatest influencing factors on driver behavior are “perception and beliefs, emotional state, and responsibility as a driver.”

As part of his presentation, Mr. Lyons presented a video featuring the 12 drivers who participated in the Yonkers’ program. In addition to the trainees, several other people were featured in the video, including Mayor Mike Spano of Yonkers, Brad Tito, former Yonkers Director of Sustainability, and John Lyons.

This video described the training that the Yonkers fleet drivers received and included comments from the participants. The participants spoke favorably of the training and expressed a competitive tone. One said, “They assumed that the driver who is going to get the best fuel mileage in the shortest amount of time is who is probably going to win.” Another comment was that the drivers were taught to think like racecar drivers, to always think ahead. In this circumstance, they were taught to think about the fuel mileage numbers, what the risks would be, and other issues about their driving. In addition, it was commented that the drivers learned to become “less reactive,” which enabled them to “be smoother on the gas pedal.” The general feeling among the drivers was that they had been successful and did drive more fuel-efficiently.

Results

- 3.5 Hour training
- 3 Trips Behind the Wheel
- Average improvement= 20.5%
High= 47%
Low =1.6%



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Chapter 5: Afternoon Keynote Speaker, Raymond P. Martinez

Administrator/Chairman Raymond P. Martinez, New Jersey Motor Vehicle Commission

The Commissioner thanked Matt Daus, who had introduced him, for his kind words. He commented that he realized it might be considered odd to have the commissioner of Motor Vehicles address this conference, but he also said that motor vehicle commissioners around the country are aware that the landscape is changing. He indicated that DMVs collect money for registrations and other things, but “a big chunk of that money goes to the general fund to support other entities, other efforts, whether it's transportation, DOT, or environmental protection where you might not have the same resources.”

He also stated that his commission is very concerned about environmental issues and does work closely with the Department of Environmental Protection (DEP) in New Jersey. He cited some examples of this relationship, including that the NJ Motor Vehicles Commission runs the emissions program because they run the inspection program for vehicles and “inspections are mostly about emissions now.” He explained that mechanical inspections have been eliminated due to the ability to inspect through the OBD device in newer cars. He also pointed out that the emissions program can be costly, so their goal is to focus on reducing the cost of this program.

Another area of conflict described by the Commissioner involved the provision of licenses for selling Tesla vehicles in New Jersey. A DMV responsibility is to license car dealerships in New Jersey, but they ran into a problem in licensing Tesla sales. The problem evolved because the way that Tesla sells cars “collided” with the existing franchise law in the State. He explained that, “Usually manufacturers in the state - in most states – do not sell directly, they sell through franchised dealers who get their territories and they're very protective of that.” The existing car dealers' objections was not to Tesla's environmentally-friendly technology, he said, but because Tesla manufacturers were selling directly. The issue was eventually resolved legislatively, and now Tesla can sell directly to consumers, unlike more traditional car dealerships.

He continued that New Jersey now has approximately 8,000 electric vehicles on the road and more than 78,000 hybrid vehicles on the road and that there are also nearly 5,000 natural gas vehicles registered as well. “And for those drivers who are doing their part for a cleaner future, we've also implemented on a state level, several programs over the past few years to reward them [and] to incentivize others to buy those types of vehicles that improve the environment for all of us,” he said. Commissioner Martinez explained that New Jersey has an emissions test exemption for green vehicles. All 2009 or later passenger vehicles or light-duty trucks are required to meet California Low Emission Vehicle Program standards under what is known as LEV or Low Emissions Vehicle Program. The LEV

program reduces vehicle emissions, helping to reduce adverse impacts that these emissions might have.

In addition, he indicated that the Commission has issued an RFP for a new inspection program, but this has also resulted in a clash with DEP due to projected cost issues. The DMV wants to propose to eliminate the previously mandated tailpipe emissions inspection, which is possible because they can now rely on OBD inspection and also because older vehicles are coming off the road.

The commissioner ended with noting some additional environmentally friendly programs in the State:

- Green Pass discount for New Jersey E-Z Pass customers.
- HOV lane exemptions for hybrid electric vehicles.
- Tax incentives for New Jersey's fuel efficient drivers.

Chapter 6: Session 4, Goods Movement and Eco-Driving

Speakers included:

Moderator: Alison Conway, Ph.D., CCNY

Kanok Boriboonsomsin, Reducing the Carbon Footprint of Goods Movement through Eco-driving

Edward McCarthy, Vnomics, Brian Brundige, Terpening Trucking, TRUE FUEL™ Driver Coaching and Analytics

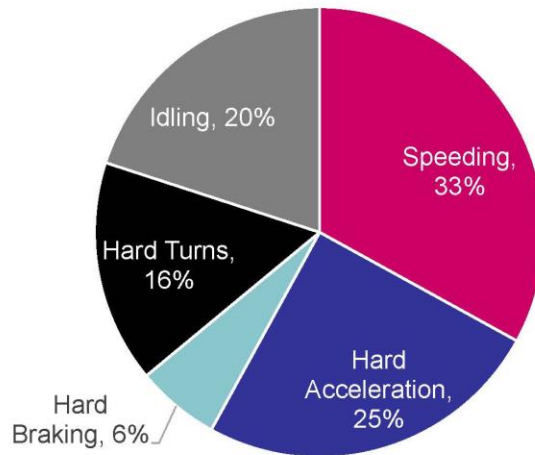
Kanok Boriboonsomsin, Ph.D., College of Engineering, Center for Environmental Research and Technology, UC Riverside

In his talk on ***Reducing the Carbon Footprint of Goods Movement through Eco-Driving***, Dr. Kanok Boriboonsomsin noted that about one third of the operating costs of commercial trucking in the United States is from fuel costs.

He continued with information about GHG emissions from medium and heavy duty trucks, stating that this level is about 22% of the total GHG emissions from the transportation sector. Fuel waste from a typical truck was mostly associated with how drivers drive the vehicles. Therefore, many trucking companies have invested in driver training for eco-driving, but in the past, the focus had been only on safety. In addition, “before and after trip” activities such as route planning and vehicle maintenance can also have an impact on fuel usage in a truck, Kanok added.



Reasons for Fuel Waste for a Typical Freight Truck



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He moved on to discuss his research on the effectiveness of truck eco-driving programs where he indicated that there are limited publically available studies. On the slide below, selected studies are summarized, showing improvement ranging from about 5 to 40 percent. However, large-scale studies with more than 300 drivers showed improvement in the range of 5 to 15 percent. Results varied due to varied sample sizes, baseline performance, type of eco-driving intervention, etc.



Examples of Truck Eco-Driving Evaluation Studies

Year	Country	Training Method	Evaluation Setting	No. of Drivers	Fuel Economy Improvement
2005	U.K.	Driving simulator	Driving simulator	>600	3.5% immediately after training
2007	U.S.	Class	Closed driving course	36	33.6% to 40.5% immediately after training
2009	Australia	Class	Prescribed real-world route	12	27.3% immediately after training; 26.9% after 3 months
2010	European countries	Class followed by monthly feedback and regular refreshing class	Actual real-world routes	322	9.4% over an unknown period
2011	U.S.	Individualized coaching and in-vehicle real-time feedback system	Actual real-world routes	695	13.7% after 2 months
2013	Japan	Class	No information available	~3,000	8.7% immediately after training
2014	U.S.	Individualized coaching and in-vehicle real-time feedback system (plus financial incentives)	Actual real-world routes	46	2.6% (5.4% with financial incentives) for sleeper cabs and 5.2% (9.9% with financial incentives) for day cabs after 2 months

Some elements of truck eco-driving programs include:

1. Incentives to the drivers. The level of improvement doubled when incentives were used.
2. A successful program includes driver education and training.
3. Vehicle maintenance and technical support is provided.
 - Government can provide free access to air pumps for tire inflation at rest areas
 - Preventative maintenance routines can be streamlined
 - Fuel savings technologies can be invested in
4. Policy support from the fleet
 - Culture of fuel-efficient driving
 - Recognize fleet drivers for good eco-driving
 - Include eco-driving metrics in performance review

Challenges and Barriers Include:

1. Habits are hard to break

2. Impact of eco-driving may fade over time
3. For industry, challenge is that there is a high turnover rate for drivers
4. Most goals have to be balanced including OTP, Productivity and Safety
5. For government, the challenge is to incorporate eco-driving into licensing process as a substantial institutional change would be required.
6. Also lengthy would be to work with stakeholders and manufacturers to mandate inclusion of eco-driving technologies in new trucks.
7. Limited funding

Kanok described some ongoing related research currently ongoing at his Center:

1. Truck eco-routing (planning trips can be eco-friendly)
2. Real-time speed advice (to minimize stop and go traffic)
3. Connected eco-driving (to use information from traffic signals and other vehicles to help eco-drive)

In summary, Kanok indicated that truck eco-driving is “win-win-win” for driver, fleet, and society.

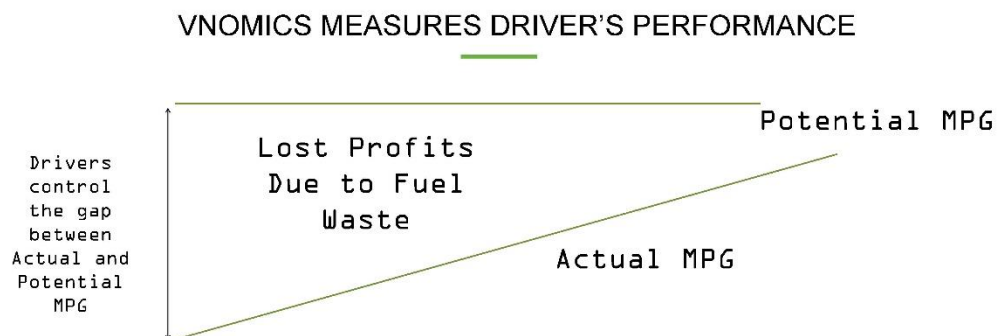
**Edward McCarthy, Vice President of Operations and Customer Success VNOMICS
/ Brian Brundige, Operations/Safety Manager Terpening Trucking Company**

This talk on **TRUE FUEL™ Driver Coaching and Analytics** was given by Edward McCarthy, from a “practical point of view,” about the Vnomics in-cab coaching and fuel driving tool, which assists drivers to drive as efficiently as they can. Mr. McCarthy has gained experience using this tool with both the Marine Corp and the trucking industry. Brian Brundige of Terpening Trucking Company, is a Vnomics’ customer, and added his insights regarding the tool, which he implemented into the operations of his company.

Mr. McCarthy pointed out that fuel costs are the second largest cost to the trucking industry and that the need to achieve bottom line savings from this expenditure drives the industry every day. Vnomics tests this point every day due to the amount of total driving from their customers, which amounts to about “½ million miles with 15,000 trucks, 20-25,000 drivers logging in every day.” Information is gained about the benefits and other issues by using the tool in the cab every single day.

He emphasized two points:

1. “Gamification” works
2. People feeling that it is fair works



Driver Results are Normalized - Drivers are assessed and ranked on how close the Actual MPG is to Potential MPG which is expressed in % Potential



He also indicated that fuel accounts for more than 25% of a fleet’s Cost Per Mile (CPM) and that fuel costs for a typical fleet has been about \$25,000 per truck per year.

In addition, their data, representing 76 million miles of drive time, shows a 3-10% improvement. This is lower than on the research side, he said, because “drivers are good at what they do.”

In addition to being taught to not idle or speed, the Vnomics program teaches “progressive shifting” to learn to drive at the appropriate and fuel-efficient gear for moving cargo and also on the automatic side, “throttle control” to be aware of not using the pedal too hard, which would defeat the purpose of using an automatic transmission.

Another aspect of the Vnomics system is that it uses gentle coaching, such as occasional beep tones, but never all day or too much. The larger product (full telematics product) also uses visual displays. The reason for gentle coaching is to not bombard the driver with sounds. Ed said, “Not many of my systems would survive the first day if we beeped them to tell them [the drivers] when to shift every single time the whole day.”

Gentle coaching “tones” the drivers when they get outside of the bands considered important. These messages are gradually tightened up as the drivers get better to coach them to their “sweet spot” of where they need to be. The drivers are given a score which serves as an incentive to do better. Generally, the approach is that the system precisely monitors each vehicle’s fuel use through a standardized network to read every sensor available in commercial trucks. Data is collected and a memory map of the engine is created. This provides data on what the driver is doing currently and compares that to the ideal point he/she should be at.

Ed emphasized, though, that the ideal point must take into account other current conditions that are not in the drivers’ control. The collected data will also give the customer an understanding of how fuel is being used, which roads are tougher on them, and to identify how much a particular route costs. He stated that “MPG is a horrible way to judge a driver,” and that the best way is to look at fuel flow as the driver goes through the day. Through fuel mapping, what the driver does not control can be normalized.

While driving, the system provides non-distracting tone alerts when change is needed. An audible shift score is provided at the end of the trip or when the driver stops for a while. The drivers compare their scores and if you monetize the reward, they have an even greater incentive.

Another key point made was that drivers who are driving eco-friendly are safe drivers because they do not speed, they do not slam on the brakes, because their score will go down. The truck owner gets savings on the truck, because better driving increases the useful life. Another benefit is that the system allows truck owners to identify the best drivers and reward them accordingly, which is very helpful do to a problem with being able to acquire enough drivers.

Brian spoke as well and offered his favorable point of view regarding how the system has helped his small to medium class trucking company. They were able to use the savings to put towards other business items. It helps his company to be corporately responsible and safe.

Chapter 7: Session 5, Policy

Speakers included:

Moderator: Matthew Daus, Distinguished Lecturer, The City College of New York

Panelists included:

Stacey Hodge, Director, Office of Freight Mobility, NYCDOT

Maureen Koetz, Koetz and Duncan LLC

Alec Slatky, AAA Northeast Government Affairs

The final session of the day, ***Policy Perspectives Roundtable***, covered policy issues and potential solutions that would be necessary to encourage more sustainable and eco-friendly transportation. The format was interactive between the moderator, Matthew Daus and three panelists, Stacey Hodge of NYCDOT, Alec Slatky of AAA, and Maureen Koetz of Koetz and Duncan, LLC. Each presenter spoke for a few minutes on their organization's perspective and then Matt asked questions of them as well as invited questions from the audience.

Matt Daus:

Matt introduced himself and the panel participants and described the structure of the session. He then invited the speakers to make brief individual presentations. The session highlights are summarized below.

Stacey Hodge:

She summarized the sustainability effort currently being undertaken in the City of New York right now. Stacey explained that in 2007-08, the City focused on adding more public space and accommodations for alternative modes such as plazas, bike lanes, and curbside bus lanes. These curbside improvements, however, impacted truck deliveries by decreasing their delivery space along the curb. Therefore, the Office of Freight Delivery had to try to recommend alternative solutions such as suggesting specific delivery windows, especially in the off-hours, to mitigate the negative impacts that trucks were experiencing. Stacey indicated that there were benefits to amenities, such as Street Seats (temporary eating plazas), for example, but they had to look at how to accommodate those trucks that used to park in the locations with temporary plazas. Her office is working with different businesses to try to see if they can assess the number of truck trips coming into their facilities. She indicated that big data helps with this type of analysis.

Truck Trips Demand



Alec Slatky:

Alec explained that even though AAA is an automobile association, they are doing some things to encourage eco-friendly mobility. For example, they conducted a survey a few years ago and found out that 8 out of 10 of their members were not interested in electric vehicles. So they try to educate their members with a green car guide online, which is interactive and can help the member find a car that might be right for them. They also offer electric vehicle education as part of their website that talks about some of the benefits of driving electric, fuel costs, maintenance costs and a map of fuel charging stations in the member's location.

AAA & the Environment

- Education
 - [Green Car Guide](#)
 - [Electric Vehicle Guide](#)
- Research
 - [Automatic stop-start systems](#)
 - [EV battery testing](#)
- Operations
 - Roadside assistance for EVs (NOT IN NY REGION)
 - Roadside assistance for bicycles
- Policies
 - HOV lanes
 - Federal gas tax

Alec mentioned a few other programs as well, such as research on automatic stop-start systems that can save up to seven percent on CO₂ emissions. The New York location was about to add roadside assistance for bicycles as well.

In addition, he noted that they have found that car ownership has been rising – 1.4% in New York, from 2014. He also said that VMT is rising everywhere. However, his point was that car ownership is not necessarily a bad thing. Buying cars and taking road trips contribute to the economy, Alec indicated. He observed that people of all income brackets own cars in New York City and that “for whatever reason, they need and use their cars.”. He did acknowledge, though, that there are negative externalities. Fatalities have increased, but the rate outpaces the VMT increase. Therefore, he suggested that something beyond just car ownership has to explain this change.

Lastly, Alec spoke about the AAA position on congestion pricing, for which they were not in favor. They are, however, in favor of the Sam Schwartz “Move New York” plan.

Maureen Koetz:

Maureen Koetz did not talk about sustainable transportation per se. She discussed enterprise capital, which consists of human, financial, physical, and natural capital. Natural capital is a key component in her theory, in that air, land, and water are a finite supply and cannot be reproduced. She said, “So if you are going to talk about sustainability, if you’re going to talk about brute land and doing what we want to do today and saving it for the future, we’ve got to start thinking about this as a supply concept.” She continued that “There is only so much air shed that we’re allowed to use, there’s only so much air space we’re allowed to use- just ask any of the developers trying to put up buildings now who need more air rights. They have to go out and buy those, right? There’s only so much water we’re allowed to use. And a lot of what you saw today was land-based. If the cars are taking up all the space on the land dedicated to transportation, where are the bicycles going to go. Where are the trucks going to go? So this is about a capacity problem and how our capacity relates to our capabilities that we want.”

Maureen indicated, that by her theory, sustainability is using the smallest amount of the constrained natural capital supply to get the largest output or throughput. In order to do this, she stressed that quantitative metrics are necessary to know how much of a supply you use before and how much after something is built and used.

Her model for implementing Sustainable Transport is explained by the following slide, which emphasizes knowing how much natural capital we have in order to use it.

<i>Implementing Sustainable Transport</i>	
<ol style="list-style-type: none">1. Recognize inherent technology features and relationships<ul style="list-style-type: none">• Scale• Design• Psychology/Behaviors2. Inventory used and available Natural Capital Capacity Supply (NCCS)<ul style="list-style-type: none">• Air, land, and water components3. Align NCCS to Performance Requirements (big data)4. Manage gaps<ul style="list-style-type: none">• Design Basis alterations• O&M Improvements• Directed Investment• Credit accrual5. Market Green to Green Market	
<i>Koetz and Duncan LLC</i>	Proprietary Information, Not for Publication
Thursday, March 24, 16	

In summary, Maureen believes that natural capital should be considered an asset and value should be assigned for anyone who saves this asset. She ended by saying that the transportation sector is one area that can offer those savings.

Q&A:

The moderator raised the issue of asset management to the panel. In light of the increased trucks and personal motor vehicles on the roads, he wanted to know how they felt about the possibility of controlling consumption, like limiting the manufacturing of vehicles or implementing controls such as congestive pricing.

Alec responded that the AAA prefers a market –based approach. He felt that there are already strong disincentives now for driving in the City and that these create a strong disincentive. He indicated that AAA prefers that pricing schemes be used for infrastructure improvements, not for dissuading vehicles. In addition, AAA represents the entire state and he pointed out that in areas with less availability of public transport, traveling is difficult without using a personal automobile.

Maureen emphasized that we need to tell the truth about the “load factor.” She added that tourists significantly add to this factor every day in NYC and should be accounted for. She said, “We must tell the truth about the load factor that vehicles are adding to a finite amount of air shed.” She observed that we control stationery sources [through NEPA], but not mobile sources that also use of our natural capital.

Matt responded that rather than incentives and disincentives, maybe we should just limit cars coming into the City, which is different from congestion pricing. He pointed out that NEPA means nothing in relation to all the “craziness on the street.”

Stacey responded that we must first understand the problem before implementing policy. She indicated that it is important to know the increase in vehicles specifically due to increased delivery of food and online purchasing. This information would be needed to inform policy.

Maureen suggested that we determine a multiplier per building. She said count the trucks in a sample of buildings and multiply that by the number of buildings that were to be built. This way we, she said, that we would know the multiplier that “will hit air shed and air space.”

Stacey added, however, that we might not know who the tenants would be and the associated use of a building at the time the building is just built. She agreed that we do need to start estimating what is going to happen, but that one agency does not have full control to do so.

Alec interjected that we should look at data before looking at “draconian measures.” Matt asked what AAA was doing regarding the issue of shared mobility. Alec said that there are a lot of things that come with an AAA membership and that the organization has been trying to diversify. For example, he said that they supported research at the federal level

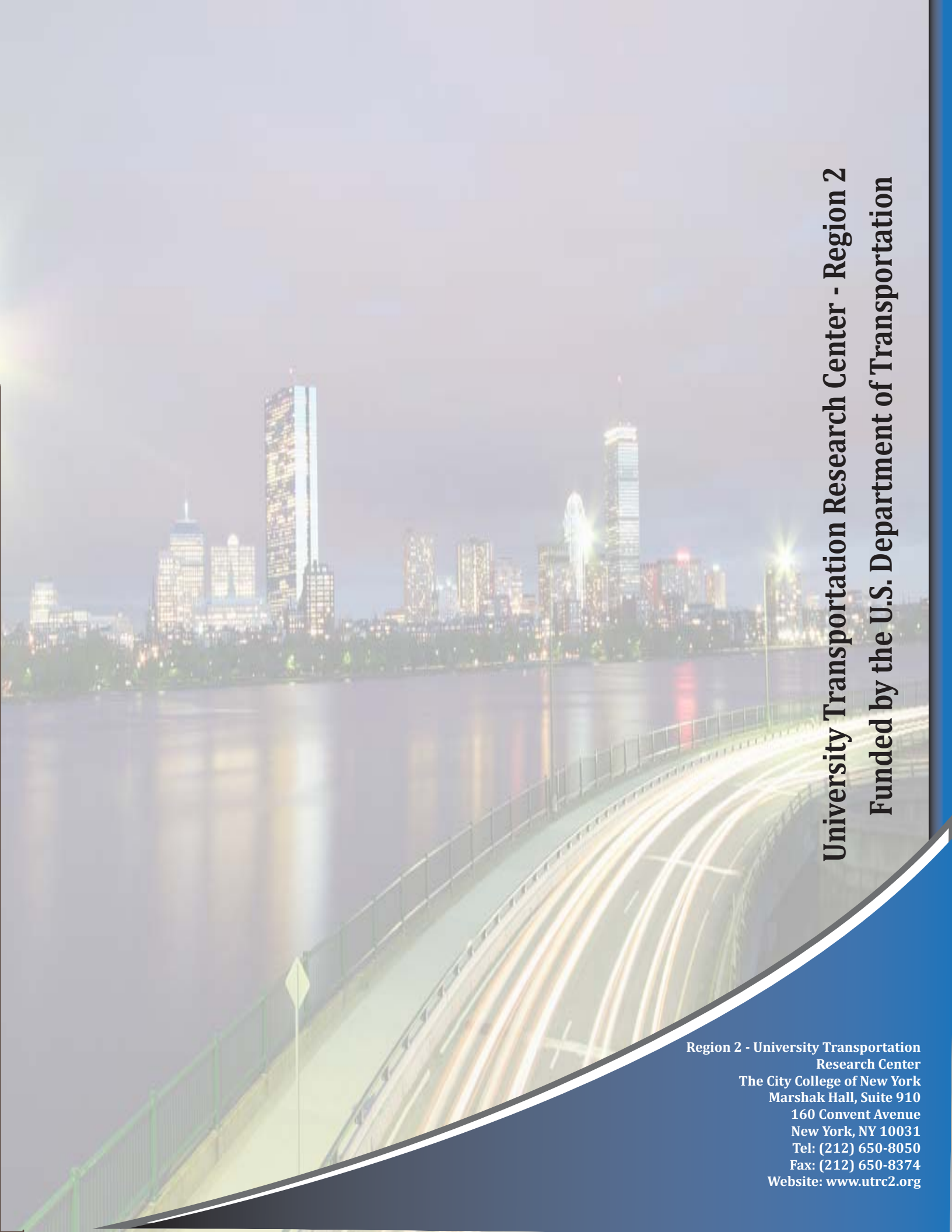
on autonomous and connected vehicles, which could lead to shared mobility. He added that there is a limit to the use of car-pooling.

Maureen compared occupancy limits in a restaurant to occupancy in Manhattan. Just like there are safety and capacity considerations in a restaurant, there should be in the City as well because “Occupancy on Manhattan Island can become dangerous. There is a load factor to natural capital.” She also pointed out that one of the dangers is that emergency response times are taking longer.

After this discussion, the audience was invited to ask questions.

An audience member agreed with emphasis being placed on measurement. He also stated that freight movement in NYC also includes movement of solid waste. Maureen responded that all enterprises, such as materials management, transport, energy enterprise, all has a land and water component. Her discussion during the conference laid out the “skeleton, but there are muscles too.”

Another question was about how the model that Maureen discussed could apply as a tax credit. Maureen responded that the idea of her model was not to reduce everything to money and that capacity could have value other than money. She indicated that they could be air emission credits or water credits. However she did agree that there could come a point where we could translate some of the savings into some kind of tax benefit.



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