

# Innovation for a Sustainable, Equitable Transportation System

A U.S. DOT Volpe Center Thought Leadership Series / Final Report

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## 2 KEY TAKEAWAYS

### THE SPEAKERS

3 U.S. SECRETARY OF TRANSPORTATION PETE BUTTIGIEG  
U.S. DEPARTMENT OF TRANSPORTATION

5 A CLIMATE-RESILIENT FUTURE IS AN EQUITABLE, JUST FUTURE  
DR. ED CARR, CLARK UNIVERSITY

6 NET-ZERO AMERICA: POTENTIAL PATHWAYS,  
INFRASTRUCTURE, AND IMPACTS  
DR. ERIN MAYFIELD, PRINCETON UNIVERSITY

8 ADVANCING A JUST AND LOW-CARBON FUTURE  
WITH URBAN ELECTRIFICATION  
DR. MARILYN BROWN, GEORGIA INSTITUTE OF TECHNOLOGY

9 THE TRANSPORTATION AND CLIMATE INITIATIVE:  
MULTI-STATE COLLABORATION TO ADVANCE EQUITABLE  
LOW-CARBON TRANSPORTATION  
DR. JAMES BRADBURY, GEORGETOWN UNIVERSITY CLIMATE CENTER

11 TOWARD CARBON NEUTRAL MOBILITY  
DR. TIM WALLINGTON, FORD MOTOR COMPANY

12 MOBILITY BEST PRACTICES AND E-MOBILITY DIVERSITY,  
EQUITY, AND INCLUSION IN ACCELERATING EV ADOPTION  
DR. SHELLEY FRANCIS, EVNOIRE

14 APPLIED RESEARCH INFORMS STRATEGIES TO OVERCOME  
TRANSPORTATION BARRIERS FOR RENT-BURDENED RESIDENTS  
DR. SUSAN SHAHEEN, UNIVERSITY OF CALIFORNIA, BERKELEY

16 CONNECTING TRANSPORTATION PROFESSIONALS AROUND THE GLOBE

# Innovation for a Sustainable, Equitable Transportation System



Between May and October 2021, the Volpe Center's "Innovation for a Sustainable, Equitable Transportation System" brought thousands of people around the world together to hear insights and perspectives from eight prominent public, private, and academic transportation professionals. U.S. Transportation Secretary Pete Buttigieg opened the series and welcomed participants after an introduction by Deputy Assistant Secretary for Research and Technology Dr. Robert Hampshire.

The annual speaker series pivoted to an exclusively virtual experience in response to the Covid-19 pandemic. This format enabled the Volpe Center to showcase guests located across the U.S., and expanded opportunities for listeners to participate in dialogue with guests. Volpe Center Director Anne Aylward hosted and moderated each of the six events.

The Volpe Center's mission is to advance transportation innovation for the public good; it is uniquely positioned to convene thought leaders who raise challenging questions and offer novel solutions to the most pressing problems facing our transportation enterprise.

This year's speakers explored how we work together to address the profound climate crisis while ensuring that decision-making and investments also address transportation equity. Solutions to these complex challenges require a comprehensive approach to reducing transportation emissions and to enhanced equity and sustainability initiatives.

Expert guests brought their bold visions for topics like energy sector transformation to achieve net-zero emissions, urban electrification and impacts on the national grid, and techno-economic pathways from the microeconomic, such as individual subsidies to incentivize travel behavior—to the macroeconomic, such as creation of regional cap-and-invest carbon markets.

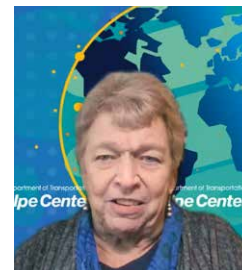
They challenged transportation professionals to think critically about the ways in which the communities that have borne a disproportionate burden of transportation emissions' health and environmental impacts can be centered in, and central to, planning and development processes at local, regional, state and federal levels, and in public, private, and academic sectors.



U.S. Transportation Secretary Pete Buttigieg opened the series.



Deputy Assistant Secretary for Research and Technology Robert Hampshire delivered remarks and introduced the Secretary. U.S. DOT Volpe Center Director Anne Aylward hosted and moderated the series.



# Key Takeaways

Each speaker interpreted the theme “Innovation for a Sustainable, Equitable Transportation System” in a unique way and through the lens of their academic research, corporate responsibility, or public policy work.

All of the speakers, however, agreed that social, racial, and economic justice and equity are bound together with environmental sustainability and resilience in the face of climate change. In some ways, this represents a fundamental shift that produces different—and often more effective—technologies, markets, and policy outcomes.

Deputy Assistant Secretary for Research and Technology Dr. Robert Hampshire, who also serves as the Department’s Chief Science Officer, underscored at the series kick-off, “this is a pivotal and exciting moment for discussions of sustainability and equity in transportation.” Read on for major themes across the series and overviews of each thought-provoking lecture.

## **KEY TAKEAWAY #1:**

Electrification and decarbonization of our energy sector, vehicle electrification, and automated technologies will transform the nation’s transportation system.

This transformation is environmental: we can dramatically reduce tailpipe greenhouse gas emissions and improve air quality; it is physical: our places and spaces are going to rapidly evolve to accommodate electrification’s necessary infrastructure; it is economic: new consumer markets for electric vehicles (EVs) and related parts, equipment, and technologies will grow, spurring new labor markets; and it is social: we can redress burdens borne by disadvantaged communities.

## **KEY TAKEAWAY #2:**

Massive federal investment can bring transformational change, especially when that investment enables regional and multi-state collaborative approaches to mitigating climate change impacts.

The timing of this year’s series coincided with a major effort to enact President Biden’s Bipartisan Infrastructure Law (BIL), which injects more than \$1 trillion into the U.S. economy. The law takes a holistic view of infrastructure, addressing traditional roadway maintenance with projects like electric utility transmission infrastructure, building the resilience of transportation facilities to extreme weather, and the expansion of broadband—a critical component of a fully connected and automated transportation system.

## **KEY TAKEAWAY #3:**

Centering equity in sustainable transportation initiatives is critical, and requires new research methods, engagement activities, and planning processes.

As we leverage new technologies, data models, analyses, and other tools to realize a sustainable transportation system, it is critically important to humanize transportation through storytelling, stakeholder engagement, and by centering the people who are most at risk. Acknowledging the unintended consequences of policy decisions improves trust, and fosters a balance between technocratic decision-making and participatory and cooperative solutions.



# The Speakers



## SECRETARY PETE BUTTIGIEG

U.S. DEPARTMENT OF TRANSPORTATION

JUNE 2, 2021

Secretary Buttigieg, the nation's 19th transportation secretary, previously served two terms as mayor of his hometown of South Bend, Indiana. There he worked to transform South Bend's future and improve people's everyday lives, launching a "Smart Streets" initiative to improve street design in the downtown and the historically under-resourced West Side. This Complete Streets strategy led to small business growth along previously neglected corridors, and hundreds of millions of dollars in new private investment. His leadership helped spark citywide job growth and facilitated innovative public-private partnerships.

### ENORMOUS CHALLENGES, ENORMOUS OPPORTUNITIES

Even before the economic, social, and personal impacts of the coronavirus pandemic, it was clear that the status quo was not working for many Americans, and moving past the pandemic offers an opportunity to act in new and different ways and with a renewed sense of purpose. For a federal entity like the Department of Transportation, this means leveraging innovation in service of important public policy goals. According to Secretary Buttigieg, the enormous challenges of the past year also offer enormous opportunities to identify the "era-defining climate and equity innovations of our time" as we are at the cusp of a transformational moment.

Secretary Buttigieg pointed to federal legislation as the vehicle for confronting a range of transportation policy issues that have had real-world impacts; for example, policies that encouraged the construction of interstate

highways in numerous cases bifurcated or destroyed minority communities. And, a focus on vehicular infrastructure has led to safety inequities among pedestrians and cyclists—so much so that the pedestrian fatality rate for Black Americans is twice that of white pedestrians.



Today's investments in infrastructure shouldn't mimic the investments of the past; "We know we should put the human being at the center of our transportation" and that should be reflected in the design of roadways, complete streets models, and incentives and resources available to encourage pedestrian and bicycle activity and alternatives to driving.

Leveraging strategic public investment will address issues of fairness and justice, reduce pollution, and mitigate the impacts of climate change; this commitment to both equity and climate intervention is woven into the mission of the Department.

### A FERTILE AND TRANSFORMATIVE PERIOD: ELECTRIC VEHICLES AND AUTOMATED TECHNOLOGIES

Secretary Buttigieg highlighted how job creation is inseparable from addressing climate and equity, noting that major legislation would not only create millions of jobs, but would include retrofitting buildings, installing electric vehicle charging stations, laying new transit lines, and expanding rail to new communities—all steps that ultimately reduce carbon emissions; infrastructure, climate, equity, and job creation are closely linked.

According to Secretary Buttigieg, electric vehicle (EV) production and adoption is one of the transformative activities the Department is engaged in. He noted the

importance of evaluating EVs through an equity lens, countering the idea that they are a luxury item. Rather, EVs can save enormous costs over time and can be more impactful for low-income Americans and those in rural communities, offering more mobility options where they are most needed.

The federal vision includes a network of 500,000 EV chargers around the country, making a public investment to ensure that Americans are not left underserved by private charging stations. Critically, U.S. DOT's work on EVs is happening in partnership with the Department of Energy to ensure that innovations are fully informed by—and responsive to—a representative range of issues and experiences.

In the automated vehicle (AV) space, Secretary Buttigieg said that while there is “exciting efficiency potential,” there remain numerous research questions to explore and concerns to be addressed. Likening the adoption of AVs to the difference between air travel and space travel, Secretary Buttigieg emphasized the opportunity for AVs to transform mobility options for those with disabilities, and also to spark massive shifts in land use patterns by reducing surface parking needs. He noted that there remain “tremendous concerns” around emissions; however, as researchers and policy-makers work to understand whether AVs could lead to a proliferation of vehicles on the road, and work with industry to understand “vehicles as a service.” The Department's research and innovation agenda will consider important “second-order effects” like land use, family commuting patterns, and macroeconomic consequences of widespread adoption of AVs.

## **CULTIVATING EQUITY IN THE TRANSPORTATION SECTOR**

Under Secretary Buttigieg's leadership, the U.S. DOT is overseeing investments in a sustainable and equitable transportation system that affects the lives of Americans across the country on a daily basis; internally, the Secretary also discussed his plans for diversifying the DOT's workforce and supporting equity in the transportation industry. Secretary Buttigieg emphasized the importance of paying special attention to those who have not historically seen themselves reflected in transportation leadership, including women and people of color. He noted, “We need a new call to service to make sure people know they can be a part of the transformational activities happening in the 2020s.”

## **PARTNERSHIPS FOR SUSTAINABILITY**

In framing prospects for innovation for a sustainable and equitable transportation network, Secretary Buttigieg discussed the vital role of partnerships and collaboration. At local levels, much work is implemented by state DOTs and metropolitan planning organizations (MPOs). The U.S. DOT plays a role in identifying the states that are engaged in innovative problem solving and who are committed to not repeating the mistakes of the past. At the federal level, interagency work with the Department of Energy and the Department of Housing and Urban Development on issues like alternative fuels and transit-oriented development can help U.S. DOT in creating a cleaner, more equitable transportation system.

# A Climate-Resilient Future Is an Equitable, Just Future

## DR. ED CARR

CLARK UNIVERSITY

JUNE 8, 2021

Dr. Edward R. Carr is the director of Clark's International Development, Community, and Environment program and the director of the Humanitarian Response and Development Lab. He is a lead author for Working Group II of the Sixth Assessment Report of the Intergovernmental Panel on Climate Change and is the author of a monograph titled *Delivering Development: Globalization's Shoreline and the Road to a Sustainable Future*.

### CLIMATE-RESILIENT DEVELOPMENT PATHWAYS

The Ghanaian village of Dominase provided the foundation for Dr. Carr's exploration of decades-long trends in agricultural and economic development, changing weather and climate patterns, responses to vulnerabilities, and resilience.

His story stretched back more than century to a community that went through a cycle of development, expansion, and ultimately abandonment resulting from the twin challenges of drought and timber industry collapse. Dr. Carr emphasized that resilience "is not a response to specific impacts," rather, the combination of responses over time resulted in new vulnerabilities that affected different community groups in profoundly different ways. One significant takeaway from the experience in Dominase is to think carefully and critically about the question, "To what are our resilience-building interventions vulnerable?"

### JUSTICE, EQUITY, AND THE SUCCESS OF TRANSFORMATION

According to Dr. Carr, vulnerability to climate change has three components: exposure, sensitivity, and adaptive capacity. While humans in a given locale may all be equally exposed to the same event or climate impact (e.g., drought, severe storms, wildfires, etc.), there is huge variability in how sensitive or susceptible to negative effects particular groups of individuals may be. Further, among various groups of people there will be variability in their capacity to adapt to those events or impacts.



Certainly, adaptation actions will never benefit everyone equally, and an equity lens must frame the entire process from problem identification to generation of potential solutions. These pathways can vary at the neighborhood and community levels, city and state levels, and country levels.

In addressing our current situation, Dr. Carr refers to the literature on global climate change to underscore the need for major transformational change as the only effective response to safeguard and promote our future well-being; incremental pathways will be ineffective at adapting to the impacts that are inevitable. It is important for us to invest now in the transformations we choose, rather than adapting to the transformations imposed on us by major environmental shifts. Adhering to a pathway marked by reactionary recoveries and limited investments or policy change could result in "path determination," where it becomes impossible to achieve the outcomes associated with transformational interventions.

# Net-Zero America: Potential Pathways, Infrastructure, and Impacts



## THE PURPOSE AND POWER OF STORYTELLING

Conceiving and implementing transformational changes in response to climate change will require the participation of a constellation of actors across communities, cities, and nations. Dr. Carr maintains that one of the most effective tactics for engaging both the public and policymakers is identifying and telling compelling stories about exposure, sensitivity, and adaptation to climate change over time in different locations. Although there is a complex interplay among these three elements, the “complexity is a pathway to hope.” The academic field of environmental humanities offers a framework for working toward transformational, equitable, and just climate change adaptation actions.

## DR. ERIN MAYFIELD

PRINCETON UNIVERSITY

JUNE 22, 2021

Dr. Erin Mayfield is a sustainable systems engineering and public policy researcher and postdoctoral scholar at Princeton's Andlinger Center for Energy and the Environment and the High Meadows Environmental Institute.



## MODELING AFFORDABLE AND TRANSFORMATIONAL DECARBONIZATION SCENARIOS

While policymakers discuss high-level domestic and global imperatives to reduce carbon emissions, researchers like Dr. Mayfield and the Net-Zero America team are leveraging a multidisciplinary approach to modeling “least cost” alternative techno-economic pathways to emissions targets by 2050.

Rooted in a framework of six pillars of decarbonization, the Net-Zero America investigation considered five scenarios; the study is unique in its examination of the broad contours of domestic energy supply transformation as well as the details regarding planning and investment decision-making. The modeling tactic produces a more geographic and temporal granularity than prior studies.

The research highlighted that transitioning to net-zero by 2050 will require significant mobilization of capital, and an up-front investment of more than \$3 trillion in the 2020s alone—more than double the study team's “no new policies” reference case.



## SUSTAINABLE AND EQUITABLE PATHWAYS CAN SPUR JOB CREATION AND TRANSFORM THE DOMESTIC WORKFORCE

The research process emphasized transformational shifts in domestic energy supply, including significant transitions from fossil fuels to renewable sources of energy for both industrial and residential applications, electrification of our multimodal transportation network including electric vehicles, and improved efficiencies in meeting the energy needs of buildings and structures. All the pathways to transition to net-zero emissions, Mayfield presented, will spark transformations in capital mobilization, physical infrastructure, the energy workforce, air pollution, and public health.

Dr. Mayfield's data was mapped and modeled at national, state, and, in some cases, county-level scales, producing scenarios that quantified the effects of net-zero energy by 2050 on our labor force while taking into consideration training and workforce development, population shifts, land use patterns and development requirements, and dozens of other factors and sensitivities. Across the five scenarios described in the Net-Zero America report, all result in direct job creation, with the most transformational scenarios resulting in 8 million energy sector jobs and an expansion in the share of the U.S. labor force employed in the energy sector from 1.5 percent in 2018 to 4 percent in 2050—a staggering rise.

Notably, Dr. Mayfield stressed the importance of a balanced transformation that acknowledges the heterogeneity of potential workforce and economic benefits. While all scenarios resulted in national net increases in energy jobs, there will be early declines in regions that are fossil fuel industry strongholds. She noted, "It is important to help facilitate an equitable and just transition ... to deliver on the transitions."

## CO-BENEFITS, TRADEOFFS, AND IMPACTS

The Net-Zero America analysis is not predictive; rather, the models produce scenarios that can be compared against one another and against a "no new policies" or status quo scenario. This allows policymakers to weigh a range of trade-offs and "co-benefits," which are indirect positive impacts.

Each of the five scenarios reveals significant co-benefits to air quality and public health. For example, decarbonization, the researchers found, can avoid more than 100,000 premature mortalities by 2050 through pollution reduction.

Dr. Mayfield's work depicts the range of possibilities for meeting net-zero energy objectives while positively impacting employment and labor force participation. She noted that while policymakers have not reached consensus on a specific pathway, current legislative proposals reflect a magnitude of investment—and investment in the categories of energy generation—that is consistent with a commitment to net-zero goals over at least the next 10 years.

Net-Zero America's findings, including a web portal with downloadable data sets, can be found at [NetZeroAmerica.Princeton.edu](https://NetZeroAmerica.Princeton.edu).

# Advancing a Just and Low-Carbon Future with Urban Electrification



## DR. MARILYN BROWN

GEORGIA INSTITUTE OF TECHNOLOGY

JULY 20, 2021

Dr. Marilyn Brown is the Regents' and Brook Byers Professor of Sustainable Systems in the School of Public Policy, Georgia Institute of Technology. She created and co-leads Georgia Tech's Climate and Energy Policy Lab and the Master of Sustainable Energy and Environmental Management program.

### A “DECISIVE DECADE” FOR ENERGY TRANSFORMATION

Brown's research focuses on the design and modeling of energy markets and carbon-reduction policies and programs, highlighting opportunities on the customer side of the electric meter—including energy end-use efficiency, rooftop solar systems, vehicle-to-grid interactions, smart thermostats, and home storage devices.

The 2020s, according to Brown, will be a “decisive decade” because solutions to the climate crisis will be critical to long-term prosperity. Urbanized areas and cities, which globally consume about 75 percent of energy and generate 75 percent of worldwide CO<sub>2</sub> emissions, are at the forefront of the emerging field of urban electrification. This includes not only electric vehicles (EVs), but increases in the use of electric heat pumps, induction ranges, and advanced manufacturing using electrified equipment.

### ELECTRIC VEHICLES' CONTRIBUTION TO RESILIENCE

From Brown's perspective, transportation is the sector that will likely undergo the most rapid increase in electrification; if the grid is producing electricity with renewables, there can be significant reductions in transportation-related CO<sub>2</sub> emissions. Policies to speed up decarbonization can hasten this shift,

and according to Brown, by 2030, the U.S. electricity mix is forecast to be approximately 50 percent fossil fuels and 50 percent renewables.



Novel developments in vehicle electrification are expanding opportunities to build resilience to the impacts of climate change. EVs can also contribute to the security of electricity systems and potentially provide grid services in three ways. First, grid-to-vehicle (G2V) services include demand response and coordinated charging. Next, vehicle-to-buildings (V2B) services can include emergency backup and negative demand response. Finally, vehicle-to-grid (V2G) services like voltage control and frequency regulation offer market opportunities that can strengthen the electricity grid.

### ASPIRATIONAL AND ACHIEVABLE

Crucially, Brown pointed out the imperative to consider urban electrification and EVs through a justice and equity lens. Currently, low-income households have less access to EV charging, lower rates of EV ownership, and lower participation in energy-efficiency programs and services. “A policy makeover is needed to promote an equitable energy transition across all sectors of the economy, including transportation,” according to Brown. Initiatives like Justice 40 are outlining the contours of such a policy makeover.

In concert with major federal policy initiatives, local climate action plans must include high-impact solutions that are tailored to local geographic contexts. In 2019, Brown began the multi-year Drawdown Georgia project, an initiative to identify a strategy to significantly cut the carbon footprint of the state of Georgia, modeled after the global Project Drawdown project. The effort in Georgia analyzed dozens of potential emissions-reduction tactics, considering criteria such as market readiness and cost competitiveness.

## The Transportation and Climate Initiative: Multi-State Collaboration to Advance Equitable Low-Carbon Transportation



The team selected 20 solutions across five sectors of the economy, including transportation. The solutions created a “roadmap” to bridge gaps between state and local planning efforts; many solutions, like the expansion of mass transit, offered co-benefits beyond climate impacts, including equity, economic development and job creation, public health, and environmental quality. Brown’s work with the Drawdown Georgia project contends that Georgia can reduce its carbon footprint by 50 percent by 2030, an aspirational and achievable decline in CO<sub>2</sub> over a 25-year period.

### **DR. JAMES BRADBURY**

**GEORGETOWN UNIVERSITY CLIMATE CENTER**

**AUGUST 3, 2021**

Dr. James Bradbury is the Mitigation Program Director at the Georgetown Climate Center, Georgetown University Law Center. He oversees the Climate Center’s work in support of state efforts to reduce greenhouse gas emissions and manages the Transportation and Climate Initiative, a collaboration among 13 Northeast, Mid-Atlantic, and Southeastern states and the District of Columbia to reduce emissions from the transportation sector:



### **CENTERING EQUITY IN A LOW-CARBON TRANSPORTATION INITIATIVE**

Dr. Bradbury highlighted the importance of federal leadership in building momentum to mitigate climate change impacts, particularly in overburdened communities. Bradbury’s work with the Georgetown Climate Center builds on climate-related federal policies and investments, working at the nexus of federal and state policy and serving as a resource to states and jurisdictions. He noted that today the U.S. has a “historic opportunity to cut greenhouse gas emissions.”

Bradbury’s team manages and facilitates the Transportation Climate Initiative (TCI), a regional collaboration of 13 Northeast, Mid-Atlantic, and Southeast states and the District of Columbia designed to create equitable and just low-carbon transportation policies and programs. TCI’s goals are to:

- Reduce carbon dioxide (CO<sub>2</sub>) emissions from transportation sources;
- Improve air quality and public health, increase resilience to the impacts of climate change,

and provide more affordable access to clean transportation choices;

- Promote local economic opportunity and create high-quality jobs;
- Maximize the efficiency of this multi-jurisdictional program to ensure greater benefits; and
- Advance equity for communities overburdened by pollution and underserved by the transportation system.

### EXPLORING INNOVATIVE SOLUTIONS SUCH AS “CAP-AND-INVEST”

One of the innovative low-carbon solutions modeled by TCI is a multi-state, multi-jurisdictional “cap-and-invest” program. A cap-and-invest approach establishes an emissions cap for regulated fuel suppliers and a marketplace for auctioning CO<sub>2</sub> emissions credits. Participating jurisdictions then invest the proceeds from those auctions in low-carbon strategies that create clean, safe, and affordable transportation options.

As the cap declines over time, CO<sub>2</sub> emissions are reduced, and remaining emissions credits can potentially generate more value at auction. Each participating state has sole discretion for investment decisions within the framework of reducing pollution, advancing equity, and providing expanded and diversified transportation choices.

Equity goals can be realized by defining, for example, a floor or minimum share of proceeds that must benefit underserved and overburdened communities (the proposed floor in the TCI program is 35 percent). Other ideas developed by participating TCI jurisdictions include a lockbox provision (where cap-and-

invest funds are set apart from other state revenues), equitable public engagement processes like citizen advisory bodies, transparency initiatives (such as air quality monitoring and emissions reporting, and additional policies like clean car and clean truck standards).

### THE POWER AND POTENTIAL OF A REGIONAL APPROACH

In June 2021, four TCI jurisdictions that signed a memorandum of understanding (MOU) released a model rule and draft plans for public engagement and program implementation. Modeling facilitated by the Georgetown Climate Center on behalf of participating jurisdictions shows that the cap-and-invest program can reduce CO<sub>2</sub> emissions by 26 percent between 2022 and 2032. Continued progress will happen with complementary policies at the federal and state levels.

To assess the impact of investments, the Georgetown Climate Center helped develop an investment strategy tool that features 26 different strategies, from EV incentives and non-motorized transportation infrastructure to investments in transit systems and efficient fleet vehicles. Modest but net positive impacts on income, jobs, and the regional economy outweigh initial costs of program implementation. Monetized co-benefits to public health in the form of fewer cases of childhood asthma and avoidance of premature deaths are modeled at up to \$3.6 billion by 2032—a staggering effect.

Working across state and district boundaries can be challenging, but TCI offers a roadmap for jurisdictions to leverage standardized regulatory language, a common CO<sub>2</sub> emissions auction market, and shared best practices. TCI’s MOU provides a solid foundation to support future state-level enabling legislation for low-carbon transportation initiatives.

# Toward Carbon Neutral Mobility



## DR. TIM WALLINGTON

FORD MOTOR COMPANY

AUGUST 24, 2021

Tim Wallington, PhD, is a senior technical leader, research and advanced engineering in the Research and Innovation Center at the Ford Motor Company in Detroit and an adjunct professor at the University of Michigan. He works to understand local, regional, and global environmental impacts of transportation and has coauthored 540 peer-reviewed scientific publications, 26 book chapters, and seven books dealing with various aspects of vehicle emissions and environmental impacts.

### GLOBAL TRENDS INFORM CORPORATE COMMITMENTS

While it may be hard to predict the future, there is clear evidence of a significant increase in global average temperature and atmospheric CO<sub>2</sub> since the Industrial Revolution. The Paris Climate Accord calls for limiting global average temperature increases to no more than +1.5°C above pre-industrial levels.

Indeed, Ford Motor Company, which invests in a team of scientists and engineers who study climate change, energy, sustainability, and innovation, has made a corporate commitment to doing its part to keep climate change below +2°C and aspires to achieve carbon neutrality by 2050.

According to Wallington, Ford's corporate aspiration is rooted in an analysis of the company's emissions that is based on the Carbon Disclosure Project's projections; the analysis revealed that 75 percent of Ford-related emissions are associated with the use of the vehicles the company manufactures, and an additional 20 percent of emissions (a combination of activity generated by suppliers and supply chain, factories, and facilities) can be addressed with internal emissions reductions policies and programs. A 2050 carbon-neutrality plan that includes interim targets is science-based and aims to reduce vehicle use related emissions by 50 percent by 2035 (from 2019 levels)

and reduce manufacturing and facilities related emissions by 76 percent (from 2017 levels).



### UNDERSTANDING THE CONTOURS OF TRANSPORTATION SECTOR EMISSIONS

One of the hallmarks of Ford Motor Company's research approach is lifecycle analysis, which produces a comprehensive and wide-ranging output. Wallington places CO<sub>2</sub> emissions in a global context, comparing domestic emissions by sector; the transportation sector—and primarily surface transportation vehicles—produces just under 40 percent of U.S. CO<sub>2</sub> emissions. But he asks a critical follow-on question about where road-sector emissions come from.

The answer is the result of an expansive research effort by the International Transport Forum (ITF), an intergovernmental organization with 63 member countries. ITF's analysis compares numerous powertrain technologies (such as traditional internal combustion gas and diesel engines, battery electric vehicles, fuel-cell electric vehicles, and others) against different categories of activity such as vehicle and battery production, fuel production and delivery, and tailpipe emissions.

Fuel use dominated the emissions lifecycle, so Wallington asserts that aggressive plans for electrification are necessary to achieve climate goals. "Transformational change is underway in the global automotive industry," according to Wallington and Ford is prioritizing the full electrification of its "iconic brands" (the F-150, Transit, and Mustang). Ford Motor Company is investing approximately \$30 billion in offering electric vehicles to markets around the world.

### OPPORTUNITIES FOR OPTIMISM ABOUT CARBON-NEUTRAL MOBILITY

Wallington acknowledged that reducing and mitigating climate change is a daunting challenge, but there have been



## Mobility Best Practices and E-Mobility Diversity, Equity, and Inclusion in Accelerating EV Adoption



“remarkable changes in the past decade in renewable electricity progress, including a dramatic decline in the costs of solar and wind renewable energy.” What’s more, recent historical trends show that decarbonization and emissions reduction are compatible with economic growth as measured by GDP. He notes that “we’ve done hard things in the past” with respect to improving air quality and eliminating the use of chlorofluorocarbons.

Recent research reveals significant progress in battery efficiencies, which can help remove barriers to the adoption of battery-powered electric vehicles, and potentially higher demand based on new federal and state climate policies and regulations. Other carbon-neutral fuel options, including biofuels, hydrogen fuel cells, and synthetic “e-fuels,” are being compared across a range of criteria, from compatibility with existing fleets and fuel delivery infrastructure to energy density and raw material needs.

According to Wallington, the largest changes in the automotive industry in the past century are happening right now, “... the connectivity revolution and automation revolution, together with the electrification revolution will greatly affect urban traffic patterns, energy use, and emissions.” These advances are likely to dramatically transform the mobility landscape.

### **DR. SHELLEY FRANCIS**

**EVNOIRE**

**SEPTEMBER 14, 2021**

Dr. Shelley Francis is the co-founder and principal of EVNoire, which focuses on e-mobility best practices and e-mobility diversity, equity, and inclusion (DEI) and electrification strategies. Francis serves as a National Board Director for the Electric Auto Association.



### **HISTORICAL CONTEXT FOR PUBLIC POLICY IMPACTS ON EQUITY**

In the 1980s, researchers and activists identified the disproportionate burden of environmental degradation on minority and low-income populations. The term “environmental justice” came to describe the intersection of human rights or social justice activism and environmentalism. Today, “frontline communities” describe those who face disproportionate and significant impacts of climate change, from extreme weather and sea-level rise to pollutant exposure and reduced air quality.

According to Francis, “EVNoire envisions a world where electric vehicles are widely accessible and empower frontline communities who are impacted first and worst by climate change.” The company believes that engaging frontline communities is the key to unlocking the potential of electrification.

Francis discussed housing and transportation policies enacted generations ago that created and exacerbated inequalities among racial and ethnic minorities. Policies and practices like real-estate redlining have resulted in significant disparities in home-ownership rates, and transportation policies that created the interstate highway system and other roadway development projects bisected historically Black and Brown communities,

leaving a legacy of isolation and lack of access to a variety of services. A new focus on diversity, equity, and inclusion (DEI) in transportation and land-use policy could be one element of a restorative justice approach to right past wrongs.

## JUSTICE AND ACCESS TO NEW MOBILITY RESOURCES

Looking through this historical lens, Francis advocates for the expansion of electric vehicle (EV) charging infrastructure and EV sales in minority and economically diverse communities. Francis underscored that engaging frontline communities is the key to unlocking the potential of electrification.

Recently, Francis worked closely with the City of Kansas City, MO and a group of partners on a pilot project to install EV charging infrastructure on the streetlight system. The three-year project, which began in 2021, is designed to test and demonstrate the benefits of curbside charging for plug-in electric vehicles at existing on-street parking locations. Francis gathered feedback from diverse communities on EV charging locations and then worked with stakeholders to map charging sites that provided equitable access. Her research revealed variations in preferences for charging locations based on race and income and resulted in a pilot-project that was more responsive to the needs of underserved populations.

Francis cited the burdens that minority and diverse communities face from roadway transportation emissions, including asthma and short-term effects like wheezing and skin irritation to long-term effects like cardiovascular disease, respiratory disease, and impacts on other major organ systems.

EVNoire promotes cleaner roadway transportation options in the form of plug-in EVs (PEVs) and has raised awareness about “charging deserts” in communities that are primarily Black and Brown; using an example from New York, Francis compared the number of charging stations in Manhattan’s Upper East

Side (70 stations) with East Harlem (seven charging stations). Factors that may be correlated to this disparity include wide variations in home ownership rates and median incomes in these communities.

## AN ENGAGEMENT MODEL THAT CENTERS ON DEI AND SUSTAINABILITY

Incorporating a DEI perspective into transportation policies and EV activities can help break down barriers to EV ownership in communities of color. Francis noted that it is critical to build relationships with industry and equipment manufacturers to ensure that e-mobility is a diverse and inclusive sector; and that historically over-burdened communities have access to new economic opportunities in the EV space.

This approach offers a model for engagement that centers on the stakeholders and communities who may have been excluded from transportation policymaking in the past. Efforts to support community-led solutions, convene affected communities and listen to their ideas, and build networks and relationships with trusted intermediary sources can create more inclusive ideas and practices around electrification and EV adoption.

# Applied Research Informs Strategies to Overcome Transportation Barriers for Rent-Burdened Residents



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Dr. Susan Shaheen is the co-director of the Transportation Sustainability Research Center of the Institute of Transportation Studies at the University of California, Berkeley, and the director of the Institute's Resilient and Innovative Mobility Initiative. She is a pioneer and thought leader in innovative mobility strategies and has authored 77 journal articles, more than 125 reports and proceedings articles, and 20 book chapters, and she has co-edited two books.

Shaheen is chair of the Transportation Research Board (TRB) Executive Committee. She received the 2017 Roy W. Crum Award from TRB for her distinguished achievements in transportation research. In May 2016, Shaheen was named one of the top 10 academic thought leaders in transportation by the Eno Transportation Foundation.

### THE CO-BENEFITS OF SHARED MOBILITY

The East Bay community in Oakland, California, features a robust network of transportation options: heavy rail Bay Area Rapid Transit (BART) trains, bus, paratransit, and shared mobility options including Lyft, Uber, Zipcar, bikeshare, scooter sharing, and moped sharing.

However, the neighborhood is also considered a "community of concern" by the Metropolitan Transportation Commission, the region's metropolitan planning organization (MPO). The designation is based on the anticipated social equity impacts of transportation planning projects. Many residents of the area are considered "low-income," and many others are considered "rent-burdened." The area also periodically experiences degraded air quality associated with vehicle emissions and traffic congestion.

Shared mobility is a transportation option that can meet environmental, sustainability, and equity goals by offering lower-cost and lower-emissions options to travelers. According to Shaheen, more research is needed into the unique transportation needs of low-income and rent-burdened populations to discover barriers to adoption of shared mobility services and potential policy options.



### TRAVEL BEHAVIOR OF RENT-BURDENED INDIVIDUALS

Shaheen's team developed a mixed-methods research plan that included a combination of focus groups, surveys, GIS analysis, and agent-based simulation modeling. One novel approach in this research was using "rent-burdened" as a screener metric instead of the traditional Federal Poverty Level metric. Rent-burdened individuals are those spending more than 30 percent of their income on housing. An extremely competitive housing market in Oakland and in the San Francisco Bay Area "captures a larger group of people than other definitions of 'low income'" according to Shaheen.

The study found that there was a high level of awareness of shared mobility services, but that in some cases travelers felt they needed more hands-on education and training. The presence of options like scooters on sidewalks was effective at encouraging people to try them out for the first time, but a spatial analysis revealed that some areas had a dearth of shared vehicles (cars, scooters, or bicycles). Key barriers to more widespread adoption of on-demand shared mobility services included lack of familiarity, high or unexpected costs, lack of vehicles, and the need to use an assortment of unique and different smart-phone apps to access services provided by different private vendors.

## RESEARCH-BASED POLICY SOLUTIONS TO INCENTIVIZE MODE SHIFTS

Shaheen was keenly interested in using agent-based simulations to understand the effectiveness of different public policy strategies. By leveraging the Behavior, Energy, Autonomy, and Mobility (BEAM) model developed by Lawrence Berkeley National Laboratory, Shaheen's team modeled incentives like fare/ride subsidies for different income groups and types of rides. The simulations revealed a likely network effect when subsidizing all pooled shared mobility riders regardless of income level or rent burden: public transit subsidies resulted in the greatest reduction of vehicle miles traveled (VMT).

From a policy perspective, adopting a "MaaS" or "mobility as a service" model can spark new and different approaches to achieve equity and sustainability goals. Discounted or fare-free transit, integrated mobility digital wallets, and a focus on an expanded group of users—the rent-burdened—can have significant impacts on regional transportation systems.

# Connecting Transportation Professionals Around the Globe

This year, the Volpe Center's speaker series reached thousands of people around the world—there were more than 9,000 event registrations from transportation professionals in Asia, Africa, Europe, Oceania, and North and South America.

Participants ranged from municipal transportation planners to corporate executives to senior government officials; the diversity of attendees produced rich dialogue and questions for discussion that pulled new intellectual threads. Many

follow-on questions sparked “What now?” conversations, prompting expert guests to offer their takes on implementation and the practical application of transportation innovations. The 2021 “Innovation for a Sustainable, Equitable Transportation System” series cultivated new connections and enabled broad engagement with today's weighty and meaningful transportation topics.

The 8 events of 2021's speaker series generated

more than **9,000** registrations  
from **33** countries on **6** continents.





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