Leveraging High-Resolution Transportation Data for Healthier Cities

EDF emerging issues workshop

Around the world, nine out of ten people breathe unhealthy air. Transportation – particularly fossil fuels that are burned to help people get around – is a major source of the air pollution that is threatening public health. Of the millions of premature deaths attributed to air pollution globally, transportation is estimated to be responsible for 1 in 10.

In cities, people are constantly exposed to pollution from cars, buses and trains. Pollutants from traffic, like NO_2, are estimated to be responsible for nearly 1 in 5 new cases of childhood asthma in major urban areas. And the health burden of pollution is not distributed evenly: Transportation emissions and pollutant concentrations are known to vary dramatically across neighborhoods in cities, meaning there are also important environmental justice and economic equity implications.

Yet air quality and health have often been left out of decisions that impact traffic emissions, such as infrastructure and public transit investments, congestion pricing and policies that promote EV adoption or reduce vehicle miles traveled.

Among other things, policymakers are often limited by:

(1) a lack of available data and
(2) a lack of collaboration across disciplines that makes it difficult to "connect the dots" among available information.

Fortunately, an enormous amount of data relevant to the transportation sector is increasingly available to city, regional and state officials. In the private sector, there are various "smart cities" technologies, such as telematics, traffic light and streetlight-mounted technologies, sensor air quality monitoring data and satellite data, and many opportunities for additional data collection exist. Experts in the academic sector are using diverse data sets and sophisticated modeling to provide insight into how transportation emissions are distributed in urban areas, and what impact those emissions have on air quality and health outcomes.

Looking to the future, transportation planners are seeking to meet critical priorities like optimizing traffic flow, improving safety and reducing climate emissions, while local governments are developing plans to accommodate multimodal transportation and disruptive technologies like electric and autonomous vehicles. As the transportation sector undergoes these seismic shifts, there is a critical need for good data and robust modeling. Data can help identify where, when and how policies can be designed to have the greatest impact in terms of reducing exposure to and health impacts from air pollution.

By taking into account the real-world health impacts of transport choices, planners can help create equitable cities that are not only more connected and efficient, but are also cleaner and healthier.

Participant Survey Responses – Connecting Policy & Science

The policies and research approaches in the following pages were compiled from a survey of policymakers and researchers participating in a workshop exploring how high-resolution transportation, emissions, air quality and health impacts modeling can be applied in tandem to inform policies to create healthier cities.

Survey respondents provided examples of current and emerging practice, as well as what they see as the biggest opportunities and obstacles to developing modeling and policy that can work in tandem to enable the development of a healthier, more sustainable urban transportation system. An aggregated summary table of these responses is below.

Policies that impact flow, composition, emissions and health impacts of transportation:

This is a non-comprehensive list, compiled from survey responses. During the workshop, please use this as a guide when exploring how different research and policy approaches can be combined in high-impact ways.

Low-Emission Zones/ Congestion Pricing	**Description:** - Tools available to cities & regions but rarely used in US. Internationally, cities like Beijing, London, Delhi, Mexico City and others deploy vehicle restrictions quite actively. **Opportunities:** - Limit or restrict the activities of vehicles, particularly freight traffic - based on their vehicle emissions performance. - In New York City, the Central Business District Toll Plan (CBDTP) is an opportunity to potentially have a real impact on congestion, VMT, and air quality. - Encourage multimodal transportation (e.g. walking, biking, escooters, ebikes, electric cars, and electric buses - Virtual geospatial fences could be used to enable hybrid-electric heavy-duty vehicles to automatically switch to zero emission operations when they enter overburdened urban areas. **Challenges:** - Fee structure must be truly effective in shifting people from personal vehicles to public - Public opposition to infrastructure change/ restrictions – (e.g. neighborhoods against bike/bus lanes b/c they lose on-street parking) - Creating business structure where public transport is the default mode of transportation rather than for-hire vehicles/ rideshare - Measuring vehicle emissions performance - Quantifying reduction vs. displacement of emissions/ air quality improvements and equity implications
Reduce Vehicle Miles Traveled (VMT)	**Description:** - Switching existing modes to zero-emission alternatives won't be enough to meet GHG reduction targets. Redesigning systems to reduce VMT is critical **Opportunities:** - Incorporate air quality & health benefits in high-density urban planning - Modernize public transit options using big data - Ensure uptake of ridesharing, other disruptive tech does not increase emissions **Challenges:** - Quantifying and predicting VMT requires extensive travel demand data/ assumptions that may change with disruptive tech.

Curb management & multimodal mobility systems	**Description:** - High-impact, readily available tool for cities/ local officials, starting with things like big data for parking enforcement. **Opportunities:** - Modernize using big data strategies, image analytics, remote sensing, pricing, customer information, new models for network and infrastructure management **Challenges:** - Governance & institutional barriers
Transportation Project Prioritization	**Description:** - Incorporate health & safety impacts as criteria for project prioritization & asset management. **Opportunities:** - Opportunity to integrate health impacts reduction into existing processes. **Challenges:** - Difficult to isolate transportation impacts on health from other socio-economic factors.
Vehicle fuel economy & emissions standards/ Fuel quality standards	**Description:** - Powerful tool to incentivize transportation-sector emissions reductions across vehicle types (e.g. HDVs, passenger vehicles). **Opportunities:** - Encourage better compliance in heavy-duty sector using PEMs, other tools. - Use vehicle activity & emissions data in modeling to track/ communicate benefits geographically **Challenges:** - Federal and state leadership needed (local governments can't do this on their own).
Clean Vehicle Incentive Funds/ Programs (incl. CMAQ)	**Description:** - Many COGs administer funding for clean vehicle projects (incl. EVs, alt. fuels & diesel retrofits. Project funding is often based on NOx cost per ton. **Opportunities:** - Public engagement is growing – COGs can launch initiatives for local governments to raise awareness & uptake of clean vehicle funds. **Challenges:** - Awareness of existing programs (e.g. CMAQ funds) is sometimes lacking, especially at the state level. CMAQ dollars often used interchangeably with other funds for road-building (missed opportunity for projects with bigger/ more targeted air quality benefits.
City Policy – Scale best practices	**Description:** - A few leading cities are using extensive local analysis to inform policy design and. These approaches need to be scaled up from these tens of leaders to thousands of cities that could benefit. **Opportunities:** - Find ways to generalize the insights from leading cities and appropriately contextualize them to inform actions in other cities. **Challenges:** - Lack of resources & time to conduct this kind of in-depth analysis for all cities that stand to benefit. - Communication of best practices difficult to scale up.
Freight/ Goods Movement – Regional policies	**Description:** - Truck incentive program to encourage use of cleaner trucks on major freight thoroughfares **Opportunities:** - Reducing emissions from heavy-duty trucks is likely the biggest opportunity we have to reduce health impacts of transportation sector. **Challenges:** - Requires state and regional collaboration & buy-in, which can be difficult to coordinate

Target diesel-fueled transportation	**Description:** - Eliminating diesel particulate matter exposure has a large health and climate benefit. **Opportunities:** - Use policies targeting diesel-fueled vehicles to generate strong climate & air quality co-benefits. **Challenges:** - Need for more data collection/ modeling to evaluate/ communicate benefits of these types of policies.
Climate Action Plan	**Description:** - Increasingly common mechanism for cities to outline policies and set targets for GHG reductions, including in transportation sector **Opportunities:** - Cities can design transportation policies with air quality co-benefits. - COGs and states can provide guidance/ facilitate regional coordination. **Challenges:** - Lack of resources/ political will to implement policies to meet ambitious targets - Need for more data to track/ communicate GHG, air quality, health and equity benefits of policies (and support implementation)
US Clean Air Transportation Conformity Process	**Description:** - In US, federally funded transportation projects must prove that transportation activities will not cause new air quality violations, worsen existing violations, or delay timely attainment of NAAQS. **Opportunities:** - Key link between environmental and transportation agencies & planning processes. - Can be used to implement new and innovative approaches to reducing emissions. - Projects can improve regional data collection and modeling. **Challenges:** - Process only required in non-attainment states. - In many locations, not used to full potential.
Regional Transportation Planning	**Description:** - COGs often manage collaborative planning processes with cities, counties, ports. **Opportunities:** - This process allows for a regionally integrated transportation system. - COGs also coordinate on related issues like air quality/climate, housing/homelessness, and economic development and can help align goals **Challenges:** - Lack of in-house expertise to conduct health risk or health impact assessments - Lack of connection to public health community - Limited funding and staff capacity

State Policies – California	**Description:** - CARB has established several policies to reduce both criteria & GHG emissions, in support of California's goal to reduce population exposure to transportation-related air pollution while at the same time promoting economic growth. These include: SB 1014 (California Clean Miles Standards), SB 375 (Sustainable Community Strategies), AB 617 (Community Air Protection Program), and Federal clean air act requirements to reduce transportation related emissions. **Opportunities:** - Clean cars – target 4 million EVs on the road by 2030 - Sustainable Freight – Transition to zero-emissions where possible and near-zero everywhere else. - Clean Transit – 100% of new buses electric & High-density, transit-oriented development. - Evaluate GHG emissions from ride sharing & inform policies to increase equity of access/ sustainability. - Comprehensive planning efforts to reduce VMT **Challenges:** - California will not achieve the necessary greenhouse gas emissions reductions to meet mandates for 2030 and beyond without significant changes to how communities and transportation systems are planned, funded, and built. - To evaluate these new policies' effectiveness in advancing public health, equity, accessibility and sustainability goals, state, regional, and local agencies need more and different types of data than what has historically been tracked.
US Federal Policies - EPA	**Description:** - Information about health impacts from transportation informs regulatory development, voluntary initiatives to accelerate the retirement of higher polluting vehicles equipment, and engagement with disproportionately burdened communities. **Opportunities:** - New round of heavy-duty truck NOx emissions standards - Policies to address high emitting vehicles - Operational efficiency improvements in 'hot spot' areas **Challenges:** - Quantification of high emitters, other than those with old engines (tampered vehicles, gliders, or those with deteriorated emissions controls). Expanded roadway monitoring/remote sensing of motor vehicle emissions can close these gaps.

Research approaches to better understand emissions, air quality and health impacts of transportation:

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Measure Vehicle Emissions	**Description:** - Use remote sensing, PEMs testing, and on-board diagnostics to get a better picture of the health impact of transport emissions **Opportunities:** - In cities, use data to advance green loading zones, e-cargo bikes, truck weight regulation enforcement, etc. - Application of real-world vehicle emissions measurements to design and evaluate the impacts of local emission control policies at a higher level of spatial resolution. - Leverage these data sources to enhance emission inventory analyses. - Apply air quality and health assessment tools to rapidly evaluate benefits. **Challenges:** - Difficult to evaluate and communicate potential effects of planning and policy decisions at high spatial resolution. This is important for addressing pollution hotspots, maximizing benefits for health, and building the political will needed for ambitious action.
Mobile Source Emissions Modeling	**Description:** - Computer simulation models that use high-resolution (such as vehicle registration databases, telematics, instrumented vehicle data) to estimate the impact of transportation related activities on air quality and climate change. **Opportunities:** - Collecting and analyzing Big Data from mobile devices (spec. location records created by connected cars and trucks, smartphones, and wearables) can provide comprehensive travel pattern information. - Use of telematics and cell phone data to answer policy questions related to passenger and freight transportation systems. - Automated license plate readers (ALPR) can be installed on highway overpasses, street poles, or streetlights and used to capture all license plate numbers that come into their view. Using data from this system, we can more accurately estimate how many cars and trucks pass through different regions and communities, and the age and model year of these vehicles. **Challenges:** - New policies in CA require much more data to evaluate progress in advancing public health, equity, accessibility, and sustainability. - Transportation data is not collected at the resolution necessary to understand whether, how, and why people are shifting their travel patterns - High costs and the time required to collect and analyze travel behavior data using conventional tools can prevent us from answering our questions efficiently and empirically.
Transformative Transportation Technologies	**Description:** - Emerging technologies will change behavior of the transportation system. Public acceptance and use of new mobility services & AVs drives vehicle activity/ mix/ modes. **Opportunities:** - Cities should ensure they have access to data from new tech (e.g. connected cars) to understand patterns of users and usage **Challenges:** - Emerging technology, lack of data

Air Pollution Modeling	**Description:** - Model air pollution from local to global scales under different climate change & policy scenarios. **Opportunities:** - Exposure assessment tools (e.g. satellites, chemical transport models, mobile monitoring, and low cost sensors) that expand the possibilities for assessing exposure to air pollution among small-scale communities globally **Challenges:** - Integration of research into local policy decisions is impeded by fragmented decision-making structures at city scales - different ministries have responsibility for health, air quality, transportation planning. - Impact estimation is policy-relevant when it is done on an annual or biannual basis. Academic research is often a one-time analysis.
Epidemiology	**Description:** - Empirical research to assess population health (cardiovascular disease, asthma, life expectancy, diabetes, etc) response to air pollution exposure. **Opportunities:** - Lots of new air quality data and modeling available makes new assessments possible (e.g. low-cost air quality sensors, high-resolution mobile monitoring etc.) - Exposure assessment tools that include human mobility **Challenges:** - Health outcomes data often not available at spatial scale possible for exposure surface.
Health Impact Assessment	**Description:** - An integrated modelling framework that allows for assessment of the current status and policy impacts of transportation parameters (example: highway, flow, composition, age) across emissions, air pollution exposure, health and economic outcomes over time and geography. **Opportunities:** - Neighborhoods experiencing high exposures to air pollution and associated health risks may not be the same neighborhoods experiencing high concentrations. This should influence decision-making aimed at reducing health risks, and not just aimed at attaining air quality standards. - Participatory quantitative health impact/burden of disease assessment - Monetization of health impacts can assist with integration in policy processes. - Visualization tools for public awareness **Challenges:** - Lack of information/data to inform decision-making aimed at reducing health risks - what are the air quality improvements, avoided air pollution health risks, and other health risks (e.g. increased physical activity and mental health) from specific transportation planning actions?
Urban & Transportation Planning	**Description:** - Work at the intersection of urban and transport planning, the environment and health to formulate the linkages between planning and health (e.g. through pathways of air pollution, noise, physical activity, motor vehicle crashes etc.) and then quantify the burden of disease and premature deaths attributable to these pathways/exposures. **Opportunities:** - Better communication between transportation, environmental and health scientists would help ensure use of the best available methods and data sets from the other sectors. - Improved spatial and temporal resolution of modelling at different elements of the full chain analysis of transportation impacts. - Combining high resolution measurements with state-of-the-art modelling. **Challenges:** - Politics, big money, oil and gas and construction industries, lobbies including car makers, - Lack of close collaboration with policy maker, lack of a common language, lack of influence, - Public departments working in silos, which reinforces (and helps) the above - Lack of tools that are simple enough and cheap enough to be used in policy decision-making and practice