Urban Planning, Land Use, and Vehicle Technologies to Reduce GHG Emissions in Cities

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Residents of urban settings enjoy higher income levels and greater access to consumer products than their rural counterparts, resulting in much higher energy consumption levels, per capita. Compact urban environments offer one opportunity for significant energy savings in such contexts. With the world's population growing by over 80 million persons annually, a variety of land use strategies, real-time information sharing, resource pricing, and plug-in vehicle technologies may be key to our cities' long-term sustainability.

Energy savings in more densely developed settings can come from shared walls (in multi-family dwellings and multi-story businesses), more non-motorized travel (due to shorter distances between trip generators and attractors), lower vehicle ownership rates and smaller (and thereby more fuel-efficient) vehicle choices (due, in part, to more limited parking opportunities), smaller living and working environments per capita (due to higher land and building costs), and other infrastructure savings (e.g., fewer roadway lane-miles and sewer line-miles per capita). While most of the world's energy savings and greenhouse gas (GHG) reductions are forecast to come from changes in fuels (including power-plant feedstocks) and energy-generation technologies (e.g., carbon sequestration and fuel cells), a variety of land use strategies and urban-area policies offer important potential.

GHG emissions are impacted by land use conditions in numerous ways, from vegetative cover practices to parking polices, and compact development patterns to self-selection in location choice. While land use is rather slow to change, its relative permanence has a marked impact on long-term concerns, like climate, economic opportunity, access, and equity, as travelers and goods determine how best to navigate between sites of production and consumption, residence, and out-of-home activities. Land development decisions determine activity site locations, which are fundamental to rates of trip generation and attraction, thereby impacting travel distances, mode choices, and vehicle ownership decisions. Such choices have short- and long-term ramifications for climate, air quality, energy security, crash-related death tolls, access, economic opportunity, and quality of life. This presentation will examine the impact of various land use patterns and travel demand policies (such as congestion pricing, mode subsidies, and parking strategies) on urban system operations, including GHG emissions. The presentation will quantify the potential of plug-in vehicles and other energy-saving technologies, while identifying top tools and challenges for researchers, planners, and policymakers.

One finding is that the impacts of different policies and investments are not always clear. For example, urban growth boundaries generally result in less travel and more travel-related energy savings than high gas taxes. Parking fees tend to affect mode choice far more than adding transit service. Hybrid electric vehicles may offer far more cost-effective energy savings than plug-ins. When communities develop thoughtfully, alongside advances in vehicle technologies, they may achieve steep GHG reduction targets in the provision and operation of their transportation systems, buildings, and associated sectors.

This presentation will examine what we know and where we can go, in terms of policies and technologies, methods and metrics. For example, innovative pricing policies, reflecting different vehicles' impacts, different contexts (e.g., distinct bottleneck locations by time of day), real-time parking-space values, and the like are important ingredients in the design of sustainable systems. Resource sharing, in the form of cars, bikes, jitneys, roadspace, parking lots, batteries, and land may be key. Emerging vehicle designs, fuels and energy policies are also fundamental. Finally, spatial econometrics, geographical information systems, urban-systems simulation, and faster – and more thoughtful – data transmission and optimization techniques are key tools for researchers, planners, and policymakers, as we seek to anticipate the impacts of new designs and policies, and then introduce the best to the masses.