MBIs, Climate Change, and Sustainable Transportation Governance in Cities

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RESEARCH REPORT

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1. Key Messages

- Transportation is responsible for a large, steadily increasing, portion of global GHG emissions, and the bulk of those emissions are generated by transportation choices and actions taking place within cities. These emissions are generated by a constellation of individual actions and choices regarding location (where to live, how far from work and amenities, how much to travel), movement (how to get around) and technology adoption;
- These individual actions generate a host of negative byproducts that are both local (air pollution, public health, lost economic productivity, noise pollution) and global (production of GHGs) and that bear considerable negative cost. This creates considerable imperatives for governments at all levels to take action to address problems related to transportation;
- Due to the distributed and diffuse nature of transportation, the high elasticity of demand associated with this sector, and various challenges related to implementation and enforcement, traditional command and control efforts to regulate behavior are unlikely, on their own, to have the desired effects;
- Market-based instruments (MBIs) offer a means of responding to market failures that generate these negative externalities, driving transformative change towards increased sustainability in the transportation sector, and maintaining fidelity to strongly held values related to individual freedom of choice;
- There are two pathways along which MBIs can drive change: imposing direct costs on users, and altering the mix of public subsidization and allocation of public assets in order to lower the relative cost of alternative modes of transportation;
- Effective intervention in cities likely requires flexible adoption of both types, in combination with actions aimed at altering the spatial form of the city and increasing the energy efficiency of transportation systems;
- However, to achieve change of the scope and scale required, upper level governments must enable cities by providing resources and jurisdictional authority, and facilitate regional and national coordination and policy coherence.

2. The Issue:

Transportation is an essential component of modern urban life, enabling people and goods to move about, and come together, in enormously productive and enabling ways. However, transportation is also responsible for a host of negative effects, not least of which by contributing to the phenomenon of climate change. Transportation is a major source of greenhouse gases, second only to power generation, and global emissions from transportation are projected to *double* by mid-century.[1] While explosive growth in domestic car-ownership and use in India and China are major contributors to this trend, transportation is the sole sector in which oil consumption is not projected to decline in OECD countries.[2] North America alone accounts for over one third of global transportation-related emissions, and emissions from transportation in US and Canadian cities have trended either flat or upward in spite of technology-related efficiency gains over the past half-century.[3]

While emissions related to the inter-city movement of goods and people are an important contributor to these trends, the bulk of transportation-related emissions are generated by, and result from, intra-city travel.[4] As such, this brief focuses specifically on this aspect of the challenge related to addressing, and reducing, these emissions. Transportation accounts nearly one third of total GHG emissions in both Canada and the US and has been steadily increasing in both countries.[5] In Canada, GHG emissions from private vehicles increased at nearly twice the pace of population growth between 1990 and 2007, as a function of steady reliance on automotive transportation and increasing travel distances.[6] As a result, transportation generates a substantial source of GHG emissions in Canadian cities.

[1] IEA 2011, *CO2 Emissions from Fuel Combustion: Highlights.* P. 67

[2] Creutzig et al 2010: 9; OECD 2010: 7

[3] Creutzig et al 2010: 9; *U.S Department of Transportation, 2010. Transportation's Role in Reducing U.S. Greenhouse Gas Emissions, Volume 1: Synthesis Report. Report to Congress*

[4] To illustrate, 73% of emissions from transportation in the US are generated from passenger transportation (which includes emissions related to aviation fuels as well as inter-city travel). Looked at in terms of vehicle type, 59% of US transportation emissions are generated b y light-duty vehicles (passenger cars and light-duty trucks). More generally, over 60% of all vehicle miles traveled in the US take place in urban areas. US Department of Transportation, 2010. P. 2-17, 3-18

[5] In the US, transportation accounted for one half of the entire increase in US national GHG emissions between 1990 and 2006. See US Department of Transportation, Transportation and Climate Change Clearinghouse. Availabe at http://climate.dot.gov/about/transportations-role/overview.html; Environment Canada, National Inventory Report 1990-2010: Executive Summary. Available at http://www.ec.gc.ca/ges-ghg

[6] Nearly 80% of all trips in Canada are made by car, and the average travel distance to work increased by 9% from 1996-2006. See Statistics Canada, 2010. *Greenhouse Gas Emissions from Private Vehicles in Canada, 1990-2007*. P. 7; T-Mapper Transport Measures and Policies to Promote Emissions Reductions, Canada Report. Available at http://www.sutp.org/T-MAPPER/downloads/canada/

TABLE 1: Emissions from Transportation Sector as percentage of total city-wide GHG emissions

City	Transportation Emissions as Percent of City-Wide GHG Emissions	Year
Toronto	36%	2008[7]
Vancouver	37%	2008[8]
Montreal	48%	2003[9]
Calgary	30%	2003[10]
Ottawa	34%	2008[11]

While the costs related to the generation of such emissions are difficult to quantify, the singular reliance on automotive transportation in Canadian cities is responsible for a variety of negative outcomes that have a more immediate and measurable impact. Congestion is estimated to cost Canadian cities somewhere between $3.1 and $4.6 billion CAD annually.[12] The GTA alone is estimated to bear an annual cost, in terms of lost productivity, of $3.3 billion CAD[13] and a recent Toronto Board of Trade report ranking Toronto against a set of 24 comparable global cities placed Toronto in the bottom fifth in respect to transportation on the basis of "notoriously bad commute times" as well as a host of other factors, including systematic under-investment in local transit infrastructure.[14] The negative effects of congestion on local health further compound these costs. The National Roundtable estimates that Canada's four largest urban centers will by 2050 incur a total annual cost, resulting from premature mortality attributable to heat and air quality impacts of climate change, of $6.5 billion.[15] It is not surprising, then, that recent survey research indicates that transportation is perceived to be one of the most significant challenges faced by

[7] City of Toronto. (2013). *Summary of Toronto's 2011 Greenhouse Gas and Air Quality Pollutant Emissions Inventory.* Retrieved from http://www.toronto.ca/legdocs/mmis/2013/pe/bgrd/backgroundfile-57187.pdf

[8] City of Vancouver. (2009). *2008 Greenhouse Gas Emissions Inventory: Summary and Methodologies.* Retrieved from http://vancouver.ca/sustainability/climate_protection.htm

[9] City of Montreal. (2007). *Montreal Community Sustainable Development Plan 2010-2015.* Retrieved from http://ville.montreal.qc.ca/pls/portal/docs/PAGE/PES_PUBLICATIONS_EN/PUBLICATIONS/VERSION_SYNTHESE_EN.PDF

[10] City of Calgary. (2003). *Calgary Community Greenhouse Gas Emissions Inventory.* Retrieved from www.fcm.ca/.../**Calgary_Community_Greenhouse_Gas_Emissions_Inventory**

[11] City of Ottawa. (2012). *Memo – 2004 and 2008 Greenhouse Gas Inventories, Reduction Measures, and Approach to Future Targets.* Retrieved from http://ottawa.ca/calendar/ottawa/citycouncil/ec/2012/05-03/B-IPD%20-%20GHG.htm

[12] Urban Transportation Task Force, 2012. *The High Cost of Congestion in Canadian Cities.* P. 8

[13] More conservatively, FCM suggests that congestion has a total cost to the Canadian economy of $5 billion CAD. Federation of Canadian Municipalities, Transit and Transportation Issues. Available at http://www.fcm.ca/home/issues/transit-and-transportation/cut-my-commute-2011.htm

[14] Toronto Board of Trade, 2011. *Toronto as a Global City: Scorecard on Prosperity 2011.* P. 10-11

[15] NRTEE, 2011. *Paying the Price: The Economic Impacts of Climate Change for Canada.* P. 92

cities, and a well-integrated multi-modal transportation system to be one of the core characteristics of a "green" and economically competitive city.[16]

These figures and trends suggest a powerful imperative for Canadian governments, at the local, provincial, and federal levels, to engage in efforts to drive the transition to sustainable transportation. While Canadian cities cannot "solve" the problem of climate change, they do posses the institutional capacity and resources to set the agenda and demonstrate leadership.[17] Canadian cities have the opportunity to develop solutions that can act as models for cities around the world, potentially contributing to the sustainable evolution of such cities as they rapidly urbanize and expand while simultaneously taking steps to address a problem of significant local impact.

[16] LSE Cities, 2012. *Going Green: How Cities are Leading the Next Economy*. P. 15, 19, 26
[17] Creutzig et al 2010: 9

3. Governing transportation in cities: How to effectively and meaningfully address climate change and transportation issues in cities.

The question, then, is how to transition from the status quo to more sustainable local transportation in ways that respond to the need to reduce the production of GHGs and mitigate the negative effects of traffic congestion. There are, broadly speaking, three ways to address this task: reduce local demand for transportation; shift from higher to lower emitting modes of transportation; and increase the efficiency of the existing transportation system.[18]

First, actions can be taken to reduce the demand for transportation within the city. There is a relatively clear and well-accepted relationship between urban form and sustainability. As cities "sprawl" outwards and population density decreases they become less efficient - citizens become increasingly auto-dependent, emit more pollution, and pay more for transportation.[19] Problematically, while urban population doubled during the 20th Century the amount of land occupied by urban settlements tripled.[20] Conversely, a strong positive relationship has been identified between urban density and mode of transportation: as urban density increases, the modal share of non-motorized and public transportation goes up while the amount of energy used per passenger declines.[21] Actions to reduce demand for transportation primarily relate to influencing where people live, work, and play, and how far apart these activities take place and focus on efforts to increase population density around public or alternative transportation services. The goal is to reduce both the need for travel and the length of trips without circumscribing the nominal freedom and mobility of citizens.

Second, actions can be taken to shift transportation to more efficient modes such as walking, cycling, or public transportation. While it is imperative to reduce demand through densification and closer physical clustering of residential, working, and entertainment activities, unless the unlikely situation arises in which demand for transportation is completely eliminated then it is essential to shift the allocation of the remaining transportation pie towards low and no-carbon alternatives. This requires actions related to the provision of meaningful, accessible, and effective transportation alternatives and services, as well as actions that lead individuals to re-consider their everyday transportation decisions.

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[18] GIZ 2012: 2

[19] Kennedy, C., Miller, E., Shalaby, A., Maclean, H., Coleman, J., 2005. *The Four Pillars of Sustainable Transportation, Transport Reviews, 25:4.* P. 394

[20] Angel, S., S. Sheppard, and D. Civco. 2005. *The Dynamics of Global Urban Expansion.* Washington, DC: The World Bank

[21] World Bank, 2010. Cities and Climate Change: An Urgent Agenda. P. 28

The US Department of Transportation has found that 50% of all trips are 5 km or less in total distance yet, in spite of the fact that such as distance is "widely regarded as bikeable", less than 2% are made by bike. Nearly 60% of trips of 2.5 km or less are made by private vehicle.[22] Figures such as these contribute to pressure to expand road systems in order to reduce congestion but there is ample evidence that construction or expansion of road systems in fact has the opposite effect – building bigger roads serves to *induce* rather than *reduce* in demand.[23] What is needed, therefore, is find ways to alter individual decision-making by increasing the efficiency, availability, and cost-effectiveness of alternative modes.

Third, actions can be taken to increase the efficiency of the existing transportation system. This may take the form of transitioning to higher efficiency vehicles, using low-carbon energy sources to power public transportation, or making improvements in traffic system management. The gains to be had from simply increasing the efficiency with which traffic moves through the city are considerable. One estimate suggests that congestion causes an extra 30 Mt of additional CO2 emissions per year in the US, another indicates that vehicle emissions in conditions of congestions are 250% higher than in regular traffic, and another still suggests a total associated societal cost in the US of $20 billion USD/year.[24]

Each of the actions listed above serve different purposes, but all are necessary in order to achieve meaningful transformation and mitigation of problems related to congestion, local air pollution, and global climate change. However, this leaves open the question as to how to best go about driving change along each of these dimensions, and coordinating actions between them.

[22] Bureau of Transportation Statistics National Household Travel Survey. Available at http://www.bts.gov/programs/national_household_travel_survey/

[23] Duranton, G., Turner, M. 2009. *The Fundamental Law of Road Congestion: Evidence from US Cities.* NBER Working Paper. Available at http://www.nber.org/papers/w15376

[24] Iaione, C. 2010. *The Tragedy of Urban Roads: Saving Cities from Choking, Calling on Citizens to Combat Climate Change,* Fordham Urban Law Journal, 37:3. P. 4

Cities are widely agreed to have four primary levers with which to drive change locally: they can use their direct control of government employees, assets, and operations to demonstrate the benefits and possibilities of change[25]; they can use their formal jurisdictional authority to command changes in behavior through regulation; they can induce change through the provision of services to local constituents; and they can encourage change through the use of outreach, information, and educational campaigns and efforts.[26] The specific use of these may vary as a function of the formal jurisdictional authority possessed by a particular city, but also may be driven by local political dynamics and choices made by city officials.

Transportation offers substantial opportunity for city government intervention through either service provision (public transportation and alternative transportation infrastructure and services) and regulation (zoning and planning regulations, tax incentives, traffic calming, driving and parking restrictions).[27] Neither, however, is likely to bring about the requisite transformation on its own. Attempting to control individual choices that impact on transportation emissions (where to live, where to work, how to get around) is impractical and likely counter-productive[28] while providing meaningful transportation alternatives without creating incentives to make use of them is likely to lead to poor uptake. Market-based instruments that create incentives for behavioral change offer one approach to bringing these different sources of authority together in a manner that can potentially drive transformative change.[29]

[25] Cities can engage in self-governance by taking actions that directly affect the operations of city government itself. However, given that the direct impact of self-governing is limited to only a small proportion of total city emissions, self-governing is a decidedly limited means of addressing the issue of sustainable transportation.

[26] Bulkeley, H., Kern, K., 2006. *Local Government and the Governing of Climate Change in Germany and the UK*, Urban Studies, 43:12

[27] OECD 2010: 128

[28] See for example Rittel, H., Webber, M., 1973. *Dilemmas in the General Theory of Planning*, Policy Sciences, 4

[29] Stavins, R. 2002. *Market-Based Environmental Policies*, in Donahue, J., Nye, J. *Market-based Governance: Supply Side, Demand Side, Upside, and Downside*, Brookings Institutions Press.

4. Market-Based Instruments and Sustainable Urban Transportation

Thinking about GHG emissions, congestion, and local pollution as negative externalities produced by the transportation sector suggests the need for policy interventions that can correct market failure. A market-based instrument (MBI) is a policy intervention that aims to induce change through adjustments to the cost that users pay to engage in specific actions. In terms of transportation, this can involve policies that internalize the full costs of transportation choices (by charging a tax on gas or putting a price on road use, for example) *as well as* actions that alter the relative cost of location or mobility decisions (reduced subsidization of suburban sprawl or single-passenger vehicular travel, or increased investment in alternative transportation services and infrastructure).[30] In light of the insights generated in the field of behavioral economics, it is imperative to recognize that the existing policy context in which decisions and actions related to transportation are made already, to varying degrees, encourages or enables.[31] MBIs, then, can be used to intervene and adjust this context by either imposing new costs or adjusting existing subsidies. As compared with command and control approaches, MBIs are typically understood as increasing the cost-efficiency of policy intervention.[32] However, the benefits and limitations associated with MBIs vary depending on whether they intervene through direct price imposition or indirect adjustments to public subsidization and supply of transportation services and infrastructure. The sections below provide a review of both approaches, and the pros and cons of each.

Price-oriented MBIs: Price-oriented MBIs induce change by increasing the cost that users are required to pay in order to engage in a particular transportation activity. By internalizing the full cost of the activity, these MBIs force users to reconsider how they expend their finite resources. The upside of these is that, by forcing users to confront, and pay, the full cost of their actions, these policy instruments explicitly push users to change their behavior. Furthermore, by imposing a cost on users of public transportation infrastructure such as roads or street parking they provide a source of revenue that cities can then use to re-invest into public and alternative transportation infrastructure and services. The downside, however, is that they impose direct, measurable, and immediate costs on users, which means that they are susceptible to political pushback and resistance by constituencies that are forced to bear the bulk of these costs.

[30] Burda, C., Allan, T., Dunn, B., Lintner, A., McCleneghan, T., Zizzo, L., 2012. *Live Where you Go: Encouraging Location-Efficient Development in Ontario*; Blais, P. 2010. *Perverse Cities: Hidden Subsidies, Wonky Policy, and Urban Sprawl*, UBC Press.
[31] Sunstein, C., Thaler, R., 2008. *Nudge: Improving Decisions about Health, Wealth, and Happiness.* Penguin Books, New York.
[32] Stavins, 2002.

The most common pricing mechanisms are reviewed below, along with illustrative examples of their use in action.

- *Road Pricing:* Congestion charging is an approach to road pricing that aims to reduce the use of roads through imposition of a price on those who use them. Several cities around the world (London, Singapore, Stockholm, Milan) have implemented central city congestion charging systems that, while differing along various dimensions, are alike in that they charge road users a fee to make use of the road system in specified regions of the city. Regional freeway toll-roads are another form of congestion charging, especially if there is limited freeway access to the city. Cities such as Bergen and Trondheim in Norway and Santiago, Chile provide examples of this approach. High Occupancy Toll (HOT) lanes operate in a similar manner, in that they charge a fee to drivers that allows them to make use of lanes typically reserved for vehicles with multiple passengers. Recent examples include I-495 in Virginia (which features variable-rate pricing aimed at maintaining 85% roadway capacity) and the 110 Freeway outside Los Angeles.

- *Parking Fees:* Free parking is the expectation rather than the exception in North America.[33] As such, parking fees represent an important market-instrument available to cities.[34] Parking-related MBIs typically operate in one of two ways. First, the price of on-street parking can be adjusted in order to free up space on city roads and reducing traffic circling.[35] To give a sense of the potential impact of such actions, recent estimates suggest that cars searching for on-street parking account for roughly 33% of road traffic in London.[36] Second, the price of on-street parking can be adjusted in order to drive modal shift. The city of Vienna was able to reduce total automotive travel in the city center by 60% as a result of imposing substantial on-street parking fees. In the UK, it is estimated that a doubling of parking fees led to a drop in car usage of 20%.[37] In a similar manner, Madrid uses an escalating fee for on-street parking as a means of freeing up parking spaces and increasing the cost of car travel.[38]

[33] Research suggests that 99% of all automobile trips in the US make use of free parking. Shoup, D. 2011. *The High Cost of Free Parking*, Planners Press: Chicago. p. 1

[34] An alternative option to increasing the cost of on-street parking is to raise the property tax on land dedicated to surface parking. See Pembina 2012: 26

[35] Kodransky, M., Hermann, G., 2011. *Europe's Parking U-Turn: From Accommodation to Regulation*, ITDP Research Report. P. 12

[36] ibid

[37] ibid

[38] ibid

Supply-oriented MBIs: One of the major contributors to transportation demand and modal choice is the substantial but hidden subsidization of automotive transportation.[39] As a result, policy interventions that reduce the amount of road space allocated to single passenger vehicles serve to increase the cost of driving and lower the relative cost of alternative modes of transportation such as biking, walking, and public transit. These supply-oriented MBIs aim to drive behavioral change by lowering the relative cost of transportation choices. Supply-side actions may be more politically feasible since they avoid direct cost imposition. However, this may come at the expense of diminished cost efficiency.[40] In addition, by avoiding the imposition of direct costs cities deny themselves a source of revenue, which can undercut ability to invest in alternative transportation service provision and infrastructure development.

Examples of common policy interventions along with illustrative examples are listed below:

- *Road Space Rationing***:** An alternative to road pricing is road rationing, in which access to roads is capped and allocated to users. Road rationing systems are typically based on license numbers, and limit access during peak hours. The extent of the rationing can be updated in order to increase or reduce the amount of cars allowed into the system. Road rationing systems can be found in Mexico City, Santiago, Sao Paolo, La Paz, Bogotá, Quito, and Beijing. One difference between congestion charging and road rationing is that, while the former allows individuals with the financial means to avoid behavioral change by simply paying more to continue driving, the latter is, nominally at least, more equitable in that it applies equally to all drivers regardless of financial capacity. However, the financial capacity of wealthy households to own more than one car may give them the ability to circumvent this restriction on their mobility.[41]

[39] Transportation systems can be conceptualized as consisting of three distinct elements: vehicles, right of way, and terminal capacity - cars, roads, and parking spaces in the case of automotive transport. Cities typically subsidize drivers through over-provision of free parking (and minimum parking requirements for developers) which "skews travel choices towards cars and away from public transit, cycling, and walking" by hiding the true cost of parking/driving, contributing to sprawl, and increasing travel distances. Similarly, investments in public sidewalks, or regulations that mandate private maintenance of sidewalks, are typically lacking and essential to increasing the walkability of cities and altering modal split. Shoup 2011: 9; Shoup, D. 2010. *Putting Cities Back On Their Feet*, Journal of Urban Planning and Development, 136: 3: 225-233

[40] Prud'homme, R., Kopp, P., 2008. *Worse than a congestion charge: Paris traffic restraint policy*, in Richards, H., Bae, C, eds, *Road Congestion Pricing in Europe*, Edward Elgar. The authors suggest that the cost of road-restriction and road space reallocation in Paris far exceed their benefits but do not include GHG emissions in their analysis.

[41] Road space rationing can be transitioned into a demand-side MBI if individual allocations are made to be transferable. Proposals have been mooted to convert road-space rationing programs into local trading initiatives (whereby all citizens would be granted a certain amount of road space credits, and would then be free to either use them or sell them to others) but no city has adopted such an approach. Kockelman, K., Kalmanje, S., 2005 *Credit-based congestion pricing: a policy proposal and the public's response*, Transportation Research Part A: Policy and Practice, 39

- *Road Re-Purposing:* Such measures include the conversion of road-space (streets, parking spaces) into pedestrian zones or physically separated bike or bus lanes, as well as regulations that limit the amount of on-street parking available in cities as a means of increasing its' implicit cost. Actions such as these, if overall road supply is held relatively constant, affect change by decreasing the subsidization of automotive transportation and redirecting public funds towards alternative modes of transportation. Zurich and Hamburg both use local zoning regulations to cap the total amount of on-street parking in their respective city centers, and the latter mandates that for every new on-street parking spot created, another must be removed.[42] Amsterdam and Zurich have shifted from a minimum to a maximum parking space requirement in new developments in an effort to limit or reduce total new parking spaces that are created in the city.[43] Amsterdam mandates that new developments with close proximity to public transportation supply very limited amounts of new parking spaces while those with limited access to public transportation include more.[44]

- *Provision of Enhanced Public Transportation Services:* Policy interventions can also act to reduce barriers to modal shifting by increasing the supply of public transit or other modes of transportation. Examples include construction and expansion of underground and above-ground rail systems (subways, trams) as well as enhanced bus service. Bus Rapid Transit (BRT), which aims to mimic the service and performance of underground rail-based public transit, is an approach to low-cost/high-capacity public transit pioneered in Latin America in the mid 1970s that is increasingly catching on in cities around the world.[45] Bogotá first developed the TransMilenio BRT system in 2000 and has gradually expanded the system in the years since. Financed by local government revenues, a dedicated fuel tax, grants from the national government, and international climate change funds, the system moves 47,000 passengers per hour/per direction (over 1.5 million per day), has reduced average commuting time by 32%, and has achieved substantial reductions in local air pollutants as well as GHG emissions.[46] TransMilenio buses operate on a network of over 80km of dedicated and physically separated lanes, physical space that has been reallocated from cars to buses.[47]

[42] ITDP 2011: 16
[43] ibid
[44] ibid: 17
[45] In 1990 there were 10 BRT systems in operation, in 2000 there were 23, and as of 2012 there are 146 BRT. See http://brtdata.org/
[46] TransMilenio was also the first transportation project to be certified to generate credits under the UNFCCC Clean Development Mechanism (CDM) system. Center for Clean Air Policy. nd. Reducing Traffic Congestion in Bogota Through Bus Rapid Transit and Non-Motorized Transport. Available at: ccap.org/assets/CCAP-Booklet_Colombia.pdf
[47] The TransMilenio network of dedicated bus lanes is scheduled to expand by over 130km as part of its' Phase III development

- *Alternative Transportation Infrastructure:* Modal shift may also be enabled by increasing the supply of public space allocated to alternative transportation infrastructure such as bike lanes and pedestrian walkways. Copenhagen has invested heavily in building, and expanding, local bike infrastructure. One third of the city's road transportation budget is allocated to cycling-related expenditures and investments, and there are indications that the city aims to increase spending in this area.[48] Copenhagen has over 345 km of physically separated bike paths, as well as a network of bike routes that connect the city with outlying suburbs.[49] The city has converted a substantial number of on-street parking spaces (400 spaces between 1995 and 2000) into bike lanes and pedestrian pathways (the total amount pedestrian pathways increased by over 4000 square meters over the same years).[50] Additionally, Copenhagen has optimized traffic signals on certain roads and routes through the city in order to provide cyclists with consecutive green lights – a system known as the "green wave" –improving average trip speed by 10%.[51] The city provides accommodation for bicycles on both suburban trains as well as the city metro system, and has expanded bike-parking facilities at public transportation stations.[52] The result of these measures is a modal share of 20% for all trips, and 36% for work commuters as of 2005.[53] Bogotá has created 300 km of paved bike paths, introduced a program that shuts down 120 km of streets to vehicular traffic every Sunday, imposed a license plate-based road space rationing system that only allows 60% of private vehicles to access the city during peak times, and reduced or eliminated on-street parking by re-purposing road space to non-vehicular uses.[54] The combination of these measures increased modal share for bus transit as well as a shift from private vehicle to BRT (one study estimates that 10% of BRT ridership consists of users who previously drove a private vehicle to work).[55]

[48] Pucher & Buehler 2007: 26, 27
[49] ibid
[50] ITDP 2011: 16, 18
[51] Pucher & Buehler 2007: 27
[52] ibid
[53] ibid: 26
[54] UNDP Public-Private Partnerships: Case Studies of Sustainable Development. Available at http://www.ncppp.org/undp/bogota.html
[55] Wright, L., 2004. *The Limits of Technology: Achieving Transport Efficiency in Developing Nations.* P. 16

- *Alternative Transportation Services:* Re-allocation of public funds towards the provision of alternative transportation services such as bike- and car-sharing systems signal changing attitudes towards transportation enable modal shifting and reduced travel demand. As compared with provision of tradition public transit, these options have the benefit of lower upfront and ongoing costs, with cities often contracting out operational responsibilities in exchange for advertising/branding opportunities. Additionally, in the case of car-sharing systems cities often are able to encourage such systems through provision of parking spaces and updated regulation.

  Bikeshare systems, pioneered in the 1960's, began to catch on in the mid-2000's. Such systems have been implemented in over 300 cities around the world as a complement to traditional public transportation, providing an option to cover short-distance trips within city limits at relatively low incremental costs. Carshare systems operate in a similar manner, acting to reduce demand for car ownership and providing supportive capacity to enable cities to reduce city assets and space dedicated to parking.

  The bikeshare system in Hangzhou, China is currently the largest in the world. Developed in 2008, the Hangzhou system quickly expanded to over 60,000 bikes and 2600 stations throughout the city. The aim of the system is to provide, along with other modes of public transportation (BRT and Metro systems) an integrated alternative to automobile transportation. The Hangzhou system is supported by a network of dedicated, physically separated bike lanes, has an average of 240,000 trips per day (out of a total population of 6.7 million) and operates on the basis of scaled payment schedule (free for the first hour of use, and priced at increasing increments for every hour of use beyond the first hour) with a payment system is fully integrated across all modes of transportation.[56]

Lesson #1: Use Market Incentives Through Demand and Supply Interventions: Policy actions aimed at mitigating GHG emissions and reducing other negative externalities produced by the transportation sector can take multiple forms that drive change along different pathways. As outlined above, market-based instruments can operate through the imposition of direct costs on users as well as actions that, less directly, change the cost of driving relative to other options. The former impose costs that are direct and meaningful, rendering them effective but susceptible to political resistance and blockage. The latter impose costs that are implicit and indirect, providing cities with a means of symbolically signaling shifting priorities in transportation by increasing the provision of public assets in support of non-automotive transit. In order to effectively drive

[56] ICLEI Ecomobility Case Study – Hangzhou. Accessed 22 Oct 2012 at www.iclei.org/ecomobility/cases; http://www.smartplanet.com/blog/cities/worlds-largest-bike-share-system-in-china-dwarfs-popular-us-program/611

change in the transportation sector, and reduce GHG emissions, demand and supply-oriented MBIs in combination with regulatory measures and education/outreach campaigns are likely needed. More importantly, over-emphasizing one approach at the expense of others is likely to be unproductive, since it reduces the resilience of local policy and increases the risks of political resistance and blockage.

Lesson #2: Leverage Co-Benefits; Beware of Cross-Purposes: Actions that encourage transformation towards increased sustainability in the transportation sector can be framed in multiple different ways: as efforts to reduce the negative effects of traffic congestion on public health, economic productivity, or quality of life; as actions intended to provide leadership or respond to the moral imperative of reducing GHG emissions; as policies that can create economic and employment opportunities; as initiatives that can increase citizen mobility and equal access to the city. Sustainable transportation has multiple different dimensions, and policy actors need to remain conscious of the ways that they interact and the implications that result.[57] This creates opportunity and simultaneously sounds a note of caution for cities engaging in transportation policy. Opportunity results from the ability to frame policy interventions in ways that are appealing to local political context. Congestion pricing in Milan, for example, was initially implemented as a means of addressing the severe problem of local air pollution and only later was updated to focus more explicitly on spurring modal shift. While this indicates opportunity related to problem and policy framing, it also illustrates possible tensions that may emerge when pursuing multiple objectives. The orientation of the Milanese road pricing system towards reducing local air pollution led it to include systemic incentives for users to shift to low emitting vehicles since these were initially exempted from the charge. This limited the ability of the system to reduce traffic congestion and drive systemic change in the transportation sector.[58] Co-benefits thus offer a powerful means of overcoming local political resistance, getting transportation-related issues onto the local agenda, and implementing transformative policies but they need to be used with caution and sensitivity to the possible tensions between competing objectives that may result.[59]

Lesson #3: Integrate and Balance Policy Interventions: As the range of possible interventions expands, there is a need to ensure they are coordinated across municipal departments and agencies and integrated with overarching climate and sustainability strategies. Responsibility for actions related to transportation are often distributed across multiple city departments and agencies (streets, land-use and zoning, transportation, parks) requiring efforts to ensure

[57] Schipper, L., 2001. *Sustainable Urban Transport in the 21st Century: A New Agenda*, in Sperling, D., Kurani, K. eds, 2001. *Transportation, Energy, and Environmental Policy: Managing Transitions*, Transportation Research Board
[58] Mattioli, G., Boffi, M., Colleoni, M., 2012. *Milan's Pollution Charge: Sustainable Transport and the Politics of Evidence,* Paper presented at the Berlin Conference on the Human Dimensions of Global Environmental Change, Berlin, October 5-6, 2012
[59] Betsill & Bulkeley 2003

coherence and coordination so that actions are synergistic and not at cross-purposes. This need is well illustrated when considering unintended consequences as well as counter-productive actions. The former is illustrated in the preceding paragraph. The latter can be seen in policy actions related to city planning and the allocation of public space to car parking. In New York, at the same time that the city has utilized zoning to encourage a shift to alternative modes of transportation and reduce travel demand, city regulations continue to subsidize automotive transportation by mandating minimum parking provision for all new developments and providing under-priced or free on-street parking.[60] Integration across sectors, departments, and authority mechanisms likely requires integration of transportation actions into broader sustainability plans and objectives, high-level oversight within city government, and ongoing review and revision in order to remain sensitive to unintended consequences and contingencies. Transportation will never *be* sustainable – the hallmark of complex, cross-cutting modern policy challenges such as climate change is that resolution remains forever out of reach in spite of a pressing desire to "solve" – but rather is likely only to be further, or farther, from this ideal state; managed in better or worse ways.[61] As such, resources must be dedicated to this task in order to enable to avoid incoherence and minimize unintended effects.

Lesson #4: Empower Cities and Enable Flexibility: While increasing local policy flexibility can help to avoid or minimize local political resistance, averring from policies that impose costs of local users directly reduces the capacity of local government to invest in provision of alternative transportation services and infrastructure: these pricing mechanisms generate revenue that can be utilized to underwrite investments in services and infrastructure. Additional financial support from upper levels of government may be required in order to effectively close this gap and more fully enable cities to be flexible in terms of the type and nature of local policy interventions.[62] The provision of secure and stable funding for cities to develop, expand, and improve local transportation alternatives can give cities much needed room to better adapt to local political realities and ensure that transportation policy does not become locked into an all-or-nothing road pricing proposition. It can also serve to reduce pressure on cities to search for alternative sources of project funding or revenue generation that rely on attracting private sector investment and may lead to policy incoherence and constraint.[63]

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[60] McDonnell, S., Madar, J., Been, V., 2011. *Minimum Parking Requirements and Housing Affordability in New York City*, Furman Center for Real Estate and Urban Policy Working Paper.

[61] Problems of this sort are well-identified in the literature on both urban planning and climate change. See Rittel & Webber 1973.

[62] Bulkeley & Kern 2006

[63] This is not to say that public-private partnerships are necessarily a bad thing – there are many interesting instances of innovative and effective use (not least of which on toll-roads or in the provision of bikeshare systems). However, severe fiscal pressure can lead cities to negotiate deals that are potentially damaging. The City of Chicago provides an illustrative case-in-point. In 2008 the City agreed on a 75-year lease with investment bank Morgan Stanley for the 36,000 metered parking spaces in the city. In return for $1.16 bilion USD the bank has full ownership of all parking revenues generated over the life of the lease. The deal has been widely criticized as a result of the restrictions it places on city policy both present and future (Morgan Stanley

Lesson #5: Improve Coordination: Cities are heavily reliant on upper levels of government in order to achieve transformative change in the transportation sector. This is not to say that cities do not have substantial means through which to drive change on their own – there are numerous jurisdictional, authority, and policy actions that cities can use in order to encourage and enable meaningful change. However, cities face a set of fundamental barriers that point to the need for coordination or cooperation with other levels of government in order to produce transformative change. Given that cities are embedded in broader metropolitan agglomerations or economic regions, the challenges of governance are increasingly regional in addition to municipal.[64] Simply put, while city governments may address transportation within city borders, it is increasingly difficult to address transportation actions taking *outside* of them. Long-range commuting and exurban sprawl, combined with the gaps in public transit that often exist between outer edges and the urban core, are trends that may completely offset improvements in transportation within the city.[65] Furthermore, this can lead to political tension between core and suburbs, and to building resentment if policies are keyed towards one set of constituents (inner core transit-reliant households) at the perceived cost of others (suburban households that lack meaningful transportation alternatives).[66] Managing these sorts of tensions will require the resources and political capacity of higher levels of government: to provide investments or incentives that can satisfy the legitimate concerns of suburban households regarding unfair cost imposition; to create and empower regional governing bodies or act as regional coordinators; to give cities the authority to implement policy mechanisms; to invest in public transportation services and infrastructure linking urban fringe to city core.

In addition, while local inter-municipal competition can drive regulatory races to the bottom, free-riding, and undermine aggregate regional policy performance, at the broader national (and international) scale there is a need to enhance the transmission of best practices and effective policy actions between cities. This requires a framework for cities to gain awareness of the actions of others, and information regarding the efficacy of such actions in reducing GHGs and driving transition towards sustainability in the transportation sector. Together, this information can help cities to learn from one another, draw on one another's expertise and experience, and enhance local policy capacity. At the moment these actions have primarily been taking place within inter-

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has guarantees that limit the ability of the City to reduce the overall supply of parking spaces or alter road-space in ways that would negatively affect parking revenues), in terms of the dollar value of the lease itself, and in terms of the ways in which those revenues (most of which have already been spent) have been used (primarily to pay off existing city debt). See http://www.urbanophile.com/2010/08/22/parking-meters-and-the-perils-of-privatization/

[64] http://www.brookings.edu/research/reports/2010/11/30-global-metro-monitor

[65] This includes emissions related to inter-urban air travel, which is not included in municipal city-wide emissions inventories and is an increasing source of GHG production that is very difficult to govern on a city by city basis.

[66] Taylor, Z., 2011. *Who Elected Rob Ford and Why?An Ecological Analysis of the 2010 Toronto Election*, Paper presented at the annual CPSA conference, Waterloo, ON. Available at: http://www.cpsa-acsp.ca/papers-2011/Taylor.pdf

city networks that operate within and across national borders[67] but there is room for upper levels of government to enable and enhance this process.

Both of these problems illustrate the need for more and better communication and coordination between cities and upper levels of government: active interaction between levels of government, integration of disparate actions under common strategic frameworks and objectives, and enabling mechanisms that can give cities the jurisdictional authority and financial resources necessary to engage in meaningful local action.[68] Furthermore, the potential that policy interventions at different levels of government may end up working at cross purposes suggests the need for increased coordination and engagement between upper levels of government and city governments. Lastly, there is a pressing need to close the gap between front-running and lagging municipalities in terms of climate and transportation policy. While stronger and more stable institutional frameworks may help to close this gap, it may also be worthwhile pursuing the possibility of inter-municipal market-based policies that leverage the power of markets to drive investment and change transportation-related decision-making.

[67] The C40 Climate Leadership Group offers perhaps the best illustration of both the positive efforts towards learning and inter-city engagement as well as the negative effects of limited access for the vast majority of cities in the world.
[68] OECD 2010; Selin, H. VanDeveer, S., eds. 2009. *Changing Climates in North American Politics: Institutions, Policymaking, and Multilevel Governance*, MIT Press