Evaluating mobility and sustainability in the transportation sector at the city level

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Abstract

Local governments have a particularly important role to play when it comes to maximizing energy efficiency of the transportation system. Cities increasingly serve as incubators for forward thinking policies and practices Creating smart cities with sustainable transportation systems involves a combination of policies that target vehicle efficiency, expand mobility options, and integrate transportation and land use planning.

Given the wide range of policies that cities can implement, evaluating a city's progress towards improving the efficiency of their transport sector can be a challenge. This paper will discuss the approach taken in ACEEE's City Energy Efficiency Scorecard for evaluating local governments on their actions to improve transportation energy efficiency. It will also identify potential improvements and refinements to these methods. Finally, this paper will include a discussion of additional metrics under consideration for future versions of the Scorecard that evaluate how cities are using big data and information and communications technologies (ICT) to create smart transportation systems.

Introduction

Globally, transportation energy use accounts for approximately 19 % of total energy consumption (EIA 2016). In the United States, transportation energy use is responsible for 28.5 % of overall energy use (Davis, Williams, and Boundy 2016). Drilling down to the city level, this proportion is even higher at approximately 33 % (Ribeiro et al 2017). While fuel economy and greenhouse gas standards in the United States are largely set by the federal government, states and cities take the lead in creating innovative transportation solutions and sustainable transportation systems. Globally too cities have become incubators for forward thinking policies and play a critical role in maximizing this sector's energy efficiency potential. Municipalities, for instance, must take the lead in shaping land use, because they have jurisdiction over zoning laws and regulations. Likewise, central cities and other job centres influence regional commuting behaviour and choices, which are major factors in transportation energy use.

While there is general agreement that cities have an important role to play in shaping travel patterns and accommodating changing needs, it is much harder to pinpoint what makes a city a leader in addressing transportation energy use given the variety of strategies available for implementation. This paper describes the approach used in ACEEE's 2017 *City Energy Efficiency Scorecard* to evaluate local governments on their actions to improve transportation energy efficiency. The *City Energy Efficiency Scorecard*, which was first released in 2013, attempts to capture city progress on energy efficiency policies across 51 of the largest American cities in 5 different categories: local government operations, community-wide initiatives, buildings, energy and water utilities, and transportation. Each city is awarded a total score out of 100 points. In addition to awarding scores for implemented policies, the City Scorecard provides examples of best practices in leading cities, thus serving as a resource for local governments aiming to improve their overall energy efficiency.

The transportation scoring in the 2017 City Energy Efficiency Scorecard emphasizes that a comprehensive approach to transportation energy efficiency at the city level must adequately address the efficiency of both individual vehicles and the transportation system as a whole, including its interrelationship with land

use policies. Transportation metrics are allocated 30 out of the possible 100 points in recognition of the average proportion of energy used by this sector in cities in the United States.

Methodology

ACEEE's *City Energy Efficiency Scorecard* evaluates the central cities within the 51 largest Metropolitan Statistical Areas (core urban population of 50,000 or greater). These big cities can have influence beyond their borders and can encourage similar actions in smaller surrounding municipalities. The 51 cities included represent 15 % of the total population in the United States while the 51 MSAs chosen represent close to 55 % of total US population. A complete list of cities and their populations is shown in Table 1.

For the upcoming edition of the report, we scored cities based on the seven categories of transportation metrics outlined in Table 2, which we identified as having the highest energy savings potential. Metrics are heavily weighted towards system efficiency policies, since fuel economy standards at the federal level are seen as the primary driver for the development of the efficient vehicle market in the US. However, we do score cities on actions that go above and beyond to encourage the deployment of efficient vehicles and the relevant infrastructure at the local level.

Metrics selected to evaluate transportation energy efficiency are, in most cases, policies that city policymakers can influence in the short run and that have demonstrated energy savings potential based on a review of existing energy potential studies. More points are awarded to metrics that ACEEE considers the most important to kick starting energy savings in the transportation sector. While it is important to note that city-level policies for this sector are most effective when they interact with or build upon policies from encompassing jurisdictions, all of the metrics we chose for our comparison focus specifically on local government action. Below we include a brief discussion on each of the metrics included in the Scorecard methodology.

SUSTAINABLE TRANSPORTATION PLANNING

Sustainable transportation plans allow cities to identify key needs and implement coordinated strategies and approaches that serve to reduce energy consumption and greenhouse gases in the long run. However, without specific targets or goals within those plans, results can be elusive. Having a VMT tar-

Table 1. Population of cities included in 2017 City Energy Efficiency Scorecard.

City	Population	City	Population
New York, NY	8,550,405	Oklahoma City, OK	631,346
Los Angeles, CA	3,971,883	Las Vegas, NV	623,747
Chicago, IL	2,720,546	Baltimore, MD	621,849
Houston, TX	2,296,224	Louisville, KY	615,366
Philadelphia, PA	1,567,442	Milwaukee, WI	600,155
Phoenix, AZ	1,563,025	Sacramento, CA	490,712
San Antonio, TX	1,469,845	Kansas City, MO	475,378
San Diego, CA	1,394,928	Atlanta, GA	463,878
Dallas, TX	1,300,092	Virginia Beach, VA	452,745
San Jose, CA	1,026,908	Raleigh, NC	451,066
Austin, TX	931,830	Miami, FL	441,003
Jacksonville, FL	868,031	Minneapolis, MN	410,939
San Francisco, CA	864,816	New Orleans, LA	389,617
Indianapolis, IN	853,173	Cleveland, OH	388,072
Columbus, OH	850,106	Tampa, FL	369,075
Fort Worth, TX	833,319	Riverside, CA	322,424
Charlotte, NC	827,097	St. Louis, MO	315,685
Seattle, WA	684,451	Pittsburgh, PA	304,391
Denver, CO	682,545	Cincinnati, OH	298,550
El Paso, TX	681,124	Orlando, FL	270,934
Detroit, MI	677,116	Richmond, VA	220,289
Washington, DC	672,228	Birmingham, AL	212,461
Boston, MA	667,137	Salt Lake City, UT	192,672
Memphis, TN	655,770	Providence city, RI	179,207
Nashville, TN	654,610	Hartford, CT	124,006
Portland, OR	632,309		

Source: United States Census Bureau 2015

Table 2. 2017 City Scorecard transportation energy efficiency metrics.

Category	Metric	Points
Sustainable transportation plans and targets	Sustainable transportation plan	2
	Vehicle Miles Traveled (VMT) reduction target	2
Location efficiency policies	Zoning and parking policies for location-efficient development	4
	Complete streets	2
	Location efficiency information disclosure and incentives	2
Mode shift strategies	Mode shift targets and strategy implementation	2
	Car sharing	1
	Bicycle sharing	1
Public transit policies	Transit funding	3
	Access to transit service	2
Efficient vehicles	Incentives for efficient vehicle purchases	1
	Incentives for development of electric vehicle supply equipment (EVSE)	1
	EVSE charging locations	1
Freight policies	Sustainable freight planning	2
	Freight information and communications technology (ICT)	1
Low income transportation access	Affordable housing requirements or incentive for transit oriented development (TOD)	3

get (or transportation-specific GHG target) in place is an essential component of such plans because it gives cities specific benchmarks for fostering sustainable transportation which can include strategies such as the development of transit-oriented communities and the use of non-motorized transportation options. Cities with a sustainable transportation plans in place to reduce VMT or greenhouse gas emissions from transportation earn points in this category. Additional points went to cities with codified reduction targets.

LOCATION EFFICIENCY

Where we choose to live and develop our neighbourhoods has a huge impact on overall energy use

Location efficiency strategies are largely a local government responsibility and are, therefore, highly indicative of a government's leadership in transportation policies generally.

Zoning and Parking Policies for Location Efficient Development

Where we choose to live and develop our neighbourhoods has a huge impact on overall energy use. Households can reduce their transportation-related energy use by locating in compact, mixed-use communities that are well connected and near transit facilities (EPA 2011). Policies that encourage such choice of location reduce the need to drive in the long run (Vaidyanathan and Mackres 2012). Location efficiency strategies are largely a local government responsibility and are, therefore, highly indicative of a government's leadership in transportation policies generally.

Well-crafted zoning codes form the crux of effective location efficiency policies by promoting the creation of walkable, mixed-use communities. Changes to municipal zoning regulations can direct investment and development toward high-density, mixed-use construction near existing transit facilities.

In general, zoning codes that support location efficiency should recalibrate zoning to require mixed-use zones, allow for compact development, increase building density around transit nodes, create walkable communities, and importantly, reduce requirements for parking space. Conventional zoning codes often have minimum parking requirements that claim significant surface area and drive up development costs, preventing denser, more-compact development from flourishing and perpetuate automobile-oriented neighbourhoods. To enable the growth of compact developments, developers need to facilitate access by non-auto modes and set aside less land for parking. Full points were awarded to cities with location-efficient zoning codes that applied to the whole city, and half points to cities if the code applied only to certain areas or neighbourhoods.

Complete Streets

According to the National Complete Streets Coalition (NCSC), 30 % of all trips in metropolitan areas in the United States are of one mile or less and can be made by walking or using other forms of non-automobile transport (NCSC 2011). Complete streets create a network of streets, sidewalks, and bicycle lanes that connect to transit facilities, making people less likely to drive. Therefore, they can lower a community's fuel consumption and promote economic development as nonvehicle transportation proliferates. ACEEE's scoring of complete-streets policies in this report leverages the National Complete Streets Coalition complete-streets policy scores, which range from 0 to 100 according to the quality of the adopted policy (NCSC 2016). The higher the NCSC score, the more points awarded in the *ACEEE City Energy Efficiency Scorecard*.

Location Efficiency Information Disclosure and Incentives

Cities may use a number of incentives ranging from tax credits to fast tracking the permitting process to encourage compact growth and mixed-use projects. Such financial and nonmonetary policy levers can make these projects deeply attractive to

developers. Financial incentives help promote transit-oriented development or other community land use priorities in that they bring down the overall cost of construction to developers in areas for which denser development is a priority. Commonly used measures include low-interest loans and property tax abatement programs. Similarly, nonfinancial measures such as density bonuses and expedited permitting similarly provide incentives for compact, mixed-use development.

Additionally, cities may require disclosure of information on the location efficiency of buildings to potential buyers or tenants as a part of a real estate transaction or rental listing to attract potential residents to transit-oriented development and mixed-use communities. Programs such as WalkScore in the United States, which rates neighbourhoods on how walkable they are, help potential renters or buyers incorporate transportation use and costs in their decision matrix. Cities with a financial or non-financial incentive program for location-efficient development or with a disclosure policy were awarded for each incentive or policy in place.

MODE SHIFT

To improve the efficiency of a transportation system, cities must make efforts to implement policies that encourage other modes of transportation (e.g., public transit, ridesharing, bicycles, walking). This can be achieved through transportation demand management programs, vehicle sharing efforts, and, more holistically, by ensuring that cities integrate land use and transportation planning.

Mode Shift Targets and Strategy Implementation

Cities can use a number of policy levers to shift travel from personal vehicles to more-efficient modes of transport, including modal share targets. Modal share targets aim to increase the percentage of trips taken on non-automobile modes of transportation. Cities that commit to concrete, long-run modal share targets can change the travel behaviour of their communities in favour of modes of transportation that consume less energy. However, action plans to achieve the outlined targets are critical in order to create a road map and track progress towards changing development patterns and travel behaviour. Cities with a codified modal share targets earned full points. Half points were awarded if these targets were part of a general sustainability plan but not codified through formal adoption.

Car Sharing and Bike Sharing

Car-sharing services give drivers access to shared vehicles on a time-limited basis as an alternative or supplement to vehicle ownership while still providing convenient access when a car is desired. The emergence of companies such as Zipcar, Car2Go, and other services in recent years indicates that these services are becoming more popular with metropolitan residents who do not want the cost and maintenance burden of owning underutilized personal vehicles.

Likewise, bicycle-sharing programs present commuters and city residents with another alternative to owning or driving a personal vehicle. Bike-sharing systems provide publicly accessible shared-use bicycles that are available for trips of short to medium distance. Bike sharing increases the ease of urban mobility, increases the use of public transit, and reduces overall energy use within a metropolitan area. A city that is served by car-sharing programs or supports private market programs through permitting or incentives earned full points, while a city with a program in the planning stages earned half points. The same approach was taken for bike sharing programs.

TRANSIT

Well-connected public transit networks reduce residents' need to drive and therefore the number of vehicle miles travelled in metropolitan areas. Cities can increase funding and ensure adequacy of transit service to make public transit a viable alternative to driving.

Transportation Funding

Federal, state, and local transportation funding in the United States continues to favour road and highway maintenance over transit expansion. Local funding for transportation is generated in a variety of ways and can make up a significant portion of expenditures on transit expansion. Common strategies for funding transit include sales and property taxes, user fees, revenues from road and parking pricing schemes, and transit fares. We scored cities based on the ratio of regional transit funding per capita to city funding of highways and parking per capita.

Access to Transit Service

There has been a gradual growth in public transit use in the United States in recent years. The number of people who use some form of public transportation increased by 20 % between 2000 and 2014 (APTA 2014). Therefore, to adequately rate a city's transportation efficiency, we thought it important to include a metric that evaluates the quality of public transit service. The development of quality transit services, including adequate service frequency, is essential for public transit to be a viable option in a city. Efficient transit systems within metropolitan areas designed in connection with land use planning can make public transportation a viable substitute for automobile trips. To rate each city, we used the Center for Neighborhood Technology's Transit Connectivity Index, which measures the availability of transit service by estimating the number of rides available per week on transit within walking distance of the average household scaled by the frequency of service (CNT 2016).

EFFICIENT VEHICLES

The global vehicle market has seen an increase in high-efficiency options for consumers in recent years. Manufacturers are maximizing the efficiency of conventional internal-combustion-powered vehicles, and many more conventional hybrids, plug-in hybrids, and electric vehicles are now available for sale. Cities can continue to encourage this trend in efficiency by using the following policies.

Incentives for and Investment in Energy-Efficient Vehicles and Vehicle-Charging Infrastructure

A key barrier to the full deployment of technologically advanced, fuel-efficient vehicles in the US is high cost. To encourage consumers to purchase these vehicles, financial incentives, including tax credits, rebates, and sales tax exemptions are important policy levers. Currently, these incentives are provided largely at the state level. However, a few cities across the country further subsidize the cost of these vehicles with supplemental incentives. The city of Riverside,

California for instance offers buyers of electric vehicles a $500 rebate for qualifying vehicles. For electric vehicles, an added barrier to adoption is the lack of comprehensive public charging infrastructure. As a result, a number of cities have begun evaluating their EV readiness and have also begun developing policies to enable the installation and availability of charging sites. Cities were evaluated on whether or not they had an incentive program to support the implementation of electric-vehicle-charging infrastructure.

We awarded cities points if they provided purchase incentives for hybrid, plug-in hybrid, or electric vehicles – all vehicle types that typically have high fuel efficiency – or for conventional vehicles with high fuel efficiency. Additional points were awarded if cities had 50 or more charging stations available to the public.

FREIGHT

Policies and infrastructure for the movement of freight in cities and their metropolitan areas can facilitate improvements in efficiency. Strategies that reduce the fuel used in the movement of goods, such as streamlining logistics, are particularly useful for improving the overall efficiency of the freight system.

Sustainable Freight Planning

Addressing energy use in freight traffic in addition to passenger vehicles is critical to improving the overall efficiency of the transportation sector at the city level. According to the Energy Information Administration, freight trucks accounted for 18 % of total transportation energy use in the United States in 2015 (EIA 2016). Cities across the US are beginning to develop their own freight plans that address freight efficiency at the local level and go above and beyond state requirements and policies. These plans serve as the foundation for policies and strategies to increase freight efficiency. They can include strategies such as truck loading plans, multi-modal requirements, street design, last mile delivery solutions, zoning provisions or off-hour delivery programs (City of Portland 2012). Each one of the strategies can single-handedly have a positive effect on a city's freight efficiency, but having a plan in place that incorporates a comprehensive package of strategies can result in even greater fuel savings. We awarded cities full points if they had a standalone sustainable freight plan or a freight mobility plan that outlines strategies to increase freight efficiency.

Freight ICT

Advances in information and communications technologies have enabled better coordination of freight traffic and shipments. The incorporation of ICT in freight transportation can address this problem. Internet based applications and services such as Otto or Transfix have spurred the transformation of the freight industry by connecting shippers and carriers directly, which helps to streamline and simplify logistics, and by also providing freight carriers with dynamic, real time road updates which reduces fuel consumption by minimizing the time spent in traffic. Many cities have incorporated such services in city-run internet platforms where real-time data is available and used to streamline freight operations. However, since this is a relatively new technology, cities were awarded points if they had some form of internet- based application or service that helped coordinate freight transportation, even if the service is provided by a private company. Cities earned points if they had some form of internet-based application or service that helped coordinate freight transportation.

LOW-INCOME TRANSPORTATION ACCESS

Urban sprawl and current land-use patterns across cities in the US have had a disproportionate effect on low-income households.

As cities have grown outwards and jobs have moved away from urban cores, many low-income and minority communities are inadequately served by affordable and efficient transportation options. Transportation options are often limited to automobiles, and expenditures for vehicle, fuel, insurance, and maintenance for these households can be very large and very unpredictable (Vaidyanathan 2016). To create a more equitable and sustainable transportation system, residents of all incomes must have access to affordable, efficient transportation options. Cities can do this by implementing policies that require affordable housing for new developments or preserve existing affordable housing in transit areas. Cities earned points for each requirement or incentive in place that encourages the creation of affordable housing in transit-served areas.

Results

Table 3 shows preliminary results from the upcoming 2017 rankings. Please note that these results are still subject to change.

Portland, New York City, and Boston topped the transportation rankings, although none of these cities achieved the maximum possible score of 30 points. Hence there is still room for improvement even amongst leading cities in the United States. The methodology used in the *ACEEE City Energy Efficiency Scorecard* to evaluate transportation efficiency does a reasonable job of rating cities that are known to be transportation policy leaders. All three of the top scoring cities have placed a priority on reducing energy consumption and greenhouse gas emissions from the transportation sector in recent years. Below is a description of some of the key policies and best practices adopted in each of the top three.

PORTLAND, OR

While not the largest or the densest metropolitan area in our list of evaluated cities, Portland has long been a leader in efficient and sustainable transportation. Guided by a state policy that places strict growth boundaries on urban areas to prevent urban sprawl and encourage the efficient use of land and transportation, the City of Portland has supplemented these state regulations with additional city level actions and goals to further improve transportation system efficiency. The 2015 Portland Climate Action Plan, adopted by the city council, includes an ambitious goal to reduce transportation-related carbon emissions by 40 % below 1990 levels by 2030 with additional mode share goals for commuting. By 2030, Portland aims to achieve a mode-share goal of 25 % for public transit, and an additional 35 % goal for walking and bicycling.

Portland is also one of few cities in the United States to have developed an urban sustainable freight strategy to improve the efficiency of freight movement within and through the Portland metropolitan area. While the strategy doesn't contain specific quantitative reduction goals, it does outline a number

Table 3. Transportation results by city.

City	State	Sustainable transportation plans	Location efficiency	Mode shift	Transit	Efficient vehicles	Freight	Low income	Total
Portland	OR	4	6.5	4	4	2	2	3	25.5
New York City	NY	2	5	3	4.5	2	3	2	21.5
Boston	MA	4	4.5	4	4	2	0	2	20.5
Chicago	IL	3	4	4	3	3	1	2	20
Seattle	WA	4	5	3	1.5	2	2	1	18.5
Atlanta	GA	2	4	4	3.5	2	0	2	17.5
San Francisco	CA	4	4	4	4	1	0	0	17
Austin	TX	3	5.5	3	1.5	2	1	1	17
Los Angeles	CA	4	3	2	1.5	2	1	3	16.5
Philadelphia	PA	3	3.5	3	4	0.5	1	1	16
Washington	DC	4	3.5	4	2	2	0	0	15.5
Denver	CO	2	5	4	1.5	1	0	1	14.5
Minneapolis	MN	2	4.5	3	1.5	1	1	1.5	14.5
Kansas City	MO	3	4	3	2.5	1	0	0	13.5
San Antonio	TX	3	4	4	1	1	0	0	13
San Jose	CA	2	2.5	4	2.5	1	0	0	12
Cleveland	OH	3	3.5	1.5	2	0	0	1.5	11.5
Riverside	CA	3	2.5	1	0	1.5	1	2	11
Houston	TX	0	4	2	1	1	0.5	2	10.5
Salt Lake City	UT	3	2.5	3	1.5	0.5	0	0	10.5
Dallas	TX	1	2.5	1.5	2.5	1	0	2	10.5
Louisville	KY	4	1	3	0.5	0	1	1	10.5
Nashville	TN	0	5	3	0.5	1	0	1	10.5
Richmond	VA	1	4.5	1.5	1.5	0.5	1	0	10
San Diego	CA	3	2	2	1	1	0	1	10
Phoenix	AZ	0	5	1	1	1	0	2	10
Baltimore	MD	1	4.5	1	2	1	0	0	9.5
Jacksonville	FL	4	2	1	1	1.5	0	0	9.5
Pittsburgh	PA	1	1	2	4	0.5	0	0.5	9
Miami	FL	1	2.5	2	2	0.5	1	0	9
Raleigh	NC	0	4.5	1.5	0.5	1	0	1.5	9
Columbus	OH	0	4	2	1.5	0.5	0.5	0	8.5
Milwaukee	WI	1	3	3	1	0.5	0	0	8.5
Indianapolis	IN	0	4.5	2	0.5	0.5	0	1	8.5
Las Vegas	NV	2	2	2	1	1	0	0	8
Fort Worth	TX	0	4.5	2	0.5	0	0	1	8
Memphis	TN	0	4	1.5	1.5	0	0.5	0	7.5
Charlotte	NC	2	1	1	1.5	1	0	1	7.5
St. Louis	MO	1	3	1.5	1.5	0	0	0	7
Cincinnati	OH	0	3.5	2	1	0.5	0	0	7
Orlando	FL	3	1	2	0	1	0	0	7
El Paso	TX	1	2.5	1	2	0.5	0	0	7
New Orleans	LA	2	3.5	0.5	1	0	0	0	7
Providence	RI	1	3	1.5	1.5	0	0	0	7
Sacramento	CA	2	1.5	1.5	1	1	0	0	7

The table continues on the next page. →

City	State	Sustainable transportation plans	Location efficiency	Mode shift	Transit	Efficient vehicles	Freight	Low income	Total
Tampa	FL	1	2	2	0	1	0	1	7
Virginia Beach	VA	1	4	0	0	0	0	0	5
Birmingham	AL	0	3.5	1	0	0	0	0	4.5
Detroit	MI	0	0	1.5	0.5	0.5	0	0	2.5
Hartford	CT	0	1.5	0	0.5	0	0	0	2
Oklahoma City	OK	0	0	1	0	0	0	0	1

of strategies that the city aims to use to streamline freight operations. These include last mile solutions, centralized freight distribution districts and off-hours delivery.

NEW YORK CITY, NY

New York City is one of the world's busiest, most populous cities and has the highest proportion of trips taken by non-vehicle modes of any metropolitan region in the United States (City of New York 2014). Adding to that achievement, the city has continued to support the creation of a smart transportation system through the adoption of a number of ambitious transportation efficiency policies. The Subway system is the transportation backbone of the city and, as a result, expenditures on operations and maintenance of public transit facilities and services far outweighs money spent on roads and highways. Additionally, the city offers some of the most comprehensive incentives for location efficiency through the R10 Program. New developments that provide affordable housing in high-density "R10" districts are eligible to receive density and floor area bonuses. Additionally, these benefits are available to developers who build in Inclusionary Housing Designated Areas in medium- and high-density neighbourhoods.

BOSTON, MA

Boston also excels in providing residents with alternatives to driving. With a transportation-specific greenhouse gas reduction target of 25 % by 2020, Boston has been making a concerted effort to reduce driving overall within its city limits. Investment in public transit infrastructure has been a top priority for the city in recent years, with expenditures on public transportation operation and maintenance amounting to more than 6 times what is spent on highways and roads. As a result, city residents see a high concentration of bus routes and train stations within walking distance of their households and a generally high frequency of public transit service.

To add to the variety of transportation options available to residents, the city has attracted a number of car sharing services to the area and has invested in creating a large bike sharing program called Hubway. Hubway has 160 stations, 1,600 bikes and approximately 10,000 annual members that have generated close to 5 million rides to date since its inception in 2011.

Challenges and Improvements

As mentioned above, developing a methodology to evaluate a city's policies to reduce energy consumption in the transportation sector is challenging. While there is a universe of policies available, the differences in demographic composition and density between various urban centres in the United States mean that policies effective in one city may not be relevant to others. Additionally, given that a lot of transportation policy occurs at the regional level in the United States, teasing out the role that local governments have with regards to creating efficient transportation systems in their cities can be challenging. A lot of regional and municipal policies work best in tandem with one another, yet our methodology is limited to evaluating only local-level policies. Nevertheless, the *ACEEE City Energy Efficiency Scorecard* attempts to provide cities in the United States with a general sense of how they compare to each other on transportation efficiency policy using the best practice metrics described above.

We also hope that the Scorecard will serve as a useful tool to sustainability-minded cities globally who are interested in learning from some of the best practice policies and programs outlined in the report. Although the City Scorecard analyses and scores efficiency policies only in the largest U.S. cities, it can be valuable to all local governments. ACEEE created a Taiwan City Energy Efficiency Index in 2016 by adapting metrics from City Scorecard at the behest of the Taiwanese central government. Additionally, communities of all sizes can adopt or modify the policies we describe in the Scorecard, particularly the best practices. To help interested communities use our policy assessment methodology, ACEEE has developed the Local Energy Efficiency Self-Scoring Tool (Ribeiro and Bailey 2015). Policymakers and other local stakeholders can use this spreadsheet-based tool to evaluate their own communities' energy efficiency efforts. They can generate scores based on the metrics we use in the Scorecard, and they can compare their community's performance to that of similar communities.

Nevertheless, while the *ACEEE City Energy Efficiency Scorecard* is a valuable tool for municipal energy planning, methodology improvements can always be made. In particular, we focus on an area that is only briefly covered in our current methodology: the increasing availability of transportation data and the role of information and communications technology (ICT) in transportation policy.

TRANSPORTATION DATA AND ICT

Like other end use energy sectors, the transportation sector has embraced the use of information and communications technology to improve efficiency, and safety and mobility options. Cities, in particular, have played an active role in understanding where data and information technology can be implemented to fill transportation gaps. The recent US Department of Transportation Smart Cities Challenge competition showed that many cities are keenly interested in this intersection. The challenge awarded USD $50 million to a city to develop ideas for a smart transportation system that would use data and technology to help people and goods move more quickly, cheaply, and efficiently. 78 different American cities applied for the grant. While only one winner was chosen, the competition spurred cities to come up with technologically advanced plans for sustainable transportation systems that could reasonably be implemented in the coming years.

While we have accommodated some of this recent activity in our methodology by awarding points to cities who have some form of internet-based application or service to coordinate freight transportation, we have not to date addressed the role of data access and ICT in the passenger transportation sector. ICT strategies in the light-duty transportation sector can be quite varied. ICT-enabled devices help drivers drive more efficiently but can also reduce the need to drive altogether and provide commuters with alternatives to using single-occupancy vehicles. For instance, car and bike sharing programs have become very popular in many large urban centres across the world. Bike sharing programs encourage use of alternative modes of transportation, while car sharing removes the onus of owning a vehicle by providing members with shared access to vehicles as and when they need them. Both cars and bicycles are available for short, spontaneous trips. ICT applications are crucial for bike and car share members as they enable them to locate vehicles in the vicinity as well as identify return points with the touch of a smartphone (Vaidyanathan 2014).

Likewise, real-time transit data has also become critical to transit commuters across the world. Faced with the need to get to their destinations in a timely, efficient manner, commuters can benefit greatly from bus and train tracking systems, dynamic transit maps and schedules, and fare-based applications to navigate growing and increasingly complex transit systems. Transit authorities also recognize the importance of such tools to commuters, and a growing number of urban transit companies have begun to invest heavily in making data accessible to the general public and in the development of applications that interact with the user through GPS or smartphone interfaces to provide them with real-time information on transit arrivals, departures, stop locations, fares and connections between systems and modes.

As open data and communications technology continue to become more and more crucial to the creation of smart, sustainable transportation systems, *ACEEE's City Energy Efficiency Scorecard* will need to find a way to evaluate cities on their actions in this sphere. As a first step, an additional metric on open access to passenger transportation data could be added to identify cities that are invested in dispersing transportation data in a way that encourages the development of travel that give residents the information they need to make efficient transportation decisions.

Conclusion

Local governments have a particularly important role to play when it comes to maximizing energy efficiency in the transportation sector. ACEEE captures cities' progress on energy efficiency broadly in its *City Energy Efficiency Scorecard,* scoring cities on energy efficiency policies in local government operations, community-wide initiatives, buildings, energy and water utilities, and transportation. The transportation sector methodology scores cities on both efficient vehicle policies and strategies to reduce improve the efficiency of the transportation system. Metrics selected to evaluate transportation energy efficiency reflect, in most cases, steps that city policymakers can take in the short run. Portland, New York and Boston preliminarily top our rankings for 2017 with scores of 25.5, 21.5 and 20.5 respectively. While the *ACEEE City Energy Efficiency Scorecard* is a valuable tool for municipal energy planning, to effectively capture recently developments in the transportation sector, future editions of the scorecard must include metrics that evaluate cities' use of data and technology to create smart and efficient transportation systems.

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