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Mineta Transportation Institute
College of Business
San José State University
San José, CA 95192-0219

Tel: (408) 924-7560
Fax: (408) 924-7565
Email: mineta-institute@sjsu.edu

transweb.sjsu.edu

040819

EXECUTIVE SUMMARY

Freight movement accounts for a significant and growing share of energy use and greenhouse gas emissions (GHGs). Although many cities have developed climate action plans (CAPs) to address their transportation GHGs, freight transportation has received little attention. The overarching question that we answered throughout this research has been the following: How can cities better incorporate innovative strategies to reduce GHG emissions from freight transport through climate action planning?

This research involved three phases. First, through a review of the literature, we identified innovative strategies to reduce freight emissions. Second, by analyzing the content of 27 advanced local CAPs in the United States, we uncovered gaps in local climate action planning efforts related to freight emissions reduction. Third, by comparing local CAPs with several freight plans, we found potential areas where local CAPs and freight plans can be linked together for better effectiveness of strategies to reduce freight GHG emissions.

Findings indicate that there is a disconnect between local climate action planning and freight planning efforts in most cities. More specifically, although most plans mention freight or indicate the impact and importance of freight, only six out of 27 advanced local plans explicitly address freight transport in their GHG emission reduction strategies or actions. Likewise, most of the freight plans we analyzed do not directly address the reduction of GHGs or set a goal for GHG emissions reduction. To the extent that environmental goals, such as the reduction of local air pollution and/or GHG emissions, were included in the freight plans, they were addressed largely through recommended improvements in freight mobility. The environmental improvements from proposed freight strategies and actions were included mostly as ancillary benefits.

We recommend that all CAPs explicitly discuss GHG emissions from freight transport specifically and develop targeted strategies and actions for reducing freight emissions. Since cities do not control all aspects of a freight transportation system, planners working on municipal level CAPs should coordinate more closely with planners working on city, regional, and state freight plans to identify and include freight initiatives that will reduce GHG emissions.

II. BACKGROUND

The transportation sector is a significant contributor to global greenhouse gas (GHG) emissions and energy usage. In the US, transportation represents 28% of total GHG emissions from the economy.[1] Nearly 96% of GHG emissions from transportation is comprised of carbon dioxide (CO_2) produced from the combustion of petroleum fuels. Hydrofluorocarbons (HFCs) emitted from refrigerated trucks and vehicle air conditioners contribute 3%, while nitrous oxide (N_2O) and methane (CH_4) account for the remainder.[2] While progress has been made in stabilizing or reducing GHG emissions in other sectors (electricity generation, industry, commercial and residential land use, and agriculture), emissions from the transport sector have been growing at a fast pace. Global CO_2 emissions from the transport sector increased 45% from 1990 to 2007, and are expected to continue growing.[3] The International Energy Agency (2009) predicts emissions from transportation to grow by 50% by 2030 and by 100% by 2050 from 2007 levels.[4]

Within the transport sector, freight movement accounts for a significant and growing share of energy use and GHG emissions. In the US, goods movement accounts for 28% of total transportation energy use, or 8% of overall energy use.[5] As a share of total urban transportation, urban freight contributes a quarter of CO_2 emissions.[6] Furthermore, freight is expected to experience the fastest growth in GHG emissions with an increase of 30% by 2050, compared with 20% for the transport sector as a whole. This growth is not a new development, as emissions from freight transportation have been increasing for the past 40 years. From 1973 to 1992 emissions and energy use from freight transport grew faster than any other sector in an analysis of 10 industrialized countries.[7] Within the US, trucking is the largest mode of freight transport based on tonnage carried, and is responsible for 60% of freight GHG emissions with pipeline (16%), water (13%), rail (6%), and air (5%) accounting for the rest.[8]

CLIMATE ACTION PLANS (CAPS)

Climate action planning is defined as mitigating a community's GHG emissions and adapting to the adverse impacts of climate change. In the context of the United States, a lack of consistent and meaningful action at the federal level along with growing public awareness of the reality of the problem has created a fertile ground for bottom-up climate action. In this arena, cities and metropolitan agencies have played a major role by developing climate action plans (CAPs) and implementing innovative strategies to combat climate change. Typically, these CAPs have set emission reduction targets and have additionally included policy measures to address emissions from various sectors of the economy—including energy supply and demand, agriculture and waste, and transportation and land use.

Across the nation, local CAPs vary greatly in terms of their specific strategies employed or considered, as well as their goals and the rigor of their implementation. Nevertheless, research has shown that CAPs have typically set low near-term targets and ambitious long-term targets.[9] This means that even the most rigorous CAPs—which have met or are on track to meet their near-term targets—rely heavily on major technological and policy innovations to meet their ambitious long-term targets (e.g. reduce emissions by 80% by 2050). Therefore, there is a need to identify and evaluate innovative emission reduction strategies employed or considered by the cities and other metropolitan agencies.

An analysis of state level CAPs by Alexander (2016) shows that most states have set lower emission reduction goals from transportation and land use compared to the contribution of these sectors to total emissions.[10] Because many cities have developed CAPs as a response to state level legislation or following state CAPs, it is likely that many cities also set low transportation emission reduction goals. This creates an opportunity to research and assess strategies that can potentially reduce emissions from the transportation sector specifically. Within the transportation sector, the literature is particularly thin in the area of strategies to reduce emissions from freight movements that CAPs can adopt.

URBAN FREIGHT TRANSPORTATION

Urban freight, or urban goods movement, is defined as the transportation of goods by or for commercial entities into, out from, through, or within an urban area. It encompasses deliveries, pick up, and through transport of a wide range of commodities, including supplies, materials, parts, products, consumables, mail, parcels, packages, and waste. Urban goods movement also includes commercial home deliveries to households, but not personal shopping trips.[11]

The processes of urbanization and freight transportation development are interconnecting and mutually reinforcing. Cities have emerged and grown because of their role as important nodes on freight transport networks. Cities have grown around seaports, rail stations, truck terminals, and airports. Today, cities are linchpins in global trade networks and facilitate the operation of global supply chains. Likewise, many freight transport functions have concentrated in cities because they are centers of population and economic activity. As urban areas have grown and play a larger role in economic development, the scale and intensity of urban freight transport has increased. In the US, more than 80% of all US goods movements either start or end in the 100 largest metropolitan areas. With the growth of global trade and supply chain networks, we are growing increasingly more reliant on freight movement. The annual volume of freight moving per capita is expected to increase from 55 tons in 2010 to 70 tons in 2040—an increase of 27 percent. The American Association of State Highway and Transportation Officials (AASHTO) forecasts that for every two trucks on the road today, by 2030 there will be an additional truck to carry the expected growth in food, consumer goods, and manufacturing equipment.[12]

URBAN GOODS MOVEMENT CHALLENGES IN SMART GROWTH ENVIRONMENTS

Since at least the 1950s, the dominant urban growth paradigm in the US has been decentralized suburban growth, characterized by low-density development in newly urbanizing areas on the metropolitan fringe facilitated by automobiles and highway transport. While providing many individual quality-of-life improvements, US-style suburbanization has come with increasing economic, social, and environmental costs due to the sprawling nature of this development. Numerous studies have shown that there are considerable costs associated with urban sprawl, including higher levels of vehicular traffic and congestion, gasoline consumption and total energy costs, GHG emissions, local air pollution, and other negative externalities.[13]

In response to the realization of the costs of urban sprawl and limited alternatives to suburban-style development, many city planners, developers, architects, and advocacy groups have been espousing a 'smart growth' approach to urbanization. Relying on concepts such as new urbanism, infill development, affordable housing, historical preservation, transit-oriented development and urban growth boundaries, the main thrust of the smart-growth movement is to encourage more high-density development in already urbanized areas that contain a mix of land uses close enough together to encourage more walking, biking, and public transit use.[14]

While the intended effect of smart growth planning is to create more livable, attractive, and sustainable urban environments, significant challenges to implementing this vision of urban growth remain present. One of these centers around the movement of freight, especially the delivery and pickup of goods and products in smart-growth environments.[15] Higher-density zones that are designed increasingly for pedestrians, bicycles, and mass transit may not be amenable to the movement of large freight transport vehicles. Freight carriers are finding it more difficult to service higher-density urban centers due to increased roadway traffic, more limited street capacity for freight vehicles, lack of freight vehicle parking, and increased demand for timely deliveries and pickups from a growing number of businesses and residences in these areas. Many parcel delivery companies such as FedEx and UPS are finding it more difficult to find places to park vehicles while delivering and picking up items, forcing drivers to search highly-congested areas for an open spot and/or park illegally. Han et al. (2005) estimated that the total cost of delay induced by pickup and delivery illegal parking activities in urbanized areas in the United States was approximately $10 billion in 1999.[16] The challenges of urban goods movement in urban areas threaten to diminish the GHG mitigation and other benefits of the entire smart growth approach.

III. LITERATURE REVIEW

STRATEGIES TO REDUCE GHGS IN URBAN FREIGHT TRANSPORT

There are a number of strategies that have been suggested to reduce GHGs and improve efficiency from urban freight transport. Some of these strategies are intended for the freight transport industry generally, while others are developed specifically for cities, metropolitan areas, or states. The development and implementation of more effective urban freight strategies rely on the participation of freight transport companies (carriers), the businesses that utilize these services (shippers and receivers), and the communities where these activities occur.

Frey and Kuo (2007) identified a set of 59 potential best practices for reducing GHG emissions in the major modes of freight transportation—truck, rail, air, water, and pipeline.[17] For trucks, they identified 11 subgroups of best practices including anti-idling, air conditioning system improvement, aerodynamic drag reduction, tire rolling resistance improvement, hybrid propulsion, weight reduction, transmission improvement, diesel engine improvement, accessory load reduction, driver operation improvement, and alternative fuel. They found that some alternative fuel strategies, such as the use of B20 biodiesel and an increased use of hybrid trucks, could result in significant reductions of GHG emissions. They also found that large percentage reductions are possible through increased intermodal shifts in traffic, e.g. from truck to rail.

In 2004, the US Environmental Protection Agency (EPA) launched its SmartWay program, a voluntary public-private endeavor designed to help freight companies achieve supply chain sustainability through measuring and benchmarking freight transport efficiency and atmospheric emissions. According to the EPA (2017), the SmartWay program: (1) provides a comprehensive and well-recognized system for tracking, documenting and sharing information about fuel use and freight emissions across supply chains; (2) helps companies identify and select more efficient freight carriers, transport modes, equipment, and operational strategies to improve supply chain sustainability and lower costs from goods movement; (3) reduces freight transportation-related emissions by accelerating the use of advanced fuel-saving technologies; and (4) is supported by major transportation industry associations, environmental groups, state and local governments, international agencies, and the corporate community. More than 3,500 companies across the supply chain spectrum (trucking, rail, maritime, air cargo, and their customers) have joined SmartWay. The EPA (2017) estimates that, since its inception, the SmartWay program has reduced oil consumption by more than 196 million barrels, resulting in nearly $30 billion of savings for US trucking companies alone. SmartWay has helped its partners avoid emitting over 94 million tons of air pollutants, including particulate matter, oxides of nitrogen, and carbon dioxide.[18]

At the scale of cities and metropolitan areas, a quick scan of GHG emission-reduction strategies oriented to freight transport include a mix of approaches that rely on changing practices in the freight industry and specific place-based initiatives. Some strategies are aimed at reducing truck emissions and energy consumption by improving engine performance, shifting to cleaner (and quieter) conventional diesel trucks or alternative-fuel

trucks, shifting freight to more energy-efficient modes, and/or reducing freight vehicle miles traveled.[19] Another example comes from the City of Portland (2012), which identified five common themes of sustainable freight strategies: clean-vehicle technology, low-emission zones, urban consolidation centers, last-mile solutions, and off-hours deliveries. Cities can encourage the use of cleaner vehicles, such as hybrid electric or natural gas-powered trucks, through various incentives and regulations. Cities can designate some highly-congested areas as low-emission zones and restrict highly-polluting vehicular traffic in these areas.

Urban consolidation centers are places where large freight vehicles can load and unload commodities without having to travel within and through highly congested urban districts. From urban consolidation centers, local pickups and deliveries are handled by smaller and cleaner vehicles that can maneuver more effectively in these environments. Last-mile solutions are intended to improve the efficiency of deliveries and pickups in crowded urban environments through such approaches as collection/delivery point networks and locker banks. Instead of trying to deliver packages and other goods directly to each individual business and residence in a high-density environment, delivery companies can use specific collection/delivery points where designated freight parking is available on a scheduled basis. Receivers then pick up (or drop off) their goods at selected times or the goods can either be stored in locker banks for collection at another time. Shifting goods movement and delivery to off-peak hours is another strategy that has the benefit of reducing traffic during the busiest times of the day. Locker banks can be utilized as a part of an off-peak delivery strategy, as well.

IV. RESEARCH METHODS

This research involved three phases. First, we scanned the literature to identify innovative strategies to reduce greenhouse gas emissions (GHGs) from freight transportation. Second, we reviewed 27 advanced local CAPs (i.e. CAPs that have been in the implementation stage for approximately one decade or longer) to assess the extent to which freight emissions were considered and whether the plans developed relevant strategies to reduce freight emissions. Lastly, we scanned the relevant freight plans to find out: (1) whether emission-reduction strategies were included in the freight plans; and (2) whether or not these strategies were mentioned in the CAP. This last step was necessary to identify linkages between freight plans and CAPs and opportunities to integrate these plans for more effective and efficient policy implementation.

Local CAPs vary not only in terms of the scope and scale of their policy measures, implementation strategies, and evaluation protocols or processes but also the stage of their climate planning processes. For example, cities should first develop a sectoral inventory of their GHG emissions before developing measures to mitigate their GHGs from various sectors of the economy, such as transportation. Freight emissions are only a subset of GHGs coming from the transportation sector. Thus, CAPs that are at a more advanced stage of planning are more likely to have thought through detailed strategies to reduce GHG emissions from freight. This is because best practices in the field of climate action planning are still developing, and we anticipate that early actors in the field would revise and improve their plans once implementation and monitoring of their policies advance. To identify such advanced local CAPs, we used data collected by ICLEI—Local Governments for Sustainability, a leading global network of local governments dedicated to climate action and sustainability. ICLEI offers a systematic framework for climate change mitigation planning that involves five milestones:

(1) Inventory GHG emissions;

(2) establish reduction targets;

(3) develop a CAP;

(4) implement policies and measures; and

(5) monitor and verify results.

All 27 CAPs that we reviewed had achieved the implementation milestone (i.e., milestone number 4 since 2009 (the latest year ICLEI reported these data about local CAPs). Out of the analyzed 27 CAPs, 10 had reached ICLEI milestone 5 (monitoring and verifying results) and 17 had reached ICLEI milestone 4 (implementation) in 2009.

Our analysis of the selected 27 CAPs was conducted by three researchers in two steps. First, one researcher collected and scanned all 27 CAPs and organized them based on the presence or absence of discussions about reducing GHG emissions from freight or goods movement. The strategies and policy measures to reduce GHG emissions from

freight were then listed in a table including the year the plan was adopted and/or revised. Then, two researchers independently analyzed all CAPs using a simple protocol indicating whether the CAP mentions freight, whether it indicates the impact and importance of freight, and whether the CAP includes strategies to reduce freight-based emissions. The results were then compared (see Table 1).

The results reveal that the two coders agreed on 26 of the 27 CAPs in their assessments of the level of discussion of freight transportation and goods movement. This equates to a percentage agreement of 96.3%, which is well above the accepted threshold of 80% for intercoder reliability.[20]

In order to provide a more robust assessment of how cities are addressing the role of freight transport in GHG emission reduction efforts, we also analyzed city, regional, and state freight plans that are most relevant to the local CAPs we targeted. We analyzed these plans to determine the degree to which GHG emission reductions were included, and compared these results to those from the CAPs. Not every city with a CAP that we analyzed has a freight plan. Therefore, we analyzed freight plans from states and/or regions representing those cities. Overall, we analyzed 20 freight plans to check, augment and supplement our analysis of CAPs, but freight plans were not the focus of this study. One researcher collected and analyzed freight plans with a focus on strategies to reduce GHGs. These data were then compared to information contained in CAPs.

V. ANALYSIS AND RESULTS

CLIMATE ACTION PLANS (CAPS)

Most of the analyzed 27 CAPs did not include GHG reduction strategies or actions that explicitly targeted commercial freight transportation (see Table 1). While all of these plans had sections identifying goals to reduce GHGs from transportation overall, the emphasis was clearly on passenger transportation, especially efforts to reduce emissions from automobiles and other passenger vehicles. Most of the plans we examined did contain indirect measures that included freight transportation. CAPs targeted reducing emissions from city-owned vehicles, including trucks, through conversion of their fleets to include more alternative fuel vehicles. Most plans called for reducing vehicle miles traveled overall, including freight, but did not single out efforts aimed at the freight sector. Most CAPs identified the importance of increasing fuel efficiency standards for vehicles across the board, but acknowledged the limited role that cities can play in what is largely the domain of the federal government. For example, the Climate Protection Plan produced by the city of Cambridge, Massachusetts (2003, pp. 5-14) noted that "Changing CAFÉ (Corporate Average Fuel Economy) standards is the single most important measure the nation can take to curtail GHG emissions from motor vehicles," but freight was not specifically targeted.

Table 1. Assessment of Climate Action Plans for Freight Transportation

ICLEI Milestone 5 Plans				
City	**Plan**	**Coder 1**	**Coder 2**	**Actions/strategies related to freight**
Burlington, VT	Climate Action Plan (2013)			Focus on reducing GHG emissions for city vehicle fleets only.
Cambridge, MA	Climate Action Status Report (2011) Climate Protection Plan (2002)	**	**	Focus on reducing GHG emissions from buildings. With over 80% of Cambridge GHG emissions being connected to buildings, only 17% attributed to transportation overall. Reduce motor vehicle emissions, including heavy-duty trucks.
Chula Vista, CA	Climate Action Plan (2017)			Promote alternative fuel vehicle readiness in general.
Denver, CO	80 x 50 Climate Action Plan (2018)	*	*	Goal: By 2050, have 75% of freight trucks utilize carbon neutral fuel. Support electrification of local and regional delivery trucks and other heavier vehicles.
Fort Collins, CO	Climate Action Plan Framework (2015)	*	*	Strategy: Accelerate adoption of fuel efficient and electric vehicles including for commercial and municipal fleet systems.
Madison, WI	The Madison Sustainability Plan (2011) Climate Protection Plan (2002)	*	*	Action: Create a City Fleet Transition Plan to incorporate low or no-carbon/efficient fuel supply options.
Miami-Dade Co., FL	Climate Change Action Plan Greenprint (2011)	**	**	Strategy: Improve connectivity and mobility on the existing system to help ease the conflict between commercial trucks and personal passenger vehicles on urban streets and major roadways.

City	Plan	Coder 1	Coder 2	Actions/strategies related to freight
Minneapolis, MN	Climate Action Plan (2013)			Support increased fuel efficiency in public fleets.
Portland, OR	Climate Action Plan (2015) Climate Action Plan Progress Report (2017)	***	***	Action: Improve efficiency of freight movement within and through the Portland metropolitan area.
Santa Monica, CA	Climate Action Plan Final Report (2016)			Reduce greenhouse gas emissions from municipal fleet fuel use.

ICLEI Milestone 4 Plans

City	Plan	Coder 1	Coder 2	Actions/strategies related to freight.
Ann Arbor, MI	Climate Action Plan (2012)	*	**	Mentions replacing trucks with trains for goods delivery over 100 miles.
Austin, TX	Community Climate Plan (2015)	***	***	Work with community partners to develop a freight plan that reduces emissions within the region from the trucking industry, fosters more efficient freight movement, and provides assistance to freight companies to help them identify how to reduce emissions from their vehicles.
Berkeley, CA	Climate Action Plan (2009) Climate Action Plan Update (2017)	*	*	San Francisco Bay area is expected to triple freight volumes from 2000 to 2035.
Brattleboro, VT	The Climate Action Plan (2003)			Anti-Idling Campaign for cars and trucks.
Brookline, MA	Climate Action Plan (2012) Climate Action Plan (2018)			Enforce idling rules on trucks.
Durham, NC	Greenhouse Gas and Criteria Air Pollutant Emissions Inventory and Local Action Plan for Emission Reductions (2007)			Truck-stop electrification and anti-idling.
Los Angeles, CA	Sustainable City pLAn (2015)	***	***	Accelerate air quality improvements at the Port of Los Angeles from the current Clean Air Action Plan. Convert local goods movement to zero-emissions. Reduce emissions from goods movement with a focus on low-income neighborhoods.
Medford, MA	Climate Action Plan (2002) Local Energy Action Plan (2013)			Anti-idling policy for municipal fleet vehicles.
Oakland, CA	Energy and Climate Action Plan (2018 Update)	***	***	Engage the Port of Oakland and related industry in reducing GHG emissions.
Salt Lake City, UT	Climate Positive 2040 (2017)			

City	Plan	Coder 1	Coder 2	Actions/strategies related to freight.
San Diego, CA	Climate Action Plan (2015) County of San Diego Climate Action Plan (2018)	*	*	Convert Municipal Waste Collection Trucks to Low Emission Fuel.
San Francisco, CA	Transportation Sector Climate Action Strategy (2017) Climate Action Strategy (2013 Update)	**	**	Although emissions from goods movement and other heavy duty commercial fleets could be significant, inadequate data were available for inclusion.
San Jose, CA	Climate Smart San Jose (2018)	***	***	Strategy 3.3: Make commercial goods movement clean and efficient. This includes: a. reducing carbon emissions; b. Increasing the percentage of electric local delivery vehicles; and c. Increasing the percentage of alternative fuel heavy goods vehicles.
Seattle, WA	Climate Action Plan (2013)	***	***	Develop a Freight Master Plan that includes goals to make freight movement more efficient and reduce its impact on greenhouse gas emissions. Recommendations to reduce freight emissions by increasing efficiency of roadway, minimizing congestion, decreasing passenger vehicle trips, and supporting programs that promote cleaner trucks.
Takoma Park, MD	Sustainable Energy Action Plan (2014)	**	**	Emissions from freight motor vehicle travel included in community inventory.
Toledo, OH	Climate Change Adaptation (2013)			
Tucson, AZ	Climate Mitigation Report (2011)			

Coding Key:
(blank) No explicit mention of freight
* Mentions freight
** Indicates the impact and importance of freight
*** Includes strategies to reduce freight-based emissions

Out of the ten CAPs that achieved ICLEI milestone 5 in 2009, only one (Portland) identified strategies or actions to reduce freight-based emissions beyond city-owned fleets as part of efforts to reduce GHG emissions. Portland's CAP (2015) had the most focus on freight among the ICLEI milestone 5 CAPs with its objective number 5: to improve the efficiency of freight movement within and through the Portland metropolitan area and objective number 7: reduce lifecycle carbon emissions of transportation fuels by 20%. Portland developed a Central City Sustainable Freight Strategy "to prioritize action to improve productivity and reliability while reducing environmental impacts, including emissions and noise" (p. 84, 2015). Two other CAPs (Cambridge, MA and Miami-Dade Co., FL) indicated the impact and importance of freight. Cambridge's Climate Protection Plan (2002) discussed the importance of freight but its 2011 Climate Action Status Report focused on reducing GHG emissions from buildings because over 80% of Cambridge's emissions were related to buildings, and only 17% were attributed to transportation overall. Miami-Dade's CAP (2011, p. 16) includes a goal of "completing mobility projects to help ease the conflict

between commercial trucks and personal passenger vehicles on urban streets and major roadways" related to its strategy to improve connectivity and mobility on the existing system. Three other ICLEI Milestone 5 CAPs (Denver, CO; Fort Collins, CO; and Madison, WI) mentioned freight, and four CAPs (Burlington, VT; Chula Vista, CA; Minneapolis, MN; and Santa Monica, CA) did not mention freight at all.

Out of the seventeen CAPs that reached ICLEI milestone 4 since 2009, only five (Austin, Los Angeles, Oakland, San Jose and Seattle) identified strategies or actions to reduce freight-based emissions. In three of these cases (Los Angeles, Oakland, and Seattle), their significant maritime port activity and related GHG emissions was a major topic. In Los Angeles' Sustainable City pLAn (2015), goals included accelerating air quality improvements at the Port of Los Angeles from the current Clean Air Action Plan and converting local goods movement to zero-emissions. Oakland's Energy and Climate Action Plan (2018 Update) identified a Priority Action to reduce GHG emissions associated with the Port of Oakland and related industry by collaborating with them to monitor emissions and develop reduction strategies. Seattle's CAP (2013) explicitly mentions that transportation overall is the largest contributor to Seattle's GHG emissions accounting for 40% of the total, with nearly half of that coming from heavy and medium-duty trucks involved in the movement of freight. Seattle's CAP includes recommendations to reduce freight emissions by increasing the efficiency of roadways, minimizing congestion, decreasing passenger vehicle trips, and supporting programs that promote cleaner trucks. It also recommends engaging the freight community to reduce GHG emissions through its Freight Master Plan and to support programs that help heavy duty truck owners and operators transition to more efficient vehicles and cleaner fuels. Austin's Community Climate Plan (2015) recommends working with community partners to develop a freight plan that reduces emissions within the region from the trucking industry, fosters more efficient freight movement, and provides assistance to freight companies to help them identify how to reduce emissions from their vehicles. The Climate Smart San Jose Plan (2018) includes a strategy to make commercial goods movement clean and efficient by reducing carbon emissions, increasing the percentage of electric local delivery vehicles, and increasing the percentage of alternative fuel heavy goods vehicles.

Only five other ICLEI Milestone 4 CAPs (Ann Arbor, MI; Berkeley, CA; San Diego; San Francisco; and Takoma Park, MD) either indicated the impact and importance of freight or just mentioned freight, while the remaining seven (Brattleboro, VT; Brookline, MA; Durham, NC; Medford, MA; Salt Lake City, UT; Toledo, OH; and Tucson, AZ) did not mention freight at all.

CITY, REGIONAL, AND STATE FREIGHT PLANS

Most of the freight plans we analyzed did not target GHG emission reductions as an explicit focus. The freight plans were largely concerned with improving the freight transport system in their areas with particular attention to increasing reliability and efficiency of movement, including investment in infrastructure maintenance and capacity enhancement, exploration and implementation of emerging information technologies, safety enhancements, and contributions to economic growth. In most of these freight plans, GHG emission reduction was not a major objective. To the extent that many of the initiatives identified would improve

the flow of freight vehicles, there would be improvements in reducing GHG emissions as a byproduct. But the main focus was on reliability and efficiency of movement.

Virtually all of the freight plans recommend deploying Intelligent Transportation System (ITS) technologies. ITS utilizes Information and Communication Technology (ICT) systems to provide effective transport infrastructure services and reduce pollution, accidents and traffic issues.[21] One of the key innovations in ITS is the "V2X technology—vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I)" that utilizes wireless internet networks to exchange data between vehicles and the environment in addition to alerting drivers with real-time information of traffic jams, accident warnings, road works and other traffic-related information.[22] Specific green freight practices include:

(1) Truck Platooning, which involves two or more trucks driving closer together in groups through automated and connected vehicle technology systems that increase the capacity of roads and improves the environment through reduction in pollution levels and CO_2 emissions; and

(2) Freight Signal Prioritization, which allows traffic signals to detect traffic and prioritize freight vehicles at signalized intersections through real-time traffic data.[23]

Highway, rail, seaport, and airport improvement projects are highlighted in virtually all of the freight plans as measures to improve freight movement and thereby reduce freight emissions. Investing in maintenance and expansion of infrastructure capacity is a major element of the freight plans, and reducing emissions is mentioned as one of the benefits of these investments. Most of the plans that mention emission reduction focus on local air quality improvements through the reduction of pollutants such as particulate matter, volatile organic compounds, carbon monoxide, nitrogen oxides, and sulfur oxides. Fewer plans explicitly mention reductions in GHG emissions.

That said, there were several freight plans that explicitly targeted GHG emissions. The California Sustainable Freight Action Plan, Portland's Central City Sustainable Freight Strategy, Seattle's Freight Master Plan, the San Francisco Bay Area Goods Movement Plan, and the San Pedro Bay Ports Clean Air Action Plan are among the plans that include specific projects related to measures of highway, rail, and/or maritime port improvements, advanced technologies, clean fuel sources, zero-emission technology and freight investments.

One of the most comprehensive freight plans in this category is the California Sustainable Freight Action Plan.[24] It directly links freight transport planning with sustainability goals and is a response to Executive Order B-32-15 issued in 2015 that called for "an integrated action plan" that "establishes clear targets to improve freight efficiency, transition to zero-emission technologies and increase competitiveness of California's freight system." (p. A-1)[25] This plan incorporates and builds upon existing state agency strategies such as the California Freight Mobility Plan, Sustainable Freight Pathways to Zero and Near-Zero Emissions, and the Integrated Energy Policy Report. To achieve progress toward a sustainable freight system, the plan identifies corridor-level freight pilot projects that integrate advanced technologies, alternative fuels, freight and fuel infrastructure, and local economic development opportunities.

Both local air pollution and GHG emissions are targeted in this plan, including funding support for improvements that explicitly reduce emissions. Since 2008, the $3 billion Proposition 1B Trade Corridors Improvement Fund and Goods Movement Emission Reduction Program were able to leverage more than $5.5 billion from other sources to deliver more than 90 transportation projects and more than 13,000 clean truck, locomotive, and marine vessel technology projects in California. Specifically, the $1 billion Goods Movement Emission Reduction Program is a partnership between the California Air Resources Board (ARB) and local agencies (like air districts and seaports) to quickly reduce air pollution emissions and health risk from freight movement along California's four priority trade corridors (Los Angeles/Inland Empire, Central Valley, Bay Area, and San Diego/Border). Local agencies first apply to ARB for funding, then those agencies offer financial incentives to owners of equipment used in freight movement to upgrade to cleaner technologies. Projects funded under this program must achieve early or extra emission reductions not otherwise required by law or regulation.

The overall target of the Sustainable Freight Action Plan is to improve freight system efficiency by 25 percent. This can be achieved by increasing the value of goods and services produced from the freight sector relative to the amount of carbon that it produces by 2030. As part of this goal, the plan has set a Zero Emission Technology Target to deploy over 100,000 freight vehicles and equipment, capable of zero emissions operation. It also intends to maximize near-zero emission freight vehicles and equipment powered by renewable energy by 2030.

The City of Portland Central City Sustainable Freight Strategy (2012) is another good example of a comprehensive freight plan that explicitly targets GHG emissions and directly links freight transport with Portland's Climate Action Plan. Actions recommended by the Sustainable Freight Strategy include provisions for truck parking and loading zones, street design best practices guidelines, "last mile" solutions, centralized freight distribution districts, off-hours delivery, electric/hybrid delivery vehicles, and multi-modal freight strategies, including increased rail and barge use.

Improving the environment is one of the six main goals of Seattle's Freight Master Plan (2016), which includes a section on climate change. The plan is directly linked to Seattle's Climate Action Plan by providing strategies to help the city reach its goal of being "climate neutral" (producing zero net GHG emissions) by 2050. Specific actions to reduce GHG emissions identified in the Freight Master Plan include the following: supporting an "anti-idling" policy for city-owned vehicles; implementing an emissions signature program in which newer trucks pay less for emissions inspections; using renewable diesel and other alternative fuels for city vehicles; increasing bicycle and electric vehicle deliveries; working with the Port of Seattle to create "no-idle" zones where trucks queue before entering port facilities; and working with the State of Washington on truck fleet program grants to offer incentives for cleaner running trucks.

The San Francisco Bay Area Goods Movement Plan features three opportunity packages that include the following strategies:

- an Initial Demonstration Followed by Targeted Incentives to Promote Adoption of Zero- and Near-Zero Emissions Truck Technology for Port Drayage.
- a Rail and Terminal Emission Reduction Program;
- a Clean Truck Policy and Program Collaborative;
- a Near-Zero and Zero-Emission Goods Movement Technology Advancement Program including emission-trading programs and other incentives to encourage adoption of clean truck technologies; and
- Targeted Programs to Encourage Use of Zero-Emission Trucks and Cargo Handling Equipment, Particularly in the I-80, I-880, I-580 and SR 4 Corridors.

Addressing port activities in Los Angeles and Long Beach, the San Pedro Ports Clean Air Action Plan (CAAP) Update (2017) contributes to the California Sustainable Freight Action Plan and the State of California's efforts to significantly reduce GHG emissions from freight transport. It builds upon the original CAAP (2006) that aimed to reduce health risks posed by air pollution from port-related mobile sources, specifically ships, trains, trucks, terminal equipment and harbor craft, such as tugboats. As a result of efforts stemming from the 2006 CAAP, port-related diesel particulate matter dropped by 84%, nitrogen oxides were down 50%, and sulfur oxides have nearly been eliminated. The 2017 CAAP Update is intended to coordinate with Los Angeles' Sustainable City pLAn (2015), which called for reducing GHG emissions to 45% below 1990 levels by 2025, and to 60% below 1990 levels by 2035. In 2017, the mayors of Los Angeles and Long Beach committed to move toward zero emissions at the ports, including setting goals of zero-emission cargo-handling equipment by 2030 and zero-emission drayage trucks by 2035. The CAAP Update includes new investments in clean technology including expanded use of at-berth emission reduction technologies.

COMPARISON OF CAPS AND FREIGHT PLANS

Our analysis of CAPs as well as city, regional, and state freight plans with regard to targeting GHG emission reductions from freight transport shows that, at least for most of these plans, there is a disconnect between these planning efforts. Most of the advanced municipal CAPs that we have analyzed did not explicitly target freight transport in their discussions, strategies, or actions to reduce GHG emissions. The CAPs included more general transportation emission goals, such as reducing vehicle miles traveled overall or encouraging the use of alternative fuels for all vehicles, with respect to both passengers and freight. Most of the transportation focus in the CAPs is on passenger, not freight, transportation. Only six out of 27 ICLEI Milestone 4 or 5 CAPs explicitly address freight transport in their GHG emission reduction strategies or actions.

Likewise, most of the freight plans we have analyzed do not directly address the reduction of GHG emissions as a major goal. Most of the focus for these plans has been on improving the reliability and efficiency of freight movement, relieving freight bottlenecks, increasing investment in maintenance and expansion of freight infrastructure capacity, exploring and investing in intelligent transportation system technologies, improving safety, and increasing economic development. To the extent that environmental goals, such as the reduction of local air pollution and/or GHG emissions, were included in the plans, they were addressed largely through recommended improvements in freight mobility. Environmental improvements from proposed freight strategies and actions were included mostly as ancillary benefits. Only a few plans directly targeted GHG emissions as a major focus.

VI. CONCLUSIONS AND RECOMMENDATIONS

A sustainable freight transportation system incorporates strategies to reduce GHG emissions while enhancing the resource and energy efficiency, and cost-effectiveness, of urban goods movements. Although freight represents a substantial and growing proportion of total GHG emissions in cities, strategies to reduce freight emissions have not received enough attention, neither in climate action planning nor freight planning efforts at the local level. Out of 27 advanced CAPs analyzed in this study, only six included direct measures or programs to reduce freight emissions. Similarly, only a small number of freight plans explicitly targeted GHG emissions reduction. The lack of freight emissions reduction strategies in most CAPs and freight plans represents a large gap in our efforts to combat climate change.

One possible explanation for neglecting freight emissions in local climate action is that cities do not control all aspects of a freight transportation system. For example, without support from higher levels of government, cities struggle to set their own regulations for fuel efficiency standards. Additionally, multimodal freight transportation networks can go beyond city limits, requiring intercity or regional coordination for emission-reduction efforts. Due to a lack of direct control over freight emissions, cities might simply prioritize other transportation measures to reduce GHG emissions.

Nevertheless, developing and implementing measures to reduce urban freight transportation emissions represents several opportunities. Strategies to reduce freight emissions can bring about other valuable co-benefits. For example, many freight emission reduction strategies such as anti-idling, reduced vehicle weight, or alternative fuel requirements also contribute to clean air and community health. Similarly, Intelligent Transportation Systems (ITS) have various health, safety, and environmental benefits (including GHG emissions reduction) while simultaneously enhancing freight transport efficiency. Considering these co-benefits can energize cities to incorporate freight GHG emissions reduction strategies into their CAPs and freight plans.

RECOMMENDATIONS FOR CITIES

Based on the findings from our analysis of local climate action plans and freight plans, we recommend that:

- all CAPs explicitly discuss GHG emissions from freight transport specifically and develop targeted strategies and actions for reducing freight emissions;

- planners working on CAPs coordinate more closely with planners working on city, regional, and state freight plans to identify and include freight initiatives that will have the effect of reducing GHG emissions; and

- planners working on city, regional, and state freight plans develop a coordinated approach with planners working on CAPs to identify strategies and actions for reducing GHG emissions from freight transport.

ENDNOTES

1. Anthony J. Craig, Edgar E. Blanco, and Christopher G. Caplice, *Carbon Footprint of Supply Chains: A Scoping Study* (Washington DC: Transportation Re-search Board, 2013).

2. David. L. Greene, "Transportation and Energy," in *The Geography of Urban Transportation*, edited by Genevieve Giuliano and Susan Hanson, 302–331. (New York: The Guilford Press, 2017).

3. Andre Neves, "Transport and the Environment," in *Moving Towards Low Carbon Mobility*, edited by Moshe Givoni, and David Banister Cheltenham, 166–189. (Cheltenham, UK: Edward Elgar, 2013).

4. Anthony J. Craig, Edgar E. Blanco, and Christopher G. Caplice, *Carbon Footprint of Supply Chains: A Scoping Study* (Washington DC.: Transportation Research Board, 2013).

5. Ibid.

6. Laetitia Dablanc and Jean-Paul Rodrigue, "The Geography of Urban Freight," in *The Geography of Urban Transportation*, edited by Genevieve Giuliano and Susan Hanson, 34–56. (New York, NY: The Guilford Press, 2017).

7. Schipper Lee, Lynn Scholl, and Lynn Price. "Energy Use and Carbon Emissions from Freight in 10 Industrialized Countries: An Analysis of Trends from 1973 to 1992," *Transportation Research Part D: Transport and Environment* 2, no. 1 (1997): 57–76.

8. H. Christopher Frey and Kuo Po-Yao. "Potential Best Practices for Reducing Greenhouse Gas (GHG) Emissions in Freight Transportation" (paper presented at the 100th Annual Meeting of the Air & Waste Management Association, Pittsburgh, PA, June 2007).

9. Stephen M. Wheeler, "State and Municipal Climate Change Plans: The First Generation," *Journal of the American Planning Association* 74, no. 4 (2008): 481–496; Alexander, Serena E. "From Planning to Action: An Evaluation of State Level Climate Action Plans" (PhD diss. Cleveland State University, 2016).

10. Alexander, Serena E. "From Planning to Action: An Evaluation of State Level Climate Action Plans" (PhD diss. Cleveland State University, 2006).

11. Laetitia Dablanc and Jean-Paul Rodrigue, "The Geography of Urban Freight," in The Geography of Urban Transportation, edited by Genevieve Giuliano and Susan Hanson, 34–56. (New York, NY: The Guilford Press, 2017); Plumeau et al., *Guidebook for Understanding Urban Goods Movement* (Washington DC: Transportation Research Board, 2012).

12. Plumeau et al., *Guidebook for Understanding Urban Goods Movement* (Washington DC: Transportation Research Board, 2012).

13. Real Estate Research Corporation. *The Costs of Sprawl: Detailed Cost Analysis* (Washington, DC: US Government Printing Office, 1974); Jonathan Barnett, ed. Smart Growth in a Changing World (Chicago, IL: American Planning Association, 2007); Peter Newman and Jeffrey Kenworthy. *Sustainability and Cities: Overcoming Automobile Dependence* (Washington, DC: Island Press, 1999); Douglas Farr, Sustainable Urbanism: Urban Design with Nature (Hoboken, NJ: Wiley, 2008); Andrew Goetz, "Suburban Sprawl or Urban Centres: Tensions and Contradictions of Smart Growth Approaches in Denver, Colorado," *Urban Studies* 50, no. 11 (2013): 2178–2195.

14. Andrew Goetz, "Suburban Sprawl or Urban Centres: Tensions and Contradictions of Smart Growth Approaches in Denver, Colorado," *Urban Studies* 50, no. 11 (2013): 2178–2195.

15. Alon Bassok et al., *Smart Growth and Urban Goods Movement* (Washington DC: Transportation Research Board, 2013); Jose Holguín-Veras et al., *Improving Freight System Performance in Metropolitan Areas: A Planning Guide* (Washington DC: Transportation Research Board, 2015); Christopher Lamm et al., *Guide for Integrating Goods and Services Movement by Commercial Vehicles in Smart Growth Environments* (Washington DC: Transportation Research Board, 2017).

16. Lee Han et al., "Estimating the Impact of Pickup-and Delivery-related Illegal Parking Activities on Traffic," *Journal of the Transportation Research Board* 1906 (2005): 49–55.

17. H. Christopher Frey and Kuo Po-Yao. "Potential Best Practices for Reducing Greenhouse Gas (GHG) Emissions in Freight Transportation." (paper presented at the 100th Annual Meeting of the Air & Waste Management Association, Pittsburgh, PA, June 2007).

18. "SmartWay," US Environmental Protection Agency, updated December 12, 2018, https://www.epa.gov/smartway

19. Genevieve Giuliano et al., *Synthesis of Freight Research in Urban Transportation Planning* (Washington DC: Transportation Research Board, 2013).

20. Mark R. Stevens, Ward Lyles, and Philip R. Berke. "Measuring and Reporting Intercoder Reliability in Plan Quality Evaluation Research," *Journal of Planning Education and Research* 34, no. 1 (2014): 77–93.

21. Yang Chen, Arturo Ardila-Gomez, and Gladys Frame. "Achieving Energy Savings by Intelligent Transportation Systems Investments in the Context of Smart Cities," *Transportation Research Part D*, (2017): 381–396.

22. Patrick Pype et al., "Intelligent Transport Systems: The Trials Making Smart Mobility a Reality," in Automated Driving, ed. Daniel Watzendig and Martin Horn, 595–600 (Switzerland: Springer International Publishing, 2017).

23. “2017 Smart City Challenge,” US Department of Transportation, updated June 29, 2017 https://www.transportation.gov/smartcity

24. “The California Sustainable Freight Action Plan,” Caltrans, July, 2016. http://dot.ca.gov/hq/tpp/offices/ogm/cs_freight_action_plan/theplan.html

25. “Executive Order B-32-15,” Executive Department of the State of California, July, 2015. http://dot.ca.gov/hq/tpp/offices/ogm/cs_freight_action_plan/Documents/CSFAP_AppendixA_FINAL_07272016.pdf

BIBLIOGRAPHY

Alexander, Serena E. “From Planning to Action: An Evaluation of State Level Climate Action Plans.” PhD dissertation. Cleveland State University, 2016. https://etd.ohiolink.edu/pg_10?::NO:10:P10_ETD_SUBID:117332

Barnett, Jonathan, ed. *Smart Growth in a Changing World*. Chicago, IL: American Planning Association, 2007.

Bassok, Alon, Chris Johnson, Mathew Kitchen, Rebecca Maskin, Kris Overby, Daniel Carlson, Anne Goodchild, Edward McCormack, and Erica Wygonik, E. *Smart Growth and Urban Goods Movement.* National Cooperative Freight Research Program Report 24. Washington DC: Transportation Research Board, 2013.

Caltrans. “The California Sustainable Freight Action Plan.” July, 2016. http://dot.ca.gov/hq/tpp/offices/ogm/cs_freight_action_plan/theplan.html

Chen, Yang, Arturo Ardila-Gomez, and Gladys Frame. “Achieving Energy Savings by Intelligent Transportation Systems Investments in the Context of Smart Cities.” *Transportation Research Part D*, (2017): 381–396.

Craig, Anthony J., Edgar E. Blanco, and Christopher G. Caplice. *Carbon Footprint of Supply Chains: A Scoping Study*. National Cooperative Freight Research Program, Project 36 (04). Washington DC: Transportation Research Board, 2013.

Dablanc, Laetitia. and Jean-Paul Rodrigue. “The Geography of Urban Freight.” In *The Geography of Urban Transportation*, edited by Genevieve Giuliano and Susan Hanson, 34–56. New York, NY: The Guilford Press, 2017.

Farr, Douglas. Sustainable Urbanism: Urban Design with Nature. Hoboken, NJ: Wiley, 2008.

Frey, H. Christopher and Kuo Po-Yao. “Potential Best Practices for Reducing Greenhouse Gas (GHG) Emissions in Freight Transportation.” Paper presented at the 100thAnnual Meeting of the Air & Waste Management Association, Pittsburgh, PA, June 2007.

Giuliano, Genevieve, Thomas O Brien, Laetitia Dablanc, and Kevin Holliday. *Synthesis of Freight Research in Urban Transportation Planning*. National Cooperative Freight Research Program Report 23. Washington DC: Transportation Research Board, 2013.

Goetz, Andrew. “Suburban Sprawl or Urban Centres: Tensions and Contradictions of Smart Growth Approaches in Denver, Colorado.” *Urban Studies* 50, no. 11 (2013): 2178–2195.

Greene, David. L. “Transportation and Energy.” In *The Geography of Urban Transportation*, edited by Genevieve Giuliano and Susan Hanson, 302–331. New York, NY: The Guilford Press, 2017.

Han, Lee, Shih-Miao Chin, Oscar Franzese, and Holing Hwang. “Estimating the Impact of Pickup-and delivery-related Illegal Parking Activities on Traffic.” *Transportation Research Record: Journal of the Transportation Research Board* 1906 (2005): 49–55.

Holguín-Veras, Jose, Johanna Amaya-Leal, Jeffrey Wojtowicz, Miguel Jaller, Carlos González-Calderón, Ivan Sánchez-Díaz, Xiaokun Wang, Daniel G. Haake, Suzann S. Rhodes, Robert J. Frazier, Molly K. Nick, Joseph Dack, Luigi Casinelli, and Michael Browne. *Improving Freight System Performance in Metropolitan Areas: A Planning Guide*. National Cooperative Freight Research Program Report 33. Washington DC: Transportation Research Board, 2015.

Lamm, Christopher, Katharine Kirk, Brian Stewart, John Fregonese, and Alex Joyce. *Guide for Integrating Goods and Services Movement by Commercial Vehicles in Smart Growth Environments*. National Cooperative Highway Research Program Research Report 844. Washington DC: Transportation Research Board, 2017.

Neves, Andre. “Transport and the Environment.” In *Moving Towards Low Carbon Mobility*, edited by Moshe Givoni, and David Banister, 166–189. Cheltenham, UK: Edward Elgar, 2013.

Newman, Peter, and Jeffrey Kenworthy. *Sustainability and Cities: Overcoming Automobile Dependence*. Washington, DC: Island Press, 1999.

Plumeau, Peter, Mark Berndt, Paul Bingham, Roberta Weisbrod, Suzann S Rhodes, Joe Bryan, Thomas J Cherrett. *Guidebook for Understanding Urban Goods Movement*. National Cooperative Freight Research Program Report 14. Washington DC: Transportation Research Board, 2012.

Pype, Patrick, Gerardo Daalderop, Eva Schulz-Kamm, Eckhard Walters, Gert Blom, Sasha Westermann. “Intelligent Transport Systems: The Trials Making Smart Mobility a Reality.” In *Automated Driving*, edited by Daniel Watzendig and Martin Horn, 595-600. Switzerland: Springer International Publishing, 2017.

Real Estate Research Corporation. *The Costs of Sprawl: Detailed Cost Analysis*. Washington, DC: US Government Printing Office, 1974.

Schipper, Lee, Lynn Scholl, and Lynn Price. “Energy Use and Carbon Emissions from Freight in 10 Industrialized Countries: An Analysis of Trends from 1973 to 1992.” *Transportation Research* Part D: Transport and Environment 2, no. 1 (1997): 57–76.

Stevens, Mark R., Ward Lyles, and Philip R. Berke. “Measuring and Reporting Intercoder Reliability in Plan Quality Evaluation Research.” *Journal of Planning Education and Research* 34, no. 1 (2014): 77–93.

US Environmental Protection Agency. “SmartWay.” December 12, 2018. https://www.epa.gov/smartway.

US Department of Transportation. “2017 Smart City Challenge.” June 29, 2017 https://www.transportation.gov/smartcity.

Wheeler, Stephen M. “State and Municipal Climate Change Plans: The First Generation.” *Journal of the American Planning Association* 74, no. 4 (2008): 481–496.

ABOUT THE AUTHORS

ANDREW R. GOETZ

Andrew R. Goetz is a Professor in the Department of Geography & the Environment and a faculty associate in the Transportation Institute and the Urban Studies program at the University of Denver. He is a co-author of four books and has published numerous journal articles and book chapters on topics including urban, metropolitan, and statewide transportation planning and policy; intermodal transportation; freight transportation; urban planning and smart growth; transportation sustainability; environmental impacts of transportation; transportation infrastructure and urban/economic growth; rail transit; high-speed rail; and air transportation and airports. He has served as the principal investigator on many funded research projects and fellowships, including those for the National Center for Intermodal Transportation, a USDOT university transportation center.

Dr. Goetz is currently a member of the Statewide Freight Advisory Council at the Colorado Department of Transportation (CDOT), and has served on the State Freight and Passenger Rail Plan working group at CDOT, the Denver International Airport (DIA) community focus group, the Transportation Advisory Committee for the City and County of Denver's Strategic Transportation Plan, and the Transportation Advisory Committee for the Denver Regional Council of Governments [DRCOG]. Dr. Goetz served as associate editor of the *Journal of Transport Geography* from 2004–2012, and still serves on its editorial board along with those of *Transport Reviews* and the *World Review of Intermodal Transportation Research.* He received the 2010 Edward L. Ullman award from the American Association of Geographers for Significant Contributions to Transportation Geography.

SERENA E. ALEXANDER

Serena Alexander is an Assistant Professor with the Department of Urban and Regional Planning at San José State University and a Research Associate at Mineta Transportation Institute. Dr. Alexander's primary research interests include environmental planning, climate action, land-use, and transportation planning, community economic development, and sustainable urban design. Much of her work is targeted toward practitioners interested in the dynamics of plan implementation, monitoring, and evaluation. Examples of her recent research include evaluation of local and state level Climate Action Plans, harnessing the greenhouse gas emissions mitigation potential of on-demand mobility and autonomous vehicles and use of simulation models and techniques to improve multimodal transportation.

Dr. Alexander has worked with many multidisciplinary teams and aims at bridging the gap between technical knowledge, policy decisions and community values. Before joining the SJSU faculty, Dr. Alexander conducted community economic development and environmental policy research at the Center for Economic Development and the Great Lakes Environmental Finance Center at Cleveland State University, where she also received her doctorate in Urban Studies, specializing in urban policy and development. She holds master's degrees in Urban and Regional Planning from California State Polytechnic University, Pomona, and Architecture from Azad University, Tehran, with a specialization

in urban design. Additionally, Dr. Alexander has more than six years of experience working as a planning and urban design practitioner.

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