The Road to Clean Transportation

A Bold, Broad Strategy to Cut Pollution and Reduce Carbon Emissions in the Midwest

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Table of Contents

Executive Summary

Transportation is central to daily life in the Midwest and to our economy. But the effects of our transportation system extend far beyond the time we spend commuting or the ability of a company to receive freight on time. Our transportation system shapes how our communities look and feel, the opportunities for advancement and growth that are available to our people, and the quality of the air we breathe.

The Midwest's transportation system is also reshaping our climate. Transportation is now responsible for nearly one-third of the region's carbon dioxide emissions.[1] Our dependence on fossil fuel-powered vehicles, and the vast number of miles we travel in those vehicles every year, contributes to global warming, which, in turn, threatens the Midwest with more extreme weather – everything from higher temperatures to more intense downpours – in the years and decades to come.

But a better future is possible.

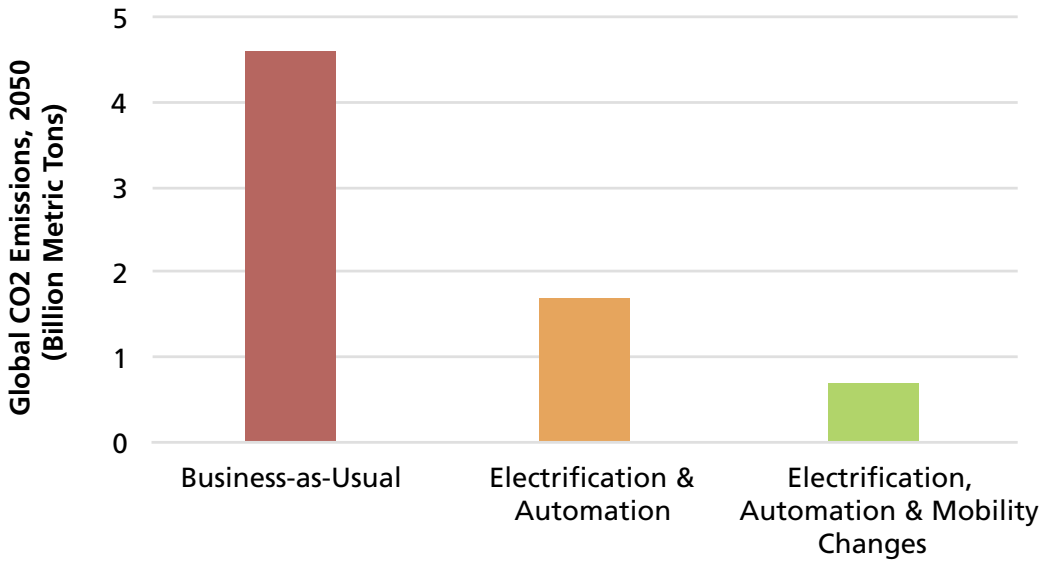
By transforming our vehicles, rethinking the design of our cities and towns, maximizing the benefits of new technologies, and doubling down on proven strategies like public transit, the Midwest can ensure that the transportation system we pass on to our children is clean, resilient, equitable and accessible to all.

Studies by leading academics, national laboratories and nonprofit groups have envisioned what a transformed transportation system might look like – and the role it might play in combating global warming. For example, a 2017 study from researchers at the University of California, Davis, and the Institute for Transportation & Development Policy found that by shifting mobility patterns through the expansion of things like public transit, walking, and biking, along with electrifying and automating vehicles, global emissions would be a fraction of a business-as-usual scenario (see Figure ES-1).[2]

A complete strategy for decarbonizing transportation that reduces the need for driving can complement efforts to power vehicles with clean energy, and can be more effective, more resilient, and create a more equitable transportation system than strategies that rely only on changes to vehicles and fuels.

The Midwest can start bringing a future of equitable, accessible zero-

Figure ES-1. Global Emissions Resulting from Three Scenarios in 2050[3]



carbon mobility closer to reality today, by embracing proven and emerging tools to expand low-carbon transportation choices, and by setting bold goals and benchmarks for the future. In the Midwest, smart transportation and smart growth strategies could reduce transportation energy demand and lead to emissions reductions of at least 20 percent by 2050, with greater reductions possible if those strategies are adopted together.

Key strategies include:

- **Smart Growth and Compact Development:** Emissions Reduction Potential – 5 to 16 percent by 2050[4]
  Sprawling, single-use developments necessitate traveling longer distances and often require the use of private vehicles. Cities and towns that prioritize compact mixed-use development bring destinations closer together, reducing the need for travel and enabling the use of a wide variety of low- and zero-carbon transportation options. In the Twin Cities area, for instance, shifts in development patterns led to a two-thirds reduction in the land area required per new resident between 2000 and 2016 compared with the decade prior, a change that can greatly reduce transportation demand.[5]

- **Public Transportation:** Emissions Reduction Potential – 0.9 to 3.6 percent by 2050[6]
  Public transit helps reduce emissions from transportation in several ways: moving large numbers of people efficiently, supporting electrification of transportation, and supporting compact development. Residents of transit-rich communities drive 10 to 30 percent fewer miles than residents of car-oriented neighborhoods; expanding transit can reduce emissions while increasing mobility opportunities for people underserved by a car-centered transportation system.[7]

- **Active Transportation:** Emissions Reduction Potential – 0.4 to 1.1 percent by 2050[8]
  Walking and biking are zero-carbon modes of transportation that can substitute for motorized transportation while improving public health. Cities that provide safe, accessible infrastructure and pedestrian-scale land uses already see high rates of walking and biking – in Madison, more than 13 percent of commuters walk or bike to work; in Minneapolis, nearly 11 percent of people walk or bike to work; in Chicago, more than 8 percent do.[9]

- **Shared Mobility:** Emissions Reduction Potential – 1 to 4 percent[10]
  Shared transportation options, including carsharing and bikesharing, enable more people to travel without owning a personal car and can help reduce total vehicle miles traveled. Shared fleets of vehicles may also help speed the electrification of transportation. In a 2016 study, carsharing participants drove an average of 11 percent fewer miles, reducing their greenhouse gas emissions by an average of 10 percent.[11]

Benchmarks to Maximize the Potential of Smart Transportation Strategies

STRATEGY	REDUCTION POTENTIAL	KEY 2030 BENCHMARK	KEY 2050 BENCHMARK
SMART GROWTH	5 to 16 percent	60 percent of new urban growth occurs as compact development	90 percent of new urban growth occurs as compact development
PUBLIC TRANSPORTATION	0.9 to 3.6 percent	Minimum 2.4 percent increase in service	Minimum 4.6 percent increase in service
ACTIVE TRANSPORTATION	0.4 to 1.1 percent	Comprehensive build-out of connected and safe walking and biking networks in all cities	Comprehensive build-out of connected and safe walking and biking networks in suburbs and exurbs
SHARED MOBILITY	1 to 4 percent	Expansion of shared bicycles and small vehicles to all cities, with access to parking and the curb	Ubiquitous availability of shared bicycles and small electric vehicles in all cities and towns, with at least 10 percent of parking spaces allocated to shared modes
SMART PRICING	3.6 to 10.7 percent	End subsidies for parking in downtowns; smart pricing implemented on highways	End all implicit and explicit subsidies for private vehicle ownership and uses

- **Smart Pricing:** Emissions Reduction Potential – 3.6 to 10.7 percent by 2050[12] In the Midwest and across America, high-carbon modes of transportation are subsidized through public policy, while opportunities to manage congestion through the use of pricing are missed. Ending those subsidies and ensuring that Midwesterners pay the full cost of their travel (including the environmental and societal costs of car use) would encourage the use of lower-carbon modes of travel and support the Midwest's ability to reduce carbon pollution.

Strategies to reduce vehicle travel and achieve significant emissions reductions can also improve societal equity. Access to robust, affordable and efficient transit systems can allow low-income families to live without a car, saving thousands of dollars a year on loan payments, gas, insurance and maintenance – freeing up funds for other priorities.[13] Expanded transportation options can connect people in marginalized communities to jobs and other opportunities that were previously unreachable without a car.

Transitioning to a low- or zero-carbon transportation system by mid-century will require immediate action and longer-term planning from all levels of government across a variety of sectors. With a bold vision and commitment to concrete steps, the Midwest will be more likely to achieve success in decarbonizing transportation at the pace necessary to prevent the worst impacts of climate change.

Introduction: A Vision for Equitable, Zero-Carbon Transportation

The Midwest's transportation system runs on fossil fuel-powered cars and trucks, traveling more than 560 billion miles per year across the region.[14] That system seems difficult to change – set firmly in concrete, if not in stone. But it didn't just emerge from nowhere. It was created starting roughly a century ago by visionaries who saw not only what the Midwest was but what it could be with access to modern transportation.

Those pioneers might not have envisioned the problems that have resulted from our car-dependent transportation system – from climate change and dirty air to societal inequity and degraded quality of life in our cities. But if we, in our generation, are to address those challenges, starting with the urgent challenge of climate change, we need to dare to be visionary as well.

What might an equitable, zero-carbon transportation system look like in the Midwest in 2050?

It might start by providing people with a wide array of low- and zero-carbon transportation options, making ownership of a personal car – which already imposes costly financial burdens on many Midwestern families – just one of many possible choices for individuals and families needing to access work, shopping, education or recreation. Every morning, residents of our cities, suburbs and small towns might wake up to choose among convenient and frequent public transportation, a selection of shared electric vehicles of many shapes and sizes, or a brisk walk or bike ride to their destination, in addition to the choice to use a personal electric vehicle.

This wide array of transportation choices would be enabled by land-use decisions that bring housing, jobs, school, shopping, health care and leisure – which we have long deliberately spread out across the landscape – closer together. Much as the Midwest's traditional small towns brought those functions together, creating convenience without car-dependence and fostering a genuine sense of community, new residential and activity hubs will emerge along public transit nodes and corridors,

enabling access to every destination by a wide variety of transportation modes. Along with revitalized cities and small towns, these areas will attract the majority of new population growth – without a net increase in traffic and, thanks to electrification of cars and trucks, cleaner air to breathe.

A zero-carbon transportation system will be electrified and powered by renewable sources – with ubiquitous support infrastructure such as charging stations for electric bike, cars and other forms of mobility. Public transportation will lead the way, while new technologies and services like autonomous vehicles will be integrated into the transportation system in ways that prioritize shared trips and reduce single-occupancy or empty rides. Shared-ride services will complement public transportation, filling gaps in service and helping consumers travel the last mile.

Communities of color and low-income communities will no longer be left behind in transportation decision-making – and, in fact, by 2050, the Midwest will have moved to repair some of the damage that transportation decisions have inflicted on these communities for generations. Reliable and efficient public transit will be available along with affordable housing in proximity to transit corridors, marginalized people will no longer bear the worst impacts of highway expansions, and disparities in the availability of active transportation options will have been eliminated. The elderly and those with disabilities will have access to zero-carbon transportation options that are just as good as those afforded to anyone else in our society.

The availability of clean, accessible, equitable transportation options won't just stop at the city limits: a vision of a zero-carbon transportation future includes a region connected by a high-quality rapid transit network, in which it is possible to access every population center without a personal car. States and communities will cooperate extensively, sharing resources and information to ensure seamless regional connectivity.

None of this will happen by itself. Transforming the Midwest's transportation system will require transforming how public policy in the region is made.

Health, livability and sustainability will become central to transportation decision-making and not mere sidelights. Walking and biking will be valued not just as ways to get people from place to place but also for their ability to help people live healthier lives, reducing the prevalence of diseases like hypertension, diabetes and cardiovascular issues. The epidemic of traffic related deaths – which claims 5,700 lives in the Midwest every year – and serious injuries will be eliminated through the adoption of Vision Zero policies and thoughtful measures to put safety in transportation first.[15]

The balance of transportation investment will shift from expanding the Midwest's already overbuilt road network to fixing our existing roads and providing new zero-carbon transportation choices to Midwesterners. Investments in transportation will be evaluated based on the environmental, equity and economic development benefits they can deliver – not just their ability to shave a few seconds off of a commute.

A zero-carbon transportation future for the Midwest also requires some difficult choices. Consumers will need to get used to seeing – and paying – the full cost of the trips they take, including environmental, societal and economic costs. Demand for scarce roadway space and parking will have to be effectively managed by pricing these resources carefully while ensuring that they do not impact low income consumers disproportionately. Trips made by efficient public transportation and zero-carbon modes of transportation will be given first priority on public infrastructure – much as trips in privately owned,

fossil fuel-powered vehicles were prioritized for generations. Public investment will be required.

The distance between today's Midwest transportation system – with its dependence on fossil fuels and its often corrosive effects on societal equity – and a bold vision of a clean, carbon-free and equitable transportation system of the future might seem impossible to bridge. But bridging that gap is worth it – enabling the region to address longstanding equity issues, improving quality of life, and ensuring that no opportunity to reduce carbon pollution from our transportation system is left on the table.

Crossing that bridge can begin with a single step. Cities and states have access to a rich array of proven and innovative tools to expand transportation access and curb carbon pollution. To build upon those steps and guide the way forward, the region can then commit to realistic but ambitious benchmarks and goals for the future.

This paper describes the wide variety of zero-carbon transportation tools available to the Midwest – tools that can complement and even accelerate the repowering of transportation with clean energy, which is at the core of any strategy to shift our transportation system off fossil fuels. It presents estimates of the scale of emission reductions these measures can achieve individually, and hints at the transformative benefits of deploying them together as part of a holistic strategy for equitable decarbonization of transportation in the Midwest. And it proposes ambitious benchmarks for the region to achieve on the path to a zero-carbon transportation system.

Transportation Policy in the Midwest Contributes to Global Warming and Inequity

Over the course of the last century, the Midwest has built its communities and transportation in such a way as to require most people to use a car for most of their daily travels. The dependence of our region on fossil fuel-powered cars and trucks has harmed our communities in numerous ways, greatly contributed to global warming, and often left the poor, the disabled and the elderly sitting by the side of the road, without convenient access to jobs, education, health care and recreation.

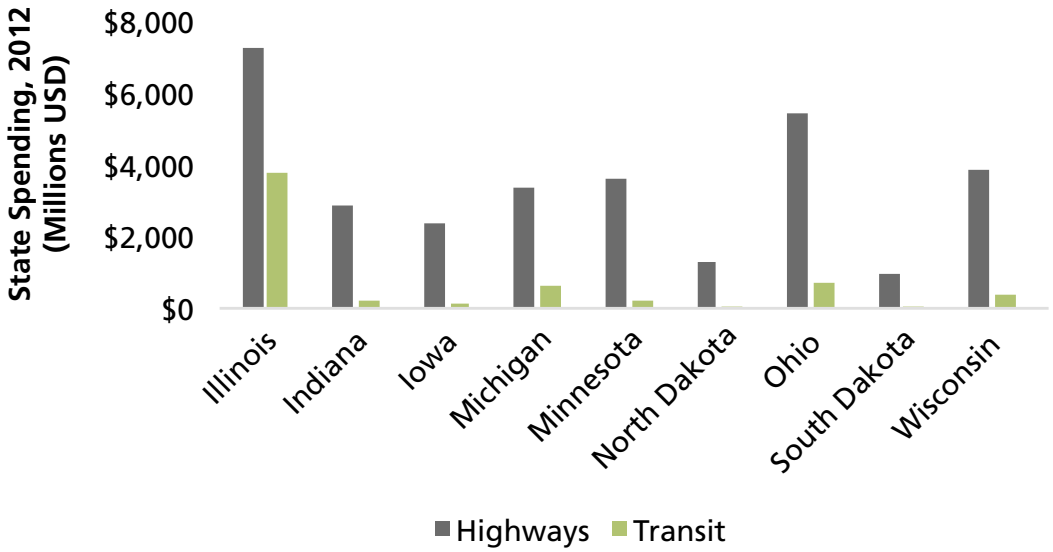
Those outcomes are the direct result of the public policy choices the region's cities and states have made – from the management of local streets to the investment of billions of dollars in annual transportation spending. At the local level, land-use policies have often made sprawl easy and compact development difficult or impossible, while transportation planners have emphasized throughput of cars and abundant free parking over safety for pedestrians and realizing the most efficient, best use of urban land.

State governments in the Midwest have focused transportation investment on highway expansion, while underinvesting in transit, biking and walking (see Figure 1). The legacy of auto-centric transportation policy in the region has fueled climate change while perpetuating inequity and livability challenges.

These policies have resulted in auto-centric communities that are characterized by:

- Greenfield suburban development, low-density single-family homes and strip mall type businesses, which require the use of a car for most daily tasks.
- Destinations built far away from one another, leading to longer trips.
- Wide highways and streets devoted almost entirely to the movement of cars.

Figure 1. State Spending on Highways and Transit in Midwest States, 2012[16]



- Destinations outside the largest metropolitan areas that are only accessible by car for most people.

Increasing roadway mileage has been directly correlated with increased driving and associated carbon emissions. One analysis estimates that just one new lane of highway mile added to an existing system increases carbon emissions by over 100,000 tons in 50 years.[17]

This legacy of auto-centered transportation policy continues today. Some recent examples include:

- **Cutting funding for walking and biking:** In 2015, Wisconsin removed all state funding for bicycling and pedestrian infrastructure from its budget, leaving only some federal money available for these projects. The state also imposed a measure in 2017 that prohibited local governments from being able to use their powers of eminent domain for the construction of pedestrian and bike trails. A single property owner who objects to a project now has the power to stop or significantly modify it.[18]

- **Cuts in transit funding:** The state of Ohio has almost completely stopped funding public transit. Between 2000 and 2017, state funding went down from $40 million annually to approximately $7 million – less than 1% of total transportation spending.[19]

- **Lost opportunities to improve transit:** In 2016, the latest attempt to create a dedicated source of funding for transit in southeast Michigan fell short at the ballot box. The referendum exposed deep polarization around transportation issues in Michigan and has effectively killed plans for increased capital investment in public transit in the southeast region of the state for the time being.[20] While the loss was narrow, suburban Macomb County overwhelmingly opposed the measure, in contrast to more urban Wayne and Washtenaw counties who supported it.

- **Wasteful highway expansions:** In 2017, a $646 million bridge opened across the St. Croix River between Stillwater, Minnesota, and Houlton,

Construction of a new bridge spanning the St. Croix River. Opponents worry it will enable further sprawl. Credit: Minnesota DOT via Flickr, CC BY-NC 2.0.

Wisconsin.[21] Building across the river, which has been federally protected since 1968, required an act of Congress to waive restrictions. Opponents worry that the project will pave the way for harmful development along the pristine river.[22] It is also expected to enable further sprawl in western Wisconsin and encourage more driving, while the project consumed resources that could have been used for other purposes.[23]

Auto-Centric Transportation Policy Undermines Equity

Transportation policies perpetuating car dependency have had significant and continuing negative impacts on historically marginalized communities.

- Explicitly racist transportation decision-making policies often led to African American communities being razed to make way for new inner-city highways.[24] For example, in the 1950s and 1960s, Milwaukee built two major freeways through the Bronzeville neighborhood, destroying more than 8,000 homes and the community's vibrant main street.[25]

- Poorer areas – more likely to be populated by people of color – often lack safe pedestrian infrastructure, with fewer sidewalks, crosswalks and traffic controls.[26] An analysis by Smart Growth America found that Native American pedestrians are nearly five times more likely to be killed while walking than white pedestrians, African Americans are nearly twice as likely, and Latino pedestrians are 1.5 times more likely.[27] In South Dakota, non-white pedestrians are more than seven times more likely to be killed than white pedestrians; in North Dakota, non-white pedestrians have nearly six times the risk, and, in Michigan, non-white pedestrians are 2.5 times more likely to be killed than white pedestrians.[28]

- Communities of color relegated to fringes alongside inner city highways also breathe higher levels of particulate matter, leading to higher rates of asthma and cardiovascular disease.[29]

- Those of lower income also pay for auto-centric infrastructure that they often do not use. The cost of building and maintaining parking is reflected in higher rents, goods and services, and often forces people with fewer transportation options to live further away from their places of employment.[30]

- People of color and those of low income disproportionately depend on public transportation. Expanding highways while systematically reducing transit funding has cut off access to jobs and opportunity and made it harder to access destinations by walking or biking.

State and local leaders continue to make transportation decisions that disproportionately harm those who have been historically marginalized. For example, in Milwaukee, a court ruled that expanding a major interchange downtown without adequately expanding public transit would increase racial disparities in the city. The state was required to provide two new bus lines, the Milwaukee "JobLines," to connect people to jobs in Milwaukee's otherwise transit-inaccessible suburbs through a $13 million settlement with community faith and public health groups. Funding for these JobLines is set to expire at the end of 2018, which could lead to the routes' cancellation unless a permanent funding source is found.[31]

In Detroit, the state Department of Transportation plans to expand Interstate 94 through downtown – a project that opponents have warned will further cut off people of color from accessing destinations in the city and increase crashes and pollution.[32]

Auto-Centric Transportation Policy Fuels Climate Change

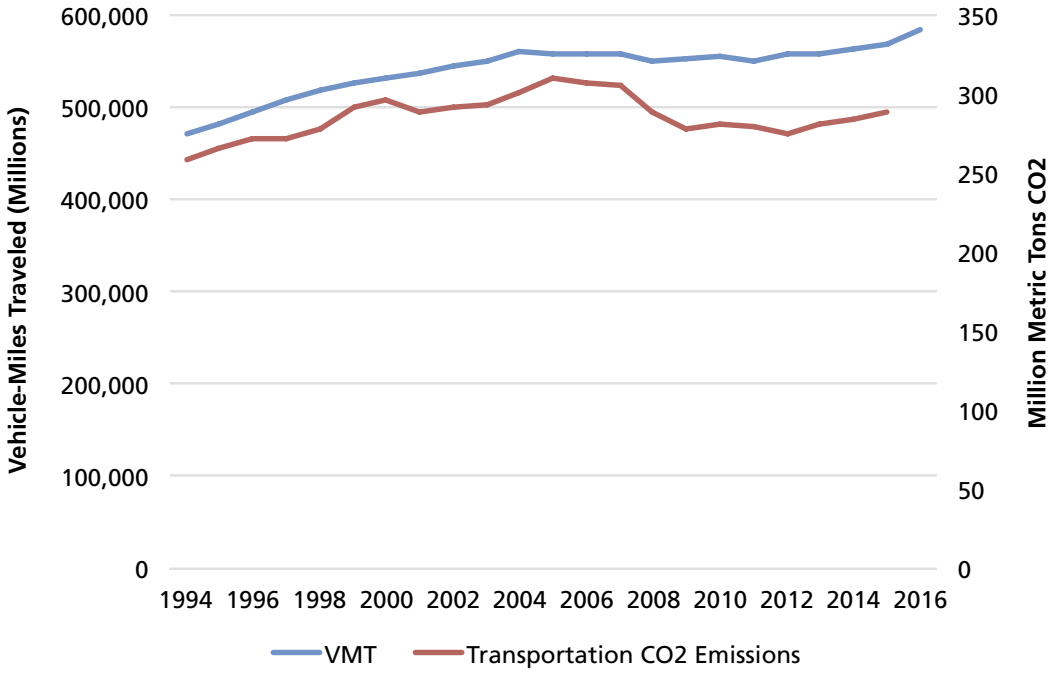
Largely as a consequence of these policy decisions, across the nine Midwestern states of Illinois, Indiana, Iowa, Michigan, Minnesota, North Dakota, Ohio, South Dakota and Wisconsin, transportation is responsible for nearly 30 percent of all carbon dioxide emissions. Transportation emits more than the industrial and residential sectors combined and is second only to electricity production for total emissions.[33]

Over time, carbon emissions from transportation has closely tracked with vehicle-miles traveled (VMT) (see Figure 2). Between 2005 and 2015, emissions fell nearly 7 percent as a result of more stringent fuel economy standards imposed on automakers, but the impact of those standards has been limited as a result of net increases in driving.[34] To decarbonize the region's transportation system by 2050, as must occur if the Midwest is to do its part to prevent the worst impacts of global warming, the pace of emissions reductions must accelerate dramatically.

Slowing or reversing the growth of vehicle travel in the Midwest can help the region reach its decarbonization goals more quickly. In the Midwest and across the United States, for much of the 20th century, VMT went up consistently, outpacing population growth.[36] Transportation policy and planning decisions were made based on the assumption that people would drive more each year, which perpetuated a cycle of auto-centric investment that increased carbon emissions.

Researchers predict future increases in VMT over the coming years if current trends continue, but at a slower rate and with a weaker link to economic performance.[37] For example, in April 2018, national vehicle travel was lower than it had been in April 2017, as was the case in

Figure 2. Vehicle-Miles Traveled and Carbon Emissions Trends in the Midwest Over Time[35]



February 2018 compared to that month in the year prior.[38] The largest declines were seen in the Midwest region, with 3.1 percent less travel in February 2018 than 2017, and 1.8 percent less in April 2018 than in April 2017.[39]

The Midwest has many opportunities to reduce carbon pollution from transportation. While Midwestern states continue to adopt policies that encourage car dependence, a growing list of cities in the region are pioneering new approaches to expand low-carbon transportation options for their residents. (See examples presented in "Smart Transportation and Land Use Strategies Reduce Carbon Pollution," page 18.)

Reforming public policies that subsidize and reinforce car dependence can help the region to address persistent inequities and to limit further increases in driving that make decarbonizing transportation more difficult than it would otherwise be. A complete decarbonization strategy – one that combines electrification of vehicles with less travel-intensive land use patterns and the expansion of public transportation, shared mobility and active modes such as walking and biking – affords tremendous benefits to our communities while helping to ensure that the Midwest follows a sure and steady path to a zero-carbon transportation future.

A Complete Decarbonization Strategy Offers Many Benefits

Around the world, leaders in efforts to decarbonize transportation have identified three strategies for moving toward the goal of a zero-carbon transportation system:

- *Avoid* the need for motorized travel through land-use planning that reduces the distances people have to travel every day.
- *Shift* from carbon-intensive modes of travel like solo driving to transit, biking and walking.
- *Improve* the carbon performance of transportation modes through improved energy efficiency and a switch to low-carbon fuels.[40]

A complete strategy that includes all three approaches has the greatest chance of positioning the Midwest for success in equitably decarbonizing the transportation sector.

Compared to a strategy reliant only on improving efficiency and switching fuels, a comprehensive transportation decarbonization strategy can:

- Achieve deeper emissions reductions,
- Reduce emissions faster,
- Provide built-in resiliency to unexpected challenges,
- Advance equity and improve livability,
- Accelerate the transition to electric transportation.

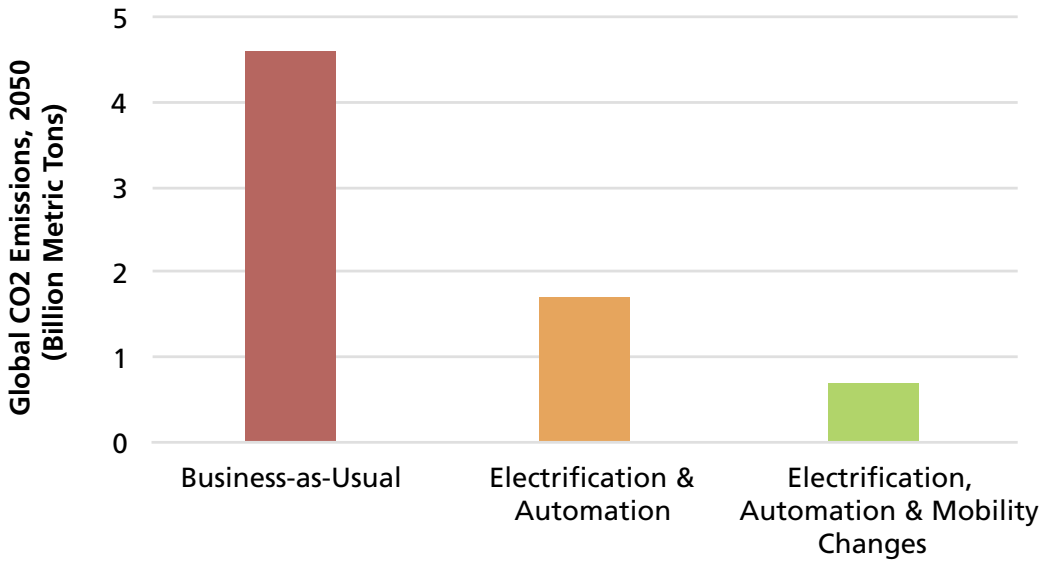
Achieving Deeper Emissions Reductions

To the extent that fossil fuels retain any role in the Midwest transportation system in 2050 – either as fuel used directly in vehicles or for the generation of electricity used in electric vehicles – a complete transportation-sector strategy can achieve deeper emission reductions than a strategy reliant on electrification alone.

A 2017 report from researchers at the University of California, Davis, and the Institute for Transportation & Development Policy evaluated the emissions reduction potential of three "revolutions" happening in transportation: electrification, automation and shared trips (including transit).[41] Electrification, the report found, can reduce emissions if the electricity grid is largely shifted to renewable energy; automation would likely result in more travel; and the increased sharing of trips (and overall reduction of vehicle trips) would cut emissions, facilitate land use changes and "greatly improve urban livability."[42]

The report considered three scenarios to reduce transportation emissions globally and found that a comprehensive strategy that included a widespread shift in mobility patterns, combined with electrification and automation, would result in the greatest emissions reductions, with 2050 emissions one-third of a business-as-usual scenario and one-half of a scenario relying only on automation and electrification (see Figure 3.)[43] The scenario of shifting to electrification and automation with widespread mobility changes, like shared trips, expanded public transport, increased walking and biking, could lead to an 80 percent reduction in transportation emissions globally by 2050.[44]

Figure 3. Global Emissions in 2050 Resulting from Three Transportation Scenarios[45]



Decarbonizing Faster and More Easily

Single-occupant private vehicles are an inherently energy intensive way to move people – requiring the manufacture of tens of millions of vehicles, the construction and maintenance of vast areas of pavement for highways and parking, and the consumption of large amounts of energy while the vehicles are in use. Switching from high-carbon to low-carbon fuels – while essential – does not address the fundamental conditions that make America's transportation system uniquely energy intensive.

Transporting single passengers in individual vehicles is highly energy intensive, whether that energy is provided by gasoline, diesel or electricity. Moving a single person in a large vehicle requires more energy than moving that same person on a bicycle or on a train with other people. For instance, a car requires more than 3,000 units of energy (Btu) per passenger mile traveled, whereas transit rail requires less than 800 Btu per passenger mile.[46]

Powering all 40 million cars across the Midwest requires a tremendous amount of energy.[47] The transition to electric vehicles will dramatically reduce the energy needs of vehicles by replacing inefficient internal combustion engines with efficient electric motors. It will also require significant investments in the region's electricity grid – both to deliver electricity to vehicles and to generate that electricity from truly clean sources such as wind and solar power.[48] Having fewer cars driving fewer miles will require less energy to power them and ease the transition to an all-electric transportation system powered by renewable energy.

Providing Resiliency

Seeking emissions reductions through multiple pathways provides resiliency against unexpected setbacks and helps ensure that the region can still achieve deep emissions reductions if any particular tool proves to be less effective than anticipated.

Recent experience illustrates the dangers of relying on a single policy or strategy to drive carbon emission reductions. Federal fuel economy and greenhouse gas emission standards have significantly reduced transportation sector carbon dioxide emissions. Fuel economy standards were increased in 2007, with fuel economy and emission standards tightened in 2009 and even stronger rules enacted in 2011 under the Obama administration, requiring that light duty vehicles average 54.5 miles per gallon across the industry by 2025 – nearly double what cars were required to average in 2011.[49] By the EPA's estimates, the standards would save Americans more than $1.7 trillion in fuel expenses and cut 6 billion metric tons of greenhouse gas emissions – an important step toward decarbonizing transportation.[50]

However, in 2018, President Trump's EPA proposed freezing the standards starting in 2020 through 2026. Worse, the administration signaled that it may attack the ability of California and 11 other states to maintain their own carbon emissions standards. If the rollback is successful, the largest emissions reductions expected from the stronger standards would be lost.[51] While a number of states have adopted stronger standards, no states in the Midwest have yet committed to pursuing stronger standards in the event of a federal rollback.[52]

Even if the fuel economy and greenhouse gas emission standards survive, the recent

threat shows that reliance on any single strategy, technology or pathway is risky. By using a variety of approaches to reduce carbon pollution from transportation, progress can continue even amid setbacks to any particular strategy and it will be more likely that critical goals will be met.

Advancing Equity

Low-carbon land use and smart growth strategies can help close racial and income equity gaps. Access to robust, affordable and efficient transit systems can allow low-income families to live full and productive lives without the financial burden of car ownership, saving thousands of dollars a year on loan payments, gas, insurance and maintenance.[53] Expanded transportation options can connect those in marginalized communities to jobs and other opportunities that were previously unreachable without a car.

A long-term Harvard study found that land use policies that promote mixed-used and reduced distances between destinations lead to better outcomes for those historically marginalized. With commute times being a key component of upward mobility, low income families have a much better chance of breaking out of a cycle of poverty by living closer to work. Areas with greater access to destinations had less racial segregation, less income inequality and greater family stability.[54]

Building walking and biking infrastructure in underserved neighborhoods can help reduce health disparities, for instance by lowering asthma rates from particulate matter and reducing chronic disease by enabling more physical activity.[55] Connecting communities of color and low-income neighborhoods with safe pedestrian infrastructure will reduce the risk of death and injury from car traffic.[56]

Inner-city highway removal or conversions to lower capacity roadways can help weave together neighborhoods separated by highway construction and expansion – historically, often communities of color – allowing easier access for residents of those communities to goods and services.[57]

These policies need to be carefully implemented in a targeted manner to undo years of discriminatory transportation decision-making. Environmental justice assessments must be carried out to understand geographic, racial and economic inequality and ensure that transportation investments are closing these gaps. It is important to ensure that those historically impacted by these policies have a leading role in identifying and recommending solutions.

Community-led efforts can help mitigate potential negative impacts of land use changes and development early on in the planning process. For example, in Denver, a partnership between the city, local nonprofits, the transit agency and funders has helped develop affordable housing on vacant land in future transit-rich areas. The Colorado Housing Finance Authority tailored a low-income housing tax credit to support transit-oriented projects, the City and County of Denver reduced parking requirements near transit, and new zoning encouraged mixed-income housing development, including projects targeted at lower-income people.[58]

Accelerating Transportation Electrification

Reducing vehicle travel with carsharing can also play a role in increasing the share of travel that is powered by renewably generated electricity. The synergies include:

Expanding Access to Charging Infrastructure: The Midwest faces a significant challenge in providing adequate electric vehicle charging infrastructure to support 40 million private cars in the Midwest.[59] A 2018 study by Frontier Group, Environment America and U.S. PIRG estimated that Cleveland and Milwaukee have only 5 percent of the charging infrastructure needed to support the number of electric vehicles expected on city streets by 2030, while Chicago only has 9 percent.[60]

Shared mobility services provide an opportunity to expand charging infrastructure available to the public and to private fleets. The electric carsharing program in Indianapolis, BlueIndy, allows people to sign up to use the program's charging infrastructure for personal EV charging.[61] Arrangements like this can simultaneously increase public access to electric carsharing (providing a viable alternative to vehicle ownership for more Midwesterners) and make it easier for private EV owners to recharge their vehicles – addressing multiple challenges at once.

Increasing Familiarity with Electric Vehicles: Electric carsharing programs like BlueIndy allow residents to experience the benefits of electric vehicles before having to make a commitment to buy. By gaining exposure to and comfort with electric vehicles, people may be more likely to purchase an electric vehicle instead of a gasoline-fueled car. After driving an electric vehicle for a year, most participants in a 2011 study from the University of California at Davis reported they were more likely to purchase an electric vehicle than before the study.[62]

Electrifying vehicles can also support efforts to reduce vehicle travel and shift to lower-carbon modes. Electric vehicles produce less noise and less air pollution, making life in cities and the use of active transportation modes like biking and walking healthier and more pleasant. By adopting a complete strategy for decarbonizing transportation, local and state officials can work deliberately to maximize the synergies among those strategies – enabling faster, deeper reductions in carbon pollution.

Easing Range Anxiety: Range anxiety – the fear that an electric car will run out of power before a trip is completed – has historically been a major concern of consumers and hindrance to the adoption of electric vehicles. The development of cheaper, higher-capacity batteries and high-speed charging have alleviated range anxiety for many EV owners.[63] But some prospective electric vehicle users are still concerned about range, or may be driven to spend more money than is necessary on an electric vehicle with a large battery. Shared fleets of electric vehicles and electrified public transportation allow people to make trips in electric vehicles without committing to use one for all of one's travel.

Smart Transportation and Land Use Strategies Reduce Carbon Pollution

Smart transportation and smart growth strategies are central to the equitable decarbonization of transportation in the Midwest. The strategies outlined in this section can reduce vehicle travel and demand for personal vehicles, while accelerating electrification and contributing to the creation of a transportation system that meets everyone's needs.

The potential of each of these strategies to reduce carbon pollution has been well-supported by (in some cases) decades of academic study. In this section, we summarize those tools and present estimates from the literature of the share of U.S. transportation emissions that could be reduced by adopting them. Less well-studied is the potential for synergies among these strategies. Given the tremendous variations in vehicle travel and transportation carbon pollution in the United States and worldwide, it is possible that aggressive adoption of these strategies can, in combination, achieve dramatically greater emission reductions than estimated here.

The Low-Carbon Transportation Toolbox

Smart Growth and Compact Development

Potential Emissions Reductions from Land Use Changes: 5 to 16 percent[64]

- 2030 target: 60 percent of new urban growth occurs as compact development; trip lengths drop 15 percent
- 2050 target: 90 percent of new urban growth occurs as compact development

The physical layout of our communities influences which transportation choices are viable and how much and how far people must travel to meet their daily needs. Sprawling, single-use developments necessitate traveling longer distances and

often require the use of private vehicles. Cities and towns with compact development patterns can be difficult or expensive places to drive, but easy places in which to catch a bus or train or travel on foot. By implementing smart growth strategies, communities can improve the viability of low-carbon transportation options and reduce the distance traveled by those who choose to drive.

Increasingly, Americans want to live in denser, more walkable communities. A 2017 survey by the National Association of Realtors found that most Americans would prefer to live in smaller homes that are walking distance to amenities, as opposed to larger homes that require driving to amenities.[65] This is particularly true for younger Americans, with 62 percent of millennials reporting that walkable communities and short commutes are more important to them than living in a detached, single-family home.[66]

Compact development is becoming popular in cities and towns throughout the Midwest:

- Around the Twin Cities, the amount of land consumed per new resident between 2000 and 2016 was two-thirds lower than in the previous decade, a testament to the growing popularity of urban living.[67]

- In Champaign, Illinois, the redevelopment of the Bristol Place neighborhood, an area of approximately seven blocks that is home to 200 people, has been recognized for its walkability, density and connectivity.[68]

- In Iowa City, the demolition of a wastewater treatment plant and creation of a riverfront park has attracted, instead of single-family homes, mixed-use development that will have up to 350 housing units, including studio apartments, as well as commercial space that supports the needs of the new tenants.[69]

Numerous studies have found that, by offering more housing and services in a smaller area, smart growth can reduce vehicle travel. A 2017 study published in the *Journal of the American Planning Association* found that a household half as far away from downtown as another household could be expected to drive 34 percent fewer miles. Increasing population density by 40 percent (through new compact development and infill), meanwhile, could decrease driving 9 percent.[70] *Growing Cooler*, a 2007 report by the Urban Land Institute, found that people living in compact development drive 20 to 40 percent less than people in sprawling neighborhoods.[71] One way that compact development reduces car dependence is by facilitating low carbon transportation. A study in the *Journal of Transport Geography* in 2014 analyzed travel data from the Baltimore-Washington region and found that a 5 percent increase in density was associated with a 4 percent increase in bike ridership.[72]

Less driving means less carbon pollution. A 2013 study showed that residents of mixed-use neighborhoods produce 12 percent fewer carbon dioxide tailpipe emissions than residents of areas with single uses.[73] Another 2013 study, by the U.S. Department of Energy, reported that changes to the built environment (including increasing density and creating mixed land uses) could reduce transportation emissions up to 10 percent.[74] Another study by the Urban Land Institute, *Moving Cooler*, concluded that if 60 to 90 percent of new development was built compactly and was coordinated with more transit, it could result in a 9 to 15 percent reduction of national greenhouse gas emissions by mid-century.[75]

Compact development can also help advance equity – provided that other public policies support housing affordability in these areas. A 2016 study by researchers at the University of Utah, the University

of Texas and the U.S. Geological Survey found that upward mobility is significantly higher in dense areas than in sprawling areas.[76] Low-income children born into more compact neighborhoods are 41 percent more likely to reach a top income tier.[77]

Compact development in the Midwest can take many forms – the construction of new compact neighborhoods on formerly industrial land, the incremental addition of new housing or businesses to existing neighborhoods or developments, or the revitalization of urban and small-town neighborhoods that have lost population, livable housing stock and businesses since the middle of the 20th century. The specific compact development strategies appropriate to Midwestern communities will inevitably vary from place to place.

Public Transportation

Potential Emissions Reductions from Transit Expansion and Improvement: 0.9 to 3.6 percent[78]

- 2030 target: minimum 2.4 percent increase in service; major corridors served by high-quality, efficient transit; increased ridership and fare reductions
- 2050 target: minimum 4.6 percent increase in service; network of efficient transit options in all urban areas; increased ridership and fare reductions

Public transportation has been an efficient, low-carbon option for Midwesterners to get around for generations. Transit enables Midwesterners to live full lives without owning a car and avoid being stuck behind the wheel in traffic, while supporting compact land-use patterns in cities and towns.

The potential for transit to reduce emissions depends greatly on the commitment to expanding and improving service. The target service improvements highlighted here from the Department of Transportation's 2010 report (2.4 to 4.6 percent increase) represent a relatively unambitious scenario and it is likely that greater investment in public transportation would yield much more dramatic emissions reductions.

While most Midwestern states are lackluster in their funding of transit (see page 9), several cities have recently taken ambitious steps to expand or improve transit service.

- Grand Rapids, MI, and Chicago have express bus service projects planned for 2018.[79]
- A new rapid bus project – the C Line – is expected to open in Spring 2019, helping improve mobility options for North Minneapolis.[80]
- Milwaukee has applied for federal funding for a nine-mile bus rapid transit route from the lakefront to a regional medical center.[81]

Public transportation helps reduce greenhouse gas emissions in several ways, including:

- **Efficiency:** Transit transports large numbers of people more efficiently than cars. For example, per passenger-mile traveled, Minneapolis' light rail uses less than half the energy used by a passenger car; Chicago's commuter rail uses nearly 18 percent less energy per-passenger mile than a car.[82]
- **Electrification:** Many forms of transit are easily electrified and can run on renewable energy. In a future of an all-electric transportation system, transit will demand less energy, thereby facilitating the transition to a renewable

electricity grid and enabling more rapid decarbonization.

- **Compact land use:** As compact development supports the success of transit, transit also supports compact development. First, transit takes up significantly less space than cars. A bus requires one-seventh as much space to move the same number of passengers as a car; considering parking requirements, buses need one-30th the amount of space as cars.[83] The development of transit can also be used as a springboard for the development of multi-use compact spaces. For instance, the areas around the Green Line, a light rail running between St. Paul and Minneapolis, have experienced nearly $6 billion in mixed-use development.[84]

A 2018 study by the Victoria Transport Policy Institute found that residents of transit-rich communities drive 10 to 30 percent fewer miles than residents of car-oriented neighborhoods.[85] By expanding and improving transit in all U.S. cities, in combination with land use changes, street redesign and other low-carbon transportation improvements, public transportation could reduce emissions from transportation by up to 15 percent in the next few decades.[86]

Failing to invest in public transportation not only encourages more people to drive, it also impacts people's ability to access jobs, services and amenities. A 2016 study by the Brookings Institution concluded that a typical job is only accessible to a third of a city's workforce within a 90-minute transit trip.[87] A University of Minnesota study ranking the number of transit accessible jobs in 49 U.S. cities finds the top cities have frequent and fast transit service, combined with dense land use.[88] In the national ranking, Chicago comes in third, Minneapolis 12th, followed by Milwaukee.[89] On the low end, Detroit comes in 37th and Cincinnati 40th.[90] Prioritizing investment in transit would help the region reduce emissions while expanding access for residents.

The Green Line light rail runs between St. Paul and Minneapolis. Credit: Eric Wheeler, Metro Transit, CC BY-NC-ND 2.0

Active Transportation

Potential Emissions Reductions from Expanded Walking and Biking: 0.4 to 1.1 percent[91]

- 2030 target: Comprehensive build-out of connected and safe walking and biking networks in all cities
- 2050 target: Comprehensive build-out of connected and safe walking and biking networks in suburbs and exurbs; compact development patterns facilitate greater number of walking and biking trips

Walking and biking are zero-carbon modes of transportation that can substitute for travel via higher-carbon modes. According to the National Household Travel Survey, more than 21 percent of trips taken in vehicles in the U.S. are a mile or less – a distance that can be walked in less than 20 minutes.[92] Nearly half of all vehicle trips are less than 3 miles – a trip that takes less than 20 minutes on a bicycle.[93] According to the EPA, if Americans walked or biked just half the number of trips under a mile, it would save 2 million metric tons of CO_2 each year, equivalent to taking 400,000 cars off the road.[94]

The Midwest already leads other areas of the country for the number of people walking to work, with a greater percentage of people walking to work in large and medium cities in the Midwest than the West or the South.[95] In Madison, more than 13 percent of commuters walk or bike to work; in Minneapolis, nearly 11 percent of people walk or bike to work; in Chicago, more than 8 percent do.[96] Small cities (often college towns) across the region also boast some the nation's highest rates of walking to work: more than 35 percent of Athens, OH, commutes to work by walking, 25 percent of Oxford, OH, and 20 percent of East Lansing, MI.[97]

People walking on State Street in Madison, WI. Credit: Flickr user Richard Hurd, CC BY 2.0.

More people are also riding bikes, and some cities are leading the way by building better bike safety infrastructure to keep up with demand. Some notable cities in the region include:

- **Chicago** was named America's Best Bike City in 2016 by *Bicycling* magazine, in part because of the city's investment in bike infrastructure, completing 100 miles of buffered or protected bike lanes in 2015 and building out a network of protected lanes in downtown.[98] The city's bikesharing program, Divvy, has helped make riding a bike more accessible for more residents, with a record 3.8 million trips taken in 2017.[99]

- **Minneapolis** has the nation's second-highest rate among large cities for bike commuting, with 5 percent of people riding bikes to work in 2015.[100] As of 2015, the city had 129 miles of bike lanes on city streets and 97 miles of off-street bikeways.[101]

- **Madison** ranks as one of the top five bike friendly cities in the country by the League of American Bicyclists for its network of protected bike paths and lanes.[102]

Studies have found that supporting safe walking and biking infrastructure encourages more people to walk and bike. That in turn creates a virtuous cycle: as more people are out walking and biking, others are encouraged to join, making the system again safer for everyone. For example, in Minneapolis, an increase in lane miles and a decrease in risk was associated with higher bike ridership overall. Similar results were found in Chicago and other cities around the country.[103] In focus groups with people of color and low-income residents, participants cited lack of safe, protected infrastructure as a barrier for biking, suggesting that improved infrastructure would allow more residents to enjoy active transportation options.[104]

By improving infrastructure and encouraging active transportation to re-

Protected bike lanes, pictured here in Chicago, increase road safety and encourage more people to ride bicycles. Credit: Chicago Bicycle Program via Flickr, CC BY 2.0

place car trips, communities across the region can reduce vehicle-miles traveled and transportation emissions. A 2015 report from the Institute for Transportation and Development Policy estimates that a scenario in which 14 percent of travel in cities is done by bike by 2050 could cut urban transportation emissions 11 percent.[105] A study in California found that offsetting car travel by walking and biking could reduce annual carbon emissions from cars by 3 to 14 percent.[106]

Shared Mobility

Estimated Potential Emissions Reductions: 1 to 4 percent[107]

- 2030 target: Expansion of shared bicycles and small vehicles to all cities; shared vehicles allocated parking spaces and curbside access; shared options like ride hailing complement rather than hinder transit; net increase in number of passengers per vehicle
- 2050 target: Ubiquitous availability of shared bicycles and small electric vehicles in all cities and towns; shared vehicles allocated at least 10 percent of parking spaces to facilitate 10 percent of the population using them; private vehicle ownership reduced as a result of shared mobility options; net increase in number of passengers per vehicle

In the past decade, a rapidly growing suite of shared transportation options – including carsharing, bikesharing, and ride-hailing services – have evolved to enable more people to travel more places without the use of a personal car. Some shared mobility services have been shown to reduce car ownership, trips taken by car and vehicle-miles traveled. Shared travel options could facilitate a quicker transition to electric transportation, since it may be easier to electrify and recharge a fleet of vehicles than privately-owned vehicles.

Examples of shared mobility include:

Bikesharing: Fleets of shared bikes, electric bikes or light-weight, low-speed electric scooters can be rented for short time increments to make one-way trips around cities. Bikeshare programs can either use docking stations or be free-floating, with users simply leaving a bike at any legal location for someone else to use when they are done with their trip. Across the country, bikesharing is booming: Riders took 35 million trips on shared bikes in 2017, up 25% from the year before.[108]

As of January 2017, there were at least 119 bikesharing systems around the country, covering nearly every urban area.[109] While some cities in the Midwest are already leading the way (Chicago and Minneapolis have two of the largest bikesharing programs in the nation), others are just getting started (St. Louis launched its first bikesharing program in April 2018 with a free-floating system, while Detroit launched its first system in 2017).[110]

Bikesharing allows users to replace short trips they may otherwise do by car with a zero-emission bike ride. It also supports other forms of low-carbon transportation, like transit. For instance, a majority of bikesharing members in D.C., New York City and Chicago reported using bikesharing at least occasionally as part of a longer transit trip.[111] A 2015 study from researchers at the University of California at Berkeley found that most bikesharing participants increased cycling and reduced personal driving.[112]

Carsharing: Like bikesharing, carsharing involves a fleet of shared vehicles, either parked in specific locations (like designated spots in parking lots) or in any legal parking spot. One-way carsharing allows users to make a trip and return the car to another location, whereas roundtrip carsharing requires the driver to return to

Minneapolis' bikesharing system is one of the largest in the country. Credit: Eric Fischer via Flickr, CC BY 2.0

vehicle to the original pickup location.

Drivers in the Midwest have a number of options for carsharing. In Ann Arbor and Detroit, for example, Zipcar and Maven allow residents to pay a monthly fee for access to fleets of shared vehicles that can be rented hourly or daily.[113] Maven also operates in Warren, MI, and Chicago, while Zipcar has fleets across Ohio, Michigan, Minnesota, Illinois and other Midwestern states.[114] In Indianapolis, BlueIndy offers 500 shared electric vehicles with 1,000 charging stations across the city.[115] Twin Cities-based HourCar plans to transition to an all-electric fleet of 100 shared vehicles by 2020.[116]

People who rely on shared vehicles may take fewer trips by car than those who own their own vehicles, since much of the cost of a privately-owned vehicle is incurred upfront, making each ride seem much cheaper (though overall costs of personal vehicles is likely higher). A survey by the Transportation Sustainability Research Center of carsharing members using the free-floating system car2go found that each shared vehicle removed 7 to 11 cars from city streets.[117] The carsharing participants drove an average of 11 percent fewer miles, resulting in greenhouse gas emissions reductions of 4 to 18 percent.[118] The most comprehensive study on roundtrip carsharing found that members reduced how many miles they drove by 27 percent, resulting in emissions reductions of 34 to 41 percent.[119]

An HourCar carsharing vehicle in St. Paul. Credit: Flickr user Tony Webster, CC BY 2.0.

Shared vehicles are expected to play a much bigger role in transportation in the future, though different studies offer a range of projections. For instance, a 2016 report by McKinsey estimated that by 2030, one in ten vehicles sold will be shared, while a 2017 report by the RethinkX think tank projected that 95 percent of vehicle-miles traveled by 2030 will be in shared electric vehicles.[120]

Ride-hailing: Popularized by Uber and Lyft, ride-hailing enables people to use an app on their phone to order a car to pick them up and drop them off at specific locations. Ride-hailing systems, in their present form, have ambiguous and mixed effects on carbon emissions. A 2017 study from the University of California at Davis found ride-hailing services were often replacing low-carbon trips like transit, walking or biking.[121] The authors conclude, however, that ride-hailing could help reduce car ownership and driving overall, if combined with other tools, like walking and biking, transit, shared rides and compact development.[122] For instance, ride-hailing can help address the problems of the "first and last mile," whereby people need to travel a relatively short distance to or from transit.

Ride-hailing services are increasingly making it possible for users to pool rides and are engaged in partnerships with transit agencies to provide first- and last-mile connections. Ultimately, however, the ability for ride-hailing to reduce emissions will depend on its success in reducing private vehicle ownership and the speed with which it can transition to electric vehicles. For example, through a carsharing program called Maven, General Motors supplies electric vehicles to Lyft's Express Drive program, which allows Lyft drivers in some cities to rent GM vehicles for ride-hailing.[123] The Chevrolet Bolt EV has become the most-requested car by Maven users who drive for Lyft and other ride-hailing services because of cost savings on fuel.[124]

Smart Pricing

Potential Emissions Reductions from Pricing: 3.6 to 10.7 percent[125]

- 2030 target: end subsidies for parking in downtowns, like taxpayer-funded free parking and commuter tax benefits; smart pricing implemented on highways
- 2050 target: end all implicit and explicit subsidies for private vehicle ownership and uses; states require companies to offer pay-as-you-drive insurance; decongestion pricing on highways reduces wasted time without expanding highway capacity

Gas taxes, vehicle fees and parking charges don't cover the full costs of driving, including building and maintaining roads, and are far from reflecting the environmental and societal costs of driving. An analysis from 2015 found that American households pay an additional $1,100 a year to support driving, beyond gas taxes and individual expenses, including general taxes for road constructions and tax subsidies.[126] Driving also imposes a set of costs on society, from air pollution and climate change to congestion and noise.

If the Midwest is to achieve a rapid reduction in carbon pollution from transportation, subsidizing individual driving and car ownership will only stand in the way. And if the region is to have any hope of finally getting a handle on traffic congestion, giving away access to the roads for free at the busiest time of day is unlikely to help. Technology can now facilitate smart pricing to help influence transportation systems that reduce emissions, such as carpooling and using public transportation.

Pricing transportation to disincentivize driving alone, at the busiest times, in the busiest locations or overall can

help reduce travel demand. Examples of pricing mechanisms that can reduce vehicle-miles traveled include:

- Carbon taxes or carbon cap-and-trade programs that can limit and put a price on pollution,
- Vehicle-miles traveled fees charge drivers based on how many miles they drive,
- Pay-as-you-drive insurance bases a portion of the price of car insurance on the number of miles someone drives,
- Smart pricing changes the price of toll roads or parking to disincentivize driving or parking during certain times or in certain locations like downtowns,
- Decongestion pricing charges drivers to enter congested areas like downtowns.

Numerous studies have found that smart pricing is an effective way to change driving behavior. A 2010 study concluded that a 10 percent increase on a toll reduces traffic volumes on that road by 1 – 4.5 percent.[127] The study also found that de-

Information Technology Supports Low-Carbon Options

The rapid adoption of smartphones has made it easier than ever before for people to connect to a wide variety of transportation options. Today, with just a few touches of a screen, users can plan, map, and pay for multimodal services, wherever they happen to be.

Some examples of the types of technologies that are transforming our transportation system include:

- Real-time information that allows users to see when the next bus or train is coming, or the nearest bikeshare station – and how many bikes are available.
- Payment systems that enable people to pay for transportation options automatically and easily.
- Multimodal trip planning to let people make connections between different systems, like riding a bike to a light rail station, or walking to their final destination after getting off the bus.

Leading cities around the world are combining these services into multimodal apps and even providing subscription services that enable users to buy a package of mobility services for a flat rate. These "mobility as a service" systems offer a complete mobility option that can compete on price and convenience with car ownership.

While information technology on its own is unlikely to directly lead to emissions reductions, many of the other tools highlighted in this section are made possible or made much easier through advances in technology. For example, a 2015 study in New York City attributed a 1.7 percent increase in weekday bus ridership to the availability of real-time information.[131]

To ensure that everyone can benefit from these tools, local governments and providers should work to ensure that the benefits provided by information technology are available to everyone, regardless of income or ability.

Screens displaying real-time information help people take transit and make multi-modal trip connections. Credit: Flickr user David Wilson, CC BY 2.0.

congestion pricing to enter specific areas of five European cities and Singapore reduced traffic volumes in those areas 12 – 22 percent.[128]

Among strategies to change travel behavior, pricing incentives and disincentives offer some of the greatest potential to reduce greenhouse gas emissions, particularly in the nearer-term, according to a 2013 U.S. Department of Energy study.[129] For instance, a combination of pricing strategies, including pay-as-you-drive insurance, additional fees for vehicle-miles-traveled, and decongestion pricing could reduce transportation emissions 4 – 6.1 percent by 2030.[130]

Smart Transportation and Smart Growth Can Drive Significant Emissions Reductions

Smart transportation and smart growth reduce energy demand for transportation – helping to pave the way for a zero-carbon transportation system. Previous research reports have evaluated a variety of pathways toward a low-carbon transportation future, showing that a combination of strategies can lead to significant emission reductions. These studies suggest that if the Midwest fully committed to the strategies outlined in this report, it could result in meaningful emissions reductions by 2030 and even deeper reductions by 2050.

For example, a series of 2013 studies, called *the Transportation Energy Future Series*, by the U.S. Department of Energy, the National Renewable Energy Laboratory and Argonne National Laboratory found that pricing driving, improving transit, expanding carsharing and ridesharing, reducing commuting, and lowering speed limits, among other demand changes, could result in a 7 to 15 percent transportation emissions reduction by 2030.[132] The longer-term strategy of changing the built environment by increasing density, creating mixed-use spaces, and designing areas to be accessible by nonmotorized travel, could reduce transportation emissions by 1 to 10 percent by 2050.[133] The study notes that achieving the highest potential reductions will likely require aggressive policy action.[134]

A 2010 report by the U.S. Department of Transportation found that reducing carbon-intensive travel through land use changes, expansion of transit, improvements for people on bikes and on foot, as well as pricing strategies, could reduce greenhouse gas emissions from U.S. transportation 5 to 17 percent by 2030, and 6 to 21 percent by 2050.[135]

Overall, the studies use moderate assumptions about the scale of transformation and it is possible that aggressive and coordinated adoption of the strategies in this report could achieve dramatically greater emission reductions.

Conclusion and Recommendations

Achieving meaningful carbon reductions from transportation by mid-century will require immediate action and longer-term planning from all levels of government. Electrifying transportation is a necessary component of this transition. But by embracing a complete strategy for decarbonization that takes advantage of the rapidly expanding set of tools now available to the region, the Midwest can likely achieve deeper emission reductions, faster, and do so with greater certainty of ultimate success. At the same time, such a strategy can repair many of the inequities built into our car-dependent transportation system – expanding affordable access to jobs, education and recreation to those who have too often been shut out.

By setting goals, shifting priorities, thinking creatively and taking bold action, towns, cities, states and the region have the opportunity to dramatically reduce transportation emissions and build a more equitable transportation system.

In particular, cities should:

Implement Development Reforms

- Reform zoning codes to incentivize mixed-use development and increased density
- Remove parking minimums and include parking maximums for new development
- Improve multimodal connectivity through subdivision ordinances
- Incentivize transit-oriented development and integrate land use planning into transportation projects
- Focus on expanding development in the center of communities, rather than on the edges, by encouraging infill and renovation of vacant properties

Change Funding Structures

- Adopt fix-it-first policies that improve quality of existing infrastructure instead of spending money to increase travel on new infrastructure
- Prioritize investment in public transit and multi-modal transportation over highway or road expansion or widening
- Increase funding for transit and multi-modal transportation
- Incorporate destination access performance measures into transportation metrics
- Ensure traditionally underrepresented communities, such as people of color and low-income individuals, are included in the planning process

Prioritize Low-Carbon Transportation Street Design

- Prioritize a rapid expansion of safe infrastructure for walking, biking and lightweight electric vehicles, starting with deployment of low-cost infrastructure that offers immediate benefits
- Plan a fully connected network to reach underserved populations and the most dangerous areas
- Identify and remove barriers that prevent people from participating in active and shared transportation options like cost, access to banking, and identification
- Allocate curbside access and right-of-way in a way that prioritizes low-carbon, efficient modes
- Reallocate space from overly abundant parking to more efficient land uses

Accurately Price Travel

- Eliminate subsidies for driving and auto-oriented development
- Ensure the full environmental and societal costs are reflected in the prices for high-carbon transportation modes

Collect Transportation Data and Improve Transparency

- Commit to collecting data and making it freely available
- Require data sharing with third party transportation agencies

Support Efficiency and Electrification of the Transportation System

- Increase accessibility to electric vehicle infrastructure
- Transition public transit and vehicle fleets to electric

Acting now is critical. Decision-makers should take immediate action to pave the way for a zero-carbon, equitable transportation system in the Midwest.

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