

Catalyst


CENTER FOR
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Scholars reflect on critical transportation topics in new Future of Mobility series

What's next in transportation? CTS and University of Minnesota researchers are working to find out. [The Future of Mobility series](#) collects the perspectives of top U of M researchers and other national experts. In 17 articles, the authors scan the horizon and reflect on critical transportation topics ranging from rural transportation to automated vehicles to equity for users. The future of transportation will be a complex, interconnected set of practices and technologies, and this series brings bold thinking together in one place.



How will the energy transition impact transportation?

The transition to sustainable energy is under way in Minnesota and across the country, propelled by a growing need to reduce greenhouse emissions and the upcoming influx of funds from new federal legislation. Last fall, CTS hosted a seminar to [explore two important aspects of the energy transition](#) and their impacts on the transportation infrastructure: “community solar” and electric vehicle (EV) readiness.



Monthly parking contracts are pervasive: Could an alternative promote more sustainable mobility?

Transportation is the largest source of greenhouse gas emissions in both the US and the Twin Cities, and commuting trips are a major contributor to these emissions. To meet its emission-reduction mandates, Minnesota needs strategies to reduce auto trips—especially those made by solo drivers. A recent U of M project aimed to leverage existing transportation infrastructure and systems to [provide more flexible, multimodal transportation options](#) for parking contract



holders.

Wearable technology could improve work-zone safety, but are highway workers on board?

Despite ongoing safety efforts, highway maintenance and operations workers have dangerous jobs. [Wearable technology embedded in work gear](#) offers hope for preventing injuries and deaths, and it is already being used successfully in other construction fields. The big question: Would highway workers accept this technology? Researchers found worker support and a notable potential for future development and investment.



Paving the way for smarter and safer AVs

Although there's been a lot of progress in recent years, automated vehicles (AVs) are still not well-equipped to handle crashes, bad weather, poor visibility, and other unexpected situations on the road. These challenges have sparked interest in teleoperated AVs, or AVs that are partially controlled by a remote operator when necessary. An interdisciplinary team of researchers is [working to see if the concept is feasible](#).



Reminder: Send us your agency's internship posting

Will your Minnesota city, county, township, or tribal agency need an intern this summer? Submit your posting to our [Local Agency Transportation Internship Program](#) and let us help connect you with current students pursuing careers in transportation. Job postings will be accepted until February 15, 2023.

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- [The right to mobility](#)
Planetizen, January 26, 2023
- [Burks appointed to national transportation study committee](#)
University of Minnesota Morris News, January 19, 2023

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What's next in transportation? CTS and researchers at the University of Minnesota are working to find out. At CTS, we lay the foundation for transportation systems that are sustainable, serve the needs of all users, support a strong economy, and improve our collective quality of life. To fulfill [this vision](#), we look forward constantly—anticipating and shaping the future of mobility.



*Kyle Shelton,
CTS Director*

Topics

- [The Future of E-commerce](#) by [Saif Benjaafar](#)
- [Is the Future the Past, with a Technology Twist?](#) by [Jennifer Dill](#)
- [United by Transportation](#) by [Yingling Fan](#)
- [The Automation Revolution](#) by [Tom Fisher](#)
- [New Revenues are Needed to Fill the Transportation Funding Gap](#) by [Camila Fonseca-Sarmiento](#)
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This Future of Mobility series highlights the perspectives of leading U of M researchers and national experts. In 18 articles, the authors scan the horizon and reflect on critical transportation topics ranging from advanced air mobility to rural transportation, from automated vehicles to accessibility and equity for users. The future of transportation will not be found in a single mode or mobility solution. Instead, it will be a complex, interconnected set of practices and technologies, and this series brings them together in one place.

Much of this future will emerge from cutting-edge research and

**Additional
resources**

by [Carrie Henning-Smith](#)

- [Mobility-on-Demand, Battery-Electric Buses May Relieve Transit Woes](#) by [Alireza Khani](#)
- [Telecommuting: The Pandemic's 'Silver Lining' May Have a 'Touch of Gray'](#) by [Adeel Lari](#) and [Frank Douma](#)
- [The Future Math of Mobility](#) by [Eric Lind](#)
- [Sensing the Future of Infrastructure](#) by [Lauren Linderman](#)
- [Deadly Speeding Epidemic Demands Urgent Intervention](#) by [Nichole Morris](#)
- [An Equitable Transition to Decarbonized Transportation](#) by [Will Northrop](#)
- [Access to Tourism and Outdoor Recreation in Rural Areas](#) by [Xinyi Qian](#)
- [Addressing Challenges for Autonomous Vehicles on Winter Roads](#) by [Rajesh Rajamani](#)
- [Advanced Air Mobility](#) by [Susan Shaheen](#) and [Adam Cohen](#)
- [Transportation Safety in a Second-Best Environment](#) by [Gregory H. Shill](#)
- [Connected Vehicles and Cybersecurity—A New Frontier of Risk](#) by [Raphael Stern](#)

evolve from new innovations. Other pieces will be simple improvements to our existing systems (think street design tweaks that make roads safer). Our mobility needs have always been served by this mix of innovation and workhorse technologies and modes. It is critical that we not only push forward on emerging technology, but that we also look to continuously evaluate and strengthen our existing systems.

Propelling our forward gaze even further are the disruptions caused by the pandemic and the opportunities in recent federal legislation for massive transportation investments. The pandemic has tested our daily mobility practices—stressing supply chains, changing work commutes, and altering how we view

Video: [Future of Mobility kickoff event](#)

Article: [...a Hub for Collaborative Research](#)

Video: [Addressing the Challenges of CAVs](#)

Video: [Transportation Safety in a Second-Best Environment](#)

Video: [Humanizing Transportation](#)

Video: [Technology for Bridge Preservation and Maintenance](#)

Video: [Transportation and Happiness](#)

Video: [Short Films, Big Visions panel discussion](#)

and move through our communities. The [Bipartisan Infrastructure Law](#) and the [Inflation Reduction Act](#) offer a huge window to build from the disruptions: We can improve our old systems, identify new tactics and

technologies, and invest in infrastructure that will serve us for the next 20 to 30 years.

At this unique moment, it is critical that our universities and leading researchers point us to the transportation future. Discovery and knowledge—next week, next year, or a decade from now—will support our public agencies and officials, communities, engineers, and planners as they build new systems and embrace new best practices.

At this nexus of investments and focus, CTS is making mobility foremost in our work. The “Future of Mobility” serves both as the theme for this series and our work at CTS throughout 2023. We will continue to support and share learning that helps us understand where we are going and the many ways we might get there.

CTS will also host speakers and webinars asking “What’s next?” And, most importantly, we will connect that *next* to where we are today—and chart a path that gets us from here to there, together.

— [Kyle Shelton](#), CTS Director



How will the energy transition impact transportation?

January 17, 2023



The transition to sustainable energy is underway in Minnesota and across the country, propelled by both a growing need to reduce greenhouse emissions and the upcoming influx of funds from new federal legislation. On October 26, 2022, CTS hosted a [seminar](#) to explore two important aspects of the energy transition and their impacts on the transportation infrastructure: [community solar](#) and electric vehicle (EV) readiness.



[Gabe Chan](#), an associate professor at the U of M's [Humphrey School of Public Affairs](#), provided an overview of community solar—solar facilities shared by multiple community subscribers—in Minnesota and elsewhere. According to Chan, advantages of community solar include equity, environmental benefits, jobs, revenue, local control, and technical benefits to the electric grid.

“Efficient and equitable policy needs to consider the institutional structure of energy systems, such as market and political power,” Chan said. “Community solar provides an opportunity to deploy energy resources while rethinking cost and benefit allocation—distributing power and wealth more intentionally.”

Community solar is poised to play a key role in transportation’s energy transition, he continued, because the electrification of transportation will increase electricity demand. Careful planning will be needed to avoid significant additional grid expenditures and higher greenhouse gas emissions.

“We need to think about the electrification of transportation in concert with the supply side

in order to manage our greenhouse gas emissions, and offsite renewables like community solar can play a really important role in this,” Chan said. “For example, we expect that companies with fleets of vehicles will be interested in solar projects to offset their emissions by putting new renewable energy onto the grid in proportion to the amount their vehicle fleets are pulling.”

Chan’s current research is helping move forward renewable energy projects that build from experience in community solar—specifically, through an innovative [project with the Minnesota Department of Transportation \(MnDOT\) and the Red Lake Nation](#). The project is assessing the feasibility of a new solar energy project model that could help meet state and tribal energy needs and greenhouse gas reduction goals.

“MnDOT would be the subscriber to a solar project sited in Red Lake and would use it to help offset the agency’s electricity consumption,” Chan explained. “If this partnership is successful, it could provide a framework for similar agreements in the future, especially as the agency works to encourage and incentivize the electric vehicle charging network.”



Next, Diana McKeown, director of the metro Clean Energy Resource Team at the [Great Plains Institute](#), gave an overview of the new [EV Smart Communities Certification Program](#). The program is funded by MnDOT’s Clean Transportation Pilot Program.

EV Smart Communities is a recognition program designed to provide communities (both cities and native nations) with a roadmap to EV readiness, including securing funding and getting projects off the ground. Categories in the program’s framework include planning, regulation, utility engagement, education and incentives, government operations, and shared mobility—with an overarching goal of equity.

“The path to becoming EV-ready involves a portfolio of best practices and actions, including both simple steps and more complicated initiatives that make it possible for any community to participate,” McKeown said, adding that local leadership is essential to creating a self-sustaining EV market. “Local governments shape the action of residents and businesses, use tools to foster their community’s transition to EV, and signal to the market that we are ready for EVs.”

McKeown also emphasized that equity is a critical aspect of building out the EV infrastructure, and that local governments will be critical to ensuring equity is infused in their EV readiness initiatives. “If the siting of EV infrastructure is left to private developers and

charging operators rather than addressed through planning, access to underserved communities will be limited," she said. "Advancing equity will require accessibility of equipment, multifamily supportive policies, right-of-way supportive policies, and geographic coverage."

Writer: Megan Tsai



Monthly parking contracts are pervasive: Could an alternative promote more sustainable mobility?

January 5, 2023



Transportation is the [largest source of greenhouse gas emissions](#) in both the US and the Twin Cities, and commuting trips are a major contributor to these emissions. To meet its emission-reduction mandates, Minnesota needs strategies to reduce auto trips—especially driver-only trips without passengers.



A recent U of M project aimed to leverage existing transportation infrastructure and systems to provide more flexible, multimodal transportation options for parking contract holders at Minneapolis' [ABC Ramps](#)—thereby reducing the number of solo trips.

“Of the many strategies to reduce car trips, encouraging multimodal integration is a promising direction, as a single transportation mode is unlikely to fulfill the mobility needs of various commuters,” says [Yingling Fan](#), a professor with the [Humphrey School of Public Affairs](#). “Our goal for this project was developing and implementing a flexible commute program that incentivizes commuters to drive less—an answer to the ubiquitous monthly parking contract model that provides little incentive for commuters to avoid driving from one day to the next.”

ABC Ramps is a 6,000-stall garage complex in downtown Minneapolis owned by the Minnesota Department of Transportation (MnDOT). Most users tend to drive alone.

The research team began by working with a group of Twin Cities transportation planning

practitioners to design and implement a hybrid parking–transit product for ABC Ramp users; the group included Elliott McFadden, manager for MnDOT’s state shared mobility, and Nicole Campbell, MnDOT’s lead for the ABC Ramps.

The resulting program—known as FlexPass—offered unlimited transit use along with in-and-out privileges at the ramps for 10 or 14 days per month, depending on the chosen contract. The cost of FlexPass was calculated to offer a discount over simply combining existing transit and parking products, thereby rewarding commuters for embracing limitations and mode flexibility.

Next, the study team collected data to assess the viability of this alternative parking contract design. These efforts included online interest surveys, online evaluation surveys, and travel behavior data collection using the [Daynamica](#) app. The research was conducted in two phases, beginning in February 2020 and ending in August 2022.

During the project’s second phase (beginning in October 2021), FlexPass was adjusted to offer two options—a parking-only 14-day flexible pass and one that offered parking plus unlimited transit access—in response to a survey of interested FlexPass users collected during summer 2021.



The implementation of the FlexPass program, however, was severely impacted by the COVID-19 pandemic, which drastically altered commute patterns in Minneapolis. For example, in fall 2021, ABC Ramps were filled at only 20 to 30 percent of their daily capacity, and in December 2021, ridership on Metro Transit was half of pre-pandemic levels.

“We set out to investigate the ability of commuter programs to shape commuting behavior and test the viability of a combined parking and transit program. Little did we know the study would be conducted during COVID, causing a large shift in metro-wide commuting habits,” Fan says.

Despite the challenges of COVID, researchers found that integrated parking and transit passes designed to limit the number of single-occupancy vehicle (SOV) driving trips are a potentially viable option that could offer downtown commuters flexibility and an incentive to telecommute or take transit to work more often—promoting more sustainable mobility.

Moving forward, MnDOT will [continue to offer the FlexPass option at the A Ramp](#) with an eye

toward making FlexPass a permanent product for ramp users. Future opportunities for advancing this project include better integrating parking with transit, offering FlexPass in more of downtown Minneapolis, and simplifying commuter tax benefits.

“While we were unable to develop definitive findings on the impact FlexPass had on reducing SOV trips, it was extremely popular among its users and gives employers a more flexible, affordable option to offer their hybrid telework staff,” McFadden says.

The project was sponsored by MnDOT and the Metropolitan Council.

Writer: Megan Tsai



Wearable technology could improve work-zone safety, but are highway workers on board?

January 25, 2023



Despite ongoing safety efforts, highway maintenance and operations workers have dangerous jobs. According to the [Federal Highway Administration](#), an average of 135 highway workers lose their lives each year because of traffic incursions and limited space for maneuvering. Wearable technology embedded in work gear offers the promise of preventing injuries and deaths—and is already being used successfully in other construction fields. The big question: Would highway workers accept this technology?



Photo: Shutterstock

“Success in technology projects requires careful user research, and there is typically a gap between what developers think of the system and what actual users’ perceptions are—creating the potential for end users to resist adopting technologies, regardless of the benefits,” says [Nichole Morris](#), director of the U’s [HumanFIRST Laboratory](#) and an associate research professor in the Department of Mechanical Engineering.

Morris was part of a research project supported by the National Science Foundation and led by [Hamed Tabkhivayghan](#) of the [Department of Electrical and Computer Engineering](#) at the University of North Carolina (UNC) at Charlotte. Others on the team included [Omidreza Shoghli](#), project co-investigator, and [Sepehr Sabeti](#), lead author, from the [Department of Engineering Technology and Construction Management](#) at UNC Charlotte.

Wearable technology—such as smart watches, glasses, wristbands, hard hats, and vests—

offers a new way to increase the cognitive capabilities of people in their lives and decision making. Sensing systems, for example, can detect and warn of imminent danger. Recent advances in the technology have led to greater use in different disciplines, especially building construction, but there has been limited information about highway workers' perceptions, concerns, and preferences.

The researchers conducted their study in two steps: a semi-structured interview with an experienced highway maintenance crew member followed by an extensive survey of the highway and operation maintenance community. The initial interview was designed to gain an impression of workers' thoughts and beliefs, inform the design of the questionnaire, and ensure the language and general structure of the survey was suitable for highway workers.

The survey gathered demographic information, previous experience with wearable devices, the perceived practicality of wearable devices, and the likelihood of workers using the provided devices. Survey participants were separated into two groups: highway maintenance crew, and affiliated members such as state DOT members, consultants, managers, and researchers.

Results of the survey show a promising potential for wearable technology in highway work zones and an acceptable level of engagement from highway workers. Specifically, researchers found that the majority of maintenance crew seems to feel neutral about the practicality of wearable devices. Affiliated members viewed the practicality of wearable technology more positively; they thought smart clothes and glasses would be a suitable option in highway work zones, possibly due to their experience with lighting vests and safety glasses.

The researchers believe the results of this study will pave the path toward future interaction and safety system designs for highway workers.

"Based on our findings, we see a notable potential for future development and investment in wearable-enabled technologies for highway work zones," Morris says. "We envision this study energizing developers for further research and investment in the application of wearable technology in highway work-zone safety."

Their work is published in the [proceedings of the 39th International Symposium on Automation and Robotics in Construction](#) in a paper titled "Wearable Technology for Highway Maintenance and Operation Safety: A Survey of Workers' Perception and Preferences."

Writer: Megan Tsai



Paving the way for smarter and safer AVs

January 10, 2023



There's been a lot of progress toward self-driving cars in recent years, but we still have a long way to go before the system runs like a well-oiled machine. Even with all the advances in artificial intelligence and machine learning, automated vehicles (AVs) are still not well-equipped to handle crashes, bad weather, poor visibility, and other unexpected situations on the road.

These challenges have given rise to the concept of teleoperated AVs, or AVs that are partially controlled by a remote operator when necessary. While this concept makes AV adoption more feasible, there's more to it than just a person managing the vehicle from an off-site location.

"You need the vehicle to receive directions, but you also need the system that is operating everything to quickly receive data from the vehicle and from other vehicles, to give that remote operator a sense of what's going on," said [Joseph Konstan](#), associate dean for research at the U of M's [College of Science and Engineering](#) (CSE).

It's a complicated problem, but an interdisciplinary team of researchers are determined to figure it out in a project funded by CSE's new [InterS&Ections seed grant program](#). The program was designed to spark new collaborations between scientists and engineers that could address significant challenges.

"We don't just want to make the car smart—we also want to make the infrastructure smart



The AV project team with the MnCAV Ecosystem's research vehicle, a modified Chrysler Pacifica Minivan. Photo: Rich Ryan

by using advanced network communication technologies such as 5G and edge computing,” said [Zhi-Ling Zhang](#), the project’s principal investigator and a professor in the [Department of Computer Science and Engineering](#).

Think of it as air traffic control, but for self-driving vehicles. Zhang’s team will develop new models and algorithms to move us closer to edge-assisted intelligent driving systems. Unlike larger-scale cloud computing, edge computing puts the data closer to the location where it’s being generated, at the “edge” of the network.

“The amount of data we need to collect is huge, and shifting all that information to the cloud would take a lot of bandwidth and result in delays,” Zhang said. “Edge computing will help us process the information faster.”



Cameras and sensors on the roof rack of the MnCAV vehicle

Zhang has led some of the world’s first large-scale, commercial 5G measurement studies. Co-investigator [Rajesh Rajamani](#) is a leading expert on estimation and vehicle control for intelligent transportation systems, and co-investigator [Jeff Calder](#) is an expert on graph learning and related topics. Putting their heads together, the team is likely to lay a foundation for future funding while boosting Minnesota’s reputation as a leader in AV research.

Thanks to its state-of-the-art research facilities, the University is an ideal place for this project. Under the umbrella of the new [MnCAV Ecosystem](#), researchers, government, and industry partners are coming together to develop and test connected and automated vehicle technologies. Led by CTS, this ecosystem includes a [fully automated 2021 Chrysler Pacifica minivan](#) that serves as a customizable, experimental testbed.

Ultimately, the project team will help identify the most critical needs for the nation’s physical and digital AV infrastructures. “We’re not funding this because, at the end of a year or two, we’re going to magically see these autonomous vehicles driving around campus,” Konstan said. “It’s about a longer-term national priority—and this team is addressing the gaps that need to be filled in order to get us there.”

The project was 1 of 2 selected from more than 20 InterS&Ections grant proposals to receive around \$100,000 in 2022–23. The funds will support research assistants, materials, and equipment, with potential renewal for a second year based on the team’s progress.

Adapted from [an article by Eve Daniels](#) in *Inventing Tomorrow*, a publication of the U's College of Science and Engineering.
