University of Minnesota

CENTER FOR TRANSPORTATION STUDIES

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CTS Catalyst

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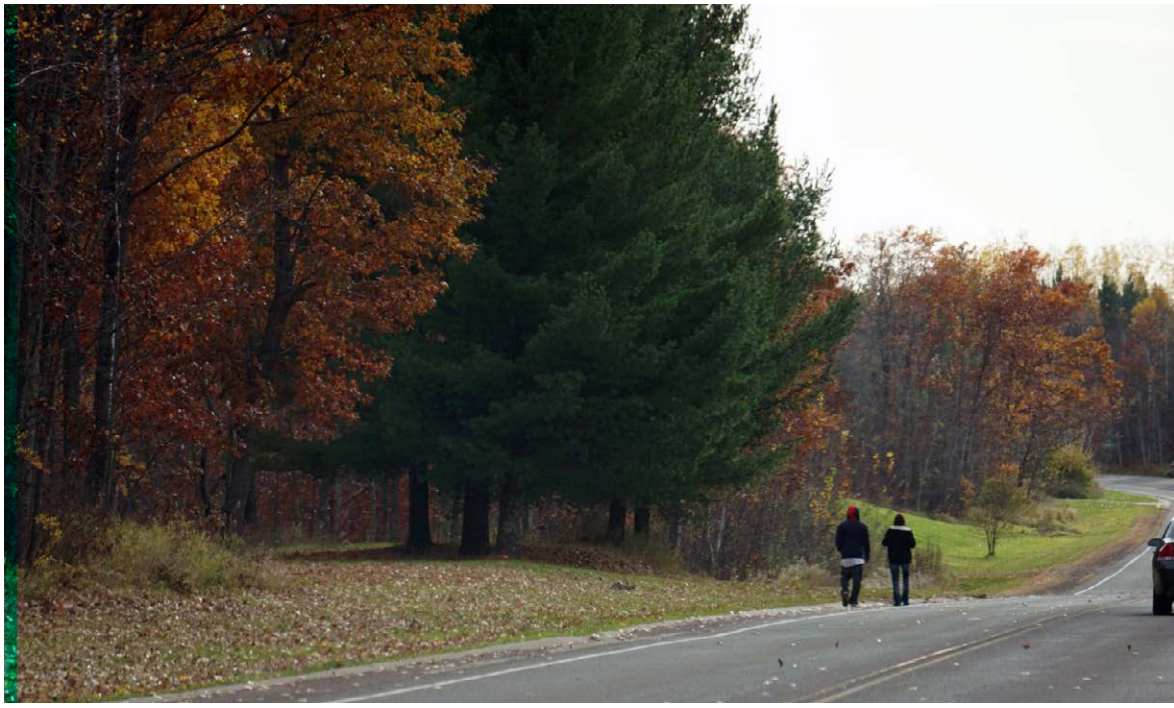
Accelerating the pace of transportation innovation



Building partnerships with tribal communities to improve safety

The motor vehicle crash fatality rate is higher for American Indians than for any other ethnic or racial group in the United States. Although the number of fatal crashes decreased in the nation as a whole by about 21 percent from 1975–2013, it increased by about 35 percent on American Indian reservation roads.

"These are huge disparities," says Associate Professor Kathryn Quick. "Clearly, this is an issue that needs to be explored."

Tribal continued on page 7

Bicycling industry, events have economic impact in Minnesota

The bicycling industry in Minnesota—including manufacturing, wholesaling, retail sales, and non-profits and advocacy groups—produced an estimated total of $780 million of economic activity in 2014. This includes 5,519 jobs and $209 million in annual labor income (wages, salaries, and benefits) paid to Minnesota workers.

These findings are an important component of a multifaceted report from U of M researchers. Their research, funded by the Minnesota Department of Transportation (MnDOT), provides a comprehensive understanding of the economic impact and health effects of bicycling in Minnesota.

Bicycling continued on page 6

Researchers invent process to produce renewable car tires from trees, grass

A team of researchers, led by the University of Minnesota, has invented a new technology to produce automobile tires from trees and grasses. The new process could shift the tire production industry toward using renewable resources found right in our backyards.

Conventional car tires are viewed as environmentally unfriendly because they are predominately made from fossil fuels. Using the new process, tires produced from biomass that includes trees and grasses would be identical to existing car tires, with the same chemical makeup, color, shape, and performance.

The team included researchers from the U of M's Department of Chemical Engineering and Materials Science (CEMS) and the Center for Sustainable Polymers (CSP) and from the University of Massachusetts Amherst. CSP is funded by the National Science Foundation.

"Our team created a new chemical process to make isoprene, the key molecule in car tires, from natural products like trees, grasses, or corn," says Paul Dauenhauer, CEMS associate professor and lead researcher of the study. "This research could have a major impact on the multi-billion dollar automobile tires industry."

Currently, isoprene is produced by thermally breaking apart molecules in petroleum that are similar to gasoline in a process called "cracking." The isoprene is then separated out of hundreds of products and purified. In the final step, the isoprene is reacted with itself into long chains to make a solid polymer that is the major component in car tires.

Biomass-derived isoprene has been a major initiative of tire companies for the past decade, with most of the effort focused on fermentation technology (similar to ethanol production). However, renewable isoprene has proven a difficult molecule to generate from microbes, and efforts to make it by an entirely biological process have not been successful.

CSP researchers have focused on a new process that begins with sugars derived from biomass, including grasses, trees, and corn. They found that a three-step process is optimized when it is "hybridized," meaning it combines biological fermentation using microbes with conventional catalytic refining that is similar to petroleum refining technology.

"Economically bio-sourced isoprene has the potential to expand domestic production of car tires by using renewable, readily available resources instead of fossil fuels," says Frank Bates, a world-renowned polymer expert and U of M Regents professor of chemical engineering and materials science. "This discovery could also impact many other technologically advanced rubber-based products."

The U of M, through its Office for Technology Commercialization, has applied for a patent on the renewable rubber technology and plans to license it to interested companies.

READ CATALYST ONLINE

for links to research reports and other resources.

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Taconite byproduct reduces road wear from studded tires

In a recent project, the Alaska Department of Transportation (DOT) used a byproduct of Minnesota's taconite mining industry for a section of the Alaska Glenn Highway.

The taconite byproduct—Mesabi sand—serves as the aggregate of a sand-seal treatment for a 4,600-foot stretch of the highway just north of Anchorage. Sand seals are an application of a sealer, usually an emulsion, immediately followed by a light covering of a fine aggregate (the sand).

"Our goal was to explore pavement preservation measures that extend pavement life and that also resist studded tire wear," says Newton Bingham, central region materials engineer with the Alaska DOT. "Studded tires are allowed from mid-September until mid-April, and they cause rapid pavement wear."

For the project, the Alaska DOT obtained sample pavement cores from the test area in 2014. Researchers then applied sand seals with two different hard aggregates—calcined bauxite and the Mesabi sand—to the surface of the cores to evaluate the effectiveness of each treatment.

Larry Zanko, senior research program manager of the Natural Resources Research Institute (NRRI) at the University of Minnesota Duluth, was the on-site representative for the taconite sand analysis. NRRI focuses on strategies to recover and utilize mineral-resource-based byproducts such as taconite and find potential beneficial end-uses for them.

Applying sand seal in Alaska

"Taconite is one of the hardest natural aggregates," he says. "Minnesota's taconite mining industry generates tens of millions of tons of byproduct materials every year that could be used as pavement aggregate. Friction aggregates could be a higher-value niche for the industry."

Testing of the sand-seals showed similar wear resistance for both types of aggregates. "We chose taconite sand since it is available from Minnesota as an industrial byproduct, whereas calcined bauxite sand has to be imported from nations on the Pacific Rim and costs more due to shipping," Bingham says.

The Alaska DOT reports good performance to date on Glenn Highway and is funding ongoing pavement wear measurement.

NRRI researchers are also studying the use of taconite for other pavement applications. Funded by MnDOT, Zanko's team developed (and later patented) a taconite compound for repairing pavement cracks and patching potholes (see September 2016 *Catalyst*). The long-lasting patches reduce maintenance costs and traffic disruption. In continuing work funded by the Minnesota Local Road Research Board, researchers will refine the repair compound and develop and field-test a low-cost mechanized system for pavement and pothole repairs.

CTS Spring Luncheon: Moving to Access

Each day around the world, millions of urban residents walk, bike, drive, bus, and metro to their destinations. This sets off an uncoordinated ballet of movement.

At the CTS Spring Luncheon, Brookings Institution fellow Adie Tomer will explore how the Institution's new Moving to Access initiative is looking at innovative policies, tools, and techniques that can help ensure that all people—regardless of income or demography—get where they need to go. Ultimately, the initiative aims to elevate accessibility through research and practical solutions, as well as assess what's currently working—and what isn't.

The luncheon will be held May 11 at the McNamara Alumni Center in Minneapolis. More information is available at **cts.umn.edu/Events/Luncheon**.

Living snow fence, snow control work wins award

In recent years, the U of M and MnDOT have partnered to find ways to keep more rural roads drift-free. Teams have studied a promising option for living snow fences and developed a website and new online tools. Their work was honored with this year's CTS Research Partnership Award.

In one component of the work, researchers analyzed shrub willows as a more affordable, fast-growing option for living snow fences. They found that shrub willows were effective at trapping snow after just two growing seasons; typical snow fence plants can take 5 to 20 years to establish themselves. The researchers also estimated the cost of a 100-meter, four-row living snow fence at less than $8,000.

In other work, teams collaborated to develop two online tools:

- The Minnesota Drift-Free Roads Design Module allows users to create two types of mitigation strategies: a road design and a snow fence design. Users are able to enter a site-specific blowing snow problem and examine solutions.
- The Cost Benefit Web Tool allows transportation agencies to estimate the return on investment of implementing blowing snow control practices such as living snow fences or standing corn rows on private lands.

Both tools are on the Blowing Snow Control Tools website, which also houses videos and other resources, at **snowcontroltools.umn.edu**.

A short
VIDEO
about the project
is on the
CTS WEBSITE.

Videos trace progress in pavement design, traffic operations

During the Annual Meeting and Awards Ceremony, CTS debuted two videos about the many contributions U of M researchers have made—and are still making—in pavement design and traffic operations.

The videos are one of the ways CTS is marking 30 years of transportation innovation. Our goal is to show how research progresses over time—from curiosity to discovery to innovation. The videos also show how U of M research meets the practical needs of Minnesotans in the Twin Cities metro and throughout the state.

Designing pavements that can stand up to Minnesota's harsh climate is a continuing priority for researchers, whose work has led to new methods, tools, and specifications to extend pavement life. The video also looks at how research teams are pushing the envelope with use of materials such as taconite waste and graphene nano-platelets for pavement applications.

The second video, about traffic operations, shows how researchers have been leaders nationally and internationally in developing tools to collect and analyze traffic data (see story in the February 2017 *Catalyst*).

Both videos are available at **cts.umn.edu/publications/videos.**

Leaders honored at CTS Awards Luncheon

CTS presented the following awards at its Annual Meeting and Awards Ceremony on February 15 in Minneapolis.

Richard P. Braun Distinguished Service Award

(outstanding leadership in research and innovation)
Mary Vogel, co-director, Center for Changing Landscapes

Ray L. Lappegaard Distinguished Service Award

(outstanding leadership, mentorship, and support for the profession)
Alan Forsberg, retired county engineer, Blue Earth County

William K. Smith Distinguished Service Award

(leadership, mentorship, and education of future leaders in private-sector freight transportation)
Vanta Coda II, executive director, Duluth Seaway Port Authority

Distinguished Public Leadership Award

(public leaders who have influenced innovative transportation policy directions)
Michael Beard, chair, Scott County Board, and member, Minnesota House of Representatives, 2002–2014

Education Awards

Matthew J. Huber Award *(students in engineering, science, and technology fields)*
Mengying Cui: Doctoral candidate, civil engineering; advisor: David Levinson
Jingru Gao: Master's degree, transportation engineering; advisor: Gary Davis

John S. Adams Award *(students in policy and planning fields)*
Jueyu Wang: Doctoral candidate, public affairs (concentration in urban planning); advisor: Greg Lindsey

Roadway Safety Institute Outstanding Student of the Year
William Barbour, master's candidate, civil engineering (concentration in sustainable and resilient infrastructure systems), University of Illinois at Urbana-Champaign, an RSI partner; advisor: Daniel Work

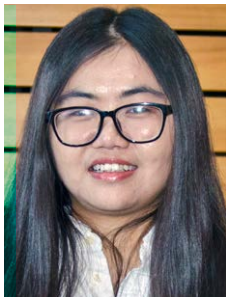
CTS presented the first Huber Award in 1988. Since then, CTS has honored a total of 76 master's and Ph.D. students for excellence in transportation research and education.

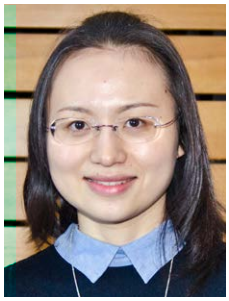

Mary Vogel


Vanta Coda II


Michael Beard


Alan Forsberg


Mengying Cui


Jingru Gao


Jueyu Wang


William Barbour

CTS Research Conference Call for Presentations

CTS has issued a call for presentations for its 28th Annual Transportation Research Conference, scheduled for November 2, 2017, at The Commons Hotel in Minneapolis.

If you or your organization would like to share the results of your research or innovations in transportation, please submit a brief abstract for either a lectern presentation or a poster to be shared at the conference. (The poster session will be scheduled only if there is demonstrated interest.)

The submission deadline is April 24, 2017. For more information or to submit your abstract, please visit **cts.umn.edu/events/conference**.

Bicycling from page 1

"This kind of bicycling study is definitely new for Minnesota but also new nationally," says Sara Dunlap, principal planner in MnDOT's Office of Transit. "This is the first time a state has attempted to assess, in a single study, the multiple impacts that bicycling activities have on the state's economy and health."

Xinyi Qian, an Assistant Extension Professor in the U's Tourism Center, was the project's principal investigator. For the bicycling industry portion of the work, the co-investigators were Neil Linscheid, Extension Educator, and Brigid Tuck, senior economic impact analyst, both with U of M Extension.

"Information about the bicycling industry is scattered, so we filled the information gaps by creating a list of bicycle-related businesses in Minnesota, interviewing bicycle-related business leaders, surveying bicycle-related businesses, and gathering additional information from relevant sources," Linscheid says. "Numerous industries and a diverse supply chain are involved." The research team then used this information to enhance an economic model that shows the economic contribution of the bicycling industry in Minnesota.

"Minnesota has a strong bicycle-related manufacturing industry that drives the bicycle-related economy," Tuck says. "Specialty bicycle retail stores, especially independent ones, are a critical component of the bicycle retail industry in Minnesota." Additionally, she says, when asked about local suppliers, bicycling businesses often provided names of other Minnesota companies, many of which are also bicycle-related businesses.

Researchers also looked at the economic impact of bicycling events—races, non-race rides, fundraising events, mountain bicycling events, high school races, and bicycle tours. Qian led this portion of the study, working with Tuck.

Through surveys and analysis, they found that an average bicycle event visitor in 2015 spent a total of $121 per day. This spending translates into an estimated total of $14 million of annual economic activity, which includes $5 million in annual labor income and 150 jobs. Event participants also brought additional people with them— more than 19,000 visitors who were travel companions but did not ride in any event.

The findings can help bring together event organizers and officials of various organizations—economic development, transportation, public health, and tourism—to promote the event facilities, the host communities, and bicycle tourism as a whole.

"Bicycling event attendees and their travel companions are a valuable audience for shopping, recreation, and amusement activities," Qian says. "Communities hosting events could explore opportunities to capture additional spending from these important visitors."

Qian notes that the analysis focused on event visitors and was not a broad measure of bicycle tourism.

An article in the February *Catalyst* discussed the health impacts component of the study; an article in the April issue will report on the magnitude of biking in the state.

Minnesota communities
host more than
100 BICYCLE EVENTS
annually.

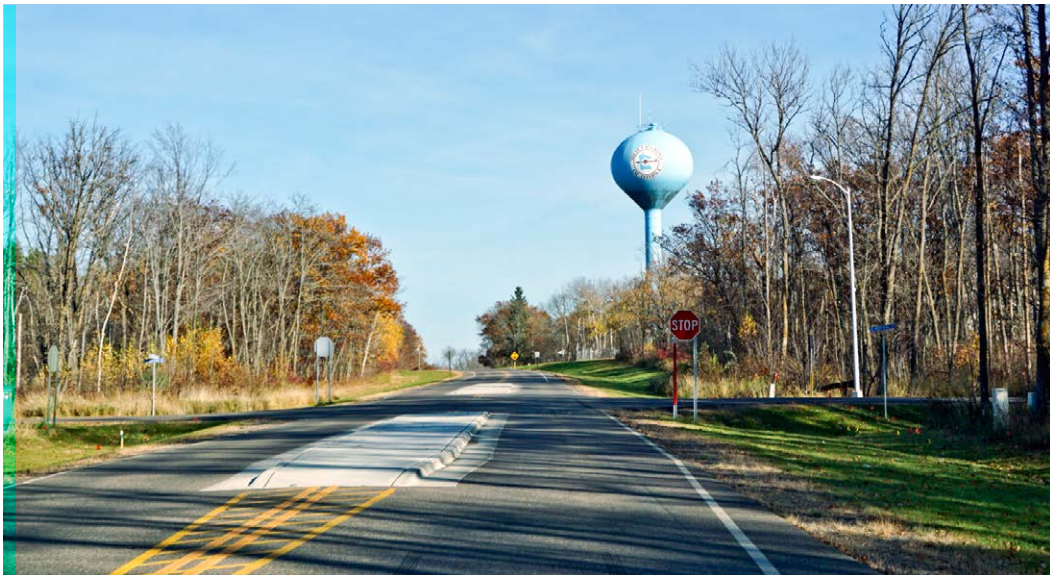
Tribal from page 1

In a project sponsored by the Roadway Safety Institute, Quick and Research Associate Guillermo Narváez, both with the U of M's Humphrey School of Public Affairs, are collaborating with American Indian communities to better understand the transportation safety risks on tribal lands and develop strategies to mitigate these risks.

As part of this work, Quick and Narváez have had discussions with 12 tribal governments to explore their transportation concerns. That has grown into collaborations with four tribal governments: the Red Lake Band of Chippewa, Leech Lake Band of Ojibwe, Fond du Lac Band of Lake Superior Chippewa, and Mille Lacs Band of Ojibwe.

In those communities, the researchers have interviewed people responsible for road construction and maintenance, law enforcement, injury prevention, and emergency response on the reservation; professional drivers who know the roads particularly well; and community residents. These interviews have produced rich data, including what local experts know about the sources of risk, how they manage those risks, and what they recommend to improve safety, Quick says. From these participants and from other tribal communities and researchers, Quick and Narváez are also gathering success stories about improving roadway safety.

So far, findings suggest that tribal transportation safety problems may be similar to rural safety problems, except for a much greater concern for pedestrian safety and the complexities of coordinating between tribal governments and other jurisdictions.



Safety improvements on a road in the Mille Lacs Indian Reservation

In some communities, the research is already leading to practical safety improvements. For example, Kade Ferris, transportation planner with the Red Lake Tribal Engineering Department, says that the researchers' work has allowed for "an unprecedented and useful integration of disparate types of data into a more comprehensive, robust picture, leading to the development of a comprehensive tribal transportation safety plan for the Red Lake Nation."

The data have also helped the tribe identify and address specific safety concerns. For example, Ferris says that data collected through this collaboration helped identify pedestrian safety concerns along Minnesota Highway 1, the main east-west highway through the reservation. The tribe then used the data to apply for and receive funding from the state of Minnesota to develop a new walking trail and street lighting to provide a safer walking environment for the reservation's residents. Quick and Narváez are also working with the Red Lake Band DOT to elaborate a protocol to analyze safe routes to school and support their request for improvement funds.

Tribal transportation leaders and others have not identified alcohol- or drug-impaired driving as a distinguishing, special feature of roadway safety in reservations, Quick notes. "We hear very mixed statements about this. Some people indicate that impairment is not a particular concern. Others indicate that it is, but emphasize they do not see a difference between on- and off-reservation patterns. This indicates that we must take great care in making blanket statements about this, because there is no clear pattern that we can describe at this time," she says.

Going forward, Quick and Narváez plan to complete their analysis of reservation safety data, expand into non-Minnesota sites, and build research and teaching capabilities about tribal governance at the Humphrey School.

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30 YEARS Celebrating 30 years of transportation innovation

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MARCH 2017

BICYCLING INDUSTRY, events have
ECONOMIC IMPACT
in Minnesota.
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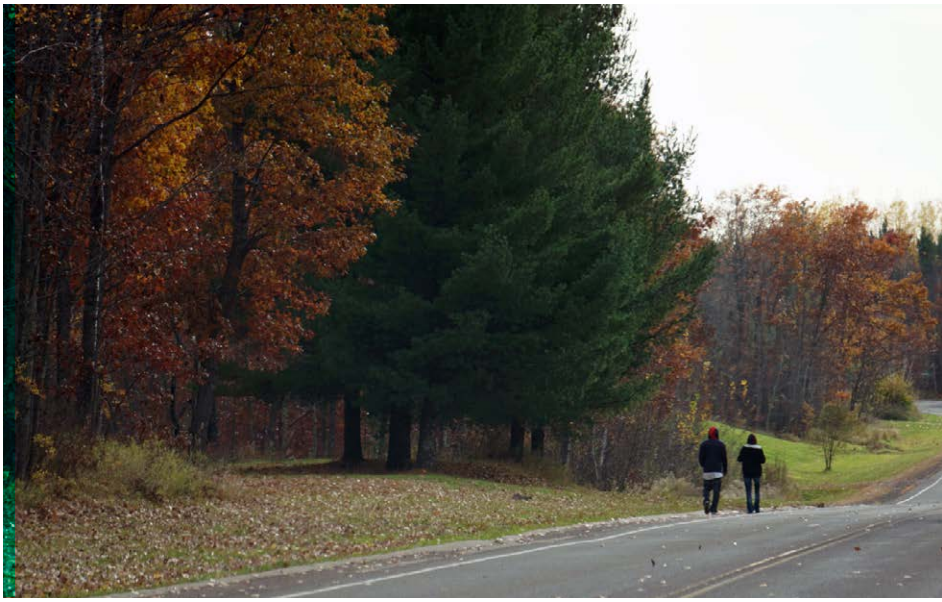
Researchers invent
PROCESS TO
PRODUCE RENEWABLE CAR TIRES
from trees, grass.
page 2

TACONITE
byproduct
REDUCES ROAD WEAR
from studded tires.
page 3



Building partnerships with tribal communities to improve safety.
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