



# CHANGING LANES

American highways are crumbling. High-tech efforts to rebuild them envision roads that are smarter, safer and more sustainable.

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Georgia is testing Wattway, a surface that collects solar power. THE RAY



Retired Gen. Lucius Clay, left, presents President Dwight Eisenhower with recommendations for an interstate highway system in January 1955. BYRON ROLLINS, AP

Matt Alderton, Special to USA TODAY

For commuters nearly everywhere, highways are hell. But before highways became black holes of congestion, Cracker Barrels and construction, they didn't actually cause headaches; rather, they cured them. ■ President Dwight Eisenhower deserves a big chunk of the credit. In 1956, he signed the Federal-Aid Highway Act, which authorized a 41,000-mile national road network to facilitate "speedy, safe, transcontinental travel" by Americans in automobiles. By the time the original plan was completed in 1992, the interstate highway system had changed everything. Before, U.S. roads were a hodgepodge of rustic country lanes that bled into busy city streets. Instead of asphalt or concrete, most were packed dirt that was dusty on the best days and muddy on the worst. ■ Back then, it took at least two weeks to drive across the USA; now it takes just five days.





An engineers' group says 1 out of every 5 miles of highway pavement in the USA is in poor condition. 2015 PHOTO BY PATRICK BREEN, THE (PHOENIX) ARIZONA REPUBLIC

Highways made commerce more efficient, created jobs in adjacent businesses, made driving safer and strengthened national security by providing better ground transport of military equipment.

And yet, less than a century after its inception, Eisenhower's dream already is cracking — literally. In its most recent "Infrastructure Report Card," published in 2017, the American Society of Civil Engineers (ASCE) gave U.S. highways a 'D' grade. According to ASCE, more than 2 out of every 5 miles of urban interstates are congested, costing the U.S. \$160 billion a year in wasted time and fuel. Furthermore, it says 1 out of every 5 miles of highway pavement is in poor condition.

This as traffic fatalities climb, reaching 37,461 in 2016, up 5.6% from 2015, according to the U.S. Department of Transportation's National Highway Traffic Safety Administration.

Highways, it seems, are now posing the very same challenges they were conceived to resolve. This time, however, the solution isn't new roads; it's better roads.

"We cannot build more physical infrastructure," says Marcus Welz, president and CEO of Siemens Intelligent Transportation Systems, which develops technology to modernize and improve urban and interurban traffic. "Instead, we must consume our existing infrastructure more efficiently."

### Safety first

Efficiency starts with safety, according to Tim Sylvester, founder, CEO and chief technology officer of Integrated Roadways, a Kansas City-based startup whose patented "smart pavement" system is the infrastructure equivalent of touch-screen technology. Consisting of precast concrete slabs embedded with digital technology and fiber-optic connectivity, the system detects tires like smartphones detect fingertips.

"We read the positions of vehicles on the roadway up to 1,000 times per second to get their exact location at an exact point in time, which gives us extremely

high-quality traffic information," Sylvester says. Smart pavement can count cars, analyze traffic patterns, measure vehicle weights and speeds, and detect driver behaviors, he says.

Eventually, that data could be communicated directly to motorists in their cars, helping them — or their autonomous vehicles — foresee inclement weather, dangerous road conditions and traffic jams. And that could in turn prevent fatal accidents by alerting drivers to potential hazards. It also could save lives when crashes happen, says Sylvester, who is working with the Colorado De-

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partment of Transportation to test smart pavement on a half-mile stretch of U.S. 285, where Colorado motorist Kristin Hopkins crashed her car in 2014.

“She drove off the roadway and was stranded upside-down in her car for five days,” Sylvester says of Hopkins, who survived but lost both legs. “We’re here to make sure nobody else has to go through that, because the same system that can detect a vehicle’s position can identify when a vehicle leaves the road under unsafe conditions and automatically alert emergency services.”

The test, which will start in 2019 after an initial pilot in Denver, is part of RoadX, a program through which the Colorado DOT is testing and deploying new technology in order to solve its most vexing transportation challenges.

“We’re at a transformative moment in transportation technology where harnessing it could help us deal with some really pressing issues that we have in Colorado and across the country,” says Amy Ford, the Colorado DOT’s chief of advanced mobility.

Smart pavement is just one of many solutions the department is exploring. Another is vehicle-to-everything technology, or V2X, which allows internet-connected vehicles to exchange data with cloud-based networks, pedestrians, other vehicles and roadside infrastructure. Although the technology is complex, the idea is simple: A highway laden with sensors can send messages to vehicles — warning them to slow down, for instance, ahead of a sharp curve.

“This is one of the cornerstones of how we build what will perhaps be the country’s first truly digital highway system — the internet of roads, if you will,” Ford says. The Colorado DOT has partnered with Panasonic, Ford and Qualcomm to deploy V2X technology across the state’s I-70 mountain corridor, where it’s expected to reduce collisions by up to 80%, he says. Automakers will begin releasing compatible vehicles next year.



**When the bulk of road construction is financed by taxes on gasoline, what happens when electric vehicles become widespread? That’s one issue transportation planners are struggling with.** 2015 PHOTO BY RICH PEDRONCELLI, AP

**“I love what Eisenhower did. The interstate system was a great stimulus for the whole country. ... But nothing about it has been sustainable.”**

**Harriet Anderson Langford**

daughter of sustainability pioneer Ray C. Anderson and head of the Ray C. Anderson Foundation

“We believe this is the future.”

So does Welz, who says Siemens is testing connected vehicle technology in Tampa as part of a pilot project with the U.S. Department of Transportation and the Tampa Hillsborough Expressway Authority. There, 1,600 volunteers whose vehicles have been retrofitted with V2X technology receive safety alerts when driving on the Lee Roy Selmon Expressway. In particular, commuters approach-

ing downtown in express lanes often encounter sudden traffic where they exit the expressway; to prevent rear-end crashes, sensors now alert them when traffic ahead has slowed or stopped, and the system can even change traffic signals to reduce the congestion.

“With connected vehicle technology, we are able to ... totally rethink the way we steer cars and avoid accidents,” Welz says.

### Earth-friendly expressways

Highways can be just as dangerous for the planet as for people. So when the State of Georgia dedicated 16 miles of I-85 to her father, the late Ray C. Anderson, Harriet Anderson Langford resolved to make it the world’s first sustainable highway.

Anderson was founder of Interface Inc., a global manufacturer of modular carpet tiles. In 1994, he became interested in environmental sustainability and set a goal to make his business carbon-neutral by 2020. When he died from pan-

creatic cancer in 2011, he left most of his wealth to a family foundation charged with continuing his environmental legacy. The Ray C. Anderson Foundation subsequently turned the Ray C. Anderson Memorial Highway in Troup County, Ga., into “The Ray,” a living laboratory dedicated to testing new road technology.

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To change that, the Ray C. Anderson Foundation is pursuing an array projects in partnership with the Georgia Department of Transportation. In 2015, for instance, it installed Georgia’s first solar-powered electric vehicle (EV) charging station at a visitor center in West Point.

“With one charging station, we’ve opened up the entire interstate between Montgomery, Ala., and Atlanta to EV travel,” explains the foundation’s executive director, Allie Kelly.

The foundation doubled down on so-

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Highways sit in the sun all day, so why not put them to work collecting energy with solar cells on the road surface and in the right-of-way on the shoulder? THE RAY

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lar in 2016, when French company Colas Group chose The Ray to host its first U.S. pilot of Wattway, a photovoltaic road surface that's installed on top of existing asphalt. Wattway collects solar energy that can feed the electrical grid, power public lighting and road signs, or support EV charging stations.

"In 12 months, our 50-square-meter pilot site generated almost 6 megawatt-hours of electricity," Kelly says. Solutions like Wattway may eventually be able to charge EVs wirelessly while they're in motion, he says.

In the meantime, another technology gracing The Ray is the WheelRight system, which measures vehicles' tire pressure and tread depth and communicates the data to drivers via text message.

"In the United States, we're wasting 2 billion gallons of fuel every year just because our tires are not properly inflated," Kelly says. "That affects national security, is extremely wasteful and jacks

up air emissions from your tailpipe."

It also jeopardizes driver safety — without which sustainability is irrelevant, Kelly says. "If we can't prioritize human life, what are we doing here?" she asks. "There's no point in cleaning up the environment for people who are dying on the roadway."

### Paying for progress

It's not enough for future highways to be safe and sustainable. For them to exist at all, they must also be profitable, says Tom Blair, a district engineer at the Missouri Department of Transportation.

"When President Eisenhower signed the (Federal-Aid Highway Act), the first interstate under construction was I-70 in St. Charles, Mo.," Blair says. "I-70 is largely the same interstate it was 60-plus years ago, and it needs to be rebuilt. Unfortunately, we have not been able to generate the \$2 (billion) to \$4 billion that's needed to rebuild it."

Under current funding mechanisms, that deficit is only going to get worse as adoption of electric and autonomous vehicles increases.

"Today, we as average citizens pay for the majority of our roads and bridges through a fuel tax," Blair says. "With the current disruptions in transportation, it's guaranteed that we will consume less fuel in the future. We already do. So probably the most urgent thing for departments of transportation right now is figuring out how we ultimately are going to transition beyond the fuel tax."

To that end, the Missouri DOT in 2015 launched Road to Tomorrow, a strategic exercise through which it solicited new ideas for generating revenue from future highways. Since then, a number of promising innovations have emerged. Both Colas' Wattway and Integrated Roadways' smart pavement, for instance, have revenue-generating potential. With Wattway, the energy collected by the system could be sold to motorists whose EVs use it. With smart pavement, traffic data could be sold to commercial enterprises with an appetite for V2X data, such as trucking companies, insurance providers and real estate developers.

"Right now, a roadway costs \$2 million per lane per mile to build and \$6.5 million to own over a 50-year peri-

od," Sylvester says. "Smart pavement costs about twice as much to build, but it pays for itself in less than 15 years because it generates revenue."

The Ray C. Anderson Foundation has another idea: In June, it launched a project with the University of Texas, Austin to analyze interstate shoulders across the country for solar power potential. Known as rights-of-way, shoulders are wasted space that could be monetized with solar arrays that generate revenue through land lease deals, power purchase agreements, the sale of renewable energy certificates or even by selling energy directly to power companies.

Transportation departments "can generate revenue by better leveraging the assets they already have," Kelly says. She says The Ray is building its own right-of-way solar project: a 1-megawatt solar farm that will be on line by October.

From the pavement to the purse, the time has clearly come for a new "Eisenhower moment," Blair says.

"If things don't change," he says, "we're going to have smart driverless vehicles on dumb, underfunded and underappreciated roadways."