INFRASTRUCTURE • WHAT TO BUILD

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MODERNIZE THE SKIES

Replacing technology dating from the 1940s saves fuel, money-and your time
BY ZEKE J. MILLER

High up in airport control towers and in darkened tracking facilities, a technological revolution is set to take your next flight into the 21st century.

Known as NextGen, the joint Federal Aviation Administration (FAA) and aviation-community program to modernize the skies is sidelining radio technology, which has been largely unchanged since the 1940s, and replacing it with GPS. The $30 billion-plus, multi-decade program marks a high- tech leap for the National Airspace System, the network of people, procedures and equipment that takes your plane from gate to gate.

The fixes aren't sexy. They are measured in seconds and gallons of jet fuel saved and CO_2 emissions prevented. But they add up to the most comprehensive investment in the backbone of the nation's skies in history.

For decades air-traffic controllers have had to leave miles-long spacing between airliners, trading a level of efficiency for safety and technical reasons. The old radar system works only within line of sight, updates only every 5 to 12 sec. (a lifetime for planes flying at over 500 m.p.h.) and suffers from increasing ambiguity the farther a plane gets from the ground-based antennas. Aviation-grade GPS, augmented by the FAA's ground-based sensors, provides planes with positional certainty within a 5-m box, and the new system gives controllers updates every second. This means flights can be safely spaced more closely together.

Another component will begin in 2020: planes flying in highly congested airspace around major airports will be required to use Automatic Dependent Surveillance Broadcast, which supplements traditional radar with a far-more-accurate satellite-based position. The shift to GPS also allows the use of more direct flight paths, in many cases replacing complex or circuitous routings.

Approach and landing procedures, which help guide planes to runways, have been updated to use GPS waypoints that shave minutes off flights. It's also the technology that will clear the way for autonomous flights, keeping the latest drones out of the way of passenger aircraft and one another.

In 2015 the FAA reached full deployment of en route automation modernization (ERAM)-the foundation of all NextGen programs-which enables controllers to precisely guide planes on descent using minimal fuel and eliminating many of the frustrating "race-track" holds loathed by travelers. ERAM also allows controllers to more accurately predict future traffic and the effect of inclement weather, which is why planes are now more likely to hold on the ground-where they burn less fuel and pollute less-than in the air.
The FAA estimates that NextGen programs saved 170,000 tons of CO2 emissions in 2014 alone. From the start, the FAA knew it couldn't singlehandedly fund the cost of the program, which it estimates to be $35.8 billion through 2030 (of which about $20 billion will come from the government).

Planes need to be updated, airports modernized, and controllers, dispatchers and pilots trained. Still, there is a reason it's hard to find critics of the program. (The most serious are those who live under the new, shorter flight paths.) One FAA study puts the estimated benefits of NextGen at $160.6 billion through 2030, including a reduction of 2.8 billion gal. of fuel.
"For our operations, NextGen means less time sitting on the ground and holding in the air" FedEx CEO Fred Smith testified before Congress on Feb. 1. "NextGen procedures can shave minutes off flight time, which translate into money saved". And it works for passengers too.

Better Batteries

A simple solution that could transform clean power

Justin Worland

In an otherwise empty lot near San Diego, two dozen trailers jammed with 400,000 batteries are part of an experiment that could revolutionize clean energy. If it works, the batteries would solve a key problem with wind and solar power - namely, that one works only on blustery days and the other when the sun Is out. Developers say the batteries will store excess energy for later use, allowing power providers to rely less on fossil fuels as a backup.

Energy experts are optimistic, as are the many investors with a stake in the sector. "Networks care about reliability" says Logan Goldie-Scot, an energy-storage analyst at Bloomberg New Energy Finance. "Energy storage is being viewed by network operators as a potential tool in their toolbox, and that hasn't been the case up until now."

This kind of energy storage would be a game changer for the growing list of cities that have pledged to source all their electricity from wind and solar in the coming decades. Until now, that goal was considered not only lofty but also practically unattainable.

Now all eyes are on San Diego's pilot program, the most expansive one to date. It's operated by San Diego Gas & Electric, which already gets more than one-third of the electricity it provides from renewable sources like wind and solar. The batteries store enough electricity to power 20,000 homes for four hours. If all goes according to plan, the program will show utilities that going 100% renewable can be more than a pipe dream.

A Safer, Smarter Grid

The threat of cyberattack calls for a manual backup

by Bryan Walsh

Unless you think trees are secretly waging war on humans, the great Northeastern blackout of Aug. 14, 2003, wasn't caused by an attack. When a transmission line in northern Ohio began to sag because of the intense summer heat, it tangled with the branches of a nearby tree, causing the wire to trip offline. One thing led to another in a perfect storm of equipment and human failure, and in barely four hours, more than 50 million people in the northeastern U.S. and Canada had lost power, including New York City. Power wasn't fully restored for days, and the blackout, the biggest in North American history, would cost some $10 billion.

That accident showed the U.S. grid for what it was: an antiquated piece of 20th century technology struggling to power the 21st century. Most utilities didn't know their customers had lost power until they picked up the phone and heard from irate customers. Regulations on utility reliability amounted to little more than industry peer pressure. The grid, in a word, was dumb.

That's changed in the nearly 14 years since the big blackout as the smart technology we were already using in computers and phones has migrated to the machines that power the grid. Thanks in part to billions of dollars in federal funding from the 2009 stimulus package, utilities have significantly upgraded the intelligence of the grid, making it smarter, more efficient and more responsive to threats and disruptions. About one-third of American consumers are now connected to power with smart meters that can send data back to control systems, enabling utilities to do things remotely-including connecting and disconnecting power-that used to require sending a worker out in a truck.

Deepening these investments is important. Smart infrastructure has already made a difference in the face of the weather-related disruptions that are still the biggest threat to grid reliability. During Superstorm Sandy in 2012, for example, smart meters let the Pennsylvania utility PECO reduce its restoration time by two to three days. And as more energy comes from cleaner but intermittent renewable sources, like solar, a smarter grid will be needed to handle a more unpredictable power supply.

The smart grid's very intelligence makes it vulnerable to a new kind of attack, one that has the potential to be far more destructive than even the worst hurricane-and that's the challenge to address in the next round of investment.

Cyberattacks on the power grid have become increasingly common - one estimate found that the grid comes under physical or cyberattack once every four days on average - and utility officials fear that a more connected grid is one that can be more easily hacked.

"A smarter grid will help prevent blackouts” Eric Spiegel, CEO of Siemens USA, a major developer of grid components, said at a 2016 utility conference. "But reliance on software and the Internet of things means it gives more points of entry for people who want to harm us".

Just how harmful became clear on Dec. 23, 2015, when cyberattackers struck power centers in Ukraine and, with a few clicks, shut down dozens of substations, eventually cutting off electricity to some 230,000 residents in the dead of an East European winter.

Power was restored after a few hours, but 2016 saw another hack, this one caused by malware sent to utility workers via email. Both attacks were blamed on Russia, which has been in an intelligent, multisite hack by experienced attackers that targeted key components like power transformers.

The conclusion: expect widespread, long-term power outages that could take several weeks to recover from, causing enormous economic damage. In their own report, the University of Cambridge Centre for Risk Studies and the insurer Lloyd's of London concluded that an attack from an organized group of hackers to knock off power across major cities like New York and Washington could cost from $243 billion to $1 trillion.

There's no going back to a dumb grid, not when the U.S. needs to improve energy efficiency and smooth the adoption of renewable power. But utilities must consider how the complexity they're introducing into the grid can be used against them. The smart grid "works well for reliability but will not stop skilled, adaptive adversaries” write energy

experts Michael Assante, Tim Roxey and Andy Bochman in a paper titled "The Case for Simplicity in Energy Infrastructure".

It turns out that the best way for utilities to protect against the threats of the future is by looking to the past. That means contingency plans for the manual operation of grid equipment, like the 1960s-era gear that saved the Ukrainians. "You want to have smart infra-structure, but you want to have backup planning for a day when you need manual operating capacity" says Scott Aaronson, executive director of security and business continuity at the Edison Electric Institute, a utility trade group. That would give utilities what Aaronson calls an "all-hazards approach" to grid security, providing a reliable backup plan whatever the cause of a blackout.

Recognizing the grid as a vital part of national security may require amending the Federal Power Act to give the Energy Department greater authority to prepare utilities for an attack-and respond to one after it happens. But cyberwarfare almost always favors offense over defense- and the grid is no different than other battlefields. Rogue hackers, however, make for a much more challenging adversary than a rogue tree.

A power station in Moapa, Nev. Cyberattacks on the U.S. grid have become more frequent.

Pick a Lock

> **Fixing outmoded locks and dams to unclog the water highway**
> *Josh Sanburn*

The worst bottleneck along America's 25,000 miles of inland waterways is in a stretch of southern Illinois where the Ohio River meets the Mississippi and the Cumberland and Tennessee rivers splinter off. There, boats carrying thousands of tons of grain, coal and steel can sit idle for days, a floating traffic jam that stretches for miles. The culprit: Lock and Dam 52, one of the 239 critical - and in many cases crumbling - structures that move vessels along the rivers mythologized by Mark Twain.

These inland waterways are one of the most overlooked and vital parts of the nation's infrastructure, a water highway that accounts for 14% of all domestic freight per year, according to the American Society of Civil Engineers. But the system is aging. Most of the locks and dams-which raise and lower boats to help them travel along rivers of different elevation-have far exceeded their 50-year life span. As a result, the average delay across the system has doubled, to 121 minutes, over the past 15 years.

Nowhere is the problem starker than Lock 52, through which 90 million tons of cargo worth some $10 billion passes annually. Crumbling concrete, rusted metal and outmoded design mean that 52, which was finished in 1928, and nearby Lock and Dam 53, opened a year later, now have average delays of 15 to 20 hours. "They're basically falling apart," says Carol Labashosky, a spokeswoman for the U.S. Army Corps of Engineers' Louisville District. The dam at 52 is so old, she says, that it's hard to find parts for the frequent repairs. "We don't get any attention until they break down," Labashosky says. "There's just not enough visibility for this type of infrastructure."

Longer transport times increase costs for everything from bread to gas. If the problem gets worse, suppliers may turn to rail or trucking, more expensive modes that could further raise prices for consumers and increase traffic on already congested roads and rail lines.

There is some hope on the Ohio. The $3 billion Olmsted Locks and Dam, an ambitious project to replace 52 and 53 that has been in the works since the 1980s and promises to get tows through in less than an hour, is finally slated to open in 2018.
Its completion is critical to keeping America's water highway moving.

Internet for all

One-quarter of the nation does not have broadband. It's time to finally close the digital divide
By Karl Vick

Appalachia is not what it used to be. Hunger no longer stalks the hollows and ridges of a region once emblematic of American poverty, and no one lacks electricity. "Except for that one guy who comes in for car batteries" says Tim Groves, from behind the counter at Advance Auto Parts in Woodsfield, Ohio. "That's because he doesn't want electricity;' explains Jason Covert, the store manager "He wants to be off the grid" .

So, progress. Yet when it comes to the Internet, the region remains as backward and stunted as its stereotype. Decades into the information age, folks in these parts continue to make do with dial-up.

Across much of America, a generation has come of age without even once hearing the stutter, squeal and shhhhhh of a home computer's modem shaking hands with an Internet server. In Woodsfield - and hundreds of thousands of other overlooked pockets of the nation - there are people who have never heard anything else. "Hell, it's barely fast enough to check your email," says Covert. "You hit the button and you wait five minutes. Then you hit it again and get a snack".

America's digital divide is not only a matter of geography. Among the quarter of Americans without broadband - basically, a connection fast enough to stream video - are many who simply cannot afford the monthly bill for service. Less than half of households living on under $20,000 are connected. The collective deficit in opportunity, education and prospects - everything implied in "being connected" - further separates us into haves and have-nots.

On that much, both parties agree. The chairman of the Federal Communications Commission (FCC) under President Obama called a 25-megabits-per-second download speed - the minimum technical parameter of broadband - the "table stakes" for participation in 21st century life. And on his very first day in office, Ajit Pai, the FCC chairman appointed by President Trump, vowed to close the divide "between those who can use cutting-edge communications services and those who do not." Trump's Commerce Secretary agrees, and 48 Senators have signed a letter urging a broadband expansion that, if it were up to Democrats, would account for $20 billion of their proposed $1 trillion infrastructure bill.

Yet no master plan exists to bring broadband to every home, at least not the way the Tennessee Valley Authority in the 1940s brought electrical power to Appalachia. In fact, many believe that the public-utility model does not quite work for high-tech.

"Universal telephone service has been around for a hundred years, maybe more. It's a well-established social principle that everybody ought to have the ability to communicate" says Mark Cooper, research director for the Consumer Federation of America, a pro-consumer advocacy group. "But electricity or water, those are services that are static, they're not dynamic. You buy electricity, it's the same kilowatt everywhere".

Not so with Internet access. "The communications system, however, has proven to be extremely dynamic" says Cooper. "You want to make sure everyone gets it, but you also don't want to strangle innovation." What if, for example, Washington had mandated that every home get DSL - the level of service that came after dial-up but was soon overtaken by broadband? Companies will not constantly rebuild networks.

So instead of mandating Internet for all, the FCC has fallen back on the slack offered by its founding legislation, which calls for communications to all people "so far as possible." The result is a patchwork of programs that has left vast portions of the country unserved. One is the Lifeline program, which subsidizes service to low-income house-holds but is viewed skeptically by Pai It is funded by the "universal service" fee that

shows up on the monthly bill for telephone landlines, a pool evaporating fast. The same fee funds the E-Rate program, which provides broadband to libraries and schools, like Conotton Valley High School, over 60 miles south of Youngstown, Ohio.

There, every student gets a Chrome-book laptop, low-cost computers having essentially replaced textbooks in many schools. But learning stops at the classroom door for students who can't get online at home. "And the kids who live in a rural area are often ones who are socioeconomically challenged" says school counselor Kelli Edwards.

For many, phones become a substitute. Pew 'surveys from 2016 found more people have smartphones (77%) than have broadband (73%). But depending on a phone has drawbacks. Policymakers trade stories of kids' completing assignments by cadging wi-fi outside closed libraries or camping out in McDonald's. "A lot of kids will try to do things on the phone, but they run out of data" says Edwards.

In Conotton Valley - pronounced like Forgotten Valley, as it gets called - some households access the Internet by satellite dish, which is slower and more expensive than terrestrial service. "And by the middle of the month, it goes to nothing" as data limits are reached, says resident Jean Siedel. Social-studies teacher Danielle Caldwell exults after trading up for DSL. Satellite "was truly horrifying;' she says. "One person can use it fully at a time. If a kid is looking at a video, I can't even see a photo on Facebook."

Rob Blick, who teaches math at Conotton Valley, is the most tech-savvy teacher in the building but had no idea that the cartoon frog a student has posted on his classroom bulletin board was Pepe, an Internet meme appropriated by white nationalists. "Good to know," Blick says with a nod. "I better take that down." The trouble is he has a master's in computer programing but no Internet at home. His mother's house has DSL, and people arrive an hour early for Sunday dinner so they can get their online banking done before the meal. The local provider said it isn't worth it to wire his neck of the woods.

"I can understand why cable companies don't want to do it" says Blick. "But then I also know power companies don't want to do it. But they do. It just seems to me it's the modern-day equivalent of the interstate highway system".

Politically, the persistence of the digital gap defies logic. Rural areas, after all, punch way above their weight in Washington. But government responds to more than constituents. The consolidation of communications giants has decreased competition and grown the industry's clout in Washington. Consumer advocates note that FCC chairman Pai, formerly a lawyer for Verizon, has voted against expansions of E-Rate

and Lifeline and places his faith in a marketplace that has not provided any where near universal access to what is now an essential service.

"I respectfully disagree. The public is our client" Pai told TIME in an interview conducted by phone as he was being driven across Ohio. After he had delivered a speech in Youngstown celebrating small-market entrepreneurship, his next stop was Cleveland, where the poky speeds of inner-city servers had produced headlines about "digital redlining," Pai's proposed fix for neglected urban areas is "Gigabit Opportunity Zones" meant to coax service providers into low-income areas. Critics say access is less an issue there than affordability.

"From my perspective, I don't really care what technology or business model or sector of the community is trying to deliver full-spectrum communications services to consumers" Pai insists. He notes that the FCC's first action under him was a $170 million outlay to encourage broadband in upstate New York. And he calls Trump's promised $1 trillion infrastructure program an opportunity to rescue the Universal Service Fund from the sinking landline. Other small-bore remedies are common sense, like requiring companies to share poles - which would solve Blick's problem - or a "dig once" policy of laying cable during road building.

Competition would also help - yet exists in only a quarter of areas wired for broadband. Some frustrated municipalities have responded by building their own servers, or "self-provisioning". But in some 20 states, cable companies have persuaded legislatures to outlaw the practice.

What's the fix? "We're kind of for all of the above" says Phillip Berenbroick of the consumer advocacy group Public Knowledge. But all of the above requires a unity of purpose not yet seen from a President who ran as a populist and arrived in Washington surrounded by captains of industry.

The Waterworks

Flint showed the danger of taking an essential for granted

Josh Sanburn

An estimated $600 billion is *needed* to *upgrade* aging *water and wastewater-treatment plants across the* nation

Clean water is as vital to the nation as roads and bridges, but it's a piece of infrastructure Americans tend to take for granted - until something goes wrong. The latest reminder came in the form of the water crisis in Flint, Mich., in 2015, during which thousands of residents were exposed to lead and other dangerous toxins. Plenty of cities rely on an aging network of lead pipes, however. The disaster in Flint emerged only after officials failed to properly treat the water supply itself.

While Flint may be a tragic outlier, water - and wastewater - treatment systems across the nation are far beyond their expiration dates and failing. East Coast cities like Philadelphia and Newark, N.J., routinely struggle with water-main breaks that disrupt the local economy, snarl traffic and leave residents without potable water. Regions in farm-heavy states like Iowa are grappling with how to prevent fertilizer runoff from leaching into municipal water supplies. And on the West Coast, states are staring down a future that could include both droughts and floods.

The Association of Metropolitan Water Agencies estimates that it would take more than $600 billion to properly fund dozens of water and wastewater projects across the U.S., including rehabbing existing systems and building new ones. The most urgent project may be in Miami-Dade County, Florida, where rising sea levels threaten to flood the 50-year-old wastewater systems that are already prone to large-scale breaks. Fixing the facilities, including replacing a treatment plant that dates from 1924, could cost as much as $13.5 billion.

Miami's troubled system has plenty of company. Baltimore is still using a water-treatment plant that is more than 100 years old. In the Rust Belt, a region that tipped the Electoral College to Donald Trump, cities like Harrisburg, Pa., and Detroit need upgrades to sewer collection systems and treatment plants in order to stop sewage from overflowing during heavy rainstorms.

Others are dealing with an unpredictable climate. In Northern California, officials are trying to build a $3.5 billion reservoir project to provide water stability during both wet and dry years.

Nationwide, more than 100 cities are under federal or state environmental mandates to upgrade their water systems, but many lack both the funding and the political will for projects that are never glamorous and sometimes not even visible.
"It's very hard to have a ribbon-cutting ceremony for a sewer," says Adam Krantz of the National Association of Clean Water Agencies. Fixing the nation's water systems demands finding a way.

Tunnel out of danger

A critical train artery depends on century-old tubes
By Sean Gregory

New York City is connected to New Jersey by two decrepit single-track train tunnels running beneath the Hudson River, each 106 years old and in desperate need of an overhaul. Their concrete is cracking. Both tunnels flooded during Superstorm Sandy, and chlorides from the seawater further damaged walls, tracks and electric cables, resulting in frequent delays.

If either of the tubes were to be shut down for an extended period - a distinct possibility, given their age and compromised condition - some 75% fewer Amtrak and New Jersey Transit trains would run between New York and New Jersey. The increased gridlock in Manhattan alone, according to one transportation economist, would result in $300 million in lost productivity per year. But the harm would ripple far beyond the Big Apple. The tunnels are a critical artery for the most used stretch of passenger rail in the nation, key to shuttling people from Boston to Washington, D.C.

"A tunnel shutdown is an existential threat to the economy of New York, the Northeast and by extension the whole country" says Tom Wright, president of the Regional Plan Association. Luckily, a solution is in the works. The Gateway Program calls for a series of improvements to the rail infrastructure between Newark, N.J., and Manhattan's Penn Station, costing about $24 billion. Federal and local entities would split the cost 50-50. The most crucial component: a plan to build two new tunnels under the Hudson. Once they're in service, the old tunnels can finally be shut down for renovation. When all construction is completed, the four tunnels under the river - plus new tracks at Penn Station - will double train capacity, easing congestion on the tracks and in waiting areas, where commuters chafe at frequent delays, routine bottlenecks and an air of uncertainty that carries costs both economic and emotional. According to an analysis prepared for Amtrak, for every dollar invested in the Gateway project, the New York metro area will see $2.20 to $3.90 in economic benefit.

Excuse some New Yorkers for scoffing while they wait. After all, the first phase of the infamous Second Avenue subway line just opened - a cool 97 years after it was first proposed. But Gateway, a truly arterial project, has some momentum. The new tunnels are already under environmental review. Governors and Senators from New York and New Jersey want it. And the project's board includes federal and local stakeholders. Barring hiccups, tunnel construction could begin in 2019 and be completed by 2025.

"We have been living off the infrastructure investments of our parents and grandparents, and in this case, our great-grandparents;' says John Porcari, executive director of the Gateway Program Development Corporation. "The challenge for Gateway is to make sure we are paying it forward to the next generations."

No one's rooting harder for the project than those harried commuters in claustrophobic Penn Station, where passengers funnel into thin stairwells like an ocean squeezing into a straw. One recent day, a train was so crowded that the conductor encouraged passengers to email railroad officials to complain. That drew a laugh.

"Oh, it has its days" Terri Jackson, a hospital administrator from East Orange, N.J., said of her commute. Better days may be ahead.

Making Trains Run on Time

Detangling chicago's rail mess would be a Win for both commuters and companies

More than 8,400 rail cars a day run through lines operated by the Belt Railway Company of Chicago

By Josh Sanburn

The most congested choke point for train traffic in North America is here in Chicago. It's where trains carrying Iowa corn meet black tankers full of North Dakota oil, where railcars with Wyoming coal rattle past others with Michigan SUVs.

One-quarter of all rail traffic in the U.S. - 1,300 trains a day - transit this city, including six of the seven biggest railroads in the country. Almost anything traveling from coast to coast comes through here, where train traffic has become so tangled that old rail-road hands like to joke it takes trains three days to get from Los Angeles to Chicago-and three more to get through Chicago.

The massive traffic jam is made worse by the fact that the region's busy commuter rail systems must compete for limited track space with the nation's largest freight lines. Chicago operates 750 Metra trains a day that shuttle hundreds of thousands of

passengers to and from the city alongside dozens of Amtrak trains carrying thousands more. An agreement hashed out between the city and the railroads gives commuter trains the right-of-way at morning and evening rush hour. Those commuter trains, says Don Orseno, Metra's CEO, all but shut down freight movement around the city during rush hour. "Things come to a standstill" he says. Problems here have far-reaching effects elsewhere, adding costly delays.

"If we were able to separate commercial and commuter rail traffic, everything across the country would run more smoothly" says Chicago Mayor Rahm Emanuel. The mayor says he's met with the Trump Administration and discussed addressing Chicago's railroad issues in any potential infrastructure package but is skeptical a comprehensive bill will pass.

The city's train traffic is also an annoyance for residents. Russell Bartmes, 66, who lives on the north side of Chicago, says one of the worst congestion points he sees is in nearby Schaumburg, where cars can sit for 10 minutes to let trains pass. "That shouldn't happen" Bartmes says. "It's really a situation that cries out for some dollars".

A major fix is already under way. An ongoing project-Chicago Region Environmental and Transportation Efficiency Program (CREATE), a $4-4 billion public-private partnership-is designed to untie the train lines and allow the rail network to operate more efficiently. So far, 28 completed projects have increased capacity by adding rail lines, removing tracks from street level by creating overpasses and underpasses, and separating freight and commuter trains. Officials say the project-an alliance of federal, state and local governments along with the railroads-could generate $31.5 billion in economic benefits and allow 50,000 additional freight trains to travel through the city's rail network in the next few decades while saving thousands of hours in motorist and commuter delays each year. And because of Chicago's vital role in sending goods around the country, a more efficient rail system could have salutary effects around the U.S.

"The public's probably not going to see 95% of what we do," says Bill Thompson, the CREATE program manager for the Association of American Railroads.

Fixing infrastructure is often less about flashy projects and more about ensuring that the nation's internal mechanics are functioning. That's clear at the 75th Street Corridor, a section on Chicago's southwest side through which 90 freight trains and 32 commuter trains pass along a stretch of rail that crosses, splinters and converges. It's the city's most congested area of track and the top priority for CREATE officials.

There, the Belt Railway of Chicago (BRC)-a switching-terminal railroad co-owned by several larger rail companies-is responsible for making sure the trains don't tie themselves in knots. Inside the railroad's dispatch center, a small, two-story brick building that sits among the high-pitched squeal of train cars entering the company rail yard, dispatchers monitor dozens of screens. One displays a digital version of BRC's 28-mile rail line, showing white track lines superimposed with stopped trains in red and moving trains in green.

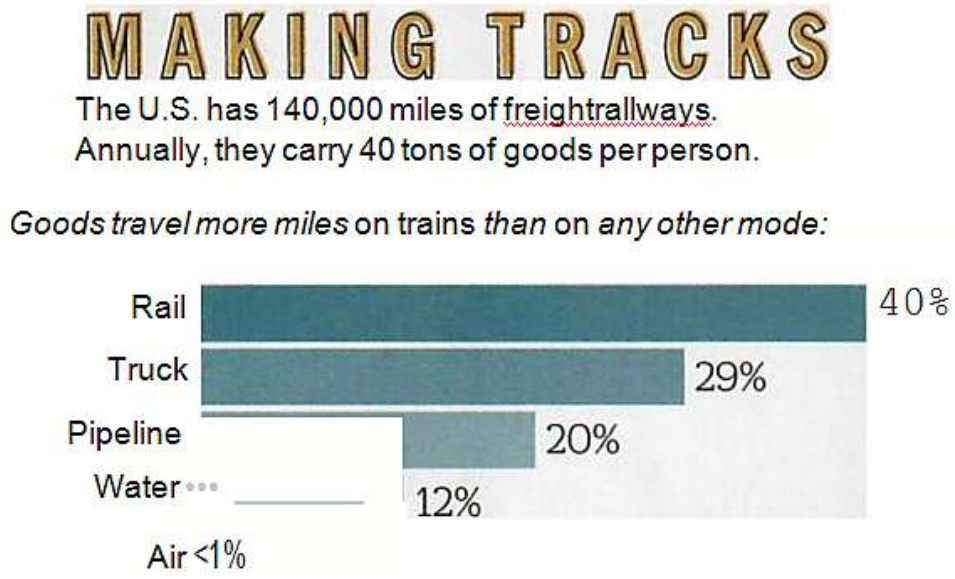
On a recent day, a 100-car train of black tankers almost 6,700 ft. long and weighing 5,000 tons sat waiting for the BRC go-ahead, which came only after dispatchers picked up the phone and called CSX, a railroad that crosses BRC's lines. "There has to be that handshake and agreement on the phone" says Frank Izzo, BRC's superintendent of transportation.

On average, up to 30 CSX trains cross the BRC daily, and BRC's dispatchers are routinely forced to hold their trains back from an area called Belt Junction - a particularly sticky stretch of track where five lines become two. If BRC trains can't successfully get past CSX's line, those trains could then block Metra, the Chicago commuter service, which sends dozens of trains through Belt Junction every day.

To alleviate the congestion, transportation officials have proposed creating a "flyover" for the CSX line that would elevate freight above street level, allowing it to pass over the BRC. They also want to create dedicated rail lines for the commuter trains through Belt Junction, freeing up the BRC lines for freight only. But improving the 75th Street Corridor, along with dozens of other CREATE projects, is currently stalled, largely because officials don't have the money. 75th Street alone will take about $1 billion to complete.

The Chicago program can point to some visible successes, including the Englewood flyover, a $142 million project completed in 2014. Before the fix, the Metra commuter rail crossed the Norfolk Southern train line, causing delays for both commuters and goods trying to get across the country, making it one of the worst chokepoints in the U.S. at the time. Instead, Thompson showed me a Metra train at Englewood barreling 70 m.p.h. above a passing freight train that would've previously sat idle for hours until rush hour ended.

"This is exactly what we want to do" Thompson said as the commuter train passed overhead at full speed.



Opinion:

Instead of a quasi- privatized, super- efficient national rail network, we have an unreliable patchwork system that defeats the federal government's anemic attempts to revive it and forces Americans onto congested, heavily subsidized highways. If we can send humans to the moon, how come we can't make trains run as fast or as punctually as Japan?

Kate Ascher

Ascher is the author of “The Works: Anatomy of a City”

Beat Back the Sea

Climate-change defenses will help keep coastal cities afloat

Justin Worland

The names - Andrew, Katrina, Sandy - are reminders of the devastating storms that hit U.S. shores every few years, claiming lives and causing billions in damage. But in many coastal cities, they can also serve as lessons in the crucial effort to guard against the increasing threat of climate change.

New Orleans finally made a long overdue investment in its flooding defenses after Katrina hit in 2005. The result is a new $15 billion, 130-mile levee system that allows the city to close 220-ton gates along waterways and pump water from the sewage system.

In New York City, after Sandy paralyzed the nation's economic capital, officials approved a project known as the Big U to protect the southern half of Manhattan. The barrier serves as a sea wall, keeping water out of the city during storms, but its integrated, parklike design will also enhance the urban environment.
The critical defense system has secured more than $500 million to begin construction in 2018 - but much more will be needed to finish.

Up the coast in Boston, officials are considering a more straightforward barrier that could close off the city from dangerous swells in the wide Massachusetts Bay.

A wall would be futile in Miami, which rests on porous limestone and is filled with high-rise towers built at water's edge. In any given year, there's an approximately 1-in-125 chance that Miami will face a storm that causes at least $15 billion in damage. By 2100, the chances will grow to 1 in 30.

The solution in South Florida may require a wholesale rethinking of the region's urban planning. Buildings need to be built on higher ground, systems relocated and some places abandoned entirely. It's a strategic approach that requires reconciling current needs with future risks - and could serve as a long-term planning template for the rest of the nation.

Bridge to the Future

Bridges are showing their age-and their hazards

By Emily Barone

Commuters who cross the Ohio River between Cincinnati and Covington, Ky., know to expect traffic jams on the Brent Spence Bridge. Constructed in 1963, the span was built to accommodate 80,000 vehicles a day. As a critical link in the trade corridor running from Michigan to Florida, it now carries twice as many.

In its age and overuse, the Brent Spence aptly reflects the overall state of bridges throughout the U.S. There are 614,000 of them, and about 40% are more than 50 years old. About 9% need significant maintenance or replacement, a figure that has steadily decreased over the past quarter-century, as governments put limited resources into bridges most at risk of collapse.

The thing is, falling down isn't the only way a bridge can fail. Older spans like the Brent Spence are structurally sound but often fall short of modern safety standards, taking lives one and two at a time. To ease crowding on the Brent Spence, shoulders became driving lanes in 1986, leaving stopped motorists exposed to traffic. The span has averaged two collisions per week since 2011, up from 1.3 before, a Cincinnati Enquirer analysis found.

One proposed solution, estimated to cost $2.6 billion, is to add a second span next to the existing bridge. Local planners and politicians are at odds over how to pay for such a fix.

But congestion is costly as well. The bottleneck at the Brent Spence ranks as the fifth worst in the U.S., says the American Transportation Research Institute. Other studies calculate the cost of delays to commuters ($9 a day in time and gas) and to the $1 billion in goods that cross it daily. Harder to quantify is the feeling that we are not moving as fast as we'd like.

How to get it Right

By Michael Della Rocca, Tyler Duvall and Robert Palter

The writers are partners at McKinsey & Company, specializing in infrastructure

America is ripe for major investment in infrastructure. But making it payoff will require not just addressing the funding gaps but also fundamentally redesigning the country's approach. McKinsey's research suggests that every well-spent dollar of infrastructure investment would raise GDP by 20¢ in the long run-if deployed correctly.
These four steps could help:

1. FOCUS ON THE OUTCOMES

U.S. infrastructure strategy almost exclusively emphasizes inputs, such as planning, procurement and construction requirements, rather than the desired outcomes. It should focus on impacts: Will a road project reduce travel times or make it safer? Will a project promote economic development, create jobs and support interstate commerce?

Large-scale, multi state projects often bring the biggest payoff. But these can also be the most difficult to deliver. Take, for example, the Gateway Program in New York and New Jersey.

By replacing century-old rail assets critical to the Northeast, it has the potential to improve citizens' mobility and foster enormous economic benefits for the region. Metropolitan congestion is a national imperative. Oil- and gas-pipeline capacity, particularly at the regional level, shapes manufacturing location decisions, national competitiveness and job creation.

2. ESTABLISH A CLEAR POINT OF ACCOUNT-ABILITY WITHIN THE FEDERAL GOVERNMENT

When it comes to approving and managing projects, federal agencies often have conflicting mandates and priorities. No one agency or entity is truly empowered to break ties. Protecting the environment is rightly a cornerstone of the U.S. evaluation process. But other democracies suggest it is possible to properly review projects and mitigate risks while also moving them forward in as little as half the time. Australia created an accountable body specifically to improve the permitting process and eliminate decision paralysis. In Canada, the Infrastructure Ontario program built more than 30 hospitals on time and on budget.

The federal government could also help catalyze better performance from the construction industry. U.S. construction-labor productivity is lower today than it was in

1968, while all other major industrial sectors have experienced impressive gains. We need a national effort to systematically unlock productivity-enhancing innovations.

3. EMPOWER STATE AND LOCAL EXPERIMENTS

In our experience, many of the most successful and innovative recent projects were delivered by mayors or governors. While these projects are city - or state-owned and operated - the federal government typically funds, finances and regulates the vast majority of water, wastewater and transportation projects. Washington can learn from cities and states, collecting and sharing innovations from across the country.

For existing infrastructure, the federal government could provide incentives for cities and states to more rapidly deploy smart solutions like demand-based pricing and Internet of Things technology to evaluate problems and manage performance in real time.

4. ATTRACT MORE PRIVATE-SECTOR FUNDING

Private investors have some $120 trillion in assets under management, and they are looking for solid long-term investments. As the head of one U.S. pension fund told us, "In theory, the U.S. would be the greatest infrastructure investment market in the world. In reality, it isn't worth the headache, and the pipeline of projects is pitiful."

Multibillion-dollar federal credit programs such as TIFIA, WIFIA and RRIF can be powerful tools to attract capital and increase the project pipeline.

Lastly, the federal government could consider providing incentives to the states to monetize existing assets and redeploy the income into new projects. Australia has spurred significant increases in infrastructure investment since its federal government implemented a program that offers a 15% premium to any state that monetizes an asset, as long as the proceeds go to new infrastructure.

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Federal Resource Guide for Infrastructure Planning and Design (May 2015)

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