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EDITOR'S NOTE

The Inside Scoop

By Matt Power
Editor-in-Chief

Surprises Are for Suckers

It's time to mothball this misleading word and get to work.

THIS MORNING, I read another report about how the solar industry has "surprised" analysts by outpacing every forecast. In 2016, solar job creation amounted to 12 times that of oil and gas extraction. The experts were surprised. The media was surprised.

The newspapers are full of "shock" headlines every day. Editors are surprised that Donald Trump and Bernie Sanders have won so many primaries. They're surprised that many people say they'd rather not vote than support Hillary Clinton.

Most of these "surprises," of course, have been unpleasant ones for the status quo. They represent events that have spun out of control of the people who are used to pulling the strings. But with a little effort, you can trace the genesis of almost any "surprise."

Trump's rise, for example, has ridden a wave of reality TV celebrity, the "war on terror," middle class rage and fear. Behind Clinton's downward spiral, you find Wall Street cronyism, fracking, excessive secrecy and a corrupt party system.



Too often, surprise is the alibi used when you get caught in a lie, a code word used to avoid responsibility for an idea that can't be suppressed.

Too often, surprise is the alibi used when you get caught in a lie, a code word used to avoid responsibility for an idea that can't be suppressed.

Of course, feigning surprise has served one useful purpose—as a smokescreen to slip real information through the veil of scientific denial.

For example, new reports this spring have cited scientists who are surprised at new records for global warming, surprised that Antarctica is melting faster than predicted, surprised that sea level is rising much more quickly than expected.

Are these experts really so naïve? Of course not. They know what's going on, but they feel they have to spoon feed us the truth, or risk censure.

It's time for a moratorium on surprises. Renewable energy is sweeping the globe. Let's applaud it, not pretend it isn't happening. Global warming is out of control. Let's tackle it. We have the tools to address clean transportation and clean energy, to demand more responsive political leaders. Let's stop acting surprised, accept the challenges of our time, and take action. Surprises are for suckers. **GB**



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Agencies Support Development of “Smart” Innovations

DOE and DOT join forces in MOU to provide resources for transportation and alternative fuel technologies.

THE U.S. DEPARTMENT of Energy (DOE) and U.S. Department of Transportation (DOT) are collaborating to accelerate research, development, demonstration, and deployment of innovative smart transportation systems and alternative fuel technologies, according to the DOE. The news was released in a Memorandum of Understanding (MOU) that will facilitate coordinated actions to accelerate analysis, tools, and applications of transportation energy technology and safety systems.

This initiative will support the DOT’s Smart City Challenge, in which one U.S. city will be awarded a grant to become the first city to integrate innovative technologies such as self-driving cars, connected vehicles and smart sensors into their transportation network.



CREDIT: BOSCH

Smart driving. Companies such as Bosch are developing automated driving vehicles that will help to eliminate human error.

Volkswagen Prepares for Emissions Scandal Repercussions

Manufacturer faces financial penalties and lawsuits in scandal’s aftermath.

VOLKSWAGEN IS PREPARED to pay \$8.8 billion in the aftermath of its emissions scandal. In September 2015, news broke that Volkswagen installed software that enabled cheating on emissions tests on more than half a million U.S. diesel vehicles and 10.5 million diesel vehicles globally, according to *Car and Driver*. The software makes the vehicle enter a test mode when being tested for emissions, which results in results within federal emissions levels. However, the vehicles produce high nitrogen-oxide emissions when driving normally—some up to 40 percent higher than the federal limit.

Car and Driver reports that the U.S. Department of Justice sued Volkswagen on behalf of the U.S. Environmental Protection Agency. The lawsuit could result in Volkswagen owing \$37,500 per vehicle, or \$18 billion in total.

In response, Volkswagen is giving some owners of affected vehicles a \$500 prepaid Visa gift card and a \$500 credit to spend at Volkswagen. Owners of any Volkswagen model can receive a \$2,000 credit toward another Volkswagen vehicle.



CREDIT: AUTO123

Green Building Continues to Rise

SmartMarket report finds green building will continue to double every three years.

GREEN BUILDING AROUND the world has doubled every three years and will continue that trend, according to the Dodge Data & Analytics World Green Building Trends 2016 SmartMarket Report. Many survey respondents forecast more than 60 percent of their projects to be green by 2018.



CREDIT: FLICKR

The report found emerging economies such as Brazil, India, Saudi Arabia and South Africa will drive the growth, with development in those countries increasing two to six times the current green building levels, according to the U.S. Green Building Council (USGBC).

Respondents reported expecting up to 14 percent savings in operational costs over a five-year period for new green buildings, and 13 percent savings in operational costs over five years for green retrofit and renovation projects. Building owners also report that they expect all green buildings, new or renovated, to increase in asset value by 7 percent over conventional buildings, according to the USGBC. In addition, the report estimates the green building materials market will reach \$234 billion by 2019.

OSHA Faces Opposition to Silica Rule

Industry stakeholders say the rule is unnecessary, costly and difficult to implement.

OSHA’S FINAL RULE limiting workers’ exposure to respirable crystalline silica—scheduled to take effect June 23—is facing opposition in the construction industry. By reducing exposure, the rule aims to decrease workers’ susceptibility to lung cancer, silicosis, chronic obstructive pulmonary disease and kidney disease, according to OSHA. The rule consists of a standard for Construction and another for the General Industry and Maritime.

In response, many construction and manufacturing organizations have filed lawsuits, stating the rule is unnecessary and will be expensive and difficult to implement. For example, the National Stone, Sand & Gravel Association and the Georgia Construction Aggregates Association filed a joint petition in the U.S. Circuit Court of Appeals against the rule. The organizations say the current standard is successful in limiting workers’ crystalline silica exposure.

OSHA states nearly 2.3 million workers are exposed to respirable crystalline silica at work, including 2 million construction workers who drill, cut, crush or grind silica-containing materials such as concrete and stone, as well as 300,000 workers in general industry operations such as brick manufacturing, foundries and hydraulic fracturing.



CREDIT: WWW.ENVIRONMENTALSAFETYUPDATE.COM

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GREEN BUILDER MAGAZINE
Editorial Offices
PO Box 97
Lake City, CO 81235
360-376-4702
F: 360-376-4703
www.greenbuildermedia.com

GREEN BUILDER MEDIA LEADERSHIP
Sara Gutterman CEO
sara.gutterman@greenbuildermedia.com
360-376-4702 x101

Ron Jones President
ron.jones@greenbuildermedia.com
360-376-4702 x102

Cati O'Keefe
Chief Development Officer /
Editorial Director
cati.okeefe@greenbuildermedia.com
360-376-4702 x105

GREEN BUILDER MAGAZINE STAFF
EDITORIAL
Matt Power Editor-in-Chief
matt.power@greenbuildermedia.com
360-376-4702 x104

Jessica Porter Managing Editor
jessica.porter@greenbuildermedia.com
360-376-4702 x110

O'Brien Design Art Direction
john.obrien@greenbuildermedia.com
207-865-9908

Therese Workman Copy Editor
info@greenbuildermedia.com

PRODUCTION
Mary Kestner Production Manager
mary.kestner@greenbuildermedia.com
360-376-4702 x107

ADVERTISING SALES
Craig M. Coale Publisher
craig.coale@greenbuildermedia.com
360-376-4702 x103
or 513-344-9754

CIRCULATION
Mary Kestner
mary.kestner@greenbuildermedia.com
360-376-4702 x107

GREEN BUILDER MEDIA STAFF
GENERAL INFORMATION
admin@greenbuildermedia.com
360-376-4702 x109

FINANCE
Lauren Wilson Accounting & Invoicing
lauren.wilson@greenbuildermedia.com
303-501-3499
or 360-376-4702 x108

Josh Sroge CFO
josh.sroge@greenbuildermedia.com
720-334-4409

SPECIAL PROJECTS
Heather M. Wallace
Director VISION House® Series /
Marketing & Social Media Manager
heather.wallace@greenbuildermedia.com
360-376-4702 x106

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Mary Kestner, Project Coordinator
mary.kestner@greenbuildermedia.com
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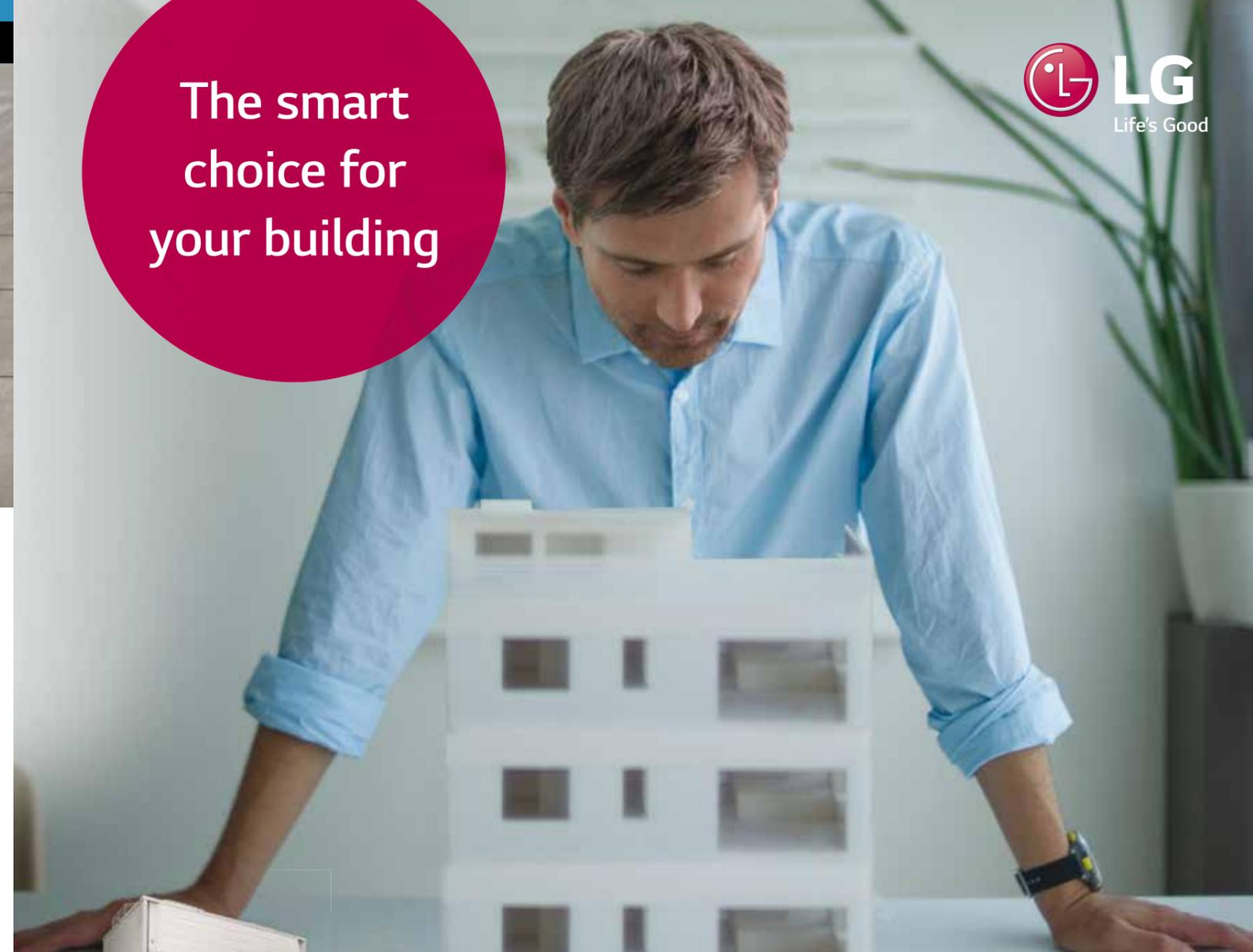
HERE'S A SAMPLE OF WHAT'S INSIDE:

Biodiesel can be a huge part of greening efforts in the construction industry. It's an industry that relies heavily on diesel equipment and can make an immediate impact on air quality and reduce emissions by simply switching to a cleaner-burning fuel.” (p.23)

**ON THE COVER
CLEANER MACHINES**
Artist: Liza Kelley

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FORD.COM ///

Medium roof shown. Available features and aftermarket equipment shown.

*Class is Full-Size Vans based on Ford segmentation. (Based on body type, body length, wheelbase and roof height.) **Class is Full-Size Van based on Ford segmentation. †Based on total U.S. reported sales (2015 CY).

Saving Fuel

Trucks and fleet vehicles reach greater energy efficiency using new technology and innovations.

THE TRANSPORTATION INDUSTRY is changing—and fast. Contractors must stay on top of innovative technology to stay in the black. That includes rental equipment, fleet vehicles and work trucks.

Alternative power—such as biodiesel and all-electric motors—are becoming more viable. Pickup truck manufacturers have introduced powerful new hybrid models, and poured R&D into fuel cell research. The future of the work truck and excavator is cleaner and greener.

The changing transportation industry also affects the type of shelter buyers want. Millennials will pay for transit-centric communities in close proximity to a variety of alternative transportation options.

Lower emissions. New fuels. Better batteries. Read about this and more in our special report on Clean Machines.



Technology innovation. Heavy-duty pickup chassis cabs with power takeoffs use less fuel-intensive hydraulics to run compressors and other equipment.



The Future of Work Trucks

Truck manufacturers compete to create efficient vehicles without sacrificing power.

BY JESSICA PORTER

TRUCK MAKERS ARE working overtime to squeeze more efficiency from work vehicles, without sacrificing range, power or turning off the market. That's not an easy task. Builders expect heavy, rugged machines that can also travel on the highway to outlying jobsites. There's no magic bullet solution, and everything is on the table: all-electric vehicles, cleaner diesel, biofuel, fuel cells and "smart" engines. Each has perks and challenges.

DIESEL-GOING TURBO

Diesel technology is one solution from truck manufacturers—and it's improving quickly. Diesel technology results in lower emissions while maintaining the torque and horsepower needed to get to the jobsite. For example, Ram's eco-diesel full-size pickup gets 29 mpg on the highway, an increase from 21 mpg just four years ago.

Ford's *EcoBoost* engine technology combines a turbocharger and direct fuel injection. The turbocharger uses a device that forces more air than usual through the engine, which makes the engine more powerful. Direct fuel injection means fuel doesn't go through the intake tract to be injected. Instead, fuel goes directly to the engine, which increases fuel efficiency, according to Autotrader.com. As a result, *EcoBoost* can provide the power of a V8 engine with the fuel efficiency of a V6.

This year, Nissan released a truck with Cummins' 5.0L V8 Turbo Diesel Engine that also included a turbocharger, which can work at high and low speeds. The truck includes Bosch's High Pressure Common Rail fuel system and piezo fuel injectors, which result in better fuel efficiency. Nissan also released the *Endurance* V8 gasoline engine, which provides torque and power while improving fuel efficiency and emissions.

Leaders in Battery Technology

LITHIUM-ION BATTERIES

Most electric vehicles on the market today use lithium-ion batteries. They can be recharged many times without losing overall charging capacity, but have been criticized for relatively low energy density.

SOLID-STATE BATTERIES

Solid-state batteries use all solid materials, solving the problems of electrolyte leaks and fires that have occurred with lithium-ion batteries.

ALUMINUM-ION BATTERIES

Aluminum-ion batteries are a new technology that is safer than lithium-ion batteries due to the use of an aluminum anode. They also take less time to charge and can bend.

LITHIUM-SULFUR BATTERIES

Lithium-sulfur batteries have a lithium anode and a sulfur-carbon cathode, which result in higher energy density at a lower cost than traditional lithium-ion batteries.

METAL-AIR BATTERIES

Metal-air batteries are a lighter option due to their cathodes being made of air. These batteries are relatively new and still experimental.

FIVE EMERGING BATTERY TECHNOLOGIES FOR ELECTRIC VEHICLES. WWW.BROOKINGS.EDU

Fuel efficiency. Ram's eco-diesel full-size pickup gets 29 mpg.



CREDIT: RAM CHRYSLER AUTOMOBILES



CREDIT: FORD MOTOR COMPANY

More power. Ford's 2016 F-150 includes EcoBoost engine technology.

AUTOMATIC TRANSMISSION

Recently, Ram introduced an automatic manual transmission in one of its commercial vans. An automatic manual transmission allows the van owner to get the fuel efficiency benefits of a manual, which typically is 10 percent less than an automatic, while avoiding the learning curve that comes with a manual transmission.

"We created the automatic manual transmissions because business owners have to be able to throw the keys to everyone on their staff," says Dave Sowers, head of Ram Commercial. "They are clutch-less and the transmission is changed automatically."

POWER TAKE-OFFS

In addition, some truck manufacturers, including Ram, make heavy-duty pickup chassis cabs. These vehicles can include power takeoffs, which allow engines from other equipment—such as compressors, generators and water pumps—to be run off the truck's transmission.

"Smaller engines are less fuel efficient and pollute more than vehicle engines, because they don't have catalytic converters," Sowers says. "Chassis cabs let you run those engines right off the vehicle's drive train."

Demand is high for more efficient work trucks with the power needed for the long haul. To meet the demand, manufacturers such as Ram, Ford and Nissan are paving the way with innovative technologies to increase fuel efficiency and reduce emissions while providing the power needed to get the job done.

EPA Truck Fuel Ratings for 2016

WITH TRUCK TECHNOLOGY improving rapidly, drivers can get the power needed without wasting fuel and producing high emissions. Although there are many options to choose from, making the right decision can be tough. The U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy released its report: 2016 Most and Least Fuel Efficient Trucks, Vans, and SUVs. Here's the breakdown for pickup trucks.

MOST EFFICIENT

The **Chevrolet Colorado 2WD** and **GMC Canyon 2WD** tied for best small pickup truck. Both are 2.8L, diesel, 4 cylinder, automatic and get a combined 25 mpg.

The **Ram 1500 HFE 2WD** was named best in standard pickup trucks. It's a 6 cylinder, 3.0L, automatic, diesel and gets a combined 24 mpg.

LEAST EFFICIENT

The **Nissan Frontier 4WD** earned the dubious distinction of being least efficient small pickup truck. It's 4.0L, 6 cylinder, automatic and gets a combined 17 mpg.

There were a lot of contenders for least efficient standard pickup truck. The **Toyota Tundra 2WD FFV** is 5.7L, 8 cylinders and automatic. The **Toyota Tundra 4WD FFV** is 5.7L, 8 cylinders and automatic as well. These trucks get a combined 15 mpg. However, it's important to note they are flexible fuel vehicles (FFV) and their mpg is based only on gasoline operation.

AVERAGE EFFICIENCY

Most pickups fall in the 18 mpg range. Though that rate is better than in years past, it's still not up to some of the more efficient trucks on the market.

The list isn't finished yet.

- The **Toyota Tundra 4WD** is 5.7L, 8 cylinder and automatic.
- The **Chevrolet Equinox AWD** is 3.6L, 6 cylinders and automatic.
- The **GMC Terrain AWD** is 3.6L, 6 cylinders and automatic.
- The **Infiniti QX70 AWD** is 3.7L, 6 cylinders and automatic.

All of these trucks get a combined 18 mpg except for the Toyota, which gets a combined 15 mpg.



CREDIT: CHEVROLET

Best small pickup. Chevrolet Colorado 2WD



CREDIT: RAM CHRYSLER AUTOMOBILES

Best standard pickup. Ram 1500 HFE 2WD



CREDIT: © GENERAL MOTORS

Best small pickup. GMC Canyon 2WD

HYDROGEN FUEL CELLS

While hydrogen fuel cell trucks aren't available just yet, they are being tested by many vehicle manufacturers. For example, General Motors is developing a fuel cell version of its Colorado pickup truck for the U.S. Army that will be suitable for combat environments, according to *Industry Week*. The company also has been testing the technology on more than 100 SUVs.

In addition, Honda is working on developing hydrogen fuel cell vehicles and has committed to helping to double the amount of hydrogen fueling stations in California.

Other companies are working on developing fuel cells that can be inserted into regular trucks. In 2014, Hydrogenics introduced *Celerity*, a hydrogen fuel cell technology that can be inserted into medium and heavy-duty trucks. According to *truckinginfo.com*, the system's low-pressure, non-humidified stack technology has a 60 kW net power output and is 300 volts at full power, with a maximum output of about 200 amps.

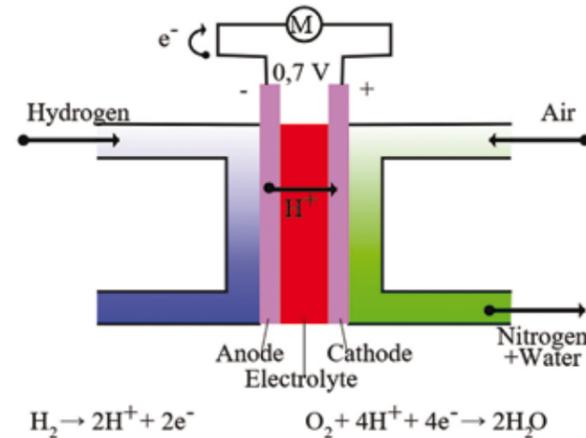
Celerity can be installed in medium and heavy-duty trucks by engineering the existing drive train. However, *CelerityPlus* Hydrogenics' second-generation fuel cell engine designed and built for medium and heavy-duty commercial buses and trucks.

Though fuel cell vehicles lag slightly behind electric vehicles in terms of adoption, they are coming. California plans on building 28 hydrogen fueling stations and major manufacturers have fuel cell vehicles in development.

ELECTRIC TRUCKS

It's becoming more common to see electric vehicles on the road today and most major manufacturers want a piece of the market. Though Tesla often is the first company to come to mind, fully electric vehicles have been created by Chevrolet, Fiat, Mitsubishi, Volkswagen, Nissan, Ford, Toyota, Kia, BMW, Volvo, Porsche and more.

In the meantime, costs are coming down, making ownership of a fully electric vehicle more feasible for the average person and increasing



Chemical reactions. According to Hydrogenics, a fuel cell converts chemical potential energy (energy stored in molecular bonds) into electrical energy. A Proton Exchange Membrane cell uses hydrogen gas (H₂) and oxygen gas (O₂) as fuel, which reacts to produce water, electricity and heat.

demand even more. Even though demand is increasing and prices are decreasing, there are no fully electric work trucks on the market today. Sowers says this is due to the fact that work trucks need to carry heavy loads, which significantly decrease the range of electric vehicles.

"We have built pure electric commercial vehicles and tested them as concepts with delivery fleets," Sowers says. "We found the battery systems weigh more than the power train of regular gas or diesel engines, and they take up a lot of space. Depending on a driver's load for the day, it really hurts the range."

Sowers says the delay of electric trucks lies in the battery, not the electric motor. "When battery technology improves enough that storage capacity increases, it will be possible," Sowers says. "There are electric motors out there today that can produce that kind of work. What's not possible today is to store enough energy in batteries to take power with you." **GB**

CREDIT: WIKIMEDIA

Hybrid Pickup Trucks Make Their Mark

GM releases first, but limited, line of hybrid trucks.

AS TRUCK MANUFACTURERS work on developing electric trucks that can provide the power and range necessary for construction, some are releasing hybrids, which use a combination of fuel and electric power. These hybrids can cut fuel consumption and reduce emissions without sacrificing the ability to get the job done. Currently, General Motors is the only manufacturer with hybrid trucks on the market—and their availability is very limited.

Just 500 Chevrolet Silverados and 200 GMC Sierras with hybrid systems will be released this year, and they will only be available in California. The trucks feature



CREDIT: CHEVROLET

Hybrid power. Chevrolet is releasing a select number of 2016 Silverados with hybrid technology.



CREDIT: GENERAL MOTORS

Hybrid technology. A limited number of GMC Sierras will be available this year with eAssist, a mild-hybrid technology.

eAssist, which is a mild-hybrid technology using components from Chevrolet's other hybrid vehicles, such as the Malibu Hybrid's battery cells and the Volt's software controls.

The eAssist system features a 24-cell, air-cooled 0.45 kWh lithium-ion battery pack. It turns off the engine when the truck is stopped at a light or in heavy traffic, and then restarts the engine when the driver's foot lifts off the brake pedal. The electric motor also provides a power boost during acceleration to save fuel consumption, and is also a generator, converting energy gained when braking into electricity to recharge the battery system. General Motors states the trucks will each have a combined rating of 20 mpg.

Ford, Ram and Toyota plan to release hybrid trucks in the next few years. Ford and Toyota recently ended a partnership to create a hybrid pickup truck, saying they will work on hybrid innovations on their own. Ford now plans on releasing a hybrid pickup truck by 2020.

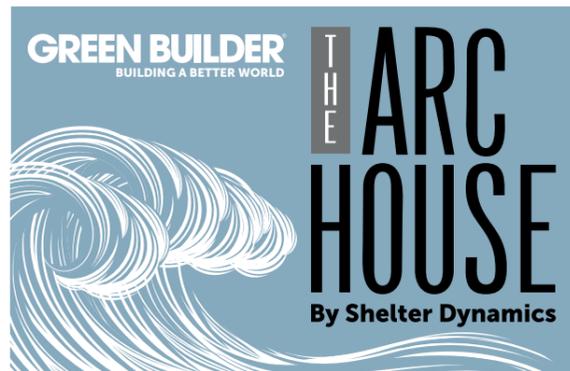
Increased efficiency. The 2016 Nissan Titan includes the efficient Endurance V8 gasoline engine.



CREDIT: NISSAN

The Arc House

SMART + SOLAR



Green Builder Media has a decade-long history of identifying and investigating the most topical, cutting-edge issues of our time.

Lately, we've been focusing on the evolution of the smart home, which converges smart home and solar technologies to provide homeowners with the ultimate control over their energy future.

To bring this concept to life, Green Builder Media has partnered with specialty modular builder Shelter Dynamics to develop the Arc House, a hand-crafted tiny home that is simultaneously net zero, resilient, intelligent, and sustainably designed. The Arc House offers next-generation ideas for independent, self-sufficient, and sustainable living.

To learn more about the Arc House, visit www.greenbuildermedia.com/vision-house-arc-house or contact Cati O'Keefe at cati.okeefe@greenbuildermedia.com

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Electric and biodiesel offer contractors renewable alternatives to fossil-fuel powered vehicles. Here's where they stand.

BY JESSICA PORTER

THOUGH DIESEL VEHICLES remain the workhorses of many industries, owners of diesel vehicles are beginning to look to alternative fuels that lessen the environmental impact, reduce dependence on foreign oil and save some money at the pump. The two most realistic alternatives (for now) are electric and biodiesel.

Natural gas-powered vehicles, adopted by many municipalities, are, in our view, a non-starter. They reduce air pollution at the point of use, but the hidden costs of fracking and other extraction methods make gas a very dirty fuel. Fuel cells (see Part 1) are promising, but so far no one can make the numbers work for small-scale commercial use. So we're left with the big two. Let's start with electric.

Electrics: The Battery Conundrum

Electric vehicles are taking the automotive industry by storm, due to their proven impact on reduced emissions and fuel consumption. However, manufacturers have had trouble designing an electric drive capable of enough range using current battery technology. But the sweet spot may just lie in fleet vehicles that make frequent stops,



Alternative fuels. Biodiesel is a more environmentally friendly way to fuel diesel-powered vehicles and equipment.

such as delivery trucks, city buses and sanitation. Some companies that fit this niche, including FedEx and Frito-Lay, are moving into the electric vehicle market.

FEDEX

In 2014, FedEx ordered two medium-duty powertrains from Wrightspeed, which specializes in creating range-extended electric



Regenerative braking. City buses, delivery trucks and sanitation vehicles are good fits for electric motors because they make frequent stops.

vehicle powertrains for fleet vehicles. Soon after, FedEx ordered 25 more. The Wrightspeed *Route* is a “repower” powertrain kit engineered for the delivery and service fleet markets. The *Route* replaces a truck’s diesel engine, transmission and differential.

The *Route* needs to be plugged in overnight and gets 20 to 25 miles of range on a full charge. However, every time it stops, the battery charges. During the drive, the diesel-powered turbine generator kicks on to provide extra range.

“Because the range extender is on there, you can get roughly three charges from full tank, which will get a FedEx driver through his route,” says Wrightspeed Product Manager Arlan Purdy.

This technology can save fleet vehicles that stop frequently up to 60 percent on fuel. “When you’re paying for an EV, it’s always in saved fuel,” Purdy says. “A lot of fuel is wasted in these frequent stop applications.”

These vehicles use a diesel-powered turbine generator, which is the same style of technology used in grid generators and the same combustion used on aircraft engines. “Turbines run at a very high speed” Purdy says. “By using a turbine specifically, you get best out of combustion and electric technology.” Turbines also burn cleanly and produce cleaner emissions.

Another key component to Wrightspeed’s vehicles is using a 39-kilowatt-hour lithium-ion battery pack. “We’re using one of the more expensive batteries. But that’s due to insight our founder had to package it all together using higher power batteries and motors—and then backing them up with a turbine generator,” Purdy says. “A lot of people go with a piston engine, which is less efficient.”

FedEx also is able to save significantly on maintenance with *Route* vehicles. “Aircrafts use turbine engines because there are fewer moving parts, making them easier to maintain,” Purdy says. “You also eliminate all common maintenance issues, such as replacing

MAGNESIUM BATTERIES. A NEW HOPE?

Toyota Research Institute of North America has been tweaking a new battery technology it says could address the biggest issue facing heavy electric vehicles: battery storage. This technology could result in rechargeable magnesium batteries to replace lithium batteries. Magnesium metal is a safer alternative to lithium metal, which is unstable and can ignite when exposed to air in its natural state. When used in a battery, ions are taken from lithium metal and put into graphic rods—a process that results in less actual metal and makes the battery able to hold less power.

Until recently, researchers have not been able to determine ways to use magnesium in a battery, even though it’s more stable. But Toyota researchers found a way to use a hydrogen storage material that may lead to the creation of longer-lasting magnesium batteries.



Electric equipment. An electric motor powers the world’s largest dump truck, the BELAZ-75710.

World’s Biggest Dump Truck Is Electric Powered

IN CASE YOU were wondering if electric motors could handle heavy lifting, the world’s largest dump truck—the all-electric *BELAZ-75710*—can haul 500 metric tons of materials. According to Siemens, that’s equivalent to seven fully fueled and loaded Airbus A320-200 planes and beat the previous record by 25 percent.

The final product includes four Siemens 1,200-kW electric motors to haul the heavy loads and the truck’s 360-ton unloaded weight. The dump truck is all-wheel drive and includes four-wheel hydraulic steering. Unloaded, it can reach up to 64 kilometers per hour. The truck is 20 meters long, 10 meters wide and has a height of 8 meters, according to Siemens.

pistons and doing oil changes. Owners also are probably not doing brake jobs during life of the vehicle.”

FRITO-LAY

FedEx isn’t the only company adding electric vehicles to its fleet. Frito-Lay uses more than 250 Smith Newton electric delivery vehicles, according to a National Renewable Energy Laboratory (NREL) report. NREL states the vehicles are powered by two lithium-ion batteries that provide about 350 VDC and 80 or 120 kWh of energy storage, depending on the configuration. The batteries charge overnight and

provide between 50 and 150 miles of range, according to Frito-Lay. The vehicles can reach a top speed of 55 mpg.

According to NREL, the vehicles include a brushless, permanent magnet motor with 134-kW peak power. Regenerative braking charges the batteries when the operator brakes, giving the vehicles that range needed in traffic and when stopping frequently.

Biodiesel. Transitional Fix

Biodiesel is one solution that could transition the truck industry to a clean-air future. But the fuel isn’t perfect, and has its detractors. Critics note that growing corn for biofuels instead of food robs Peter to fuel Paul, for example. But the new sources of biofuel may address some of these concerns

“Historically, about half of all U.S. biodiesel is made from soybean oil, while the other half comes from all other feedstock sources,” says Kaleb Little, senior communications manager of the National Biodiesel Board. “As industry volumes grow, we see the sources biodiesel is made from grow, too—including more unconventional fats and oils with things like brown grease from municipal waste water treatment facilities.”

The biodiesel industry has grown from 250 million gallons to more than 2 billion gallons during the last 10 years, according to Little. Part of that growth is due to the construction industry. In the past few decades, emphasis on more sustainable building has increased dramatically, evident through programs such as LEED.

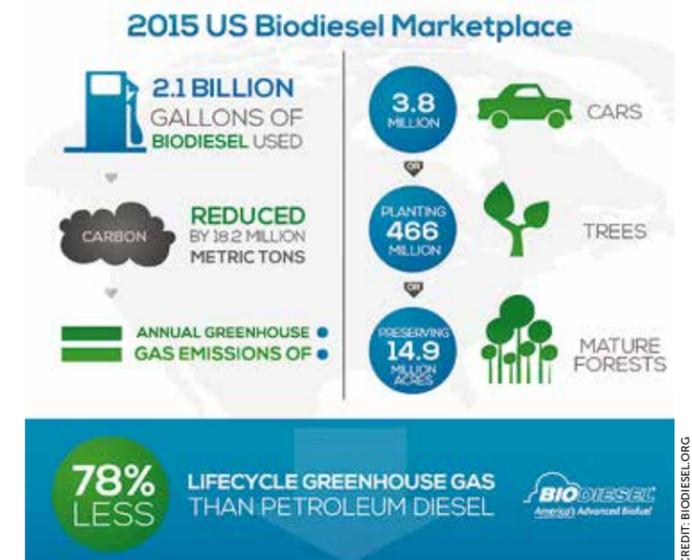
Now, these programs are mainstream—resulting in clients and owners demanding efficient buildings and construction processes. That effect is trickling down the industry, and contractors are looking at ways to increase the efficiency of their vehicles.

“Biodiesel can be a huge part of greening efforts in the construction industry,” Little says. “It’s an industry that relies heavily on diesel equipment and can make an immediate impact on air quality and reduce emissions by simply switching to a cleaner-burning fuel like biodiesel.”

Biodiesel burns much cleaner than petroleum diesel, reducing particulate matter, carbon monoxide, unburned hydrocarbons and other smog-causing particles, according to Little. It also significantly reduces lifecycle emissions and has the highest energy balance of any liquid fuel.

“For every one unit of energy it takes to make biodiesel, more than 5.5 units of energy are returned,” Little says. Biodiesel is less toxic than table salt, making it safer to store, handle and use, and it biodegrades faster than sugar.

When used as a pure fuel (not an additive), it results in 48 percent lower direct source CO₂ emissions and 12 percent lower direct source emissions than petroleum diesel, according to the Environmental Protection Agency (EPA).



Production. Biodiesel is manufactured by transesterification, a chemical process during which glycerin is separated from fat or oil. This process results in the production of biodiesel and glycerin, which is used in soap and many other products, according to biodiesel.org.

Currently, biofuel is the only alternative fuel designated by the EPA for commercial-scale production. In 2015, the United States consumed 2.1 billion gallons of biodiesel, which reduced carbon emissions by 18.2 million metric tons—more than the emissions from all the cars in Colorado and Connecticut combined, according to Little.

Biodiesel is the most commonly used alternative fuel option on the market today, with 18 percent of fleets in North America using it, according to The Association for the Work Truck Industry’s (NTEA) 2016 *Fleet Purchasing Outlook* study.

BIOFUEL COMPATIBILITY WITH DIESEL VEHICLES

“Biodiesel blends of 20 percent and below will work in any diesel engine without the need for modifications. These blends will operate in diesel engines just like petroleum diesel,” Little says. While a blend of 20 percent biodiesel to 80 percent petroleum diesel is not great, it’s a start. This blend also will result in similar horsepower, torque and mileage as diesel.

Using a blend, it’s a viable option for many different industries to use in heavy machinery such as bulldozers and excavators, pickup trucks, semi-trucks, school buses, snow plows, smaller sedans, and even home heating systems and boats.

In fact, respondents to the NTEA’s study represented a wide range of fleet sizes, vehicle weight classes and truck applications in the government, municipal, construction, delivery, utility and agricultural industries. “Biodiesel has widespread support across all diesel applications because it is easy to use with existing infrastructure,” Little says. “The use of biodiesel is as diverse as the diesel engine itself.”

Today, most major engine manufacturers support using biodiesel, including Ford, General Motors and Fiat Chrysler. “More than 78 percent of all diesel vehicles coming off production lines today cite biodiesel use in their owner’s manuals,” Little says.

Get more. Proper use and care can significantly increase fleet vehicles' lifespans.



CREDIT: FIAT CHRYSLER AUTOMOBILES

EXTEND THE LIFE OF YOUR FLEET

FEW THINGS ARE worse than costly and time-consuming vehicle repair. That's why it's important for fleet owners to understand and educate employees about ways to increase the lifespan of all the vehicles in their fleet. It starts by choosing the right vehicles for the job, doing proper and routine maintenance during their lifetime, and encouraging employees to drive the vehicles safely and efficiently. Dave Sowers at Ram Commercial offers the following tips for getting more out of your fleet:

RIGHT-SIZING

Choosing the right vehicle for the job is just as important as making sure the drivers are educated and the vehicle is properly maintained. Use a small truck if the job is smaller and doesn't require a heavier duty truck. Only use heavy duty truck for more major jobs that require more and larger equipment. That will increase fuel efficiency and prevent unnecessary wear and tear on the vehicles.

Using a smaller vehicle for jobs can be safer for the drivers. Usually, contractors hire employees based on skills and then teach them how to drive the fleet vehicles. Depending on where the job is, driving heavy-duty trucks can be challenging and dangerous to the untrained, or unconfident, employee.

Smaller vehicles usually are easier to drive, have greater visibility and can get in tighter spots closer to the actual work site, resulting in a more productive work day.

VEHICLE MAINTENANCE

Though it may be tempting to stretch out the time between oil

changes or ignore that strange rattling in the back, doing routine maintenance is key to extending the life of a vehicle. If a part isn't working properly, it will strain the other parts and cause even more damage.

Also, make sure all the tires are properly inflated by checking them on a regular basis to get the most fuel economy. And don't overload the vehicle, which can cause a decrease in fuel economy. It might be tempting for a worker to bring the whole shop to the jobsite, but just bringing the tools needed each day will result in a lighter load and higher fuel efficiency.

Check with your manufacturer for guidelines on weight capacity, oil changes and tire pressure.

DRIVER BEHAVIOR

Larger contractors should consider purchasing GPS technology to monitor driver behavior. These systems can track speeding, hard acceleration and deceleration, and driving aggressively—all factors that put more wear and tear on a vehicle, increase the chances of accidents and decrease fuel efficiency.

However, not all contractors can afford a system of GPS units for their fleets. Instead, they should coach each driver and observe actual driving performance whenever possible.

It's also important for contractors to establish the optimal route for each job. This includes avoiding areas with heavy traffic—preventing wasted time and fuel due to idling—as well as road closings and bridges with weight restrictions. Choosing the optimal route also can save on fuel and maintenance costs by avoiding driving unnecessary miles.

BIODIESEL AND HEAVY EQUIPMENT

Contractors that regularly use heavy equipment are reaping the benefits of biodiesel in their machines as well, due to higher fuel savings and lower impacts on the environment. Biodiesel works with most diesel engines, but only as a blend.

For example, John Deere engines can handle biodiesel blends of B5 to B20, which means 5 percent to 20 percent biodiesel mixed with 80 percent to 95 percent petroleum diesel. Without an exhaust filter, up to B100 (100 percent biodiesel) can be used, if permitted by law and certain specifications are met, according to John Deere's website.

However, because biodiesel is considered an ultra-low sulfur diesel fuel, it increases lubricity and can cause users to need to replace filters more frequently. In addition, many contractors switch to a lower blend, such as B5, in cold weather months due to the fuels increased lubricity.

However, biofuel is a controversial topic among rental companies. For some, the reduction in harm to the environment and client demand for cleaner fuel make the switch to biodiesel easy. But others are less willing to make the jump, as they are nervous about the fuel's potential impact on equipment's engines.

Currently, most manufacturers recommend a maximum of B5, meaning 5 percent biodiesel mixed with 95 percent petroleum diesel. Some contractors are fueling with significantly higher blends without experiencing negative consequences, but others are hesitant to not follow manufacturer recommendations.

Hybrids: Meeting in the Middle

Hybrids use a combination of fuel and alternative power, which typically is electric. While truck manufacturers are producing electric hybrid pickups (see Part 1), equipment manufacturers are working on other forms of hybrid power. Hydraulic hybrids can be more efficient options for heavy equipment because they don't need the same cooling controls as electric motors.



CREDIT: CAT

Hydraulic hybrid. Cat's 336E H Hybrid is a hydraulic hybrid excavator that reduces fuel consumption by 25 percent.

Cat's 336E H Hybrid, its newly released hydraulic hybrid excavator, uses the company's already established and standard hydraulic components to reduce fuel consumption and decrease cooling demands. And just because it's a hybrid doesn't mean users will sacrifice performance—it provides the same power as the standard machine.

The machine reduces fuel consumption by 25 percent, which is results in 66 fewer tons of CO₂ produced than the standard 336E in one year, according to Cat. The fuel reduction is due to lower engine rpm than the standard model compensated by a larger displacement, electronically controlled pump. It's also due to an auto engine idle shutdown process and auto engine speed control, according to Cat. In addition, the 336E H Hybrid is 98 percent recyclable.

The potential market for more efficient work vehicles is wide open. We expect that opening will be filled with a combination of new fuels, better engineering, and changes in how work is done. **GB**

Fueling with 100 Percent Biodiesel

THOUGH MOST DIESEL ENGINE manufacturers don't recommend using blends higher than B20, some people choose to fuel with B100—100 percent biodiesel. While it may be better for the environment, owners must take a few extra steps when fueling with B100.

B100 is compatible with engines built in the last 20 years with biodiesel-compatible material for hoses, gaskets and other parts, according to the U.S.

Department of Energy's Alternative Fuels Data Center. However, if a vehicle is not equipped with compatible parts, they can be installed by a mechanic.

STRAIGHT VEGETABLE OIL

Straight vegetable oil (SVO), another type of plant-based fuel alternative, can also be used in modified engines.

Diesel motors designed for low-emissions or low-sulfur typically are easier to convert to SVO. Because SVO is thicker than diesel, it works best with trucks that have an injection pump. Cars Direct

recommends converting Chevrolet Silverado, GMC Sierra and Ford Super Duty trucks.

Kits are available that can make diesel vehicles run on vegetable oil. They typically cost between \$1,000 and \$2,000 depending on the size of the vehicles—and another approximately \$1,500 for installation. However, drivers can install the kits themselves with the proper education. To view installation instructions for select vehicles, visit www.goldenfuelsystems.com.

Millennials Rising: Bringing Transit Down to Earth



The next generation of homebuyers will insist on cleaner, quieter modes of travel.

MILLENNIALS ARE A huge part of the rental market and are becoming a major part of the buying market. In fact, the largest percentage (32 percent) of all homebuyers are millennials, according to a 2015 report by the National Association of Realtors.

This generation is known for changing things up, and its collective views on transportation and housing are no exception. In fact, millennials are driving the trend toward communities that provide many options for transportation. They don't want to drive everywhere they go—causing damage to the environment while accumulating high vehicle-related costs.

As a result, more smart cities and communities are emerging, which blend transportation, technology and communications systems to create connected and sustainable places to live. No U.S. city has reached full smart city potential yet, but many are laying out long-term smart city plans and becoming more sustainable. In the meantime, prototypes in of these cities are being developed in smaller communities and developments.

Transportation is a major factor in these communities. Less reliance on vehicles and greater reliance on walking, biking, car sharing, and public transportation such as rail and bus systems are key components in reducing pollution.

“Millennials are more environmentally conscious than previous generations. They know that driving everywhere is a problem for the environment,” says Deron Lovaas, senior policy adviser of urban solutions for the Natural Resources Defense Council. “So there’s demand for more options, choices and competitions. They are unwilling to settle for the status quo of what’s available in transportation. And the sector has not exactly been a hotbed of innovation. Cars have been the same for many decades. Only in the past 10 to 20 years have exciting things like electric vehicles come out of the woodwork.”

More options. Millennials' demand for alternative modes of transportation is leading to an increase in transit-centric developments.

To cater to the growing market, developers are looking at ways to incorporate transportation options into their communities. Lovaas has seen developers provide residents with Zipcar subscriptions. Others ensure bike- and car-sharing options are in close proximity, while others provide mobility vouchers for nearby public and private transit options.

Now, ideas like sharing bikes and cars are becoming more mainstream. “The shared-use economy is really disrupting transportation in a good way,” Lovaas says. “There are a lot more business models and options that are available to customers at the touch of a button on their smart phones.”

New technology is popping up, due to the increase in shared-use and other alternative options, such as RideScout based in Austin, Texas. It’s an app that gives users information about all nearby transit options, including car and bike sharing, along with bus and rail systems. Users can see route options and fare prices in real time, based on nearby transportation options.

“Through the power of technology, we’re able to have access to a whole bunch of options at the palm of our hands,” Lovaas says. “It’s a game changer in terms of demanding innovations and not having to drive everywhere.”

However, there’s a less rosy reason millennials are driving this change: They joined the workforce at the height of the recession, so they are a lot more conscious about costs and value.

“Cars are expensive to own and maintain,” Lovaas says. “Given



Light rail. Charlotte’s light rail system gives residents an alternative mode of transportation.

the strained budgets of most millennials, they have an appetite for options of getting around other than buying and owning a car.”

DANGERS OF GENTRIFICATION

But there’s a dark side to the increase in transit-oriented developments. These developments are usually built in locations close to existing transportation infrastructure, which also is where low-income housing traditionally is located. Low-income residents aren’t relying on alternative modes of transportation because they don’t want to spend the money on a car or because it’s the environmentally responsible choice—they rely on public transportation for their livelihoods.

In many cities, such as New York, San Francisco, Boston and Washington, D.C., housing costs increase significantly in areas close to transportation. Higher costs don’t just mean a higher monthly rent check, they also mean a higher overall cost of living.

“Even if you can hang on and pay rent or continue to stay in your home, you may have increased incidental cost burden. Nationwide, we’re seeing significantly high levels of housing insecurity, which we define as spending at least 50 percent of income on housing, or being homeless or in a transitional housing situation,” says Mike Spotts, senior analyst and project manager for Enterprise Community Partners. “The number’s now in the ballpark of 19 million U.S. households that are housing insecure. When you’re spending that much on housing, there’s less money to pay for food, health care, education and other life necessities.”

It’s not just the major cities experiencing these growing pains. Smaller cities such as Nashville, Denver and Atlanta are experiencing high levels of gentrification in transportation-centric areas as well.

“It’s not just about heavy rail in big cities and it’s not just connected to transit,” Spotts says. “It’s the whole suite of neighborhood characteristics, so this can happen in a much smaller context.”

“It can even happen in pockets of neighborhoods in jurisdictions you don’t associate with high housing costs. I’ve seen accounts of rising pressures in places like Buffalo, Syracuse and Cleveland. These are all places that might only have bus transit, but allow for walkability and bikeability—places where the car isn’t the only way to get around. These types of neighborhoods are present in a lot of different cities.”

And the number of housing insecure households is only expected to increase, reaching 13.1 million by 2025, according to a report by Enterprise Community Partners and Harvard Joint Center for Housing Studies. Spotts says this is due to a supply and demand imbalance: There is strong demand for communities with lots of travel options, and few areas that meet those characteristics.

“If we’re going to systematically address the challenge of more affordable, walkable urban neighborhoods, we need to increase the supply of homes and create more neighborhoods that fit those characteristics,” Spotts says.

SUSTAINABLE SOLUTIONS

In response, a few initiatives were created to ensure affordable housing stays in areas being developed around transportation systems. Spotts recommends taking the following steps:



Preservation. Enterprise provided \$10.8 million in Low-Income Tax Credit equity to help finance affordable homes at Denver’s Lamar Station Crossing, which is a short walk to the train platform.

Case Study: Denver Invests in Transit

DENVER RANKS NUMBER six on a list of the top 10 cities with the most young people, according to a 2015 report by Headlight Data. With 15.9 percent of its population consisting of millennials, Denver is experiencing high levels of transit investments to help them, and the rest of its population, travel more efficiently around the city.

Spotts says Denver is the city that started Enterprise Community Partners on its path toward securing affordable transit-oriented developments. Just when the economy was pulling out of the recession, Enterprise’s Denver office noticed many plans for rapid transit investments.

To help pull out of the recession, Denver enacted FasTracks, which was an initiative to expedite construction to build a new rail network and an advanced bus system.

“We were looking at where this transit was going to reach and

were concerned that a lot of the routes were going to go through lower income neighborhoods,” Spotts says. “These neighborhoods didn’t have a lot of committed affordable housing units and many were at risk of having subsidy restrictions expire.”

In response, Enterprise participated in Mile High Connects, which is an initiative committed to advancing social equity in the transit development process to make sure disadvantaged housing communities don’t get left behind.

Enterprise also worked with public and private nonprofit partners to create the Denver Regional TOD Fund, which is a pool of capital that can be used to acquire properties and affordable housing communities close to transit.

“We won’t know the impact of these investments for a long time, but we have been able to preserve a pipeline of properties that, without our intervention, would likely be lost to significant price increases,” Spotts says.

Case Study: Kansas City, Missouri

Reaching young tech workers with easy transit.

WHEN THINKING OF cities at the forefront of innovation, most people think of San Francisco, Washington, D.C., Seattle and New York. However, add Kansas City, Missouri, to the list—as it's well on its way to becoming a full-fledged smart city.

It all started when Google Fiber came to town in 2011, which attracted a significant increase in young, tech-savvy entrepreneurs. These entrepreneurs created so many start-up businesses there's an area in town dubbed "Startup Village." Since then, the city has been determining the best ways to engage with these new residents and provide them with cutting-edge resources.

Last year, the city began working on a 2.5-mile street car line in its urban core, which is home to between 25,000 and 28,000 residents. Cisco proposed including Wi-Fi and connectivity components to the project, since the streets would already be under construction for the street car project.

"The decision was made to do it once and do it right," says Bob Bennett, chief innovation officer for the City of Kansas City, Missouri. "As we tore up the roads, we put in conduit two to three times larger than required, knowing we could put in other capabilities for a smart city."

The new street car opened to the public May 5 and includes a Wi-Fi network that is constructed, managed and owned by Sprint, as well as an app to engage with residents and visitors. It also includes smart lighting infrastructure that collects real-time data on parking, lighting, retail analytics, and public safety and security—and will result in major lighting and energy savings. Cisco also created CityPost, which broadcasts real-time, location-based information and alerts about areas along the streetcar line.

But Kansas City isn't stopping there. "This initial piece is a chance to validate an idea: that a city can be smart and work in public-



Street car. The street car connects 2.5 miles along Kansas City's urban core.

private partnerships to figure out ways to make data work in a city and interact with people in a way they expect to be engaged," Bennett says.

Kansas City's long-term plan is to learn lessons from the street car project and apply them on a much larger scale. The city recently sent a proposal for the Beyond Traffic 2045 Grant from the U.S. Department of Transportation (DOT). Kansas City was one of seven cities (out of 78) that made it through the first stage. Now it is competing against Portland, San Francisco, Denver, Austin, Columbus and Pittsburg for the grant.

If it wins, Kansas City plans on expanding the work completed on the street car project to increase connectivity. Part of the project will include creating a rapid transit bus line. Though it will be a longer route, it will condense three current routes into one line. That line will go to four multi-platform transportation hubs, which will be home to car and bike sharing opportunities, electric vehicle chargers, shuttles and access to local bus routes.

The bus line will bring connectivity to the eastern side of the city, which is where low-income and disadvantaged residents live. "The world is changing, and if you want a job you have to apply for it online," Bennett says. "If I don't give that capability to people who are willing to put in the effort, shame on me." Under the long-term plan, the city's disadvantaged population would have access to Wi-Fi coverage.

Bennett believes the bus line and increased connectivity will greatly change and improve the city. "I would like to see the districts in this city rise up organically, not in a gentrified manner. Neighborhoods are the heart and soul of the city, but because we don't have a mass transit system like the subway in New York, people tend to stay in their enclaves," Bennett says. "With this new system, you'll see folks venture out of their neighborhoods. There will be increased use of farmers markets, more participation in educational systems, and better dialogue between the city and its citizens."

The winner of the grant will be announced by the DOT at the end of June.



Increased affordability. Buses are a less costly and more efficient mode of transportation for cities without the population to support rail.

First, communities should conduct a needs assessment to determine who will struggle due to gentrification. They must figure out where those people live and work and where will they move if they can't afford to stay.

Next, communities should provide support for housing costs. Areas that have wage stagnation will always have affordability challenges. Spotts says these areas should maintain programs for tax deferrals that defray some of the ongoing costs for low-income or senior households.

"If you bought a home in a suburban area that's gentrifying with new transit access and you're seeing price growth, you may have a situation in which you're asset rich and income poor," Spotts says. "You may have people in retirement or on a fixed income who have a hard time keeping up with property taxes."

Then, preserve existing housing units and costs in gentrifying communities. Some jurisdictions have passed legislation that gives tenants the right of first refusal to purchase a home if it's being sold. That means a landlord planning on selling a 50-unit building must give tenants the opportunity buy the building at a fair price first. The tenants can organize to purchase the building, or they can assign the right to purchase the property to a third party—usually a nonprofit organization.

Finally, it's important to ensure new supply includes affordable components. Inclusionary zoning and other similar policies ensure portions of housing developments are affordable. "A crucial element to lifting supply constraints is making sure the growth occurs equitably," says Spotts.

However, there are challenges to these initiatives. In places like San

Bus Travel. The College Connection.

WHEN PEOPLE THINK of mass transit, they think of rail systems such as the subway, metro and even Amtrak. However, bus systems should not be discounted from the list of viable transportation options, especially in smaller communities that don't have the population for a rail system.

"We shouldn't forget about the humble bus as a hugely impactful way to improve the lives of low- to moderate-income people," Spotts says. "It can be just as good as rail, because of its flexibility and there's a lower barrier to entry. You can improve a bus system region-wide for the cost of half of a rail system."

Bus systems are particularly effective and popular means of travel on college campuses, which also may help to reduce the stigma of bus transit held by previous generations. According to a survey conducted at North Dakota State University, two-thirds of all students used the bus to travel to campus at least once.

In 2015, Houston completely reimagined its bus system, revamping a decades-old plan that was no longer effective. The new system included simpler bus routes and better locations for connections. It also connected parts of the city that were previously disconnected. In addition, it included weekend service, providing mobility that can be relied on every day. Spotts says Los Angeles is thinking about creating a plan to mimic Houston's system.



Kiosk. CityPost kiosks broadcast real-time, location-based information and alerts about areas along the street car line.



CLEANER
MACHINES 

CREDIT: PETER ECKERT

Living in town. Portland's street car stops in front of Gray's Landing, an affordable housing development in which Enterprise invested \$11.4 million in Low-Income Housing Tax Credit equity.

Francisco, there's so much demand there's no way supply could be added to the market quickly enough, Spotts says. Without adequate supply, there's no way to ensure affordability.

Another challenge is the character of the neighborhood. "If a neighborhood is going to be open to everyone, there has to be tolerance for all types of people and increasing density," Spotts says. "For example, a community might need to loosen its restrictions on townhomes in a single-family home community. Or it might have to allow accessory dwelling units."

WORKING TOGETHER

As innovative technologies and ideas arise, more communities and even entire cities in the United States will begin implement smart concepts. Not only are these concepts more environmentally responsible, but also a necessary component to growth due to high levels of pollution, a strained electrical grid and water fiascos like those experienced in Flint, Mich. The smart city of the future can only occur by communities working together to improve U.S. cities and increase connectivity. **GB**

"We have six 12-foot-wide by 6-foot-tall panel windows that are thermally sound and very energy efficient"

- Dean Papadopolous, homeowner



Live Better

westernwindowssystems.com

Charging Up

Here's how states, utilities and the auto industry can accelerate electric vehicle adoption.

BY THE SIERRA CLUB, ACADIA CENTER AND CONSERVATION LAW FOUNDATION

AUTOMAKERS AND AUTO dealers often say states need to create more electric vehicle (EV) consumer incentives. Government agencies and consumers often say automakers and auto dealers need to do more to advertise EVs and make them available in more states and at more

dealerships. Many question why utilities are not taking a more active role in helping consumers switch to EVs. This report makes clear that we need an all-hands-on-deck effort from government, utilities, automakers, auto dealers, and it lays out a full range of priority actions and policies to accelerate EV adoption.

EV Policies and Programs for Selected States

	LEADERSHIP		FINANCIAL/NON-FINANCIAL INCENTIVES				OUTREACH			INFRASTRUCTURE			
	ZEV STATE	MOU STATE	HIGH LEVEL TASK FORCE	CONSUMER EV PURCHASES	CONSUMER EVSE PURCHASES	HOV LANE ACCESS	FEE/TOLL WAIVERS	PREFERENTIAL PARKING	ROBUST STATE EV WEBSITE	WORKPLACE CHARGING OUTREACH	DEALER INCENTIVE/ RECOGNITION	INVESTMENT IN PUBLIC EVSE: LEVEL 1/2	INVESTMENT IN PUBLIC EVSE: DC FAST
CONNECTICUT	•	•		•	•				•	•	•	•	
DELAWARE													•
MAINE	•					N/A						•	
MARYLAND	•	•	•	•	•			•	•	•	•	•	
MASSACHUSETTS	•	•	•	•	•				•	•	•	•	
NEW HAMPSHIRE						N/A					•	•	
NEW JERSEY	•			•	•	•							
NEW YORK	•	•		•	•				•		•		
PENNSYLVANIA				•							•	•	
RHODE ISLAND	•	•	•			N/A	•		•		•		
VERMONT	•	•	•			N/A	N/A	•		•			In progress
CALIFORNIA	•	•	•	•	•	•	•	•	•	•	•	•	•

	UTILITY POLICIES	FLEET MANDATES	GHG REDUCTION POLICIES	
	EXEMPTING EV CHARGING STATIONS FROM UTILITY REGULATION	TOU / EV RATES	NEAR TERM	LONG TERM
CONNECTICUT		•	10% below 1990 levels by 2020	80% below 2001 levels by 2050
DELAWARE		•	None	None
MAINE	•		10% below 1990 levels by 2020	75-85% below 2003 levels
MARYLAND	•	•	25% below 2006 levels by 2020	None
MASSACHUSETTS	•	•	25% below 1990 levels by 2020	80% below 1990 levels by 2050
NEW HAMPSHIRE			10% below 1990 levels by 2020	75-85% below 2001 levels
NEW JERSEY		•	1990 levels by 2020	80% below 2006 levels by 2050
NEW YORK	•	•	None	80% below 1990 levels by 2050
PENNSYLVANIA		•	None	None
RHODE ISLAND		•	10% below 1990 levels by 2020	75-85% below 2001 levels
VERMONT		•	50% below 1990 levels by 2028	75% below 1990 levels by 2050
CALIFORNIA	•	•	1990 levels by 2020	80% below 1990 levels by 2050

DEFINITIONS
 DC Fast: High current fast charging station
 EV: Electric Vehicle
 EVSE: Electric Vehicle Service Equipment (e.g., charging station)
 HOV: High-Occupancy Vehicle
 Level 1: 120 volt charging station (standard outlet)
 Level 2: 240 volt charging station
 MOU: Memorandum of Understanding
 TOU: Time of Use
 ZEV: Zero Emission Vehicle (state signed onto California's ZEV regulations)

Part 1: EVs Come of Age

Plug-in EVs are good for the environment and present a clear pathway to meet climate goals.

OUR CURRENT TRANSPORTATION system is unsustainable. The transportation sector is the second-largest source of U.S. greenhouse gas emissions, responsible for 33 percent of emissions nationally, according to the Acadia Center. To reach science-based greenhouse gas emission reduction targets, which require cuts around 80 percent over time, emissions from this sector will need to fall rapidly. In addition to walking, biking, car-pooling and using public transit, the clearest pathways to achieving these deep reductions include shifting energy sources for transportation from direct combustion of fossil fuels to electricity and continuing to clean the electricity sector with renewable resources.

EV NUMBERS IN THE REGION ARE GROWING, BUT NOT FAST ENOUGH

Recognizing the significant health, environmental and economic benefits associated with zero-emission vehicle (ZEV) deployment, the governors of California, Connecticut, Maryland, Massachusetts, New York, Oregon, Rhode Island and Vermont signed a memorandum of understanding (MOU) in October 2013 committing to work cooperatively to put 3.3 million ZEVs on the road by 2025, according to the California Environmental Protection Agency Air Resources Board. The MOU and subsequent Multi-State ZEV Action Plan identify specific measures that the states will take independently and jointly to build the market for electric and hydrogen fuel cell vehicles, in addition to specifying additional actions for each state to consider, according to the ZEV Program Implementation Task Force. These commitments marked a large step forward for the six participating states.

The automakers hold the keys to effective marketing and sales of their own products. In fact, they have good reason to do so. A recent survey by Ford Motor Company found that more than 90 percent of EV drivers love their cars and will make their next vehicle purchase another EV. But there are actions that states can take to support the automakers in accelerating the EV market. Together, the six Northeast and mid-Atlantic states participating in the MOU account for approximately 50 percent of the goal of 3.3 million vehicles by 2025, with the remaining

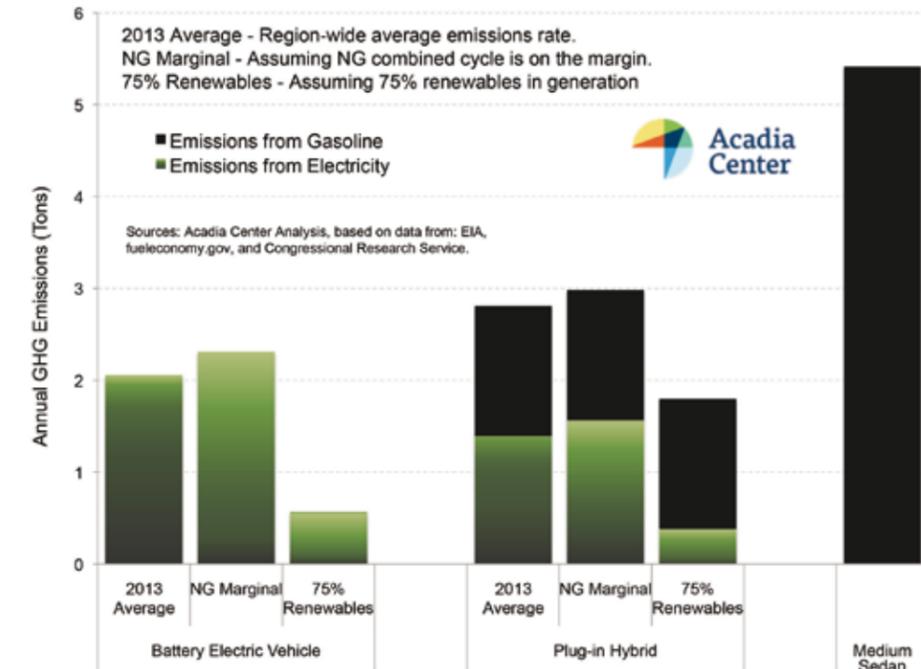
50 percent allocated to California and Oregon.

The graph below reflects approximately how many new EVs have been registered or reported in each of those six states as of August 2015, as well as how many will be needed cumulatively per state over the next 10 years to meet the 2025 goal, according to the Multi-State ZEV Action Plan. Registration numbers reflected here were reported to the authors directly from the states upon request in the summer of 2015. In some cases, registration numbers were reported as rounded or estimated figures and may not exactly reflect the number of vehicles registered as of the date of publication. The cumulative goals ramp up significantly in 2017. All of the states have significant work ahead to meet the 2025 goal.

Delaware, Maine, New Hampshire, New Jersey and Pennsylvania have thus far elected not to join the zero-emissions vehicle MOU. All of those states except New Hampshire, however, have adopted California's Clean Car Standards, although Delaware and Pennsylvania are not implementing the ZEV portion of the program. A key next step for those states is to join the rest of the region in fully adopting the California Clean Car Standards and joining the ZEV MOU. If the same modeling is used, adding those five states to the MOU would add 1.3 million zero-emissions vehicles to the 2025 target, bringing the total to 4.6 million on the road by 2025 among those eight MOU states in addition to the other Northeast and mid-Atlantic states.

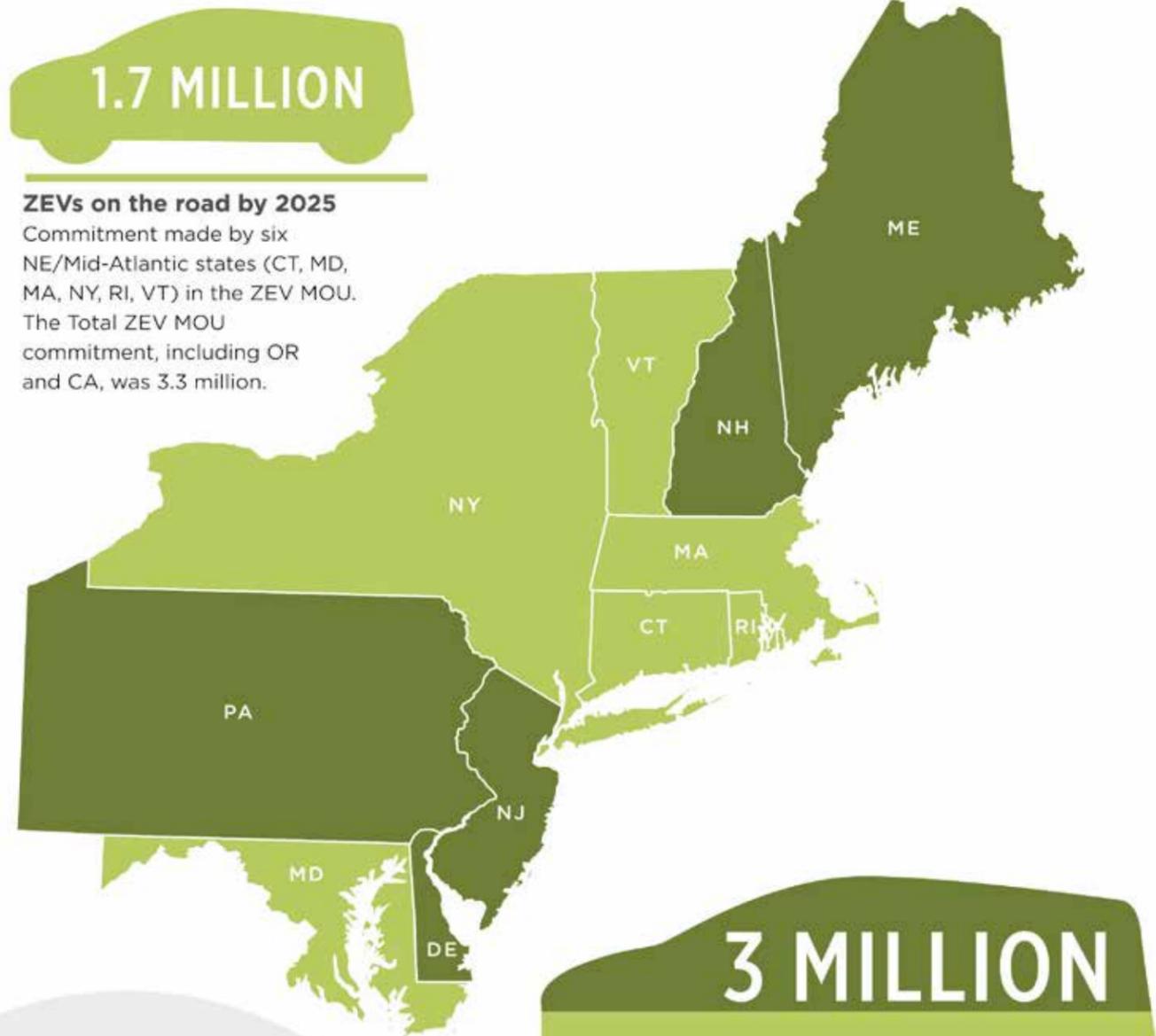
In sum, there were approximately 31,834 ZEVs reported as of

Greenhouse Gas Emissions From Electric and Conventional Vehicles in the Northeast and Mid-Atlantic



GHG Reduction. Purchasing an EV instead of a conventional medium sedan can reduce transportation greenhouse gas emissions by 60 percent.

Case Study: EV Potential in the Northeast and Mid-Atlantic



1.7 MILLION

ZEVs on the road by 2025
 Commitment made by six NE/Mid-Atlantic states (CT, MD, MA, NY, RI, VT) in the ZEV MOU. The Total ZEV MOU commitment, including OR and CA, was 3.3 million.

3 MILLION

ZEVs on the road by 2025
 The total number of ZEVs we would have in the region if the remaining five NE/Mid-Atlantic states (DE, ME, NH, NJ, PA) joined the six NE/Mid-Atlantic states already committed to slashing emissions by getting a large number of ZEVs on the road.

30,000
 About 30 thousand ZEVs on the road as of August 2015 in the eleven NE/Mid-Atlantic states, based on registration numbers reported to the authors upon request.

August 2015 in the Northeast and mid-Atlantic region, including MOU states and non-MOU states. In order to comply with the zero-emissions vehicle MOU, and to realize the full benefits available to the region from electrifying the transportation sector, Northeast and mid-Atlantic states need to take action to substantially increase that number over the next ten years.

In fact, according to one recent analysis commissioned by the Sierra Club, we actually need upwards of 10 million EVs on the road nationwide by 2025 to be on track to meet the 2050 climate goals cited in an analysis by the U.S. Energy Information Administration.

Because the EV market relies so heavily on Northeast, mid-Atlantic, and western states to be early leaders, even the above trajectory is well short of what is necessary. While setting the MOU goal in itself does not guarantee EV deployment, it is a useful measure of

The transportation sector is the second-largest source of U.S. greenhouse gas emissions.

the ambition and support levels necessary from the Northeast and mid-Atlantic states. It also provides a sense of how much more needs to be done: This goal is only ten years away, so we must pick up the pace to achieve success.

Current Reported EV Totals and Cumulative Goals for Northeast/Mid-Atlantic ZEV MOU States

STATE	REPORTED TOTAL EVs (MID-2015)	EVs NEEDED IN 2017 TO MEET 2025 GOAL	EVs NEEDED IN 2020 TO MEET 2025 GOAL	2025 GOAL
CONNECTICUT	2,957	9,613	41,835	155,105
MARYLAND	5,000	18,555	80,752	299,392
MASSACHUSETTS	5,475	18,829	81,944	303,814
NEW YORK	12,000	52,793	229,762	851,855
RHODE ISLAND	421	2,702	11,759	43,596
VERMONT	943	2,163	9,413	34,898

Current Reported EV Totals and Projected Cumulative Goals for Northeast/Mid-Atlantic Non-ZEV MOU States

STATE	REPORTED TOTAL EVs (MID-2015)	EVs NEEDED IN 2017 TO MEET 2025 GOAL	EVs NEEDED IN 2020 TO MEET 2025 GOAL	2025 GOAL
DELAWARE	146	2,670	11,622	43,089
MAINE	263	3,155	13,730	50,906
NEW HAMPSHIRE	835	4,881	21,244	78,763
NEW JERSEY	2,494	31,218	135,866	503,732
PENNSYLVANIA	2,087	36,369	158,281	586,835

Part 2: Utilities and Regulators Converge

Electric utilities and their regulators should help promote EV adoption and optimize the electric system.

THROUGH THEIR INFLUENCE on electricity rates and investment programs, utility policies have significant power to affect how quickly EVs become widely adopted. To be most effective, any regulatory changes to benefit EVs must be pursued in conjunction with other trends in energy systems, such as the widespread adoption of solar and other clean distributed generation, micro-grids and energy storage.

Following are examples of reforms and programs that can incentivize EV adoption, allow for more charging infrastructure and decrease costs to ratepayers.

- Time-varying rates, managed charging, demand response, and vehicle-grid integration programs can benefit EV drivers and minimize ratepayer costs.
- Certain types of rate structures, including high demand charges, can inhibit otherwise sound investments in public fast-charging and other high-power-draw applications such as electric buses.
- Planning and investments should improve opportunities to charge EVs and manage demand.
- Criteria for evaluating utility investments should include benefits from reduced oil consumption, healthier air and lower greenhouse gas emissions.
- Utilities should have incentives to promote a shift to clean distributed resources such as EVs.
- Utilities should be notified of EV purchases.

Policies Can Help Ensure Charging Stations Are Widely Available, Consumer-Friendly and Distributed Equitably

Reforms in a variety of other policy areas can promote the widespread availability of charging stations, allow easy access by the general public and minimize unnecessary installation costs.

Burdensome utility regulations shouldn't apply. Charging station owners and operators should be exempt from regulation as a public utility, and many states, including Maine, Maryland, Massachusetts and New York, have already taken this approach. In addition, weights and measures authorities should apply reasonable consumer protections, such as the requirements developed by the National Institute of Standards and Technology at the U.S. Department of Commerce.

Consumer-friendly policies can ensure access to the public. Signage should clearly identify charging locations and prices, and interoperability of charging infrastructure should be strongly encouraged. In addition, publicly accessible charging stations should not require memberships or subscription fees, must allow payment by credit card or mobile technology and should be included in public databases.

Building codes and permitting policies should be reformed to minimize long-run costs and encourage installations. If the necessary electrical capacity and wiring is included when the building is constructed, the cost of installing charging can be greatly decreased. In addition, reasonable requirements for EV-ready wiring for parking lots and garages should be included in



CREDIT: BOSCH

Increased availability. Ensuring charging stations are conveniently located is key to promoting EV adoption.

planning processes and regulations, and permitting processes should be streamlined to encourage installations. Finally, unreasonable requirements on charging stations at multi-family developments should be forbidden.

Targeted incentives and programs should be implemented for high-priority charging categories and hard-to-reach market segments. Additional incentives and programs should be designed as needed to ensure that all communities have access to vehicle charging and other public policy needs are met.

State and Local Governments Should Lead By Example

States, counties, cities and towns have a variety of opportunities to lead by example to promote vehicle electrification. A 2015 International Council on Clean Transportation report shows, for example, that when U.S. cities put in place key policies, they have EV adoption rates two to seven times higher than the national average.

- **Governments as fleet owners.** Governmental bodies should change their procurement policies to ensure full consideration of EVs for suitable uses. They should also develop and adopt best practices to maximize electric miles driven. In addition, states should have fleet-wide fuel economy requirements and rules that a minimum percentage of purchased and leased vehicles, such as 25 percent, should be plug-in by 2025.

- **Governments as workplaces.** Governments are major employers and should provide their employees with workplace charging stations and education on the benefits of EVs.
- **Governments as parking managers.** Governments can install charging stations and designate preferential parking spots for EVs in publicly accessible lots and other public parking areas. Similarly, they could reduce or waive parking fees for plug-in vehicles. Additionally, communities can encourage EV car-sharing to give people first-hand experience driving an EV. Government agencies can help reduce the cost to private car-sharing companies of offering such a service by paying for designated parking spaces.



Electric fleets. In 2011, Frito-Lay released all-electric fleet of 176 delivery trucks.

CREDIT: WWW.PLUGINRECHARGE.COM

Part 3: Auto Makers: Step It Up

Auto companies and dealers can accelerate EV sales—and states can help.

AUTOMAKERS AND DEALERS play an important role in how rapidly consumers are switching to EVs. Corporate sustainability goals and federal light-duty vehicle emissions standards, as well as zero-emission vehicle regulations in 10 states, have encouraged automakers to offer more than 20 plug-in models in the United States. However, it's important to note that automakers have chosen not to sell some of the most attractive EVs outside California. Instead, they manufacture only enough to meet that state's requirement that large automakers offer a certain number of ZEVs for sale. These "compliance cars" include Fiat 500e and Chevy Spark EV.

Automakers and dealers are missing out on a ripe opportunity to capture new business. However, EV buyers are often frustrated with their experience at dealerships, where they find EVs unavailable and dealer staff not knowledgeable about the products. In fact, UC Davis found only 21 percent of EV buyers said they would "definitely" purchase from the same dealer again, as compared to 35 percent of conventional vehicle buyers.

While companies such as Nissan, General Motors and Tesla Motors lead in monthly EV sales figures, all companies would be selling more EVs if automakers, dealers and government agencies took or accelerated specific actions.

For example, Consumer Reports found consumers looking for plug-

in models often visit dealerships and find no plug-in models on the lot. Both automakers and dealers need to increase plug-in car inventory. If dealerships do sell EVs, they often place them at the back of the lot. The dealerships that are most successful at selling EVs are those that place EVs and charging stations prominently at the front of the lot. Some even get creative and place HOV lane stickers (in states that offer these for solo EV drivers) on the cars and/or signs about rebates to remind consumers of the types of incentives EVs will afford them.

Also, automakers spend a lot of money on nationwide print, online and television advertising. Dealerships advertise in local and regional radio, television, and print outlets. If automakers and dealerships increased their advertising efforts for plug-in models and showed off the cars at community events, consumers would be more aware of and eager to buy EVs.

While in some ways EVs are just regular cars, in other ways they are a new technology. Many shoppers report knowing more about EVs than the dealers they consult. In a 2014 investigation, Consumer Reports dispatched 19 mystery shoppers to 85 dealers across four states, and they found many dealers knew little about the EVs they sold. In some cases, dealers outright discouraged EV purchases.

Consumers appreciate knowing how and where the cars refuel, how fueling costs are significantly lower than for conventional cars, which rebates and incentives apply to them, etc. Promoting incentives like the federal tax credit (up to \$7,500 per car) and certain state rebates (up to \$3,000 per car) could be huge selling points to customers. Corporate automakers make some information and training available to dealerships about plug-in cars, but they could accelerate these efforts significantly. Dealers, too, could increase



Selling EVs. Dealers can increase EV sales by educating employees and keeping EVs in stock.

CREDIT: WIKIMEDIA

Educating. What Works?

Widespread education builds public awareness and enthusiasm.

THE VAST MAJORITY of car buyers are still lacking the basic knowledge they need in order to even consider purchasing an EV, even though those who drive EVs love them. According to Consumer Reports, in 2014 the Tesla Model S was the best-loved car—of any car, not just electric—with 98 percent of owners saying they would buy one again. In addition, the more affordable Chevrolet Volt was the best-loved compact. Most people are unaware of these accolades. Automakers bear a large responsibility for advertising the benefits of their vehicles to consumers, but government agencies, utilities, nongovernmental organizations and others must play an important role as well.

ORGANIZE FUN AND EDUCATIONAL EVENTS, INCLUDING RIDE-AND-DRIVES

A 2010 survey of 900 Southern California Edison residential customers who intended to purchase or lease a new vehicle in the next five years found that "the vehicle acquisition decision is influenced more by what co-workers, friends and neighbors drive than by dealers or promotional materials."

For example, the Sierra Club, Plug In America, and the Electric Auto Association, as well as other local partners, have organized National Drive Electric Week events to educate the public about the benefits of EVs since 2010. Part of the draw of the events is that they are held in public, not at car dealerships. Government agencies and organizations like Plug In America also put on other educational EV events at workplaces, on college campuses and at conferences throughout the year.

PROMOTE WORKPLACE CHARGING

When employers install charging stations, it helps reduce several barriers to EVs by providing employees, vendors and customers with a daily, visual reminder that EVs exist. A survey by the U.S. Department of Energy (DOE) found people are 20 times more likely to drive a plug-in vehicle if they have access to charging

infrastructure at work.

The DOE's EV Everywhere Workplace Charging Challenge provides technical support as well as recognition to companies, municipalities, universities and others that take basic steps to offer workplace charging to employees.

CREATE A STRONG WEBSITE

Some states have informative and easy-to-navigate websites about the benefits of EVs and the steps to purchase one.

- DriveElectricVT.com is an excellent model of a website created through a public-private partnership.
- The Massachusetts Offers Rebates for Electric Vehicles program has a user-friendly website, MOR-EV.org.
- The Sierra Club has created an interactive online Electric Vehicle Guide that has information about all plug-in models on the market, how much people will save in fuel costs and emissions in their region of the country, and what government and utility incentives are available in their state. It also includes Pick A Plug-In, a quiz to help people figure out which EV, if any, is right for their lifestyle.
- The Union of Concerned Scientists created a useful report titled State of Charge, which indicates the regions of the country that are "good, better, and best" for switching to EVs when it comes to reducing carbon emissions.

CREATE COMPELLING EV ADS AND OUTREACH

Automakers and dealers should invest more in ads for EVs that will reach a large audience. At government-owned buildings and other locations, the agencies should require EV parking spaces and signs. In addition, government agencies and utility companies should create public service announcements and mailings about the benefits and incentives regarding EVs.

their own training efforts, including identifying key seasoned staff members and training them to become their EV experts.

State agencies should partner with and incentivize dealerships to sell more plug-in cars by offering monetary or promotional rewards, coordinating incentives and discounts, and educating dealers about state EV programs and policies.

AN OPPORTUNITY FOR LEADERSHIP

A major switch to plug-in EVs will enable states to increase energy independence as well as slash air pollution and climate change emissions. Leaders with government, utilities, auto companies,

and auto dealers all have tremendous opportunities to design bold, creative, and effective policies and programs that will accelerate growth in the EV market. The programs and policies described in this report offer leaders powerful examples and opportunities to improve and scale up. Now is the time for audacious and rapid action, leadership, vision, creativity and collaboration that will hasten the transition to a clean energy future. **GB**

This article consists of excerpts Charging Up, a report by the Sierra Club, Acadia Center and Conservation Law Foundation. To read the entire report, visit www.sierraclub.org.

Central Vacs: Essential Tools for Reducing Indoor Air Pollution

WRITTEN BY CATI O'KEEFE
SPONSORED CONTENT

Indoor pollution, including house dust, is one of the most common problems addressed by allergists. Here are tried-and-true ways to greatly reduce allergens in your home.

SPONSORED CONTENT

INDOOR ALLERGIES may seem like an easy problem to fix. Use a dust cloth and your portable vacuum to get rid of dust and dust mites. Keep pets out of the house. And close the windows and doors when the pollen starts to blow. But you're not going to get rid of the dog. Dust mites will continue to thrive in most homes, and whenever you enter or leave the home, pollen will find its way inside.

Your first order of defense is understanding how allergens move in and get cozy in your home. Your next step is to kick them out.

Allergic rhinitis, more commonly known as Hay Fever, is the most common form of allergy and a particularly aggravating condition for sufferers. It is caused by allergens that are inhaled—including seasonal allergens, pollen, mold spores, and others—and perennial (year-round) allergens like pet dander, house dust and dust mites. Of these allergens, house dust mites (HDMs) and their leavings are present in all houses except in arid climates and are a leading trigger of Hay Fever, as well as its sister ailments: house dust allergy and asthma.

Getting rid of HDMs and other allergens can be tough:

- Most insecticides that could control them are harmful to humans.
- Cleaning them away is impossible, as they exist in areas that can't always be reached.
- Using a portable vacuum to eradicate allergens can actually disperse them into the air because of leakage through the vacuum bag or dust cups or by exhaust air blowing allergens off of interior surfaces.
- Air cleaners and purifiers can be a good defense against airborne allergens, but are not a particularly good defense against allergens on interior surfaces.

Sounds like a no-win situation, but fortunately for allergy sufferers, the University of California at Davis School of Medicine conducted a study* of people suffering from Hay Fever to discover ways to improve their quality of life. According to the resulting report, the BEAM 2100 central vac (the unit tested) can markedly reduce all forms of allergens from a home.

Authors of the report note that in all areas studied—activity, sleep, nonnasal symptoms, practical problems, nasal symptoms, eye symptoms and emotions—people who were using the central vac experienced reduced symptoms and problems compared with those who used a conventional vacuum. (See *Influence of a Central Vac System*,” right, for specifics)



A necessity. More than one-third of American homes would be equipped with central vacuum system, such as this BEAM Alliance built-in vacuum, if homeowners had their way. A recent survey by the National Association of Home Builders Research Center found that 34 percent of respondents considered a central vac a “must have” in their next home.

Breathe Easy, Live Easy

Central vacuums are a powerful defense against allergies because of how they mechanically operate and where the canister is stored. The power of the central vacuum unit provides the right amount of suction to remove the HDM allergen and confine it to the collection unit. This collection unit, in most houses, is outside the living space—such as in a garage or unfinished basement—where the contents can be disposed of easily and directly into an outdoor trash bin.

Anyone can benefit from a central vac system. While they are typically installed in new homes, they can be retrofitted into existing homes as well. (See “Not Just for New Homes,” page 47.)

Central vacuums have recently become a mainstream amenity because of the increased consumer interest in healthy indoor air, and because of their superior cleaning ability. As the popularity of them has grown, manufacturers have innovated many new options that make the process of vacuuming more enjoyable.

***The Influence of a Central Vacuum System on Quality of Life in Patients with House Dust Associated Allergic Rhinitis**, Stanley M. Naguwa and M. Eric Gershwin, Division of Rheumatology, Allergy and Clinical Immunology, University of California at Davis School of Medicine, Davis, CA, USA

Here are some of the highlights that BEAM Built-In Vacuums has recently brought to the market:

- The *Precision* power brush that includes a retractable blade that cuts through hair, thread and pet hair that get tangled in the brush roll.
- Extra power clean to clean ultra-plush carpets, where allergy-causing debris can really hide.
- Two-way communication between the power unit and hose handle for constant operating performance information sharing.
- Sound-suppressed motor that delivers up to 700 air watts of cleaning power while using 30 percent less energy.
- Hose handle power control that can reduce suction on linen drapes and dig deep into plush carpet.



Monitor performance. The BEAM Alliance Advanced Smart Screen is interactive and keeps you informed about your system's performance with a motion-detecting LCD screen that illuminates to provide status information such as motor speed, suction level and when to empty the dirt receptacle.

Part of a Smart Green Home

BEAM Built-In Vacuums has earned National Green Building Standard certification by the National Association of Home Builders' Home Innovation Research Labs. Installing a BEAM central vacuum power unit can earn a builder three points toward meeting the standard's indoor environmental quality requirements. The system also qualifies for an indoor environmental quality certification point in the U.S. Green Building Council's LEED for Homes Program.



High performance. BEAM is featured in many demonstration projects, such as VISION Houses Mariposa Meadows and Tucson, shown here.

This is a vote of confidence in central vacs to help provide good indoor air quality, which is important if you are concerned about allergies. As detailed on page 46 in "9 Tips for an Allergen-Free House," there are many paths to an allergen-free home. According to the 2015 *SmartMarket Report* by Dodge Data and Analytics, there are several features in homes that have been demonstrated to have a positive impact on the health of the occupants. The report cites the following healthy home features as paramount to homeowners and being used by the most forward-thinking green builders:

Use of adequate sunlight/daylight. Sunlight positively impacts the mental health of occupants.

Use of non-chemical pest prevention. Sealing, caulking and screening are a healthy alternative to allergy-triggering chemicals.

Employing a fresh air system. This may increase the cost of an HVAC system, but can have a big impact on air quality.

Installing an exhaust fan in the garage. This is an emerging area of interest as more is learned about the unhealthy air quality of garages.



The BEAM Alliance 700TC

BEAM's top-of-the-line central vacuum system combines ultimate cleaning power with convenience, quiet and Interactive Smart Screen technology. Special features include a monitoring system that communicates with the hose handle to keep you informed about system level performance while vacuuming, a quick-clean valve for cleanup around the power unit, a press-and-release bucket for simple emptying of the dirt receptacle, and a self-cleaning filter, which filters 98 percent of particles down to 0.3 microns without the need to buy a separate filter bag.

Influence of a Central Vac System

Here are the study results as measured by the Juniper *Rhinoconjunctivitis Quality of Life Questionnaire*. Visit bit.ly/1rPhT6P for the full report. The improvement percentage listed in each of the seven areas is compared with use of a conventional vacuum.

- 1 Nasal Symptoms** ↑47% Improvement
Stuffy/blocked nose, runny nose, sneezing and postnasal drip
- 2 Non-Nasal Symptoms** ↑48% Improvement
Fatigue, thirst, reduced productivity, tiredness, poor concentration, headache or feelings of being worn out.
- 3 Eye Symptoms** ↑61% Improvement
Severity of itchy, watery, sore and swollen eyes
- 4 Sleep Symptoms** ↑44% Improvement
Difficulty getting to sleep, waking up at night, lack of a good night's sleep
- 5 Practical Problems** ↑52% Improvement
Carrying a handkerchief, rubbing eyes or nose, blowing nose
- 6 Activities** ↑46% Improvement
Severity of allergy symptoms during work and other normal activities
- 7 Emotional Symptoms** ↑61% Improvement
Severity of emotional symptoms such as frustration, restlessness, irritability and embarrassment

In terms of building products, the most widely used green building product is the carbon monoxide detector, followed by low-VOC paints and finishes, no-formaldehyde products, air purification systems, MERV filters, and central vacuums.

"This study points out how green building is entering a new phase in which the health of the homeowner and their family is becoming very important both to builders and remodelers," notes Jim Carmichael, global product manager, BEAM Built-In Vacuums. "Central vacuum systems, which historically have been purchased as a built-in convenience, are gaining popularity because of their ability to improve indoor air quality. Unlike most healthy home features, which are static or hidden inside the walls or embedded in products, a central vacuum system is a product that a homeowner will actually use several times per month to clean the home and remove allergens from the living space."

(continued on page 48)



Quiet operation. The BEAM Serenity Quiet Series boasts a patented Quiet Pak sound insulation and Sound Off muffler for quiet operation. The unit will perform like new for up to 15 to 20 years, according to the manufacturer.

9 Tips for an Allergen-Free House

A BEAM Built-In Vacuum removes 100 percent of captured dirt and allergens from the living space without stirring up dust during cleaning. It's why BEAM systems have been clinically proven to relieve allergies and why both LEED and the National Green Building Standard award certification points for homes that include these systems.

In addition to installing a central vac, here are some other recommendations from the UC Davis study on house dust-associated allergies on how to mitigate the effects of airborne particulates and house dust mites:

- Air conditioners/central heating units can be fitted with filters to remove HDM allergens. HEPA filters are replaceable and may not require a retrofit but increase air flow resistance as the filter becomes "loaded." Electrostatic filters are helpful in removing allergens but are expensive and generate ozone. Window-mounted air conditioning units should be fitted with a HEPA filter. The unit must fit snugly and the room closed off from the rest of the house for it to work effectively.
- Room air cleaners or purifiers recirculate air in a room through a collector (HEPA, electret, electrostatic filters, ionizers). They can control airborne particulate matter and some gaseous material in a confined space.
- Because the human body provides warmth, humidity and food for house dust mites, bedding should be washed in hot water. Pillows, comforters and mattresses should be put in "mite-proof" coverings.
- Bedrooms should feature clear, smooth nonporous surfaces to the fullest possible extent. These surfaces should be mopped every two to three days with a clean damp cloth.
- Dust-attracting devices, such as radios, TVs, audio systems, speakers, computers etc., should be kept as free as possible of dust, stored in an enclosed space and covered when not in use.
- House plants catch dust, as well as generate mold, mildew and plant spores or pollen, and should not be in bedrooms if the occupant has allergies.
- Venetian or similar slatted blinds should be dusted often.
- Use hypoallergenic décor and minimize the use of harsh chemicals for cleaning.

For a good resource for products, research and advice for improving indoor air quality, check out IAQ Central.

www.greenbuildermedia.com/iaq-home-page-green-builder

Central Vacs: Not Just for New Homes

MANY HOMEOWNERS shy away from installing central vacuum systems in their existing homes, because they fear that the installation process must be part of a full-scale renovation. However, almost one-third of all central vacuums sold in the United States are installed in existing homes without tearing out sections of walls or ceilings. In fact, the entire installation process usually takes less than a day.

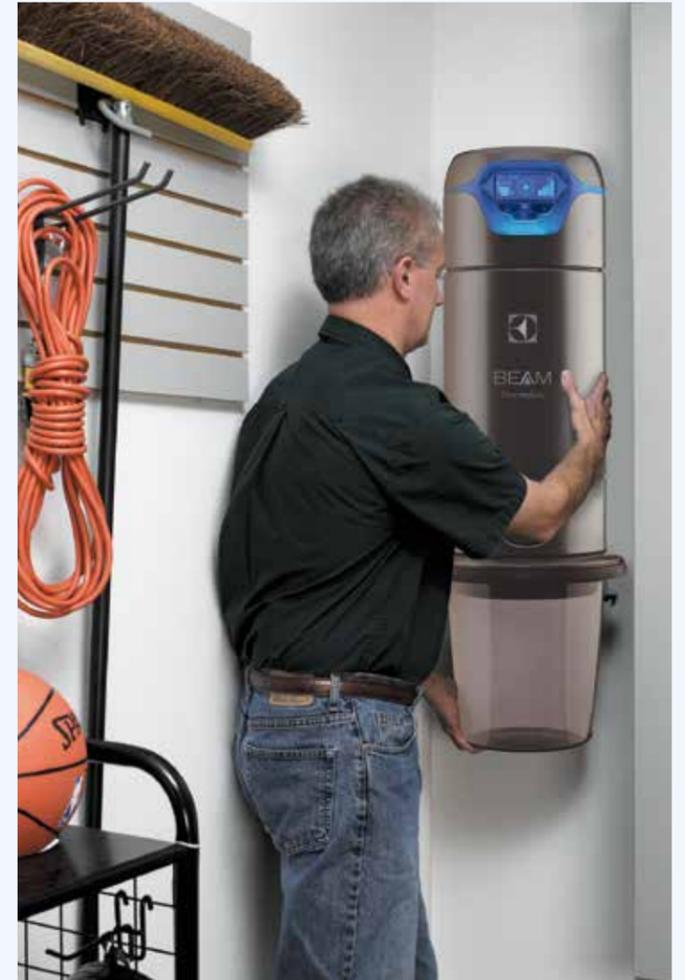
Central vacuum systems are built into the home. They include three basic components. A power unit that includes the system motor, filtration and a collection bucket is typically installed in a garage, basement or utility room and provides three to five times more cleaning power than a traditional vacuum. PVC tubing and wires are installed inside interior walls and between floor joists that connect the power unit to strategically located inlet valves. A powered 30- or 35-foot hose and attachments plug into the inlet valves and activate the system.

The added cleaning power and the location of the motor outside the living area allow a central vacuum system to completely remove captured dust and allergens without blowing air into the living space during cleaning.

"An existing home installation should look like the house was built with a central vacuum system," says Jim Carmichael, global product manager and a former BEAM dealer. "You'll want the dealer to visually inspect the home before the installation to determine where to place the inlet valves in interior walls, where to place the power unit and the best route to install the tubing and wiring that connect the system."

Homes with unfinished basement ceilings, crawl spaces or attics allow for simple installation, Carmichael says.

When installed, the inlet valves cover approximately 600 to 700 square feet of the home; the average home of 2,400 square feet will only need four inlets, at the most. The inlets are installed in interior walls at the same height as standard electric plugs. Small holes no larger than a standard electrical outlet are cut into the drywall to accommodate each valve; the valves are then connected to the system by vacuum tubing inside the walls from below or above. The vertical tubing then is fitted to a main trunk line that is installed between floor and/or ceiling joists from a basement, crawl space or attic that connects to the power unit. All the inlets in the home are tied into the one main line



Easy installation. Almost one-third of all central vacuum systems are installed in existing homes. The process usually takes less than a day to complete.

to assure the best suction possible and the least amount of tubing. Cover plates attached to each valve conceal all of the tubing and wire.

A thin, lightweight electrified hose is inserted in the inlet valves and activates the vacuum from a touch of the switch on the hose. One advantage of a central vacuum is that the homeowner can clean a room from top to bottom—floors, furniture, crown molding, ceiling fan and baseboards—without having to change inlet locations. When finished, simply turn off the vacuum at the hose handle and hang the hose in the closet. The only maintenance for the central vacuum system involves emptying the system's collection canister every three to four months.



Easy clean-up. Under-cabinet intake makes cleaning up kitchen messes a cinch.

Because consumers desire healthy homes, green building is advancing to the next level. "People used to talk about low-VOC and no-added formaldehyde, which is wonderful and good, but what about later, when a home is no longer in its brand-new state?" Carmichael asks. "How do you address day-to-day healthy home issues and how particulates are dragged into the house? Issues such as air infiltration, ventilation and central vacuums are now being looked at carefully. It's all part of a new emphasis on the healthiness of the home."

Raising Home Values

Central vacs help homes sell faster or sell for more money and earn higher appraisals than comparable homes without central vacuums, says Walter Molony, economic issues and media manager for the National Association of Realtors. The reason for this is clear: People want them.

According to a NAHB Research Center survey, 34 percent of home buyers want a central vac in their next home. "The results clearly show that consumers want technologies that make their houses safer and healthier," says Carmichael. "Our products play a significant role by removing 100 percent of contacted dirt and allergens from the living space, relieving allergy symptoms and improving air quality." The units do this at a bargain when you consider that, according to BEAM, a typical household would burn through four or five vacuums in the same time they used one central vac system.

That research also proves that central vacuums are mainstream. Josh Anderson of Element Design Build in Las Vegas was the builder of the 2016 New American Home, a nationally recognized showcase of residential building products and technologies. He put a state-of-the-art built-in home cleaning system from BEAM into the show



BEAM Precision Power Brush

The painstaking task of cleaning the brush roll of your central vacuum is a thing of the past with a new powerhead that cleans itself. A window at the top of the powerhead allows you to view the powerhead in operation to see if the brush roll is tangled. If it is, you can step on the Brushroll Clean pedal to activate a retractable blade that cuts through hair and thread that is entangled in the brush roll.

house. The home was constructed to meet the National Association of Home Builders National Green Building Standard. The BEAM Alliance System helped the builder earn its points to meet the standard.

"We look at the health factors that impact the livability of the home, and that can be off-gassing of materials and indoor air quality," says Anderson. "Most of your traditional vacuum systems are removing dirt from the floor and putting it into the air. With the central vacuum, you are removing it entirely from the home."

In addition to being suitable for mainstream living, central vacs are invaluable in less conventional housing, too. "You might not automatically include central vac systems in off-grid, remote projects," says Ron Jones, president of Green Builder Media. He is building a carbon-neutral project called VISION House Mariposa Meadows in the Rocky Mountains of Colorado. "When you consider the vertical design of these structures, a central vac option becomes quite appealing," he says. "The superior cleaning performance, saving our limited storage space and not needing to haul conventional vacuum cleaners up and down the stairs will make the job of maintaining the living spaces at Mariposa Meadows much easier."

"A central vacuum is an investment," Carmichael emphasizes. "It's an investment in your health; it's an investment in your property. As education spreads on the role of central vacuums in allergen relief, homeowners are going to demand builders put them in both new and retrofit houses." **GB**



BEAM Serenity Quiet Series

This system's high-efficiency motor removes 100 percent of captured dust and allergens from your living space. The HEPA CleanStream Filtration System makes sure they don't come back in. The patented Quiet Pak sound insulation and Sound Off muffler makes sure you have all the cleaning power with very little noise.

INNOVATION UPDATE

The Intersection of Smart Cities and Connected Mobility

Innovations in technology reduce environmental impact and improve quality of life.

BY JESSICA PORTER

WITH OVERPOPULATION IN major cities resulting in failing infrastructure and increasing damage to the environment, many organizations are looking for efficient and progressive solutions. One of these solutions are “smart” cities, which are designed to increase residents’ qualities of life and reduce their carbon footprint using intelligent technology.

These cities will combine sustainable living with environmentally responsible access to travel. Prototypes are being developed around the globe as communities, which allow major industry players, such as Bosch, to create, test and perfect innovative solutions to life and travel in urban locations.

An example of a “smart” community being developed in the United States is The Shipyards Communities by FivePoint Holdings (formerly known as Lennar Urban) in San Francisco. Bosch is working with FivePoint Holdings to blend connected mobility and efficient housing on the project, which is being constructed on San Francisco’s last undeveloped piece of land—a 750-acre lot on the city’s southeast waterfront.

“It’s really unique to have a city of that size and have the opportunity to develop 12,000 residences,” says Matthew Jennings, Bosch’s regional president of the Americas for Bosch Software Innovations. “When we were planning, we began trying to determine what we could do differently and what we could do make it intelligent, smart and convenient.”

Just as important as providing green living spaces is providing energy efficient access to local amenities. For the past 130 years, Bosch has been developing technology that aims to provide a better way of life.

“We offer software for the smart city of the future,” says Mike Mansuetti, president of Bosch North America. “If we look at IoT, which is backbone of connected communities, we’re connecting on all three levels: sensors, software and services. We’re taking those



Parking buddy. Sensors help drivers find vacant parking spots without unnecessary driving by reporting spot availability to a central control station.

technologies and bringing the capability to the consumer space, including smart city applications.”

Bosch recently launched the Bosch IoT Cloud, its own cloud for web-based services comprised of technical infrastructure and platform and software offerings for IoT that enable these type of solutions for smart cities, connected mobility and more.

The Shipyards project offers the opportunity for Bosch to showcase recent mobility innovations and technology that can improve some common challenges and lead to sustainable solutions to transportation and accessibility in urban living.

Parking

“We’re working on more efficient use of transportation that will result in time savings and fuel savings, which will reduce CO₂ emissions and congestion,” Mansuetti says. “One of the cases we’re working on now is parking. Depending on the city, you can expect to spend a large amount of time looking for a parking space, which contributes to congestion and results in frustration and higher gas emissions.”

Bosch and FivePoint Holdings are exploring incorporating Bosch sensor systems into a new parking garage structure being developed

FORGING AHEAD

Bosch says additional transportation-related innovations in development will result in increased efficiency and safety.



Collision warning. Bosch technologies work to improve travel-related safety.

LIGHT RAIL COLLISION WARNING SYSTEMS

Visual and audio warnings will alert drivers of light rail systems to provide better stopping time and result in safer travel. A camera will monitor the track and send real-time information to a radar sensor. That information will be sent to the control unit, which determines whether there are possible obstructions, such as vehicles or pedestrians, on the track. Then, the driver is alerted and can respond by slowing or stopping appropriately.

eBIKE

These bikes provide electrical pedaling assistance. Users still need to pedal, but can select the level of assistance. If a user commutes with the eBike, he or she can select a high level of assist for extra help with pedaling to and from work. If the eBike is used for fitness, the user can select much lower assist to do most of the pedaling themselves.

PEDESTRIAN PROTECTION

Bosch’s stereo video camera can see in 3-D and detect movement to protect pedestrians from vehicles in motion. Vehicle manufacturers can integrate these cameras in their vehicles, which will result in emergency braking if a pedestrian is detected in close range.

INTERMODAL APP

Intermodal Apps will allow residents in a community to see nearby bike and car sharing options, taxis, Ubers, and public transit options such as rail and bus from their smartphones. They also will be able to pay for their trips and plan their optimal route—whether it’s the shortest, cheapest or most environmentally friendly.

at Candlestick Point in The Shipyards community. Bosch sensors can be used in a garage to help drivers find parking spots without unnecessary driving. Each spot has a sensor that will be able to determine whether it is occupied or vacant. The sensor will report the availability to a central station, which will alert drivers to empty spots.

Once the future of automated cars becomes a reality, Bosch is working on taking parking garages to a whole new level with “valet” parking. Drivers will get out of their vehicles at the entrance of the parking garage and the vehicle will automatically drive to an available space. This also will increase the capacity of parking garages, as there will be less room for human error and cars can park closer together.

Cars also will be able to more easily find street parking spots in a community. As a person drives around the area, the vehicle will be measuring gaps between cars to determine potential parking spaces. That way, the driver spends less time searching for a spot—leaving the hard part up to the vehicle. It also will reduce traffic congestion.

Community Access

All residents of The Shipyards Communities also will have access to the Smart Community app, which was developed by Bosch and FivePoint Holdings. The app will provide residents with real-time, localized information about the development and nearby community.

“The app is managed by the community,” Jennings says. “It’s a platform, and if the city decides it wants to do more with the app, it’s simple to add more functions.”

Residents will be able to use the app to monitor transportation options, whether that means viewing the location of the community shuttle, hiring an Uber, finding a bike or car share, or seeing the status of the local bus or train. It also will allow residents to connect with local businesses. Business owners will be able to post updates about events, sales and news to communicate with residents.

In addition, the app will provide maintenance updates about resident’s living units and will allow residents to communicate with and give feedback to the development. If a resident walks past an overturned trashcan on the street that has created a mess, he or she will be able to alert maintenance crews.

The app is completely customizable by community members and resident users. For example, if users are interested in the local art community but not the local baseball team, they can subscribe to updates related to exhibits and galleries and unsubscribe to alerts about scores and ticket sales.

“The exciting part about the app is how it will evolve in community, what demands it will place on community and what needs to be in community to meet those demands,” Jennings says. “We won’t know all those factors until the project is complete and the app is in use.”

The Smart Community app and innovative parking solutions are just a few of the ways Bosch is working to improve quality of life and relieve common urban problems with intelligent technology. But these solutions are just the beginning. In the next few decades, Bosch and other industry leaders will be able to provide even more custom solutions to sustainability, mobility and connectivity.

“The world is becoming increasingly connected,” Mansuetti says. “As people become more connected and data becomes much more available to the end users, we can start to make a lot more intelligent decisions.” **GB**

TINY HOUSES

Are Tiny Houses Greener Than RV Trailers?

The overall environmental footprint depends on driver behavior.

BY MATT POWER,
EDITOR-IN-CHIEF

I TOURED A FRIEND'S RV recently and began to think about what makes an RV different from a tiny house. A well-designed, modern RV is made to be lightweight and require almost no maintenance. Inside, it has ample space, especially with the addition of side pop-outs. Many models have an attached awning that can be rolled out when at camp. They have built-in storage for water, sewage, propane tanks, spare tires and more.

SURE, SMALL IS GREENER

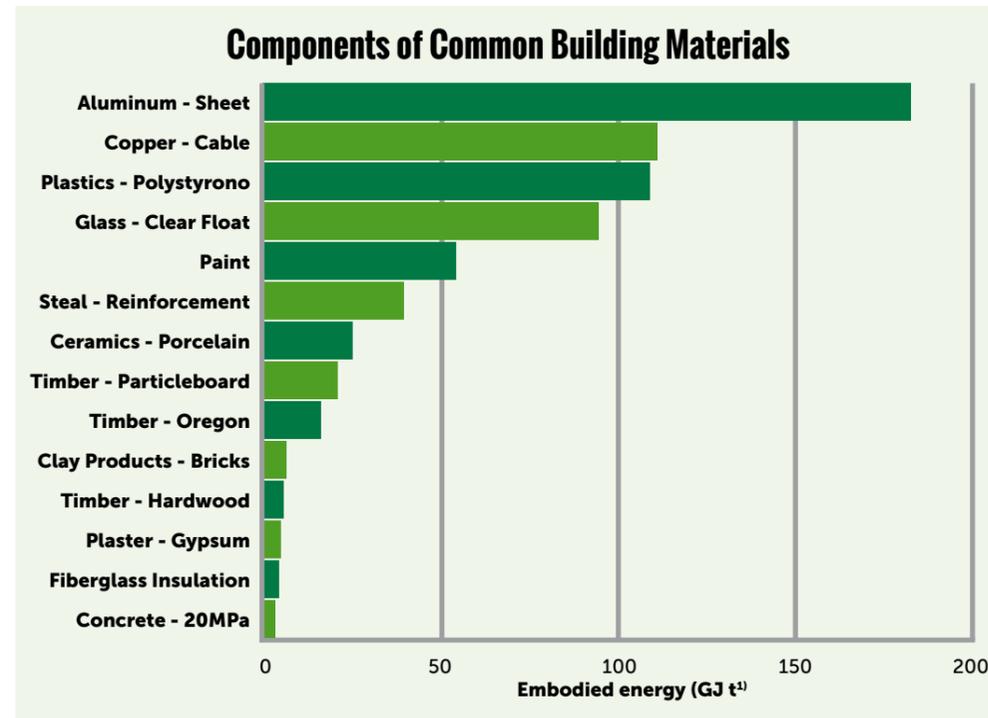
Before you accuse me of being too hard on tiny homes, let me give the credit they are due: Living in a 240-square-foot space instead of a 3,000-square-foot home is an automatic eco-win. As a general

rule of thumb, every time you double a home's floor space, you triple the amount of energy required to heat and operate it.

However, most of the tiny houses I've seen (watch *Tiny House Nation* for a sampling)—especially when occupied by couples or small families—require a lot of sacrifice from their occupants. So, there must be some moral high ground that makes it all worth it, right? Otherwise, what makes them preferable to a more comfortable, flexible off-the-shelf RV camper?

Let's be honest. Tiny houses are tough for anybody but a devoted bachelor to live in. It's hard to cook, tough to socialize, slightly traumatic to use the composting toilet and nearly impossible to find a private space. Sure, they look prettier inside than most RVs, but is that enough? How about some green cred?

Let's say you're truly committed to the doing the right thing and minimizing your eco-footprint. You're willing to endure the discomfort indefinitely. You adapt and adjust, store your kids' toys in the bathtub at night, clean them out every morning so you can shower, and then put them back in. You manage your toilet



compost perfectly, avoiding pharmaceuticals (and asking your guests to abstain too), so you can dump the resulting compost on your gardens. You're living the green dream, right? Greener than that eccentric couple in the RV park next door with the Harley in their yard.

Or are you? Let's put aside the comfort issue for the time being, and look at some of the environmental pros and cons for RVs and tiny houses.

INITIAL ECO-FOOTPRINT

For a typical site-built home, the construction of the building accounts for somewhere around 11 percent of the lifetime greenhouse gas emissions. That figure is important because those pollutants stay in the air up to 60 years.

Most tiny homes I've seen are built with a traditional wood frame, often insulated with expanding spray foam. This makes them super tight and road worthy. The wood is renewable, so it has a small eco footprint. The foam has a much larger eco-impact. However, if the



Weight (Unloaded): Up to 10,000 lbs.
Cost: \$38,000 (recent resale price)

Weight (Unloaded): Under 3,000 lbs.
Cost: \$16,372

home is occupied for many years, it may be the best choice, because of the greenhouse gas emissions it will allow the owners to avoid later on. It's complicated stuff. You can see why it's not easy to understand "green" sometimes.

Another factor is paint. Latex exterior paint has a huge environmental cost. Most tiny houses have some kind of painted or stained wood siding that will need regular re-coating every few years for its lifespan. Then, at some point, the siding will need to be replaced completely. A typical RV has an aluminum exterior that never needs painting. But aluminum comes at a very high cost to the environment, especially virgin aluminum. On the other hand, it lasts virtually forever, with almost no maintenance.

The bottom line is that building materials matter, but the eco-pedigree difference between an RV and tiny house is not black and white. I'd guess that when you factor in all the plastics and synthetics of an RV, it probably tips the scale in terms of greenhouse gas (GHG) emissions over tiny houses, but not by a huge margin.

WATER MANAGEMENT

An RV has some features that most tiny houses don't—most notable are a holding tank for fresh water and a tank for blackwater (sewage). Most tiny homes have no sewage tank, so they rely on a form of composting toilet and a well or city water supply.

On the plus side, this means an RV has most of the infrastructure in place for a rainwater collection system. It's also less finicky about how you use the "facilities."

The sewage tank has to be pumped out every couple weeks, an inconvenient chore and financial cost. But possibly a green choice. That sewage will go through a sophisticated treatment process before the relatively harmless effluent is discharged into a waterway.

A composting toilet can be a good environmental choice, but, if you've ever owned one, you know they can be finicky. They need to be managed carefully to avoid odors, cleaned out at regular intervals and they take up a lot of room. And you have to have someplace to put the processed poo that's ok with your composted humanure. That's not always easy to find.

"Shelter is second only to transportation in the typical U.S. citizen's impact on the Earth."

TRAVEL: THE SHADOW SIDE OF TINY

Here's where tiny houses start to fall behind. A tiny house is portable, yes, but not very portable. Tiny homes weigh two to three times as much as an equivalent-sized RV trailer. Do you really want to tow a 10,000-lb. box back and forth to Florida each year?

Ah, but I'm jumping ahead. Most tiny homes I've seen are intended to stay put, often for years at a time on a rural or outer suburb lot where their (typically) millennial occupants can pay off their \$30,000 mortgage, freeing up money for them to travel the world.

Meet the Falcones: a young couple in Michigan who want to downsize to tiny living. They move out of their parents' home in the city to a tiny house on a lot 15 miles out of town.

Let's compare them with Gary and his girlfriend Sheila, the couple with the RV in the park next door. If the Falcones stay put in their tiny house through the Michigan winter, driving about 30 miles a day in their Toyota Camry, their overall footprint to heat that 240 square feet should be pretty minimal: a mere fraction of what their suburban neighbors are costing the Earth in resources. They'll also use some energy driving to social events, to visit friends and so on.

Maybe Gary and Sheila stay home this winter, too. Their heating costs are quite a lot higher, because the RV is poorly insulated. But it's too cold to drive the Harley so they take public transportation instead. They socialize mostly with friends next door in the RV park.

Again, tiny house vs. RV results in very little difference environmentally. Now let's change a couple of behaviors.

This year, the Falcones decide to escape their tiny house and get away for a couple of weeks to Florida. They fly down in January, stay in a hotel and rent a car.

Gary and Sheila also say "screw this damn snow," and haul their RV to a trailer park in Orlando for the winter.

THE OWNER'S ROLE

A study by PFK Consulting looked at a scenario like this. It found that in almost every case, RV travel is softer on the environment than a vacation by plane. In most cases, it produces about half the CO₂ emissions. In fact, another study by Uscusa.org found that short family vacation by air can produce more GHG pollution than an entire year of commuting by car.

"Ok," you're saying, "that's not fair. It's not really looking at tiny house impacts at any more. It's looking at behavior."

That's true, but tiny houses are all about behavior. They're major lifestyle statements. Shelter is second only to transportation in the typical U.S. citizen's impact on the Earth. But shelter doesn't happen in a vacuum. If you build a tiny house, but treat it as a part-time landing pad while you travel by plane, you're cooking the GHG books.

Don't get me wrong. I love the idea of tiny houses. But if the force driving you to build one is a desire to reduce how much you scar the Earth, look hard at whether you can handle living in it over the long haul. Are you up to the task?

If you really want to "go green," but keep air travel in the picture, you might as well live well in an RV and be a snowbird. While you're at it, switch to a vegetarian diet and cut your food footprint in half. When you start getting serious about curbing your GHG production, every choice makes a difference. **GB**

CODE ARENA

The Latest Rules, Regulations and Codes Impacting Sustainable Construction

Bill Amends Utah's Energy Conservation Code

BY MIKE COLLIGNON

ON MARCH 24, Utah's governor signed HB 316 into law. This bill amends the 2015 International Energy Conservation Code (IECC) so it more closely resembles the 2009 IECC. The state legislature passed the following changes.

- The ERI path is allowed, but the levels range from 65 to 69.
- The 2009 IECC backstop requirements were removed, which means builders can sacrifice the building envelope for better equipment.
- Builders get to choose whether they follow the air barrier and insulation installation instructions or perform air leakage testing. They are not required to do both.
- Prescriptive duct leakage requirements were doubled (in a bad way) from 4 cfm to 8 cfm, and only decline to 6 cfm on (or after) Jan. 1, 2021.
- The bill would change the state's code cycles to every six years, instead of the usual three.

In an April 7 press release from RESNET, Shawna Cuan, building and industrial energy efficiency program specialist of the Utah Governor's Office of Energy Development, stated: "Utah is committed to being on the forefront of building standards, and this action means more energy efficient, durable and healthy homes for Utahans."

There were two positive provisions in the bill. Permits cannot be denied for projects using ICFs that:

- a) meet certain flame spread and smoke indices; and
- b) are designed and stamped by a state-licensed structural engineer.

Also, gray water systems now are allowed on single-family projects. The bill reads: "Gray water recycling systems utilized for

COURTESY OF

The Green Builder Coalition

The Green Builder Coalition is a not-for-profit association dedicated to amplifying the voice of green builders and professionals to drive advocacy and education for more sustainable homebuilding practices.

For more information, visit GreenBuilderCoalition.org

For more information, contact Executive Director Mike Collignon at mcollignon@greenbuildercoalition.org.

Complete Streets Improves Communities' Non-Vehicular Accessibility

LAUNCHED BY THE National Complete Streets Coalition in 2004, Complete Streets integrates people and places in the planning, design, construction, operation and maintenance of transportation networks. The coalition promotes the development and implementation of policies and professional practices that:

- ensure streets are safe for people of all ages and abilities;
- balance the needs of different modes of transportation; and
- support local land uses, economies, cultures and natural environments.

While the National Complete Streets Coalition offers policy suggestions, they are quick to point out there are many different designs in use and the community should determine what is most relevant to its needs. To date, more than 900 policies from more than 730 agencies at the local, regional and state levels have adopted Complete Streets policies nationwide. To find a community with Complete Streets near you, visit the Coalition's Policy Atlas.

For more information, visit www.smartgrowthamerica.org.

subsurface irrigation for single-family residences shall comply with the requirements of UAC R317-401, Gray Water Systems."

Cons: Yes, this new Utah energy code technically represents an improvement from Utah's last code, but that's not saying much. Though it states Utah is "on the forefront of building standards," they must not be aware of what truly leading-edge states have for energy codes. Since a new energy code won't be adopted until 2021, Utah's removal of the 2009 IECC backstop requirements means representatives will be looking at updating a code that's 15 years in the past when they update the code in five years. At that point, it's doubtful anyone will be describing this code as "being on the forefront."

Pros: The silver lining is the lowered hurdles to use ICFs. By using those homebuilding systems, a builder would easily comply with many of the provisions of the state's energy code. It's also nice to see a state being proactive about gray water systems—something more states should be doing. **GB**



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Learn about innovations in green building and sustainability.

This year's keynote speaker will be renowned author and champion of sustainable development, Hunter Lovins. Hunter is the president and founder of Natural Capitalism Solutions.

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Growing Roots: Housing Features that Discourage Wasteful Travel

Tips for developers to convince potential residents to leave the car behind.

COMMUNITIES LOCATED CLOSE to a variety of transportation options are on the rise, and some developers are even creating completely car-free communities. While many people would gladly say goodbye to car payments and high maintenance costs associated with car ownership, others would be less likely to leave the car behind. However, there are effective ways developers can reach potential residents and convey the benefits of living without a car.

LOCATION

Deron Lovaas, senior policy adviser of urban solutions for the Natural Resources Defense Council, says there's a two-pronged approach that is likely to work. "First, describe all the amenities nearby, such as retail, restaurants, coffee shops, breweries and art galleries—whatever is within easy walking or biking distance."

In addition, Lovaas says these amenities need to be a quarter to a half mile away along routes that are clearly marked and safe to travel.

"Second, transportation services that allow access to even more opportunities can be a key selling point as well, such as car- and bike-sharing stations, bus or train stops, and bike trails." Lovaas also recommends offering prospective buyers or renters a subscription or fare card for a year or more.

AFFORDABILITY AND CONVENIENCE

Another important way to convince people to go car-free is to make other modes of transportation cost effective and efficient, says Bob Bennett, chief innovation officer for the City of Kansas City, Missouri. If the nearby bus system is pricey or unreliable, it will be difficult to convince people to leave the car behind.

"Most Americans accept the fact that a car is just a gasoline-powered money sucker, but we retain cars because we need to go places," Bennett says. "Once we mitigate that need with something more cost effective, it's easy for anyone to go car-free."

Bennett says a variety of modes of transportation needs to be available on a macro, micro and individual level to convince people to go car-free. For example, there needs to be mass transportation to get people from home to places of employment or entertainment centers, like sports venues. Then, there needs to be micro transit



CREDIT: THE OVERHEAD WIRE

More mobility options. Convenient alternative modes of transportation such as bike riding must be in place to create a car-less community.

for smaller groups of people with a collective task to accomplish, like ride-sharing. Finally, there needs to be personal options, such as taxis, Lyfts or Ubers, to help people go to doctors' appointments or run errands.

"The comprehensive system of all these capabilities makes a city truly livable," Bennett says. "But it can only happen when the ability get things done can be accomplished through these means of transportation more cost effectively than parking a car in the garage."

TECHNOLOGY

Technology plays a key role in promoting alternative modes of transportation. Lovaas says technology linked with as many modes of transportation as possible will help convince residents to go car-free.

"My dream is of a world where I walk out my front door, take



CREDIT: THE OVERHEAD WIRE

Multiple modes. Transportation needs to be available on a macro, micro and personal level to successfully promote car-less communities.

out my smartphone, and open a one-stop-shopping application that lays out multiple means of getting to my destination safely and comfortably," Lovaas says. "Most places, especially in suburbia, aren't there yet. But we'll get there as consumers demand more transportation choices where they live, work and play."

TARGET MILLENNIALS

Not surprisingly, the link between technology and transportation is being driven by millennials. Developers on the forefront of these communities must find ways to relate to this generation.

"Demographically, it makes sense to market to the largest generation currently: Millennials, whose budgets can be squeezed by car ownership, who are postponing getting drivers' licenses and many of whom consider driving a distraction when they'd rather be socializing online or in person," Lovaas says.

However, there's another slightly more unexpected generation willing to take advantage of going car-free: baby boomers. "Generally, they have more discretionary income, empty nests and are retired or retiring," Lovaas says. "Many of them would gladly trade some house size and parking space for access to social opportunities as well as aesthetic and cultural amenities nearby, such as nearby community theaters and churches." **GB**

Report: Bike-Ready Trails Are a Growing Urban Trend

HERE'S BEEN a lot of talk about transit-oriented development, but now there's also trail-oriented development. Trail-oriented development is growth that capitalizes on increasing interest in biking and other forms of active transportation as a predominant mode of travel, according to *Active Transportation and Real Estate: The Next Frontier*, a report by the Urban Land Institute.

Currently, the report states 1 percent of all trips in the United States use bicycles. However, the country would save more than 693 million gallons of gasoline each year if that number were doubled to 2 percent, according to the Rails-to-Trails Conservancy. The report states doubling the amount of bicycle trips would also lower air pollution, decrease carbon emissions and improve public health.

To be successful, trail-oriented developments must be convenient to trails that connect to important amenities, such as jobs, grocery stores, restaurants and entertainment venues. They must include amenities that cater to their bike-riding residents, such as storage, maintenance areas, washing areas for bicycles and bike-sharing options.

Following are examples from the report of communities that focus on active transportation.

Bici Flats in Des Moines, Iowa biciflats.com

Bici Flats is located at the intersection of three trails that connect the community to downtown Des Moines. It includes in-unit bike storage, a bike repair room, a bike washroom, wide hallways and a bike storage room.

Circa in Indianapolis, Indiana [www.liveatcirca.com](http://liveatcirca.com)

Circa is located in downtown Indianapolis right next to an already-established trail connecting to popular areas in the city. It includes bike storage, a workroom, a bike-washing station and a bike-sharing program.

The Flats at Bethesda Avenue in Bethesda, Maryland [www.flatsatbethesdaavenue.com](http://flatsatbethesdaavenue.com)

The Flats at Bethesda is located on a trail that connects Bethesda, Washington, D.C., and Silver Spring, Maryland. It includes on-site open space, a bike drop-off and bike storage.

Hassalo on Eighth in Portland, Oregon hassalooneighth.com

Hassalo is located on streets with protected bike lanes, allowing residents easy access to safe travel on city streets. It provides bike parking with a valet, a bike-washing station, a bike workroom, on-site repair and parts, and a shower and locker room.



IoT

THE INTERNET OF THINGS

Mining Data to Run a Greener Fleet

Smart GPS tracking can boost fleet efficiency.

BY JENNY MALCOLM

FOR TODAY'S BUILDER, running a sustainable business is more important ever before. In the United States, approximately 20 percent of greenhouse gas (GHG) emissions are contributed by light-duty vehicles. It is essential that businesses that use vehicles as part of their operations find ways to limit environmental impact and improve sustainability.

Construction fleets are implementing GPS tracking systems to better manage fleet resources to limit GHG emissions, which contribute to climate change, air pollution and disease. GPS tracking systems increase sustainability by monitoring fuel usage, limiting speeding and idling, monitoring fleet use, increasing route efficiency, streamlining maintenance management and more.

IMPROVED FUEL MANAGEMENT

One of the easiest ways to limit unnecessary fuel usage with a GPS tracking system is to monitor vehicle idle time. Excessive idling will not only hike up fuel costs significantly for construction businesses; it will also cause vehicles to emit detrimental amounts of greenhouse gas into the atmosphere. Businesses will improve their sustainability by putting a cap on unnecessary idling by tracking idle metrics through a GPS tracking system's reports and alerts, and taking action as soon as vehicles surpass acceptable idle time thresholds.

Another method construction fleets are implementing to scale back on unnecessary fuel use is correcting inefficient driving. Along with safety implications associated with monitoring driver behavior, fleet managers can use a GPS tracking system to review quantities of fuel used from unproductive driving. This data will allow construction fleets to coach drivers to improve behavior and reduce excessive fuel use. It is also a best practice for construction businesses to send alerts straight to drivers when their vehicles are speeding, idling, harshly braking or rapidly accelerating to stop these behaviors while they are happening.

REMOVAL OF UNDERUSED VEHICLES

According to the U.S. Department of Energy, fleet rightsizing is a management practice that can help fleet managers build and maintain sustainable, fuel-efficient fleets. Maintaining more vehicles in the fleet than needed will increase fuel and maintenance expenses, as well as its environmental impact. Construction businesses will increase sustainability by rightsizing the fleet to ensure vehicles are being used to the maximum. Monitoring fleet utilization reports allow fleet managers to identify if vehicles are being under-utilized or over-utilized. If vehicles are being used less frequently, fleet managers can decide if they can be eliminated all together for better sustainability.

PURCHASE OF GREENER VEHICLES

Along with weeding out under-used vehicles, construction businesses can increase sustainability by incorporating fuel-efficient vehicles during new vehicle acquisitions. Hybrid vehicles will drastically lower environmental impact, and some GPS tracking systems are able to provide tracking and reporting capabilities for hybrids. Not all providers track mixed fleets, so it is important to make sure the system has this capability to receive the benefit of tracking the full fleet.

SELECTION OF OPTIMAL ROUTES

Ensuring that drivers take the most efficient routes to jobsites is beneficial for several reasons. It saves time, resources and ultimately decreases miles driven, which directly correlates to GHG emitted. GPS tracking systems enhance sustainability by automatically determining the fastest routes to and from the jobsite so construction fleets are able to dispatch drivers more efficiently. Dispatchers can even send turn-by-turn directions to a driver's smartphone or Garmin navigation device to prevent drivers from taking their preferred route or getting lost and adding extra miles to their trip. By viewing route efficiency reports, fleet managers will be able to identify wasteful trips and coach drivers to eliminate excessive GHG emissions.

REDUCED ENVIRONMENTAL IMPACT

Construction fleets that stay up-to-date on maintenance ensure vehicles are eco-friendly, because cleaner running vehicles emit less GHG. GPS tracking systems streamline maintenance management by automatically tracking run time and odometer readings, sending reminders when vehicles are due for important services. Automated maintenance reminders will ensure preventative services, such as emissions testing and oil changes, are never missed so the vehicle runs as cleanly as possible. Scheduled maintenance reports are also available for fleet managers to view on a daily, weekly or monthly basis to ensure no outstanding maintenance items are due.

Environmentalism is becoming increasingly important in the United States, and businesses with fleets of vehicles and powered assets need to be particularly conscious of their sustainability. Construction fleets are adopting GPS tracking technology to better manage fuel use, rightsize their fleet, track fuel-efficient vehicles, increase route efficiency and streamline maintenance management. **GB**

Jenny Malcolm is the content marketing specialist for GPS Insight. For more information, visit www.gpsinsight.com.

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Nearly 13 Million EV Chargers Expected by 2020

THE GLOBAL MARKET for electric vehicle chargers are on the rise and expected to grow from more than 1 million units in 2014 to more than 12.7 million units in 2020, according to the *EV Charging Infrastructure* report by IHS Inc.

AC and DC are the two main types of charging stations. AC charging stations are the most common and provide electrical current to the on-board vehicle charger, which typically results in five to 15 miles of electric range per 30-minute charge. On the other hand, DC charging stations provide current directly to the vehicle battery, which typically results in 80 miles of electric range per 30-minute charge. The report states this type of charging station is best suited to charging on the road.

Because AC charging is relatively cheap and will require the least amount of upgrade to the existing electric grid, IHS estimated it will remain the most popular charging method. The report states approximately 10 percent of EV charging stations will be in the public



Powering up. The market for EV chargers is expected to rise significantly by 2020.

CREDIT: BOSCH

First Solar Electric Freight Vessel Delivers Cargo

Solar-assisted freight vehicles are now a reality.

BY MATT POWER, EDITOR-IN-CHIEF

SOLAR SAL, THE first-ever solar electric delivery vessel, carried four tons of cargo more than 300 miles to Cascades' Mechanicville facility this past month. Named after the mule in the 1905 song "Low Bridge," recorded after Erie Canal barge traffic moved from mule power to engines, Solar Sal delivered the first-ever cargo transported across the Erie Canal without the use of any fossil fuels. It was powered exclusively by the sun, its solar arrays and the storage capacity of its onboard batteries.

The ship and its virgin voyage were sponsored by The Chamber of Southern Saratoga County, Cascades and Hullspeed® Performance Marine Coatings, and transported four tons of recycled cardboard more than 300 miles.

How efficient is the solar drive?

Professor-emeritus David Borton of Rensselaer Polytechnic Institute designed the system so the vessel actually runs at its peak performance using only half power. Given that the on-board batteries can hold enough charge for an additional 50-mile run after dark, Solar Sal theoretically has no limits for canal usage other than the need for the crew to get a good night's rest.



Making waves. Solar Sal was the first solar electric delivery vessel.

Fast-Charging Stations Are Still in Play

In 2013, car manufacturers such as Audi, BMW, Daimler, Chrysler, Ford, GM, Porsche and Volkswagen began releasing vehicles with fast-charging capabilities, according to the IHS report *The North American and European standard for fast charging is a Combined Charger System (CCS).*

However, that standard is far less popular than the Japanese charging standard CHAdeMO. From 2010 to 2014, IHS expects 7 percent of electric vehicles globally used the CCS charging system, compared to 65 percent that used the CHAdeMO standard. Japan is the global leader in CHAdeMO, with more than 2,800 DC fast charging stations using the standard—more than 50 percent of all CHAdeMO charging stations worldwide.

or semi-public domain in dense urban areas by 2020. DC charging stations are predicted to be much less accessible and located on the outskirts of cities and highway infrastructure.

While growth in countries like Japan may be higher, the rise of electric vehicle chargers in the United States is highly influenced by state initiatives.

"EV charging station deployments are primarily driven at the state level. As an example, the 'greener' states, like California, deploy more EV charging stations than others," said senior analyst at IHS Automotive Ben Scott in the report. "This is highly dependent on the individual state's level of incentives and legislation supporting the adoption of EVs, along with regulations for fuel economy."

The report states installation of EV charging stations also are dependent on price, which are highly variable. An EV charging wall box can cost \$399, while a DC charging stations can cost more than \$35,000—without taking installation costs into account, which can be as high as \$10,000. **GB**

Hybrids Rising

Amid slow electric vehicle growth, U.S. plug-in hybrid electric vehicles increase.

Though electric vehicles have been slow to take off in the U.S. consumer market, plug-in hybrid electric vehicles (PHEV) are becoming more main stream. This year, the IHS report estimates global PHEV production will exceed EV production for the first time. Because they need to be plugged in similar to a true electric vehicle, PHEV's also are contributing to the increase in charging stations.

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FROM THE TAILGATE

New Offerings for the Sustainable Minded

By Ron Jones

No More Excuses

THESE DAYS, THE BULK OF communication and commentary emanating from the predictable homebuilding industry sources, as well as the trade media that pander to those same organizations, appears reflective of a well-choreographed, strategic campaign to rally anyone who will listen to take up arms against the evils of regulation.

If you listen to these folks, it seems as though all the woes of the housing industry can be attributed to the sinister actions of policymakers at every layer of government. According to the chorus of those who believe a vast conspiracy rife with ulterior motives, policymakers exist exclusively to harm the builder's version of "the American dream."

Just about every response to proposed tightening of the rules is the popular mantra employed by these groups: Government "overreach" is strangling the industry and making it impossible for us to house the people of this country. They would have us believe the homebuilding industry should be at the front of the line of those deserving to be self-regulating.

Meanwhile, the public homebuilders are reporting soaring quarterly revenues and robust sales numbers in almost every instance in virtually all parts of the country. Those builders are not reluctant to attribute their successes, at least in part, to efficiencies and sound business decisions. Still, it is interesting that some companies appear to not only be surviving this alleged tsunami of regulation, but thriving and setting new records.

What is glaringly absent from all of this uproar is any acknowledgment, or even suggestion, that what might really be limiting the industry is not completely attributable to external forces. Rather, it may be attributable to the standards to which the industry is willing to hold itself. What you won't hear from the industry establishment is a challenge to builders to take an honest look at our own ethics and those of our competition.

However, not every builder is ready to hide behind the skirts of monotonous trade association rhetoric and excuse making.

On a recent industry-generated article outlining the costs of a new home that can be attributed to regulation, the vast majority of comments posted by readers reflected how successful efforts to place the blame elsewhere can be. However, there was a notable exception, and that lone responder posted the following:



"I'd like to see builders who are responsible with storm water management, land use/preservation, energy-efficient construction and healthier housing get a break/rebate/reduction in regulation related fees. As a builder, I serve clients in the middle class that currently live in housing with \$300 monthly utility bills and moisture issues ... the house was cheaper to buy but harder to keep. I build homes with bills averaging \$60 a month and above-code moisture management strategies ... and I should get a break, since I don't need regulation to build a better home like many of my competitors."

To that builder I want to shout, "thank you!" It is truly a breath of fresh air to hear a fellow builder take responsibility for what he produces and to suggest that we should be seeking rewards for exceeding the minimum requirements, rather than letting others manufacture excuses for us as they endlessly complain and endeavor to drive down our standards of quality and performance. **GB**

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