Electric Auto Association

Current EVents

November 2019 Promoting the use of electric vehicles since 1967 Vol. 51 No. 11

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If you have comments, please send them to ceeditor@electricauto.org

Current EVents Back Issues

The EAA has put most of its issues from 2001 to 2019 on its website.

Please visit
https://electricauto.org and from the home page, click on "*Documents*" in the top navigation bar. You wll see the document library. Click on that to reveal a listing of years (in a folder), which, when selected, will list the issues for each month. In that folder you will be able to download the PDF that contains the issue you choose.

The "Woodstock for EVs"

Trending: Getting Your EV News & Education from YouTubers

By Raejean Fellows, President

Can you imagine a "happening" for electric vehicles? On February 1st and 2nd, thousands of EV enthusiasts and the EV curious will travel from far and wide to Austin, Texas to learn, experience and be entertained by YouTube personalities, electric car "stars" and race car drivers. Over half of the attendees are predicted to travel from out of state. People will stream the show LIVE globally and watch it recorded, on YouTube for years to come. The reach and impact of this show is expected to be epic—like Woodstock, over 50 years ago!

More and more people are getting their EV news from YouTube channels. Fully Charged LIVE has over 500,000 subscribers and a total reach of 1.9M. Other channels like Nikki Gordon-Bloomfield's 'Transport Evolved,' Ben Sullins's 'Teslanomics,' Jesse and Zac's 'Now You Know' and others are gaining bigger and bigger audiences.

There is more and better content becoming available all the time. With the huge numbers of subscribers and Patreon supporters, this is a huge trend. Why is this? My answer would be simply this. They deliver entertainment and outstanding content.

February 1-2, 2020
Fully Charged LIVE! Austin, Texas
Join Electric Auto's team in person or stream LIVE!

As presenters with great personalities –you want to watch and listen to them. They are talented at taking highly technical content and making it understandable to a wider audience, sourcing excellent material which drills down to the salient questions of the day.

They show that electrification of transportation is happening around the globe — and they take us to those places.

When we are entertained as well as educated, the acquired content and knowledge sticks better. We are more engaged and have a more enjoyable, memorable experience. I submit the case for "entertaining to educate" goes one step further. We are more likely to take action. **Buy an electric car. Inspire others to buy an electric car.**

The Entertainment. The Education. One of two theaters is reserved for YouTubers to show off their best material. The main theater will have non-stop presenters and panelists who will look for ways to dynamically engage the

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The Austin Event

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"charged up" audience around the hot topics of the day. Food, music and a festival atmosphere will prevail outside the main venue. The venue is 'Circuit of the Americas,' currently the only Formula One racetrack in the United States.

Electric Auto Association is proud to be a "sponsoring partner" of Fully Charged LIVE Austin, Texas.
Elaine Borseth, EAA Director and Aaron Choate, President Austin EAA Chapter, will head up the EAA's **EV Corral** located outside in the Paddock. The Corral will display some of the top EVs of the day, with owners standing by to chat about their electric drive life and their car.

Chapter Leaders, Dave Hanson from Houston EVA and Doug Duke from Oklahoma EAA will lead groups making the EV road trip to Austin. Inside at the MEGA theater, Russell Corbin, EAA Student Director, and I will join the stage as panelists.

At the EAA booth, our members will engage the attendees to educate and sign them up to our chapters to keep them connected and offer them opportunities to get involved.

Our EV Owner/Educators will give ride-alongs in another area. Attendees will enjoy a display of our members' classic conversions. Dozens of student volunteers from University of Texas will engage the crowds to ensure a high visitor experience.

Want to Attend in Person?

Tickets registration is filling up fast. Sold out attendance is expected.
Get tickets at Fully Charged LIVE! (EventBrite):
Click HERE:
https://fullycharged.show/events/fully-charged-live-north-america

Register and Sign up to Volunteer:

Electric Auto Association site Click HERE:
https://www.electricauto.org/content.aspx?page_id=4002&club_id=222684&item_id=1113909

Why register at the EAA site also? *This is the only way you will be able to see other members you may know who are attending. We are looking to organize a Happy Hour on Friday Evening and a Bar-b-que get together on Sunday. Registering on the EAA site enables us to communicate with you.*

How It Works for Volunteering:

Bring your EV to display or take passengers. Help out in the EV Corral, indoor booth, usher in the theater, check-in and more. All EV Owner/Educators and Volunteers receive ***FREE Admittance.***

A four-hour shift and attendance at an Orientation pre-event call is all we ask. After serving your four-hour shift, you are free to enjoy the event. Free T-shirts supplied!

How to Apply to have *your* EV at Fully Charged LIVE!

We are looking for a variety of late model EVs in excellent condition. Cool conversions welcome.
If you are interested, click on the URL below, log in and fill in the form.
https://www.electricauto.org/content.aspx?page_id=1478&club_id=222684&item_id=2439

Join the fun with us in Austin!

This is a great opportunity to show all that Electric Auto is to the public, especially to grow our numbers of EV Educators in our chapters in Austin, Houston, Dallas, Tulsa OK and throughout the U.S. We welcome your participation—free admittance for displaying your EV and volunteering.

Electric Auto Association

Chapter Membership Drive

Membership starts at only $35/ year.

Contest Dates: October 17th – January 15th

Net Gain Members	Rewards
5	10 EV Educator T-shirts** + 10 "Ask Me" Pins
10	1 Flag + 10 "Ask Me" Pins
15	1 Flag + 15 EV Educator T-shirts**
20	2 Flags + 10 EV Educator T-shirts**
25	2 Flags + 20 "Ask Me" Pins
35	3 Flags + 20 "Ask Me" Pins + 15 EV Educator T-shirts**

*Net Gain New Members = Net increase in paid EAA members as of contest end date at 5 pm
** EV Educator T-shirts have EV EDUCATOR imprinted in navy blue on the back.

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How to track your membership numbers? To learn your starting number, email: membership@ElectricAuto.org
To see your numbers grow, go to chapter map, select your state and chapter, click MEMBERS on the pop-up.

Winners Announced at 2020 EAA Annual Member's Meeting,
January 25, 2020, San Diego, CA
Live streamed and recorded

SAVE THE DATE!
Annual Awards, Board of Director Elections and Meeting

Electric Auto Association Annual Meeting,
Saturday, January 25th, 2020
3980 Sherman St., Suite 170 SD, CA 9-2PM RSVP BELOW

https://eaa-1967.clubexpress.com/content.aspx?page_id=4002&club_id=222684&item_id=1085924

2019 Electric Auto Association Awards

The Electric Auto Association is again honoring the individuals, chapters, organizations, students, advocates, and others who have helped advocate for the transition to electric vehicles with the **EAA 2019 Awards**.

For example, do you know a member or a volunteer who, in 2019, contributed to EAA's mission in an outstanding way? Did their efforts result in ***great market impact?*** Maybe they used ***creativity*** with excellent results in their educating the public. Maybe they helped the chapter reach ***new heights?*** Did they produce a ***Chapter Newsletter*** which is valued by all the members and sharable to more? Are they an ***unsung hero?*** Whatever their actions, if their dedication to our mission of education and ***advocacy for rapid EV adoption*** made a real difference, nominate them for a ***2019 Award.***

It's easy. To nominate a person, chapter or organization for a 2019 Award, simply select an award from the ***eleven EAA 2019 Awards*** listed below, click the link for the applicable Award Application Form, complete it with your reasons for nominating them, press the submit button and that's it! Attaching a photo of a nominee is appreciated, but not required.

Winners will receive an award at the 2020 Electric Auto Association Annual Members' Meeting, Saturday, January 25th in San Diego, which is streamed live and recorded. Winners may also accept their award in a video to be shown at the meeting. They will love the awards!

Details of the 2020 Annual Members Meeting are published on the members only menu tab on http://www.ElectricAuto.org. You must be logged in.

Note: Awards are not limited to EAA Members, although some preference will be given. An award winner is considered to be a member at the time of award ceremony, January 25, 2020.

Deadline for nominations: December 20, 2019. Don't delay—Nominate Today!

EAA's 2019 Award Categories

Recognize the outstanding work of an EV Educator you know by nominating them today!

1. EAA's Most Valuable Player (MVP) Award

Recognizing the person you believe has shown the most outstanding chapter leadership in 2019, helping our EV Educators in their quest to educate the public in the benefits of electric drive in 2019.
Number of Awards. (3) East, Midwest, West
Award Application Form. http://bit.ly/MVP_Award

2. EAA's Woman of the Year in Electric Vehicles Award

Recognizing the woman continuously displaying outstanding work in public awareness and education resulting in a significant impact in our chapters and the EV marketplace over the last couple of years.
Award Application Form. http://bit.ly/EAA_Woman_of_the_Year

continued next page

3. EAA's Man of the Year in Electric Vehicles Award
Recognizing the man continuously displaying outstanding work in public awareness and education resulting in a significant impact in our chapters and the EV marketplace over the last couple of years.
Award Application Form. http://bit.ly/EAA_Man_of_The_Year

4. EAA's EV Road Tripper Ambassador Award
The member who, during 2019, has driven the most miles in an EV, particularly on trips, educating the public and community leaders on the need for a charging infrastructure.
Award Application Form. http://bit.ly/EAA_EV_Roadtripper_Ambassador

5. EAA's EV Journey Award
Recognizing the most innovative, interesting and impactful field or road trip made or lead by a member in 2019. Award Application Form. http://bit.ly/EAA_EV_Journey

6. EAA's Best Music Video Award
The electric vehicle-related music video with most outstanding entertainment and educational impact.
Award Application Form. http://bit.ly/EAA_Best_Music_Video

7. EAA's Best Educational Video Award
Recognizing the educational video with most outstanding market impact on EV adoption.
Award Application Form. http://bit.ly/EAA_Best_Educational_Video

8. EAA's Best EV-Related Photo Award
Recognizing the most outstanding EV-related image of 2019.
Award Application Form. http://bit.ly/EAA_Best_EV-Related_Photo

9. EAA's EV Entrepreneur of the Year Award
Recognizing the EV entrepreneur who has had the most positive impact on our chapters/members and in the EV marketplace.
Award Application Form. http://bit.ly/EAA_EV_Entrepreneur_of_the_Year

10. EAA's Student of the Year Awards - Young Man, Young Woman
Recognizing the students (one young man and one young woman) who have had the most positive impact in the EV marketplace in 2019.
Number of Awards. Two. Award Application Form. http://bit.ly/EAA_Student_of_the_Year

11. Organization with Best Media/Advertising Campaign for EVs
Recognizing the organization creating an outstanding promotion attracting positive attention and communicating the most impactful messaging around EVs.
Award Application Form. http://bit.ly/EAA_Media_or_Advertising_Organization_of_the_Year

Tim Benford
President, EAA's Drive Electric Dayton Chapter
Member of EAA Board of Directors
(https://electricauto.org)
EV Ambassador, Drive Electric Ohio
(http://bit.ly/Drive_Electric_Ohio)
Drive Electric Dayton
(http://bit.ly/Drive_Electric_Dayton)
Cell: (937) 604-3158
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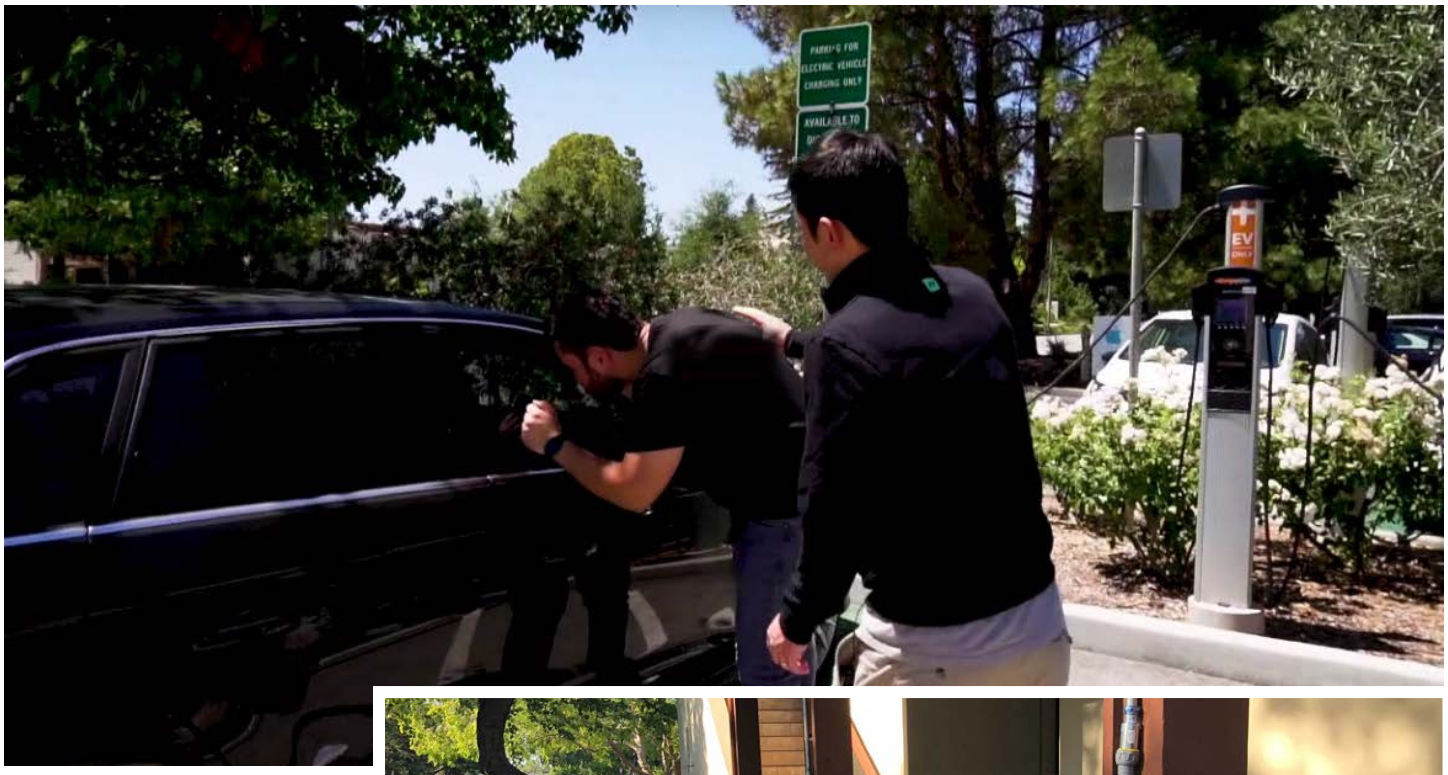
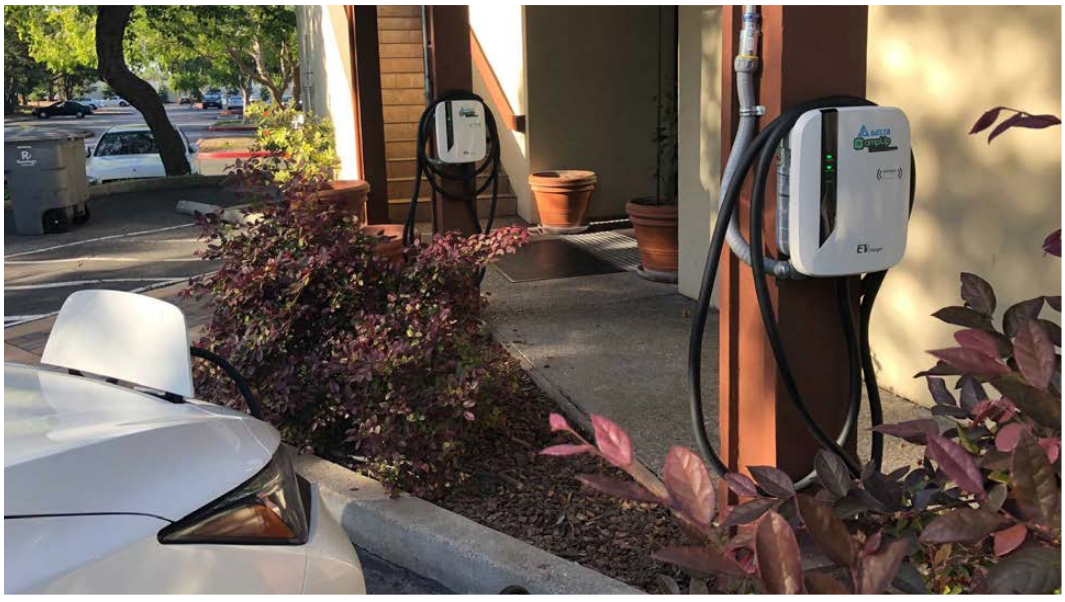
Your generous donations are vital to supporting our activities.

ampUp's Mission: To Increase EV Adoption, One Shared Charger At A Time





By: Tom Moloughney

The AirBnB of charging stations?

"Knock, knock… how much longer do you need to stay at this charging station?", another 30 minutes or so, the other person replies. Tom gets back to his EV and looks for another station. Most EV drivers face these challenges frequently. How is Tom different? He decided to do something about it.

Tom Sun is a typical bootstrapped entrepreneur. He started NAD Grip Corp in 2018, a peer-to-peer blockchain-based electricity trading company. With a zero dollar salary, Tom decided to get an EV, the 2018 Nissan Leaf, to reduce his driving costs. When the electrician came to his older Bay Area home, the quote was more than $3,000 for a home charger – an amount Tom couldn't afford at the time. NAD Grid didn't have workplace charging at that time, so Tom became a charging nomad. He tried other peer-to-peer charging platforms and had some nice experiences, but a host offering their WiFi password so Tom could work while his car was charging was not enough. More often, the experience was frustrating, such as forgetting to bring cash to pay for charging.

After countless EV charging challenges,

continued next page

Tom decided to pivot from NAD Grid and switch to P2P electricity on wheels. ampUp was born. Tom took ampUp through the YCombinator incubation program, and with guidance from AirBnB and other mentors, the app was released on iOS and Android in April 2019.

So what is ampUp?

ampUp is a mobile app that allows EV drivers to find, reserve, and charge their vehicles on a shared network of public and private chargers. ampUp exists to support the EV driving community. Many people are in Tom's shoes – they don't have access to home charging. Maybe their landlord doesn't allow changes to the home, or the home-owners association is challenging to work with. ampUp is working hard to demonstrate that anyone can own and drive an EV. While other players already exist in the EV charging space, Tom created ampUp to make the EV charging space truly simple and convenient for the average person.

"The user experience is important for ampUp. When trying other charging apps, they felt analog and clunky. Being born out of the Silicon Valley technology ecosystem, we realized that our users have high expectations. The baseline user experience bar is set high by companies such as Waze, Uber, Robinhood, and Slack. This is the bar that we continuously set at ampUp. We waited for six months before reaching out to the general EV driving community because we wanted to be sure that the app works smoothly."

How does ampUp work?

The ampUp premise is simple – in roughly 20 seconds a user can find, reserve, and pay for charging via the app. The EV driver doesn't need to worry if someone else will be charging, as the spot is reserved during the period designated by the driver. ampUp also allows charger hosts to earn money back on their investment. In less than one minute a host can list their charger, select the price, and set specific hours and days their charger is available.

Now that ampUp feels comfortable with the base functionalities of their platform, they are developing new and exciting features they will be sharing over the next few months.

https://insideevs.com/features/380026/ampup-charger-sharing-service-introduction/

MATTHEW CHAN, M.D.

Self-described Tesla superfan Matthew Chan always wanted to meet some of the key people behind the electric car maker. When the cancer patient's wish came true early in January, 2018 with a visit to the company's factory in California, he got even more than he bargained for. Not only did he go on a tour and meet Tesla's top car designer, he also came face-to-face with CEO and co-founder Elon Musk. It all started when Chan's close friend Alan Miller shared a post on a couple of Tesla (TSLA) forums.

"My best friend from medical school, Matthew Chan, is a 39 year old radiologist in Sacramento with three kids who was just diagnosed with stage 4 colon cancer," he wrote.

Chan — along with his sister, brother-and-law and Miller — got to go to Tesla's factory in Fremont, California, where their visit turned out to be even more memorable than they were expecting. Not only did Chan and his family get a "VIP" factory tour and then an hour-long sit-down with von Holzhausen. He also had a chance to meet Elon Musk.

During Matthew Chan's school years at UC Davis, his friends relied on him as the "go-to" guy to answer questions about the technology of the day. If you wanted to know about the functions of your personal digital assistant, how to use your dial-up modem to log onto an online BBS bulletin board or the early Internet, or you wanted to know the best deals on computers, software and other electronics, you asked Matt.

Matthew and his wife Eva owned two electric vehicles, and almost 100 percent of their driving since mid-2013 had been electrically powered. They never had to pay for 'gas' because his home has solar panels.

While not all health providers may have his passion for things electronic, Chan encouraged medical students as well as his fellow medical school alumni to keep pace with technological developments in their disciplines by seeking out opportunities to demo new equipment and software; embracing smartphones and tablets in the clinical setting; and taking advantage of the wealth of online medical resources. He was an advocate of Electric Vehicles and a member of the SacEVA organization. He contributed regularly to our facebook page along with juggling his schedule to show his solar powered EV to visitors.
Rest in Peace.

https://health.ucdavis.edu/ucdavismedicine/issues/fall2015/alumni/spotlight.html
https://money.cnn.com/2018/01/26/technology/elon-musk-tesla-matthew-chan/index.html

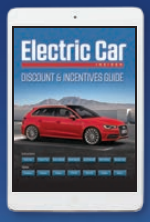
EV Educational Resources

for Individuals, Groups and Organizations

Electric Car INSIDER

EV Buyers Guide

Compare electric cars with comprehensive full page profiles



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Save thousands of dollars on EV purchases and leases

Educational Exhibits

Large scale interactive exhibits for indoor and outoor events

Electric Car Guest Drive

Test drive the latest EVs and learn from EV owners

EV Navigator

Activity framework to guide prospective EV drivers on the path to EV ownership and advocacy

ECI creates educational resources to promote EV adoption from awareness to advocacy. Email or call us for a complete catalog of products and current pricing.

sales@electric-car-insider.com **619-337-4589**

Is the Mustang Mach-E a Ford Killer?

By Frugal Moogal

No, that's not a typo. As I watched he reveal last tonight, I was curious about how the Mustang Mach-E is going to be positioned within the Ford lineup, and after some time looking into it more, I find this new pony to be an incredible business risk to Ford.

If you regularly read my articles, this may seem odd, because it appears to be the opposite of my analysis that the market has been embracing electric cars, but it really isn't. I don't think that the Mustang Mach-E is a potential "Ford Killer" because it isn't good enough, but because I wonder exactly how ready Ford is to make this shift.

Before going on, it struck me last night that Ford is going to make this change one way or another. On my end, the process started with Ford advertising its nearly non-existent electric car line up to me the past few months, and was followed by Ford rolling out what I think is the most impressive non-Tesla electric car that the market has seen so far. The Mustang Mach-E looks like an outstanding electric car.

And that's the difficulty. There seems to be this belief among many stock analysts that electric vehicles are a specific "segment" of the market. Like, you go in looking to get a gasoline SUV or an electric car, and those two things don't really cross over. This, perhaps more than anything else, is what makes me feel like traditional stock analysts really have no understanding of the current market trends.

I went electric once I figured out the price, maintenance, and time savings of a used Nissan Leaf. I fell in love with the instant torque and the silence of the drivetrain. My family bought a Tesla Model 3 as our second car because, even though it was more expensive*, it allowed us to enjoy all of the benefits of electric propulsion with a long-range travel network. (*As a complete aside, I have claimed on here that based on the way I calculate things, getting a Tesla Model 3 is saving me money. I still believe that, and will at some point write an article about why.)

These two cars replaced gas cars. Additionally, since purchasing my Leaf, talking about it with others has resulted in no less than five people who I know purchasing used Leafs in the past two

continued next page

years. Every one of them reports that they absolutely love the car, and every one of them states that they will never buy another gas car due to all the other benefits.

Why am I talking about this with regards to the Mustang Mach-E? Because this is the first time that a legacy automaker has introduced and pushed a major electric vehicle like this.

If, as you're reading this, you're thinking, "Wait — you just mentioned the Leaf, and you're overlooking the Bolt." I disagree. I love our Leaf. I have test driven a Bolt, and other than the dealership flat out telling me it would be a bad decision to get one because, 'you can't go anywhere with an electric car' (yes, seriously), it seemed like a nice car too. But, the Leaf and Bolt remind me of extremely similar gas cars made by those same manufacturers — the $15,650 Versa Note hatchback and $13,220 Spark, respectively — except those are both less than half the cost of the electric version.

The Mustang Mach-E is not that at all. It's similar in size to the Ford Escape, which starts at $24,885, nearly double the price of the gas cars I noted above. The entry-level Mustang Mach-E, including the $7,500 tax credit, starts at $36,395. While an $11,510 difference is still major, let's compare that to the other two cars I've mentioned. The Leaf, with full tax credit, is $6,840 more expensive than its gas counterpart — and quite frankly should be more competitive with it. The Bolt is a whopping $21,525 more than the Spark.

The Leaf and Bolt, especially in America, haven't been huge sellers for their brands. The Leaf I think is hurt by abysmal used car costs, subpar range, and unimpressive battery technology; the Bolt because it's simply way too expensive.

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EV Mustang

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The Mustang Mach-E appears like it could be a huge seller for Ford, is comparable to one of Ford's best selling models, and doesn't carry an insane price difference. And, unlike Nissan and Chevy, which barely advertise their electric offerings, it appears like Ford is serious about this one, which started with this commercial being shown to me regularly on Facebook a couple recently. [See the video in the article.]

Clean Technica Editor's note: I'm going to add a note that I think closes Frugal's argument — wrapping it in some points that I think are just being underemphasized a bit. The LEAF and Bolt are much better than those comparable gas models he mentions, and they do come with top features for a Nissan or Chevy. However, you would never guess that from the outside and there's almost no way for a normal consumer to learn these things. Dealers are not going to bring it up while someone is looking at gas models, ads are sparse, and the vehicles do not call out for attention.

The Ford Mustang Mach-E, however, is impressively and immediately thrown into a different category – even before you see it. Ford granted it the company's prestigious, iconic Mustang branding, though in a "Mach-E" label that sounds exciting and special. This is a Mustang, but no ordinary Mustang! Furthermore, Ford took some serious risks making a Mustang that's a crossover, but it's obvious why. People want crossovers. This is a positive thing. Ford is saying, we're the same old awesome Ford, but we're ready for the 2020s with an electric crossover that is sporty, high tech, and the future of the company. This inspires and Frugal and I clearly think it is going to pull in customers far more than the Bolt or LEAF did, for Chevy and Nissan. Ford is basically putting everything it has into this electric offering, and it shows. That compels and warrants a higher price tag. I think it is somewhat obvious to a normal consumer that the Mustang Mach-E has a higher price than the Ford Escape because it's a much better vehicle. Anyway, back to Frugal …

We've gone over 750 words now (minus the editor's note), and it seems like I'm extremely positive about the Mustang Mach-E. And to be clear, I am — unless Tesla surprises me and is planning to start CYBRTRCK production next year, I expect that the Mustang Mach-E will be the most important new electric vehicle in 2020, even surpassing the Tesla Model Y.

And therein lies the problem. When consumers start to see commercials like this, it starts to make them question their current purchases, and whether those purchases will be obsolete sooner than later. The effect is often called the Osborne effect thanks to the history of the Osborne Computer Corporation, which started publicity for a new computer that it was producing in 1983 months in advance of its release. Dealers were rumored to have canceled their orders for the existing product in droves, leaving the company with tons of unsold inventory and leading to it declaring bankruptcy in 1983.

This is where it's about to get interesting for Ford. Not just is the Mustang Mach-E an impressive car, but it has a ton of features that were clearly inspired by Tesla, including a phone app with lots of controls, passive phone entry, and over-the-air software updates to improve the user experience. These are selling points of the Mustang Mach-E, and everyone who I know who has seen them on a Tesla raves about them.

The problem? Nothing else that Ford has includes these features. Maybe you aren't ready to spend the additional money to get a Mustang Mach-E, but it's pretty clear that "Ford electric vehicles are coming," so maybe it's worth waiting a few months or an extra year to see what else they come out with. The strong rumor is the electric F-150, which Ford has also more or less started to advertise, will debut as a 2021 model … which is more interesting when you look at the Mustang Mach-E on the Ford site and realize that it is listed as a 2021 model.

continue next page

Debuting both of these cars at the same time with a hard pivot to electric is a fascinating strategy and, quite frankly, the only way I expect legacy auto to be able to make the transition, but it is fraught with risk, and I see one more major risk for Ford.

On paper, it appears that the Mustang Mach-E and the Tesla Model Y are going to be extremely similar. Standard range on the Mustang Mach-E is expected to be 230 miles, the same as Tesla expects for the Model Y Standard Range. The all-wheel-drive extended-range Mustang Mach-E is expected to get 270 miles of range, very comparable to the Model Y Long Range's 280 miles.

The difference is in how they do it, though. The standard-range Mustang Mach-E sports a 75.7 kWh battery, which is a whopping 25.7 kWh larger than a Tesla Model Y Standard Range. The extended-range Mach-E takes an extra 23.8 kWh of battery to go as far as it's going to go.

Even if we go off the recent reports from Volkswagen that it is buying batteries under $100 per kWh, we're looking at an additional cost in the thousands of dollars for the batteries. At first, I found it difficult to understand how Ford would make up the difference in money, until I realized that the Mustang Mach-E Premium is still a standard-range vehicle for $50,600. Extending your range will be another $5,000, meaning a long-range Mustang Mach-E will cost $55,600 compared to Tesla's $48,000 for the Model Y Long Range. After the tax incentive, the pricing will be nearly the same.

This is where I assume that Tesla still has a pretty massive advantage. Tesla is able to use ~25% less battery capacity to make its vehicles go the same distance. Add to that Tesla selling its vehicles directly to customers, avoiding the dealership model that Ford is forced to use, and that shaves off an estimated $2,367 more. (If you're wondering where I pulled that number, I found this fascinating Quora post a while ago and bookmarked it — look for the second answer by David.)

Combined, I expect Ford to be paying minimally $5,000 more than Tesla for each Mustang Mach-E it sells. Based on Chevy's continued statements about how it isn't making any money on the Bolt, it makes me wonder if there is any room for profit in Ford's model.

If there isn't, or even if there is but it isn't a decent profit, if the Mustang Mach-E and the advertising around it lead to a drop in sales of other Ford vehicles, Ford could be in serious trouble. In September, Ford's credit rating was downgraded by Moody's to junk status. It's worth noting here that Tesla's credit rating by Moody's is actually worse than Ford's, but I view Ford's debt as a bigger problem.

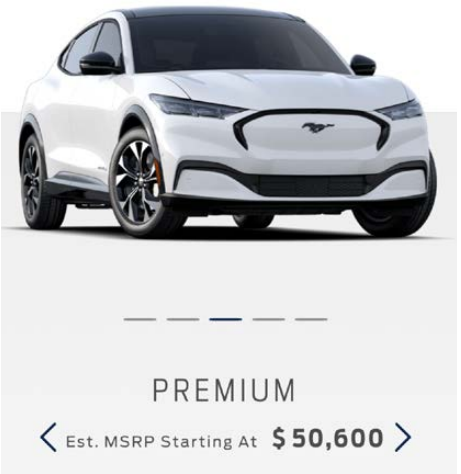
Ford carries around $100 billion of debt globally. A significant amount of that debt is tied up in internal combustion vehicle assets. *If the Mustang Mach-E kickstarts the electric revolution, Ford could face the very real prospect that those assets would be essentially stranded, in turn making it far more difficult to service the company's debt.*

This is the difficulty with any legacy automakers facing this transition. Their value is largely based on perceived value of assets that may not have any value, which is why I've felt like the Leaf and Bolt were purposely made to be not overly appealing. The problem is Tesla continues to create vehicles that are compelling compared against all other cars in their price range, regardless of propulsion method, and then is doubling down by creating and updating the most advanced tech package in the industry.

In doing so, the Model 3 captured over 1% of the US auto market share by itself. If the Model Y sells double what the Model 3 does, it's plausible that Tesla could hold 3% of the market with just two models, and that's without having advertised.

It appears that Ford is the first major legacy automaker to understand what this could mean for the company, and the Mustang Mach-E looks like an outstanding vehicle ready to truly compete against Tesla's offerings. If Ford continues pushing electric cars in commercials like the one above, and if Ford moves forward with an electric Ford F-150 for model year 2021, we could very rapidly see an increasing awareness of the arrival of electric vehicles industrywide.

What does that mean for the rest of the auto industry? And what does that mean for Ford? Can Ford survive this shift with its current debt level and product lineup? The auto industry is about to get incredibly interesting

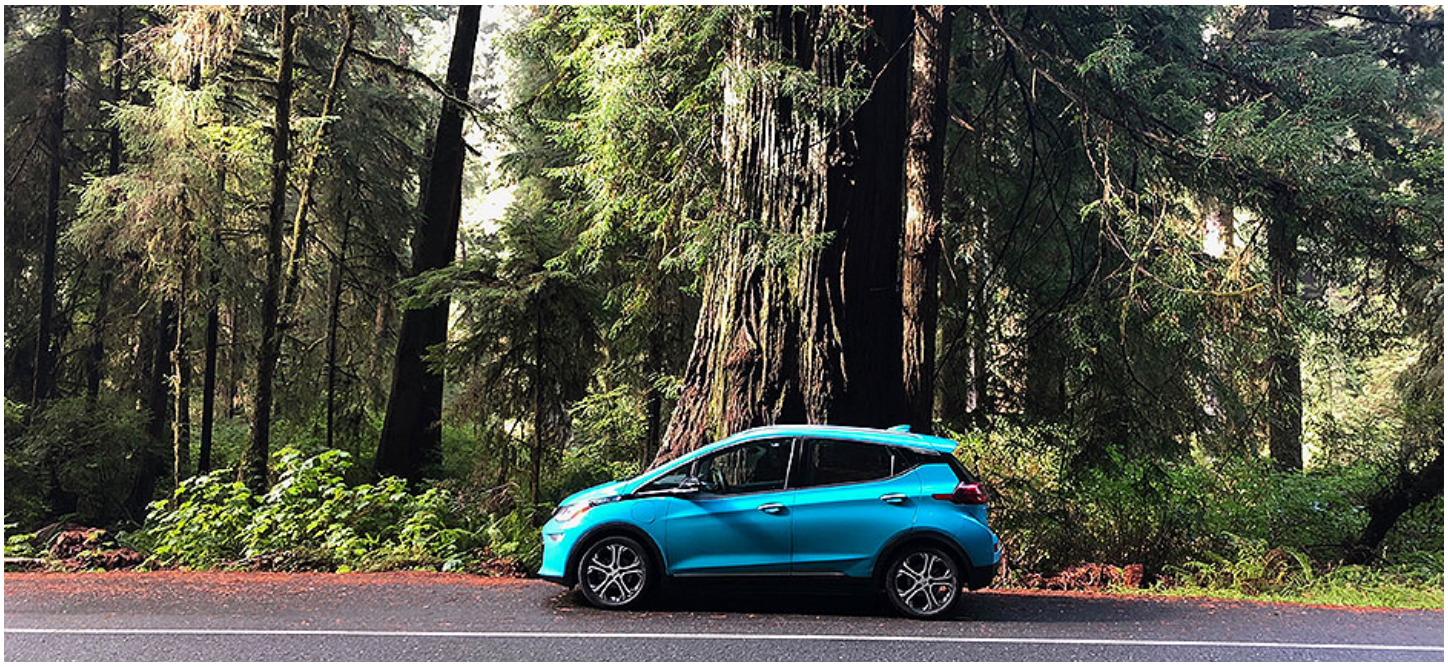


For information on Ford's charging plans, click here.

https://cleantechnica.com/2019/11/18/is-the-mustang-mach-e-a-ford-killer/

What We Learned On the Electric Road Trip

After two crazy months, we're done. An 8,000-mile journey in an electric car



The all-electric Chevrolet Bolt rests under a California redwood during the final stretch of E&E News' cross-country Electric Road Trip. David Ferris/E&E News

By David Ferris, E&E News reporter

After two crazy months, we're done. The reporters of E&E News have completed the Electric Road Trip, an 8,000-mile journey in an electric car and an investigation into how electric transportation will change America. What did we learn?

By interviewing dozens of people, driving a total of six cars and gathering many streams of data, we have a mountain of perspective. We even drove 2,000 miles more than we first planned. Our reporters wrote postcards from gas stations in Houston, a bus factory in South Carolina, the damp curbsides of Seattle, and a futuristic charging station in California.

Virtually every major automaker has dedicated billions of dollars to developing electric models on various timelines. Meanwhile, America's patchwork of charging stations is growing and changing.

From our many miles of reporting, patterns emerge. Here we present the dominant themes.

The charging 'network' needs a lot of work

The most common question we got was about the kinds of cars we were driving. But the essential, frustrating question that we confronted every day was: Where are we fueling?

This question sprang up everywhere because the charging stations could appear anywhere. Their locations seemed to follow no logic. Why does the Holiday Inn in downtown Columbus, Ohio, have a charging station, but not the Sheraton or the Marriott? Why is the charger we used in Eugene, Ore., a long walk from anyplace to stay or eat? Why does the impoverished agricultural hamlet of Huron, Calif., have almost as many chargers as the entire city of Memphis, Tenn.?

Experts talk about the need for a robust national EV charging system. What we found, however, didn't resemble the kinds of networks that Americans are most familiar with. Verizon built a national network of cellular service. The federal government built a network of interstate highways. In both examples, one entity spread a network far and wide.

With the exception of Tesla Inc.'s supercharging stations that are only for Teslas, and Volkswagen's Electrify America network of chargers, which is still skeletal, or regional networks like the one around Portland, Ore., today's charging stations are more of a crazy quilt.

Most fueling stations are where they are for the simple reason that somebody put them there. Charging infrastructure, like politics, is local.

continued next page

We found new charging stations in downtown Detroit because the utility, DTE Energy Co., along with its partners, resolved to build them. The utility in Memphis has no such charging stations. We recharged at the Chevrolet dealership in Cedar Rapids, Iowa, because the dealer put a station there. The Honda and Lincoln dealers did not. We got a quick fill-up in tiny Hope, Ark., because Walmart has a station there. Most of the Walmarts in Little Rock do not.

Sometimes we could trace the charger directly to local advocates. In Bismarck, N.D., we charged in the parking lot of the Lignite Energy Council, a coal advocacy group that has become the state's leading cheerleader for electric cars. In Huron, in California's Central Valley, we learned that a dozen chargers were built in three adjoining apartment complexes — none of which had a single EV driver — because one activist, Ray León, made a proposal for EV charging stations at the same time that Electrify America was required to spend money on rural chargers as part of a legal settlement after VW's diesel emissions cheating scandal.

The lesson we drew is that the charging network of today is the result of local initiative and leadership. If those leaders change their minds, or if leaders in other places don't step up, the electric future will be a lot longer in coming.

It's possible that centrally planned networks will become the norm. General Motors Co. has said it is building a nationwide network of charging stations with the engineering firm Bechtel, and VW's Electrify America is required to keep investing in chargers until 2027. Regional efforts are coming into focus, like the one that the CEO of utility giant Xcel Energy told us about.

An all-electric Kia and the Lignite Energy Council's Tesla Model X charge at the group's headquarters in Bismarck, N.D., under a sign that reminds drivers that they're charging up "with homegrown North Dakota energy." David Ferris/E&E News

Still, the patchwork of charging stations that we encountered isn't the foundation on which an electric car revolution can easily be built. It is fragmented and haphazard, awaiting incentives to make it better.

The big trends in jobs and manufacturing

So what did we think about the electric cars we drove? The cars were great, but we have some big questions about what their manufacturing means for the future of the U.S. economy.

The models we drove for days on end — the Kia Niro, the Chevy Bolt and the Tesla Model 3 — ended up feeling surprisingly normal, though faster and more agile because of the electric motor's instant torque. "I got behind the wheel and was completely at home," said our reporter Mike Lee, who drove the Kia from Houston to Nashville.

Our takeaway is that the auto industry is capable of building a car that is as good or better to drive than one with an internal combustion engine. But what about the auto industry that makes those cars? How will electrification, the biggest change to auto manufacturing in a century, affect factories and manufacturing jobs? There, we found a picture that is both promising and threatening.

Let's start with the base material of any electric car: lithium, the critical mineral in its lithium-ion battery. On a visit to the California desert, we learned that a huge supply of lithium underlies the Salton Sea, one of the poorest areas in California. We reported how it could be the foundation for a new clean energy manufacturing hub.

Looking further up the supply chain, we saw signs of traumatic change.

Take the forging industry, which makes 107 parts in the traditional Chrysler Pacifica minivan. An EV has one-sixth the number of parts. The transition to electric transportation could spell doom for suppliers, we reported. It is a wave likely to hit small supply shops hardest. They lack the resources to buy their way into the electric vehicle supply chain, like the big, multinational suppliers are already doing.

Meanwhile, we found that the larger auto industry is being tugged into the orbit of Silicon Valley. The move to make cars electric, along with automated and shared, is making cars

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E&E WrapUp

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into smartphones on wheels — and the auto industry into the Valley's latest target for disruption.

Other visits also turned our heads. For example, in Georgia we were surprised by the scale and vision of SK Innovation, which is building a $1.7 billion battery manufacturing plant outside of Atlanta to supply automakers in the U.S. Southeast.

It is, strangely, a manufacturing story in which America is something of a bystander. The plant is being built by a South Korean conglomerate to supply mostly European and Asian automakers that have factories in the Southeast. Still, it is concrete evidence that other countries, at least, see a growing demand for electric cars in the United States.

A more traditional American story seemed to be ripening in Normal, Ill. We reported how Rivian, a new domestic electric truck maker, swooped in and bought a shuttered Mitsubishi plant weeks before it was to be demolished, giving the entire city a sense of hope. But we also told the story of how that same hope has drained from Mishawaka, Ind., where the Chinese automaker SF Motors put its EV manufacturing plan on ice.

In sum, we learned that as EVs start to become a manufacturing reality, they will create an auto supply chain very different than the one we know today.

Don't compare a battery to a gas tank

Our blog posts are full of ways in which we compared batteries to gas tanks, and gas stations to charging stations. But when we actually tried to drive an electric car over long distances like a gas-powered one, we ran into trouble.

The worst was the near-disaster en route from Minneapolis to Fergus Falls, Minn. Excited to be at the outset of a journey, we drove too fast, drained the battery, and instead of arriving comfortably, almost ended up stranded on the shoulder of Interstate 94 in the rain.

Many drivers have had a close call with the gas tank near empty, but this was different.

Driving a gas-powered car too fast has few consequences, as long as you avoid the highway patrol. You stop at a gas station sooner. The stop takes five minutes. You probably spend more on gas.

Do the same in an EV, and the consequences are greater. Charging stations are infrequent, upping your odds of being stranded. The stop will take you half an hour, if you're lucky to find a fast-charging station. (In this case, we limped into Fergus Falls with 2% battery remaining, and while the battery took three hours at a slow charger, we found refuge in a brewery.)

Despite these drawbacks, we don't conclude that electric cars are inferior to their gas counterparts. The reason? We kept meeting scientists and engineers who were working on innovations that could drastically tilt the playing field.

We stopped at two national laboratories where, the battery researchers kept reminding us, their mission is to make batteries cheap enough to compete with gas-powered counterparts. At Oak Ridge National Laboratory in Tennessee, we met Burak Ozpineci, whose team is exploring the possibilities of embedding wireless chargers in roads. This could mean never needing to stop to fuel at all. "You never have to plug in anything. You just drive," he said.

And at Pacific Northwest National Laboratory in Richland, Wash., we arrived the very week its scientists announced a discovery that explains why lithium-ion batteries degrade.

Such breakthroughs are unlikely in the century-old practice of gas fueling. Chevron probably won't start beaming gasoline into the car without a nozzle. The size of gas tank you have today will probably not, in the future, carry you dozens or hundreds of miles farther than it does now. But such strides are real possibilities in the young business of electric cars.

Our guess is that, a few years from now, comparing a charging station to a gas station will be a quaint analogy.

So is America ready for electric vehicles?

One thing that surprised us on the Electric Road Trip was how curious people were. As political reporters, we expected to find people, especially in red states, who met the idea of EVs with hostility or saw them as a threat to their way of life. But instead, we found that minds were open.

We met Adam Nelson, a Ford dealer in Dickinson, N.D., who sells almost entirely big F-250 and F-350 trucks. He was mulling an offer from Ford to sell all-electric vehicles. "I've been thinking about this a lot recently," he said.

We met with workers at Volkswagen's manufacturing plant in Chattanooga, Tenn., and told them about how electric cars could erase manufacturing jobs because their simpler assemblies require fewer hands. One worker was enthusiastic anyway.

"I think it'll take off," said Keri Menendez. "So I'm excited. I'm looking forward to it."

continued on next page

We spoke to an auto dealer in Montana who thought EVs would never conquer America's rugged rural spaces, and another who considered them a threat to his service business. But these views were the exception.

What we were left with, after 8,000 miles and almost two months behind the wheels of electric cars, was a collective sense that their spread is inevitable.

True, the charging network is a fragment of what it needs to be. The cars are too expensive, and the batteries don't take you far enough. It takes too long to recharge when you get there. But after zipping through traffic in these vehicles, and examining nearly every facet of the future EV ecosystem, none of us looked back on the experience and said, "Nah, not gonna happen."

I keep coming back to the experience of driving across North Dakota.

It's the hardest state to cross because it has almost no charging stations, and so we conserved battery life by driving at 53 mph. The legal limit was 75 mph, and gas-powered trucks thundered past all the time.

But eventually, creeping along under the wide skies, we made it to the Montana state line. In the same way, we conclude that electric vehicles will achieve wide acceptance. They may come more slowly than many want, and not everywhere at once, and with some bone-jarring dislocations in the economy, and most importantly, not soon enough to stave off many of the harms of climate change.

But they're coming.

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Email: dferris@eenews.net

https://us19.campaign-archive.com/?e=d53d0440c5&u=2518fc9f47c32446afc12e0b9&id=2de9095c0d

How Electric Cars Will Change Driving and the Economy

Heard on All Things Considered
NPR's Mary Louise Kelly talks with ***E&E News reporter David Ferris,*** *who's part of a team traveling the country in electric cars to learn how the vehicles will change driving as well as the economy.*

MARY LOUISE KELLY, HOST: Six thousand miles through 17 states — now, that would be an ambitious road trip for anyone. It's an especially ambitious undertaking for the team of reporters who are driving that entire route in electric cars. To explain, we're joined by the leader of the pack. That's reporter *David Ferris of E&E News*, an online news site that covers energy and environmental issues David Ferris, how you doing?

DAVID FERRIS: I'm doing well.
KELLY: Good. So I want to get in just a second to where exactly on this road trip we've reached you. But start with the why. What is your team hoping to accomplish with this? It's a two-month-long road trip, is that right?

FERRIS It is two months.

KELLY: OK.

FERRIS: Well, we're in an interesting interval with electric cars. I think they've been kind of a geeky science project. And now we know that automakers are devoting billions of dollars to building these cars. And we thought it was the right time to inform ourselves, not just to what it's like to be in the car, not just to what it's like to fuel to charge the car but actually how it's going to affect the whole economy — manufacturing, cities, jobs.

KELLY: So your team began this whole journey in Texas about a month ago. Y'all are tag-teaming as you go. I know...
FERRIS: Exactly.

KELLY: ...At first, people started through southern states. Then you turned north. You went through Detroit, which I'm sure was fascinating. And then you took over on Sunday. Where exactly have we found you?

FERRIS: You're talking to me in Dickinson, N.D. This is the single-hardest leg of the trip because North Dakota has less charging, less fueling infrastructure than any place in the country. And so I've been learning some hard lessons about how to manage an electric car when there's almost no place to fuel.

KELLY: That sounds intriguing. Have you had any close calls where you were stranded on the side of the road?

FERRIS: Yes. So I left Minneapolis on Sunday. And I know I'm not going to make my destination to Fargo when I have to stop in this little town called Fergus Falls. And I know I have enough battery to get there. So I'm going down the road enjoying myself, really windy day, and I'm going along and I'm noticing that the cushion, the difference between how many miles the car tells me I can go and the number of miles I actually need to go, it's narrowing. So I'm like, maybe, I should ease it off. I'll go to 65. Night's falling. It's raining. And I have no other options because there's just simply — unless I begged with someone to plug into their dryer outlet, there's nowhere to charge. And so I finally end up limping off the interstate into this town of Fergus Falls and ease into the brewery, which, it turns out, is one of the only two places to charge.

Read the rest of the transcript **(or listen to their 4 minute podcast)** at: *https://n.pr/2rcJHqL*

Can Electric Motorcycles Prevail? This Maker Says Yes

By David Ferris, E&E News reporter
Electric motorcycles are nimble, quick off the line — and hard to sell. One of the few pure-electric motorcycle makers is Zero Motorcycles, based in Scotts Valley, near the coastal California town of Santa Cruz.

I visited the factory because recent events piqued my curiosity. Electric motorcycles have come to wider attention with this summer's rollout of the Harley-Davidson LiveWire, that giant's first foray into electric vehicles.

Harley started its electric journey in 2014. Zero was founded all the way back in 2006.

Zero's office is nestled among firs. Inside, the factory is painted white and everyone wears black. Heavy metal is on the speakers and motorcycle helmets are on lots of desks. No Tesla robots here; everything is built by hand.

"We put more people on electric motorcycles than all of our competitors combined," said Dan Quick, the company's spokesman, as he showed me around. (Zero doesn't release sales figures, but Quick said at full capacity this floor could make 10,000 units a year.)

One reason for Zero's dominance is that its competitors have gone out of business.

Two pure-electric rivals, Brammo of Oregon and Alta Motors of San Francisco, failed to thrive and were sold to bigger companies, never to be heard from again. Lightning Motorcycles, a small-batch factory nearby in San Jose, is one of the only ones left.

Some people rave about the quiet, darting performance of electric motorcycles (so they say; I'm not a rider.) The instant torque is a blast, and the electric drivetrain can be precisely tuned with software, creating an experience that a gas-powered cycle can't match.

Zero Motorcycles, based in Scotts Valley, CA, near the coastal city of Santa Cruz, is one of just a few all-electric motorcycle companies. David Ferris/E&E News

The problem is range. Zero's premium model, the SR/F, goes 161 miles on a charge; the others top out around 90 miles, and the charging stations are still few.

The company's motorhead vibe belies the complexity of what it has created.

"From a technology standpoint, we are three different companies. We are a software company, we are an industrial manufacturing organization, and we're an EV company," Quick said.

Almost every component Zero uses is custom, because its product is such a departure that off-the-shelf parts don't work. It designed its own cells and battery packs, with higher power density than electric passenger cars.

Zero is also finding customers among different kinds of machines that need precision electric motors. For example, it received an order from Duke Energy Corp. in North Carolina, to move the cherry-picker arms it uses to repair power lines.

While the ranks of small competitors have been thinned, Zero will face stiff competition from the incumbents. Harley-Davidson says the LiveWire is just the first of a new line of electric motorcycles. Polaris Inc. has signaled that it will relaunch the classic Indian Motorcycle line as electric.

"We are where Tesla was a few years ago," Quick said.

Tesla is the leader of the electric sports car category but may not be for long, as brands like Audi and Jaguar ramp up. "There's going to be a point where all the large manufacturers of the world will simply have more resources than us to throw at the problem," he concluded.

Zero sits on the outer boundary of Silicon Valley, where startups can dazzle or perish. Time will tell which fate awaits Zero.

https://www.eenews.net/roadtrip/1061373607

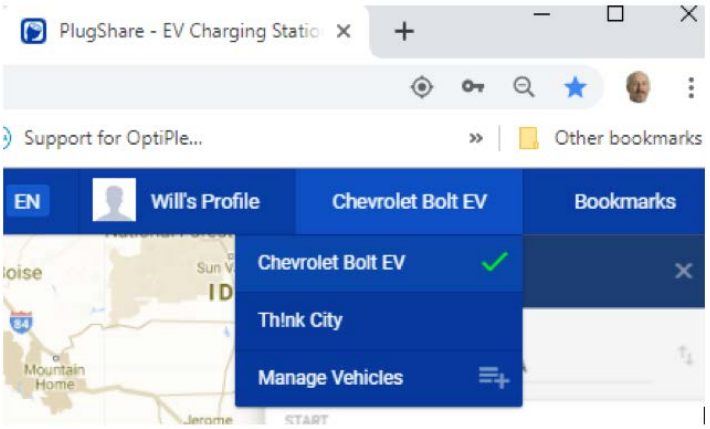
Trip Planners From PlugShare and ABRP

By Will Beckett, CCC EAA

My first EV trip planning experience was figuring out how to get from Palo Alto to the "Three Bridges Event" in San Francisco in 1995. This was a challenge for my Chevy S-10 Blazer (an EV conversion with only 60-mile range, depicted above with the author). Today my Chevy Bolt EV has a four-fold range improvement, allowing for extended road trips.

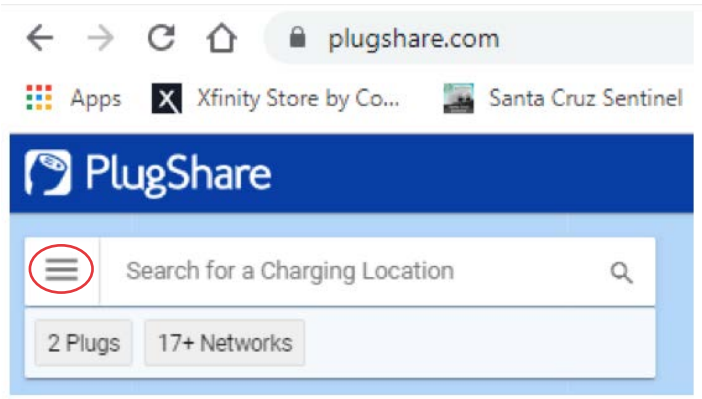
At first long range road tripping wasn't easy, because of limitations in each. By combining information from three separate applications, I made do. *Plugshare* (an earlier, more limited version); *Microsoft Streets and Trips* (not updated since 2013, no charging information); and *Google Maps* (limited to 12 stops with precious little charging information). *PlugShare* has added a trip planner and some other nice features. I routinely use *PlugShare*, then add charge stops to my *Google Maps* for use en route. But getting acquainted with and using all the features in PlugShare application can be a bit tricky.

Start by going to *PlugShare.com* and register an account using the option in the upper right. Create a profile and enter the type of car you own. This will help later because it knows how much range your vehicle has. Once you have done this and logged on, your name and the type of car you have will be displayed. With additional EVs, you can put them in as well. [See illustration top of next column.]



GETTING STARTED

Select the EV to be used. Then pull down the menu (a typical hamburger menu, with three horizontal lines).



The filter setting restricts what you'll see, helping focus on what you'll need. In this panel, you will notice plug types that could be selected, so deselect the ones you will not be using. Notice as well that you can select station brands and the minimum power that you would like PlugShare to search for. You can select "only publicly available" stations or add "restricted stations". Be careful with that selection because if you are stopping at hotels on your trip, they may have a restricted station for their clients, and you might want to stay there. If you want to add a not-yet-listed station, you can do that as well but be sure you have all the options verified. There are very few stations that have not been added already

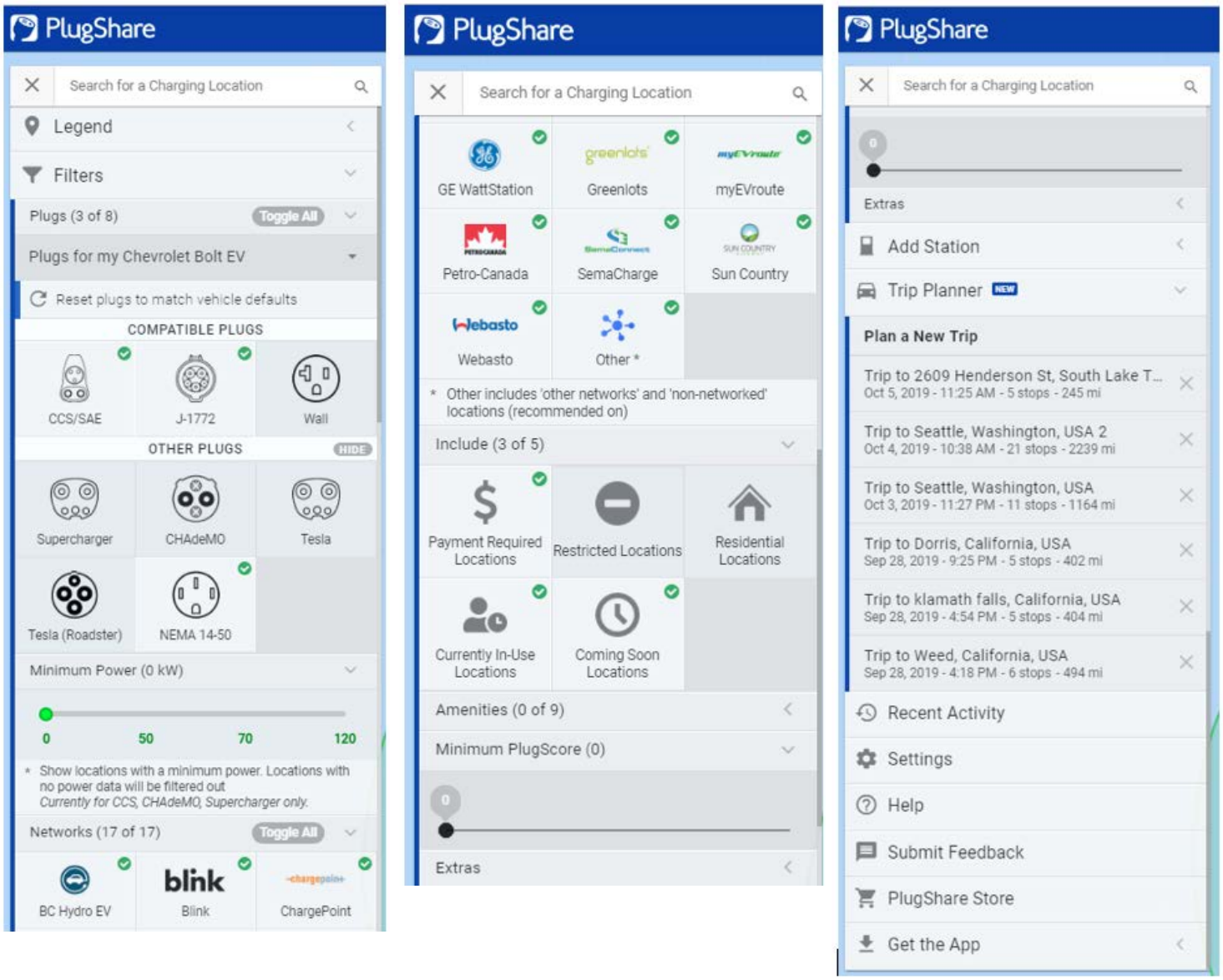
The next option is the Trip Planner illustration appears on page 24 (the three columns there will display as one, very long column for better mobile viewing. Look at the image on the third column here, under 'Plan A New Trip'). Click on

continued on page 24

Planning a Trip

continued from page 23

'Plan a New Trip'. (Any trips taken and saved will be listed below this if you want to go back and leverage them). On the right column, your cursor will be on the destination field; the starting location is assumed to be your current location. It's easy to change it if your current location is not where you will be starting. Enter a destination, click on 'Search'



Under the start location will be an orange box which shows the total miles to the next stop. Since no charging stations have been selected yet, they will just show on the map and not in this column.

DETAILS, HABITS AND REFINING

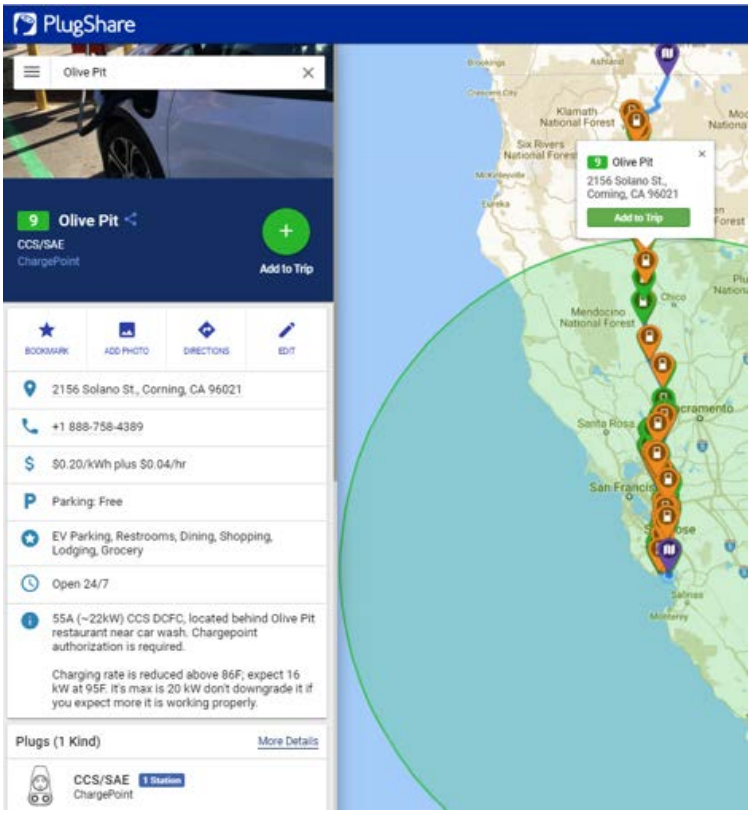
At this point you need to know a bit about your driving habits and efficiency. In my Bolt EV, I generally have no problem getting 200 miles of range regardless of how I drive and the conditions. That car shows that the best quick charging is done with less than 40% to 50% of battery capacity left. Over that, charging current is limited and your wait time at the station will be increased. Best total travel time is made by charging to 60% or 70% and driving to the next station (about

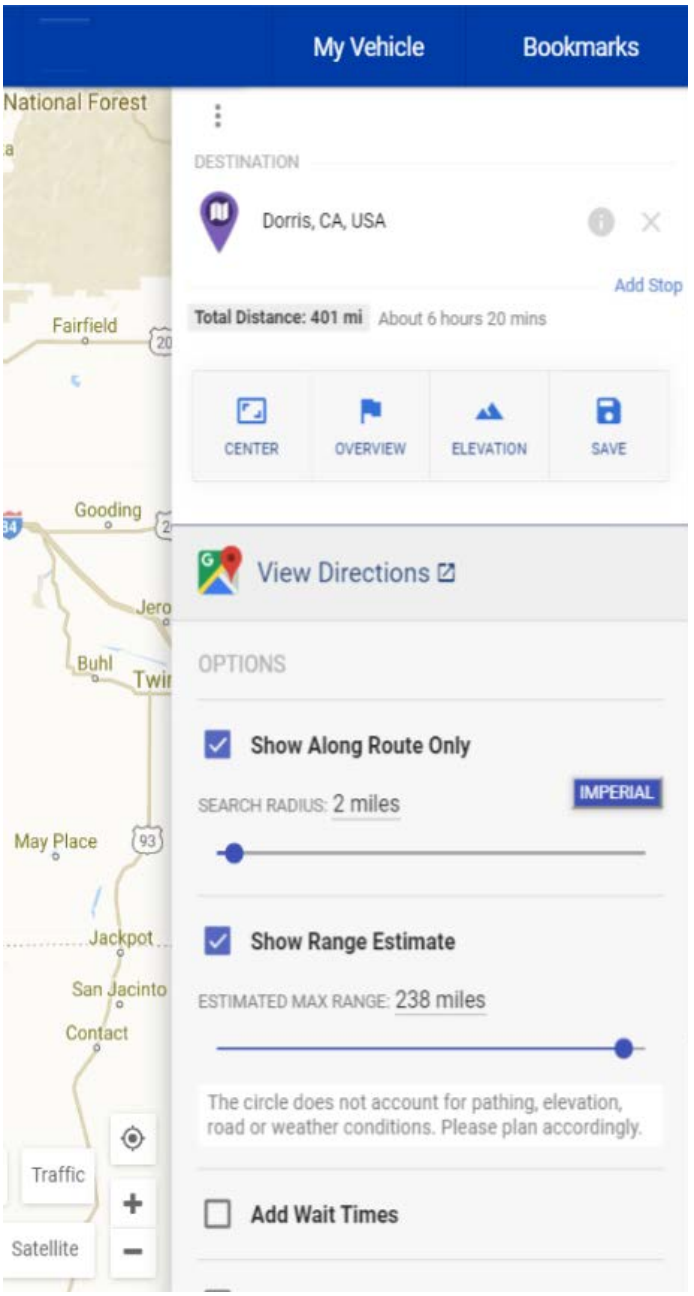
continued next page

140 miles), rather than to try to charge fully. Usually when I leave home with the full charge, my first stop will be 160 to 200 miles; then, if I will be covering more miles for the day, I look for stations that are 120 to 140 miles and only charge to 60% or 70%. Typically, in California these stops take only about 30 minutes, with stations that are 50kW or better. The (current) Chevy Bolt EV won't take more than 52kWh because of the software limitations designed into the car.

The next step in the process is to select charging stations based on this information and the reviews and shopping options at the charging site. This information will be listed as you select sites. Using my home address to start and Dorris, California as the destination this is an example of a one day I took using PlugShare to plan.

On the map, after making the start and destination selections, there will be a shaded green circle to show the expected area your vehicle will be able to reach with this charge. This can be used to identify the first charging station. Select a station inside that circle.





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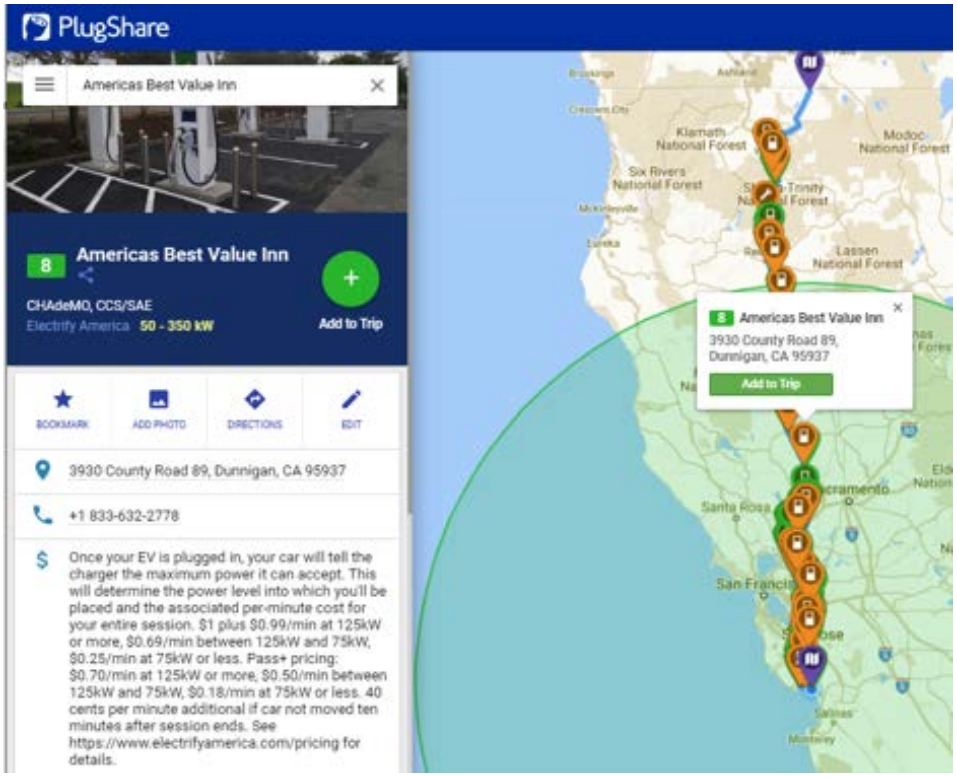
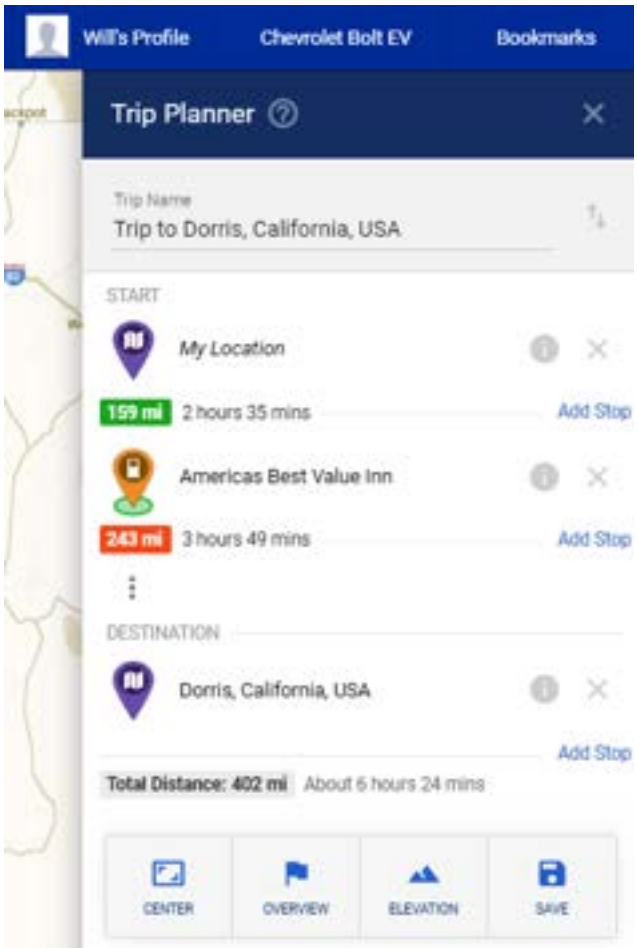
Planning a Trip

continued from page 25

I used Corning California. Notice on the left, the details about the station I selected. Comments show that it is only allowing ~22kW on the fast charging station. A bit too slow, the decision is made to move on to the next orange marker inside the circle. In this case, it is a Carl's Jr but also in the 20 kW range; so on to the next.



The next station, pictured right, is an Electrify America station in Dunnigan California. Notice that the left column shows that this station is 125kW and lists the fees. From first hand experience I know there are four quick charge stations, one with CHAdeMO and CCS and the others with dual CCS. There are more cars with long range using the USA standard CCS than Nissans using the Japan standard CHAdeMO. I also know this site has a lot of solar on the motel roofs where the stations are installed, so it is very clean power. To select this as my first charging stop, I click on the 'Add to Trip' button.

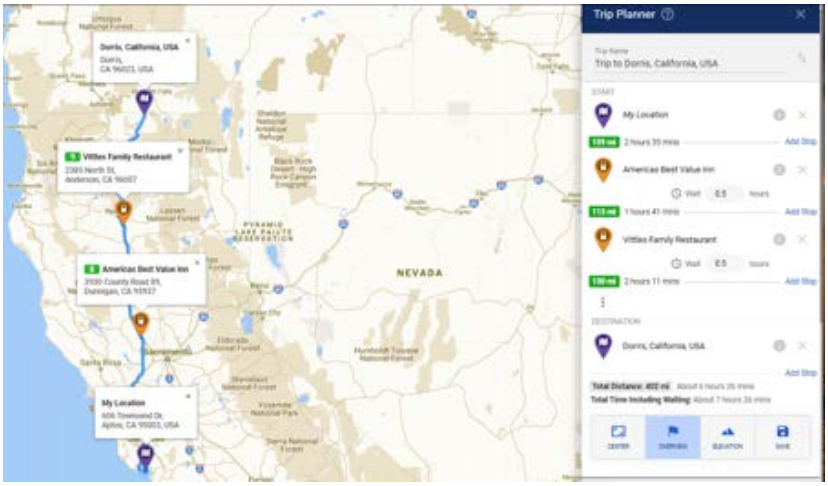


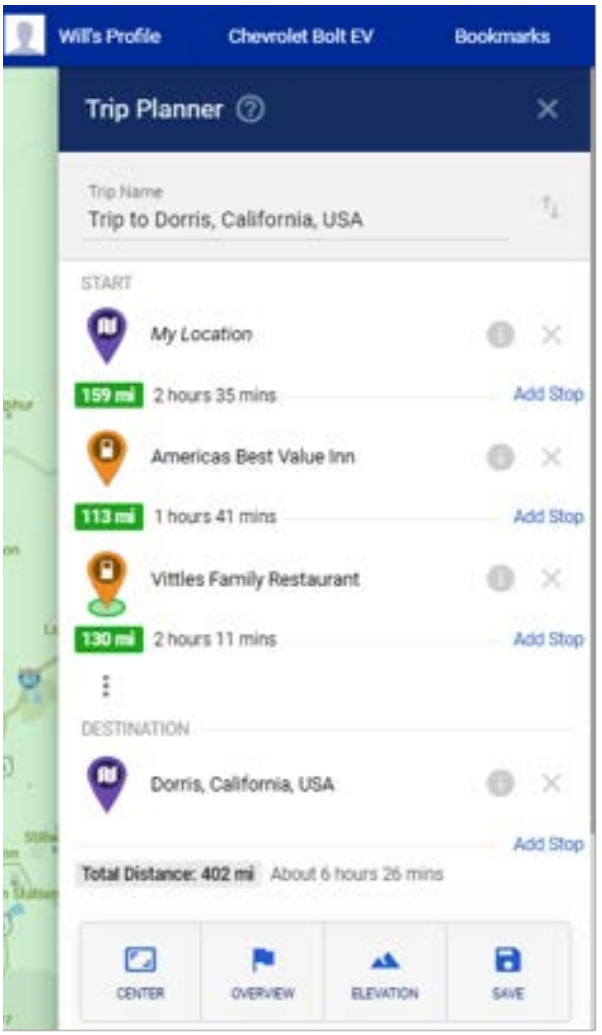
The green box below 'My Location' shows the distance to the charging station as 159 miles 2 hours 35mins. That color is communicating that your vehicle has the range to reach this charging station. Below the charging station is a similar block but it is red and shows 243 miles 3 hours 49 mins. This means your car will not be able to make it to there so you will need to stop at that other charging station. Now assuming you only charge to 60% or 70%, your range will be 120 to 160 miles, so it would be best to find a station within that range from this charging station. Using this method, select stations with 50kW or more, and add it to the trip planner.

continued next page

When all the boxes below the stops show green you're nearly done planning. It is important to watch the tools you use in your car to be sure your charge will indeed, get you to the next charging station, without range anxiety. To use the planner to show you the total travel time, check the box in this column to 'Add Wait Times'. Add at least 30 minutes (0.5 hours) to each charging stop.

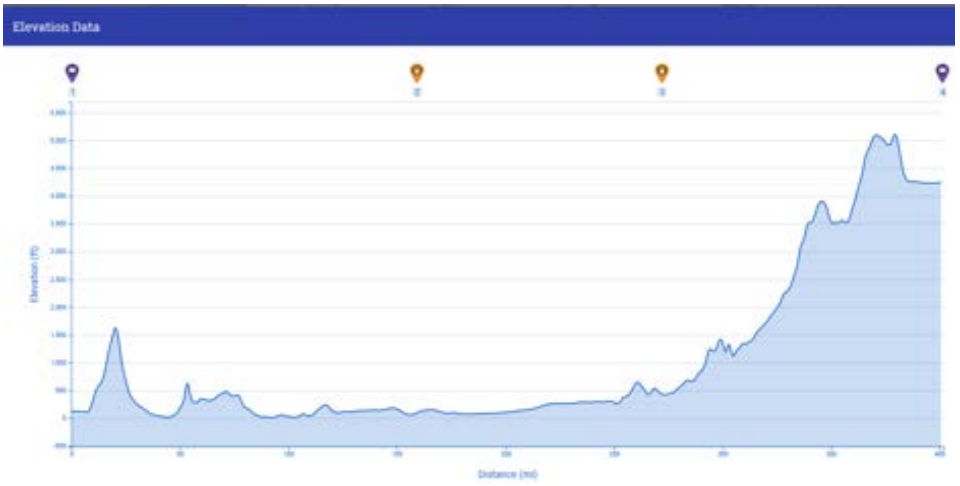
Handy features you see include buttons below the 'Total Distance' field: Center, Overview, Elevation, and Save. Use Overview to show only the stations you will be stopping at, on your route. Use Elevation to give you a heads up about major elevation changes so you can adjust your charge time to give you more range as needed. Now 'Save' your trip, so you can come back and make adjustments later.





GETTING HIGH

When I did this trip, I stopped in Mt. Shasta at a really great 50kW station in a shopping center with rows of Tesla charging stations. I did this knowing I needed to round trip Dorris, California, 60 miles from Shasta and looking at the elevation map, there is a lot of uphill on that trip! I ended up staying in Red Bluff for the night after 800 miles and did it in 12 hours. I would have gone back home the same day but prefer to keep my driving in daylight. That story can be found on my web site *http://beckettpcs.com* and just click on Other Links.



I do still use *Google Maps* in the car. After the trip is planned, I enter the charging stops into *Google Maps* and track the miles to the station and minimum available miles meter and total battery capacity, on the Chevy Bolt EV.

A BETTER ROUTE PLANNER

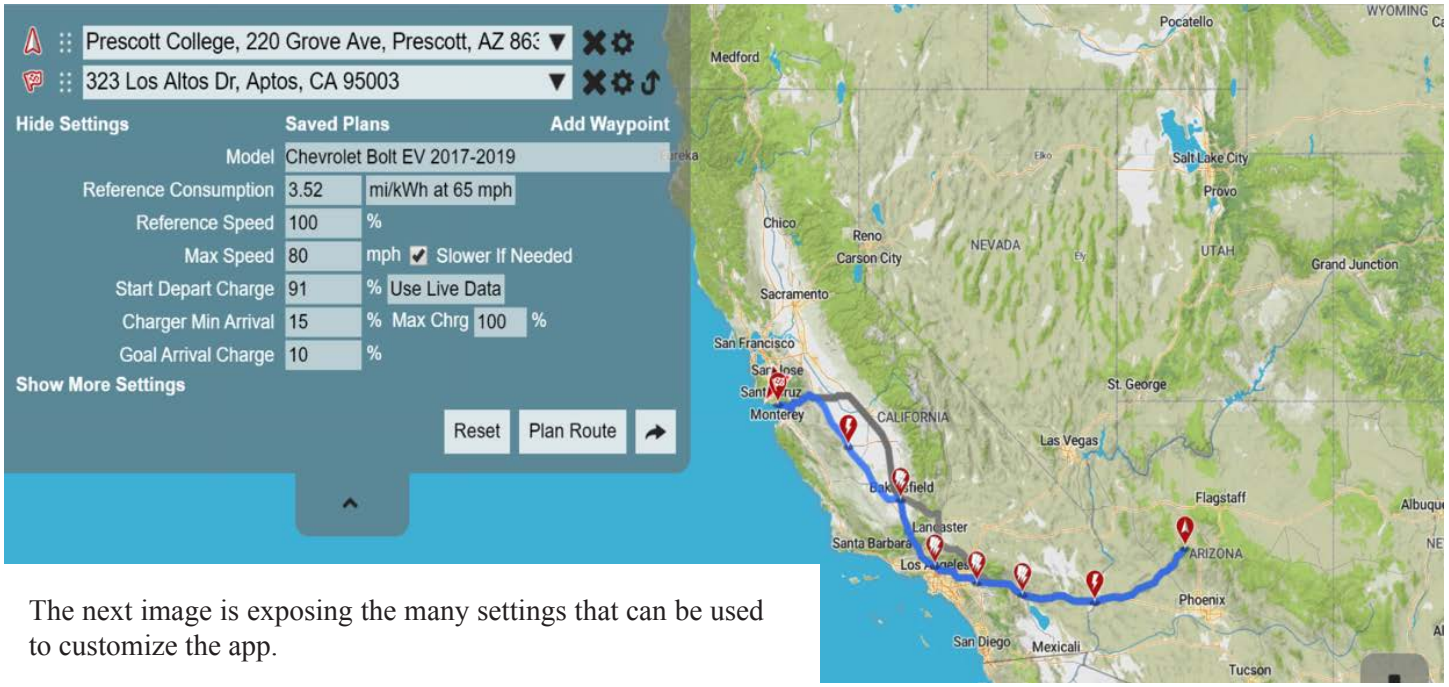
This software (abbreviated ABRP) was written by a Swede and is available for free on ABetterRoutePlanner.com. Many others contributed to this result. It allows a growing variety of vehicles

continued on page 28

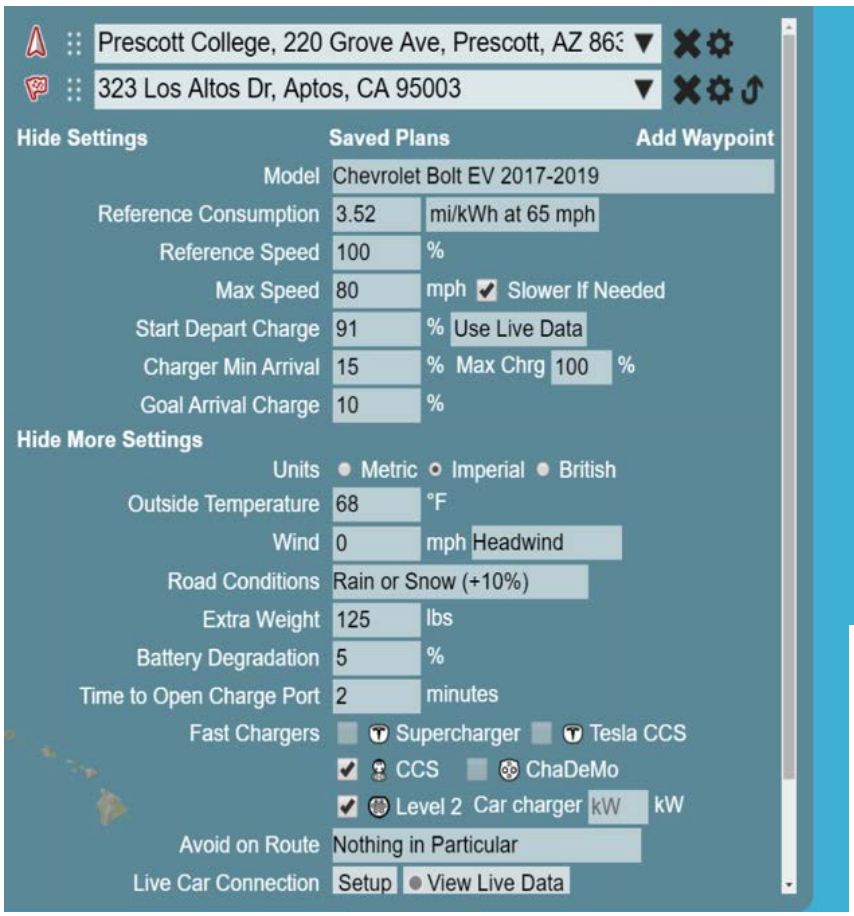
Planning a Trip

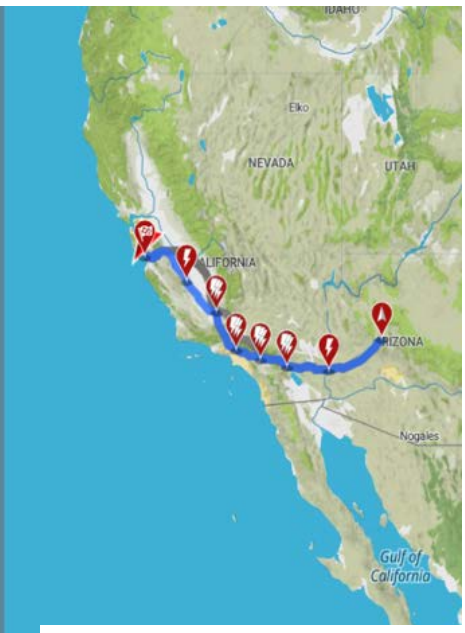
continued from page 27

to be selected, and functions in the US and Europe. When zoomed out, the highest power charging stations are displayed, and as you zoom in, lower power alternatives intuitively come into view as well.
Here is a screen capture of this flexible planner.



The next image is exposing the many settings that can be used to customize the app.





Using the roller wheel on our mouse, magnification levels change, so zooming in more closely reveals additional lower power charging stations within the field of view. This is illustrated in this next image, showing just two of the red DC-FC stations.

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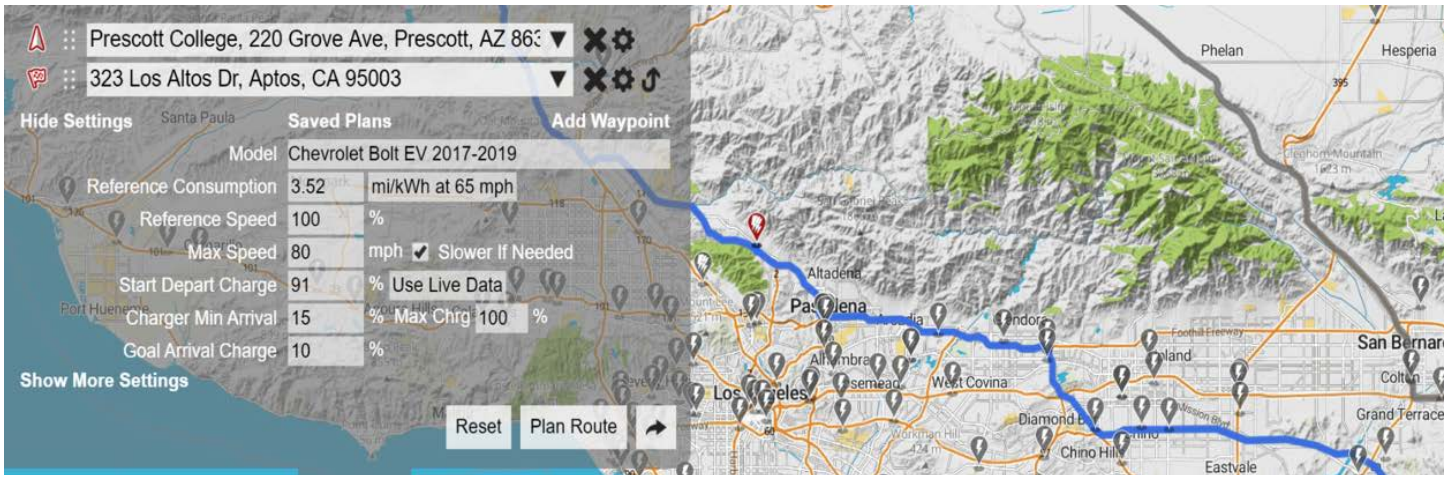
TRIP PLANNER APPLICATIONS



Details on the individual stations are also found by clicking on their respective boxes in the image here.

And using another newly introduced app from AmpUp.io (see article on page 10, this issue), reserving a charger can further help EV drivers.

Conclusion:

Plugshare and ABRP both assist EV drivers in getting to their destinations and choosing alternative paths, with simple straight-forward user interfaces (UI's) even if your EV's telematics are not quite what you want. Plus, with revisions on these apps being updated more frequently than our vehicle firmware, you stay on top of the latest releases with ease.

High-Income Earners Need Not Apply

California Just Made it Harder to Buy an EV

As of December 3rd, 2019, California's Clean Vehicle Rebate Program (CVRP) is undergoing some significant changes.

By: Tom Moloughney

The reshaping makes it pretty clear that the goal is to use the available funds to better serve low to moderate-income individuals and families, while reducing the number of rebates issued to higher-income applicants. Some of the changes that will help to achieve that goal are capping the rebate to vehicles with MSRP of $60,000 or less, limiting the rebate to one per individual (lifetime) and reducing the rebate from $2,500 to $2,000 for battery electric vehicles, and from $1,500 to $1,000 for plug-in hybrids. Rebates for fuel cell vehicles have also dropped by $500, from $5,000 to $4,500.

> With an increasing program demand that exceeds the current program budget, the California Air Resources Board approved changes to ensure that this year's funding allocation provides a meaningful incentive to encourage EV purchases while maintaining a program that is viable for a longer portion of the upcoming year. On December 3rd, 2019, the requirements for CVRP will be changing. If the CVRP rebate was important in your decision to purchase an electric vehicle, we encourage you to apply as soon as possible and prior to the new program changes taking effect. All applications received on or after this date will be subject to the new Terms and Conditions in place. - CVRP website

It's yet to be determined if these changes will significantly hurt sales of the higher-end EVs in California, like the Audi e-Tron, Jaguar I-Pace and Tesla's Model S & X, but one thing's for sure: it certainly won't help.

The real CVRP winners with these changes are the low-to-moderate-income individuals & families. They now get an "Increased Rebate" equal to $4,500 for battery electric vehicles and $3,500 for plug-in hybrid purchases or leases. They also qualify for a whopping $7,000 for a fuel cell vehicle.

continued next page

> Consumers with household incomes less than or equal to 300 percent of the federal poverty level are eligible for an increased rebate amount as listed below. The option to apply for an increased rebate is shown on the online application based on the income information the applicant provides. Applicants who are claimed as dependents are not eligible for increased rebates regardless of their income. Increased rebate amounts are available for fuel–cell electric vehicles, battery electric vehicles, and plug–in hybrid electric vehicles. - CVRP website

In addition to the financial changes, eligibility for plug-in hybrid vehicles has also become more strict. Currently, to be eligible for the rebate, a PHEV had to have a 20-mile all-electric range, according to the EPA Urban Dynamometer Driving Schedule, or (UDDS). Under the new rules, a PHEV must now have a 35-mile range under the UDDS range rating scale. It's worth noting that the UDDS is less strict than the EPA's 5-cycle range test that we typically use for our official EV range ratings.

For instance, the 2018 Audi A3 eTron PHEV is currently eligible for the $1,500 CVRP rebate. However, it only has an EPA range rating of 17 miles per charge. The current CVRP program requires PHEVs to have a 20-mile all-electric range, so why is it eligible? That's because it does have more than a 20-mile all-electric range using the UDDS range rating. Confused? Yeah, I was too when I looked into this. Why they just don't use the standard EPA 5-cycle range test that's used everywhere else is unknown to me.

Personally, this is one aspect of the changes that I agree with. Twenty miles of range under the UDDS is too low of a bar. If these low-range PHEVs continue to qualify for subsidies then the manufacturers won't feel pressured to offer them with more all-electric range. A 35-mile UDDS range is probably the equivalent of about 25 miles of range on the EPA 5-cycle test, and I think that's a good low-bar for qualification. In 2020, PHEVs with under 20 miles of all-electric range shouldn't qualify for any incentives, in my opinion.

CVRP Eligible Vehicle Type	Standard applications before 12/3/19	Standard application on and after 12/3/19	Increased rebate amounts
Plug-in Hybrid Vehicle (PHEV)	$1,500	$1,000	$3,500
Battery Electric Vehicle (BEV)	$2,500	$2,000	$4,500
Fuel Cell EV Vehicle (FCEV)	$5,000	$4,500	$7,000
Zero-Emission Motorcycle	$900	$750	$750

Here's an outline of the new rules directly from the CVRP Website:

Purchaser or Lessee Requirements:

Vehicle Purchaser or Lessee:

- Rebate limits are reducing from 2 rebates to 1 rebate per any single entity for individual and business applicants. This will not be applied retroactively. Applicants who have not already met their rebate limit prior to December 3, 2019, will be eligible for one additional rebate after December 3rd, 2019. Those that have already met their two-rebate limit will remain ineligible for an additional rebate.
- Applicants will need to submit applications within 3 months of the vehicle purchase or lease date (post-purchase applications only). Vehicles purchased or leased prior to December 3rd, 2019 will continue to have an 18-month eligibility window in which to submit an application.

Important: Applications are subject to the Terms and Conditions in place at the time of application submission. Exceptions will not be granted.

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CVRP Changes

continued from page 31

Vehicle Eligibility:

Vehicle Eligibility Criteria:

- An MSRP cap of $60,000 will be instituted on all vehicles with the exception of fuel cell electric vehicles
- The Urban Dynamometer Driving Schedule (UDDS) all-electric range will be increasing from 20 miles to 35 miles.

Beginning December 3, 2019, vehicles that no longer meet eligibility requirements as defined above will be removed from the eligible vehicle list. Please check back soon, as the final vehicle eligibility list is still being determined.

Eligibility Based on Income:

- Income verification is required for all members of the household ages 18 and older (currently 17 and older).

Vehicle Rebate Amounts:

- Standard rebate amounts will be reduced. The new rebate amounts will be:
  - ~ $4,500 for Fuel Cell Electric Vehicles
  - ~ $2,000 for battery or range-extended electric vehicles
  - ~ $1,000 for plug-in hybrid electric vehicles
  - ~ $750 for zero-emission motorcycles

- Increased Rebate amounts are unchanged.
  - ~ $7,000 for Fuel Cell Electric Vehicles
  - ~ $4,500 for battery or range-extended electric vehicles
  - ~ $3,500 for plug-in hybrid electric vehicles
  - ~ $750 for zero-emission motorcycles

[The photo at the beginning is from a video that begins this article. See it at the URL below.]

Alex Guberman from *E For Electric* offers his thoughts on the CVRP changes and makes it pretty clear that he's not a big fan of them.

https://insideevs.com/news/382176/california-amends-cvrp-rebate-program/

SacEV Regional News

The Latest About EVs Around Sacramento

Imminent Changes to California's EV Incentives

If you recently bought a new EV, planning to buy an EV, or someone you know falls in that camp, here are some important changes to the California rebate program (CVRP).

- Last day under the old rules to take EV delivery and apply for the rebate is December 2nd, 2019.
- Rebated amount drops by $500 for each category. BEVs will be $2,000. PHEVs will be $1000. Rebates for low income applicants are unchanged.
- If you recently purchased an EV, and have not applied yet for the California incentive, you will receive $500 less if you don't apply by 12/2.
- A new higher minimum electric-only mile requirement caused several PHEVs to fall off eligibility list. PHEVs must meet the 35 Mile California All-Electric Range. This range is known as the Urban Dynamometer Driving Schedule (UDDS) or the EAER. It is more generous than the EPA electric range number. Below is the new list as we best understand it.
- MSRP base price (i.e. the lowest trim version) of an EV model must be $60,000 or less. Example: The base price of the Tesla Model 3 is about $36,000, so all Tesla Model 3's are eligible. The base prices of the Tesla Model S and X are over $60,000, so all Tesla Model S and X vehicles are not eligible.
- Rebate limits are reducing from 2 rebates to ONE rebate per individual (not per household)

Read more on these important changes to the California rebate program (CVRP). URL below.

https://cleanvehiclerebate.org/eng/faqs/what-should-i-know-about-december-3rd-program-changes

CVRP PEV Limits 12/3

In	EAER 35	Out
Karma Revero		Volvo 560 TB, Volvo 590 TB, Volvo XC60 T8
Chevrolet Volt		Volvo XC90 T8
Honda Clarity Plug-in Hybrid		Mitsubishi Outlander PHEV
Chrysler Pacifica		Subaru Crosstrek PHEV
Hyundai Ionic PHEV		Audi A3 e-tron
Kia Optima Plug-Hybrid		BMW 530e, BMW 330e, BMW 740e,
Kia Niro Plug-in Hybrid		BMW i8, BMW x5, xDrive 40e
Hyundai Sonata Plug-in Hybrid		Cadillac CT6 Plug-in
Toyota Prius Prime		Mercedes-Benz GLE550e
Ford Fusion Energi		Mini Cooper SE Countryman ALL4
		Porsche Cayenne, Porsche Panamera

Equivalent All-Electric Range (EAER)

Assesmbled by Guy Hall SacEV

Los Angeles Rolls Out More Lamp Post Electric Charging Stations

By: Janaki Jitchotvisut

Power to the people.

Range anxiety is a major impediment to mass electric vehicle adoption. Luckily, the city of Los Angeles wants to lead the way in showing how cities can solve that problem. That's why it's installing EV charging stations at some of its street light poles, with plans to keep adding more going forward.

Back in 2013, LA completed its major shift to LED street lighting, and moved completely away from the old, energy-inefficient sodium lamps of the past. Power plants noticed that they now had surplus energy, which Mayor Eric Garcetti called "totally gravy," according to *Wired*.

The city didn't go into the initial LED street lamp plan with this ambitious EV charging station plan in tow. Instead, it was an opportunity that just made total sense. By August 2016, the city had already installed 27 such charging stations. It likely helped that Mayor Garcetti himself has been riding the EV train for a long time, all the way back to having purchased two successive GM EV-1s as daily drivers back in the day.

LA has a Green New Deal of its own, and part of Garcetti's plan is to get 100,000 electric vehicles into the city by 2025. The Bureau of Street Lighting, LA Department of Transportation, and LA Department of Water and Power have all been working together to implement this plan on the ground.

Although the video above focuses on LA's EV charging stations as managed by Quebec-based company Flo, other EV charging companies have stations around the city as well. These include GreenLots, Charge Point, and EVGo, according to LAist. Rates for charging typically cost around $1 or $2 per hour, but your parking in those charging spots is free.

Greater access to Level 2 and fast charging is essential, particularly in cities where many people rent. LA is also working to create infrastructure for EV charging in its parking garages. LADOT currently has plans in place to add 44 fast chargers to its existing parking facilities in the next six months, a representative told LAist at the end of October 2019. Also, 10 percent of spaces will be pre-wired for easy installation of chargers in the future, as the need grows.

Currently, the BSL plans to add 150 EV chargers to its street lights within LA every single year. This plan is concurrent with LADOT's existing 106 parking garage spaces and 200 metered parking spots with EV chargers, to which that department also plans to add more. Mayor Garcetti's plan calls for 28,000 publicly available EV chargers in the city by 2028.

Is it ambitious? Yes, but it's making constant progress—and hopefully other North American cities can learn from and use it to inform their own EV infrastructure plans going forward.

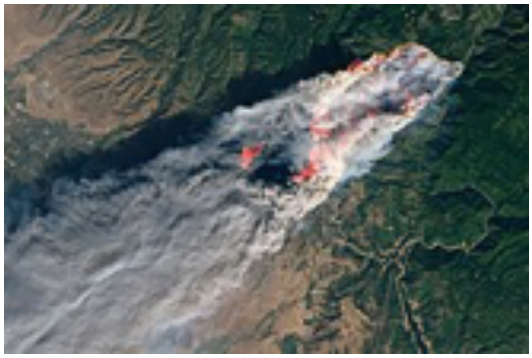
[See the video at theURL below.]

https://youtu.be/SGbGP5u588Y

(Warming) Earth, Wind and Fire: Why Wind and Overhead Utilities Matter to EVers

By Ron Freund, SJEAA

Over the last three years, Northern California has suffered from unusually strong autumn winds which have driven large and deadly wildfires. In 2017, the area north of San Francisco, world famous for the wine from the Napa and Sonoma Valleys, was engulfed in a nasty, wind driven fire, destroying thousands of buildings and resulting in a large loss of life. Similarly, in 2018, Paradise, CA was nearly wiped from the map with a utility sparked fire[1], costing 85+ lives.



This Landsat 8 satellite image taken from 435 miles above the Paradise Campfire shows the effect of those seasonal northeasterly winds. Downwind, in the greater Bay Area the air quality was the worst anywhere on the globe on that day. Yes, it was worse than even Beijing and Bangladesh! The responsible investor owned utility involved in providing power to all drivers here was Pacific Gas and Electric (PG&E), currently in bankruptcy due to these expected wildfire liabilities of over $30 billion.

Just this past month the Kincaid Fire in Napa County again destroyed large swaths of land and numerous buildings. That area is home to many EV drivers, including some pioneers who have driven conversions and early first-generation OEM EVs from Ford, GM, Honda, Toyota, and the like. Their numbers increased significantly in the past decade. Fortunately, we have not yet, however, heard of any EV losses resulting directly from these blazes; perhaps that's because they were used as "getaway vehicles"!

Today, EV drivers still are able to charge their vehicles; the power is back on after pre-emptive scheduled shutdowns and evacuations. The overland transmission lines and feeders are mostly on overhead towers, some well over seventy years old. There is a call for "undergrounding," but not only is it impractical in some cases, it is generally prohibitively expensive, especially for these high voltage connections. Esti-mate run upward from $1.6 million per mile. The affected PG&E territory spans much of the northern portion of the state (see their Greenbook on page iii of this link):
https://www.pge.com/includes/docs/pdfs/mybusiness/customerservice/startstop/newconstruction/greenbook/servicerequirements/greenbook_manual_full.pdf

"ROCK-A-BYE BABY"…

The familiar rhyme goes "When the wind blows, the cradle will rock, when the bough breaks, the cradle will fall." Overhead conductors likewise, move in response to wind, and can fail. They are actually fairly large, much like a garden hose. Air currents are set in motion by local and regional temperature differences. Wind gusts in recent weeks at the top of Northern Californian area coastal mountains reached over hurricane speed (70 mph)! Such winds generate substantial forces on these conductors, along with vibrations. Mechanical and electrical engineers have studied these and have devised clever ways of dealing with those forces. Called "aeolian vibrations", here is a highly technical paper discussing the science.
http://www.tdee.ulg.ac.be/userfiles/file/Vibrations_eoliennes_intro.pdf

Paraphrasing the paper's introduction and excerpting: Aeolian vibration is a low amplitude swinging, high frequency (5 to 150 Hz) phenomenon. *These are one of the most important problems in electric power transmission lines because it represents the major cause of fatigue failure of conductor strands.* (Yes, wires do occasionally actually fall down.)

The photo on the next page (from the referenced paper) illustrates a typical broken strand due to aeolian vibration after removal of the suspension clamp. One of the big wildfires in these past three years started when a support broke, downing the conductor. Sparks ignited the tinder-dry surroundings.

Forces induced by vortex shedding are the cause of this type of vibration, researched over fifty years ago.[2]

Conductors of either aluminum or copper on a steel core have a life-expectancy. The response of the conductor to vortex shedding fatigues the wire. Controlling conductor vibration amplitude to below the fatigue endurance limit is the solution that researchers

continued next page

found, and now utilities can provide adequate control with the proper damping (a design requirement). If necessary, additional damping can be introduced in the form of damping devices such as dampers and spacer-dampers. This keeps the conductor in place under the most severe circumstances.

WHAT DOES A DAMPER LOOK LIKE?
This is a video of a utility worker installing just such a vibration damper to contain Aeolian vibration from a helicopter on an energized line in Canada.
https://www.youtube.com/watch?v=GxDKVAYJ_t4

The impact-type spiral vibration damper, made of rugged non-metallic material, with a tight helix on one end, grips the conductor or wire. The shape is such that the conductor impacts it during Aeolian vibration activity. Those impacts disrupt and negate the motion produced by the wind. Today, monitoring such vibrations can be done remotely, allowing corrective actions to be taken.

Another video of a helicopter-based tree trimming service cleverly and quickly clearing the right-of-way for a high voltage transmission line is here:
https://www.youtube.com/watch?v=Pla06PO6Odk

LESSONS LEARNED?
After three devastating fires in the past three years, this year PG&E proposed and actually did de-energize overland feeders, out of an abundance of caution. Sadly, this year's large Kincaid fire was again caused by faulty and still energized PG&E feeders. Even with days of advance notice, EV drivers (as well as ICE drivers, whose gasoline pumps require electricity to function) were impacted across a large area of the state. **When given the "heads up", make sure your car is fully charged**. (Or else be ready to flee to an area not under siege!)

We may take our electric power for granted, but when it's suddenly taken from us for 24, 48 or even 72 hours, one begins to appreciate the benefits of our power grid. As EV drivers we're happy to have it – even as it has become nearly second nature to us. And for the many EV drivers with rooftop solar power and on-site storage – they felt nothing, for up to five days. Some early solar installations remained useless without the grid providing that 60 Hertz reference to enable on-site generation. Newer solar installations may actually provide limited output for powering refrigerators while disconnected from the utilities. Maybe it's time to upgrade those to a battery storage solution?

CONGESTION AT FUELING POINTS
Imagine Florida during Hurricane Irma, where even far the storm center there were severe fuel shortages in the lead-up to Irma. Think how gas cars would manage such an evacuation. It takes a significant time to transport fuel to gas stations where it can be pumped into cars. Electricity, on the other hand, is easily "transported" to the point of distribution, at least up until the disaster hits and power lines are taken out (at which point both charging stations and gas stations are all "down").

If such an evacuation were to happen, you would still have to deal with the fact that all those cars would be competing for time at public charging stations. Home charging would be necessary to get started but enroute, any source would be available. Enter Plugshare and other aps like it (see related article on page 23).

Unless people planned well ahead (they usually don't), it's probably going to fall a bit short. But once outside of the area of concern, there are still more available electric power sources than gasoline fueling stations! Virtually every habitable building in the US has an outlet. Count that in the 10's of millions.

With a regular 120 Volt outlet you might be able to extend your range by 100 miles overnight. This would probably give you enough to reach an unaffected area. While not ideal, they are always more useful than nothing at all. This could help alleviate the demand, but of course, the throughput with those is going to be far less as well.

References:
[1] *https://en.wikipedia.org/wiki/Camp_Fire_(2018)*
[2] Blevins 1990, Buckner 1968, Claren et al 1969 & 1974

We Estimate Cost Savings for Tesla's New Battery Line

If Tesla goes this new route, how much money could the Silicon Valley automaker save?

By: George Bower

Summary

Tesla hasn't come right out and said they are going to make their own line of batteries but at this point based on their acquisition of Maxwell and Hibar it seems to be a given. Maxwell is known for its high-speed dry electrode manufacturing process and Hibar makes battery line manufacturing equipment.

We estimate the cost savings for Tesla's new battery line at approximately 20%. The bulk of this cost reduction is due to an increased line speed (production rate) facilitated by Maxwell's new solvent-free dry electrode manufacturing process.

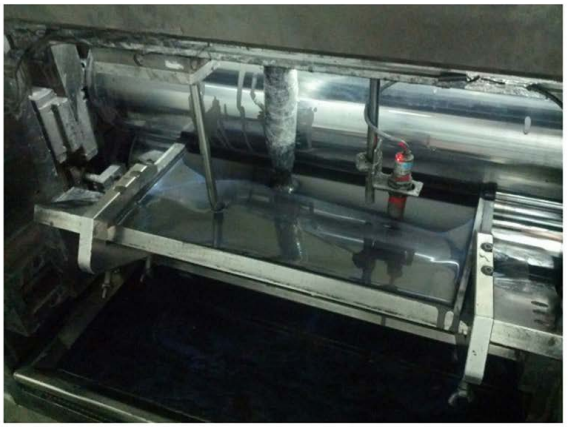
Our estimate is for finished battery packs — not just cells — and it includes other secondary benefits derived from no "middle-man" markup (Panasonic), integrating pack and cell production, using the Hibar custom high-speed battery manufacturing equipment (such as its high-speed electrolyte filling equipment), higher energy density from increased electrode coating thickness, and possible reductions in formation cycling and charge retention testing.

f1 Estimated Battery Pack Cost Reduction for Tesla's Proprietary Battery Production Line

Item	percent battery pack cost reduction
Increased production rate (X4) -Maxwell's solvent free dry electrode manufacturing process	12%
No middle man markup	4%
Misc Increased efficiency from: -integrating cell and pack production -lower electrolyte filling time -reductions in cell testing time	4%
Total	20%

Traditional Solvent Based Li Ion Battery Electrode Coating Method is time consuming, takes up a large factory floor area and has high capital equipment cost.

Fig 2



Source: "How Lithium Batteries are Made", Sparkfun.com

A thin layer of the slurry of carbon and lithium is applied in large square swaths onto the terminal material.

Discussion

Maxwell's solvent-free, dry electrode manufacturing process

Maxwell was covered in two earlier articles (ref 1, ref 2). Maxwell's big selling point is their dry electrode manufacturing process, which can increase line speed (production rate) up to 16 times (we used four times in our analysis). As we mentioned in the summary, this increase in line speed is where the bulk of the cost savings is derived.

We don't have a lot of details of Maxwell's dry process but we imagine it perhaps similar to electrostatic

continued next page

The Solvent Drying Process is time consuming, takes up a large factory floor area and has high capital equipment cost.

Fig 3

Large, long oven used to evaporate Solvent – then solvent must be recovered

Source: "How Lithium Batteries are Made", Sparkfun.com

In a continuous fashion, the material is fed through an oven to cure the slurry onto the terminal. This was probably 30m (65 ft) long and pretty toasty.

Fig 4

Table 5.4 Summary table of the baseline plant

100,000 Battery Packs per Year, 50-kW Battery Power, 40-Ah Capacity, 60 Cells per Battery
Operating year: 300 days with three 8-hour shifts (two shifts per day for receiving and shipping)

			Direct Labor			Cap. Equipment			Plant Area	
	Annual Baseline Rate (R_o)		Workers/ Shift	Baseline Hours/yr	Scale Factor, p	Baseline $millions	Scale Factor, p		Baseline Area, m^2	Scale Factor, p
Receiving (two-shift operation)	869,416	kWh energy	3	14,400	0.4	3.60	0.6		900	0.5
Materials preparation										
Positive electrode	1,712,524	kg active material	2	14,400	0.5	2.00	0.7		600	0.6
Negative electrode	1,060,374	kg active material	2	14,400	0.5	2.00	0.7		600	0.6
Electrode coating										
Positive electrode	8,209,039	m^2 cell area	4	28,800	0.5	8.00	0.8 (0.2)		750	0.8
Negative electrode	8,209,039	m^2 cell area	4	28,800	0.5	8.00	0.8 (0.2)		750	0.8
Solvent recovery	2,309,021	kg NMP	2	14,400	0.4	3.00	0.6		225	0.6
Calendering										
Positive electrode	8,209,039	m^2 cell area	2	14,400	0.5	1.00	0.7		225	0.6
Negative electrode	8,209,039	m^2 cell area	1	7,200	0.5	1.00	0.7		225	0.6
Materials handling[a]	8,209,039	m^2 cell area	4	28,800	0.7	1.50	0.7		900	0.6
Electrode slitting	8,209,039	m^2 cell area	4	28,800	0.5	2.00	0.7		300	0.6
Vacuum drying	8,209,039	m^2 cell area	2	14,400	0.5	1.60	0.7		300	0.6
Control laboratory	869,416	kWh energy	4	28,800	0.5	1.50	0.7		300	0.6
Cell Assembly in Dry Room										
Cell stacking	6,315,789	total cells	5	36,000	0.7	4.00	0.8 (0.3)**		600	0.8
Current collector welding	6,315,789	total cells	5	36,000	0.7	4.00	0.8		600	0.8
Enclosing cell in container	6,315,789	total cells	3	21,600	0.5	3.00	0.7		600	0.6
Electrolyte filling, and cell sealing	6,315,789	total cells	5	36,000	0.5	5.00	0.7		900	0.6
Dry room control and air locks	2,000	m^2 operating area[a]	2	14,400	0.4	20.00	0.6		100	0.4
Formation cycling	6,315,789	total cells	8	57,600	0.7	30.00	0.8 (0.3)**		2,200	0.8
Final cell sealing	6,315,789	total cells	2	14,400	0.5	2.00	0.7		450	0.6
Charge retention testing	6,315,789	total cells	3	21,600	0.4	4.75	0.7		900	0.6
Module assembly	6,000,000	finished cells	6	43,200	0.5	6.00	0.7		600	0.6
Battery pack assembly and testing	100,000	battery packs	6	43,200	0.5	6.00	0.7 (0.3)***		900	0.6
Rejected cell and scrap recycle	6,315,789	total cells	5	36,000	0.7	2.50	0.7		600	0.6
Shipping (two-shift operation)	869,416	kWh energy	6	28,800	0.5	5.00	0.7		900	0.6
Total			90	626,400		127.45			15,425	

[a]One-third of the space for materials handling is within the dry room.

*The baseline cost for capital equipment for electrode coating, C_o, is based on the evaporation of the baseline annual solvent weight (Rs_o) of 2,309,000 kg for the positive electrode and 1,527,000 kg for the negative electrode. For batteries requiring different solvent evaporation rates Rs, the cost is multiplied by (annual solvent rate (Rs)/baseline rate (Rs_o)) raised to the 0.2 power. Thus, Cost = $C_o*(R/R_o)^{0.8}*(Rs/Rs_o)^{0.2}$.

**The baseline costs of the capital equipment for cell stacking and formation cycling is for 40-Ah cells. To correct the baseline cost (C_o) for cells of different capacity, the cost is multiplied by the capacity ratio, (Cap)/ 40 Ah, raised to the 0.3 power. Thus, Cost = $C_o*(R/R_o)^{0.8}*(Cap/40)^{0.3}$.

***The baseline cost of the capital equipment for battery assembly is for a battery with four modules. To correct the baseline cost to a battery with a different number of modules (Mod), the cost is multiplied by the ratio of the number of modules, (Mod)/4 raised to the 0.3 power. Cost = $C_o*(R/R_o)^{0.7}*(Mod/4)^{0.3}$.

Traditional Solvent-Based electrode coating process is labor-intensive, expensive, and uses a large part of the factory floor. Source: "Modeling the Performance and Cost of Lithium Ion Batteries for Electric Vehicles ANL 11/32".

Fig 5

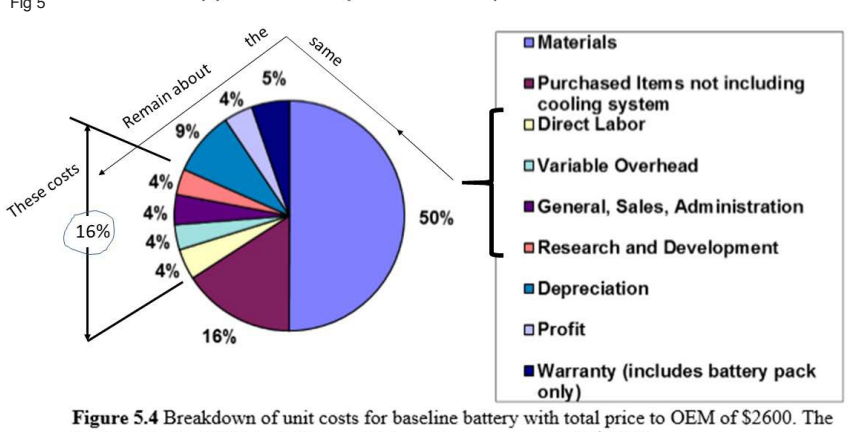


Figure 5.4 Breakdown of unit costs for baseline battery with total price to OEM of $2600. The total cost to the OEM, including pack integration components, is $3,360.

This figure was used to estimate the effect of line speed (production rate) on pack costs.

painting or powder coating, thus the term "dry." Traditional coating process uses a solvent-based electrode coating procedure that has very expensive equipment and uses up a large percentage of the factory floor as we show in figure 2 (previous page and figure 3 left).

Argonne labs did a bottom-up analysis and computer program of the battery manufacturing process entitled: "Modeling the Performance and Cost of Lithium Ion Batteries for Electric Vehicles ANL 11/32".

Its report shows that the direct labor cost associated with the solvent-based electrode coating process is 11% of the total pack labor costs, the capital equipment costs are 15% of the total plant equipment costs, and the factory floor area is 11% of the total plant area.

In addition, our research indicates solvent drying times around 100 minutes. In other words, the old solvent-based electrode coating process is time-consuming, labor-intensive, the equipment is expensive and it uses up a large part of the factory.

However, just because the traditional solvent-based electrode coating process uses 11% labor doesn't mean you save 11% in the final battery cost. You can see from the Argonne report that direct labor costs are only 4% of the total pack costs. We used the figure (left) to estimate how much-increased line speed (production rate) would lower pack costs.

What happens when you increase the production rate by a factor of four? Some costs stay constant even though you are making four times as much product so your, which brings you per-item cost down. In the above figure, we assumed that Direct Labor, Overhead,

continued on page 38

Battery Cost Savings

continued from page 37

General sales, administration costs and research and development costs would remain constant even at four times the production rate. Contrarily, things such as materials and purchased items would go up by a factor of 4.

The costs that remain constant are 16% of the total cost of the pack. So, if you double your production rate, those costs go to 8% and if you double production rate again (to a factor of 4) those fixed costs drop to only 4%. Therefore, increasing the production rate by a factor of four drops your costs from 16% to 4%, thus equating to a 12% cost reduction for increasing your production rate by a factor of four. With that being said, it's potentially a 12% cost reduction for increased production rate shown in the figure 1 summary on the first page.

No Middle Man

If you make your own batteries, you eliminate the middle man and his associated markup. We don't know how much Panasonic marks up their batteries but we expect it is not that much. The Argonne pie chart above shows a 4% mark up so that's what we used in our analysis. A recent article in WSJ detailing the travails of the Panasonic/Tesla relationship suggested Panasonic was losing money on its Gigafactory battery operation (ref).

Miscellaneous Cost rReductions

We assumed another 4% in miscellaneous cost reductions as follows.

Integrating pack and cell production

We covered this fairly extensively in two other articles (ref 1) and (ref 2). If your end-product is a battery pack as opposed to a battery cell, then it makes no sense to have two wholly separate manufacturing facilities (one for cells and another for packs). There should be some synergies for combining the two processes as much as possible.

In the ref 1 article we described a Tesla patent that outlined some possible ways the two processes could be combined. As an example, the traditional current collectors on top of the battery pack are replaced by a circuit board. This circuit board acts as the end plates of the cell and also contains such functions as cell fusing, cell overpressure and cell balancing. The result being something like a printed circuit board. Filling the cell with electrolyte would be faster if it is done with both cell ends removed. Also, we know that Hibar makes high-speed electrolyte filling equipment.

There are other parts of the cell manufacturing process that could be speeded up as well. This can be seen in the following figure from the Argonne report.

Fig 6

Table 5.4 Summary table of the baseline plant

100,000 Battery Packs per Year, 50-kW Battery Power, 40-Ah Capacity, 60 Cells per Battery
Operating year: 300 days with three 8-hour shifts (two shifts per day for receiving and shipping)

			Direct Labor			Cap. Equipment		Plant Area	
			Workers/	Baseline	Scale	Baseline	Scale	Baseline	Scale
	Annual Baseline Rate (R_b)		Shift	Hours/yr	Factor, p	$millions	Factor, p	Area, m²	Factor, p
Receiving (two-shift operation)	869,416	kWh energy	3	14,400	0.4	3.60	0.6	900	0.5
Materials preparation				-					
Positive electrode	1,712,524	kg active material	2	14,400	0.5	2.00	0.7	600	0.6
Negative electrode	1,060,374	kg active material	2	14,400	0.5	2.00	0.7	600	0.6
Electrode coating				-					
Positive electrode	8,209,039	m² cell area	4	28,800	0.5	8.00	0.8 (0.2)*	750	0.8
Negative electrode	8,209,039	m² cell area	4	28,800	0.5	8.00	0.8 (0.2)*	750	0.8
Solvent recovery	2,309,021	kg NMP	2	14,400	0.4	3.00	0.6	225	0.6
Calendering				-					
Positive electrode	8,209,039	m² cell area	2	14,400	0.5	1.00	0.7	225	0.6
Negative electrode	8,209,039	m² cell area	1	7,200	0.5	1.00	0.7	225	0.6
Materials handling[a]	8,209,039	m² cell area	4	28,800	0.7	1.50	0.7	900	0.6
Electrode slitting	8,209,039	m² cell area	4	28,800	0.5	2.00	0.7	300	0.6
Vacuum drying	8,209,039	m² cell area	2	14,400	0.5	1.60	0.7	300	0.6
Control laboratory	869,416	kWh energy	4	28,800	0.5	1.50	0.7	300	0.6
Cell Assembly in Dry Room				-					
Cell stacking	6,315,789	total cells	5	36,000	0.7	4.00	0.8 (0.3)**	600	0.8
Current collector welding	6,315,789	total cells	5	36,000	0.7	4.00	0.8	600	0.8
Enclosing cell in container	6,315,789	total cells	3	21,600	0.5	3.00	0.7	600	0.6
Electrolyte filling, and cell sealing	6,315,789	total cells	5	36,000	0.5	5.00	0.7	900	0.6
Dry room control and air locks	2,000	m² operating area[a]	2	14,400	0.4	20.00	0.6	100	0.4
Formation cycling	6,315,789	total cells	8	57,600	0.7	30.00	0.8 (0.3)**	2,200	0.8
Final cell sealing	6,315,789	total cells	2	14,400	0.5	2.00	0.7	450	0.6
Charge retention testing	6,315,789	total cells	3	21,600	0.4	4.75	0.7	900	0.6
Module assembly	6,000,000	finished cells	6	43,200	0.5	6.00	0.7	600	0.6
Battery pack assembly and testing	100,000	battery packs	6	43,200	0.5	6.00	0.7 (0.3)***	900	0.6
Rejected cell and scrap recycle	6,315,789	total cells	5	36,000	0.7	2.50	0.7	600	0.6
Shipping (two-shift operation)	869,416	kWh energy	6	28,800	0.5	5.00	0.7	900	0.6
Total			90	626,400		127.45		15,425	

6% 13% 7% 20%

[a]One-third of the space for materials handling is within the dry room.

The baseline cost for capital equipment for electrode coating, C_{cc}, is based on the evaporation of the baseline annual solvent weight (Rs_{cc}) of 2,309,000 kg for the positive electrode and 1,527,000 kg for the negative electrode. For batteries requiring different solvent evaporation rates Rs, the cost is multiplied by (annual solvent rate (Rs)/baseline rate (Rs_{cc})) raised to the 0.2 power. Thus, Cost = C_{cc}(R/R_b)^0.8*(Rs/Rs_{cc})^0.2.

**The baseline costs of the capital equipment for cell stacking and formation cycling is for 40-Ah cells. To correct the baseline cost (C_{cc}) for cells of different capacity, the cost is multiplied by the capacity ratio, (Cap)/ 40 Ah, raised to the 0.3 power. Thus, Cost = C_{cc}*(R/R_b)^0.8*(Cap/40)^0.3.

***The baseline cost of the capital equipment for battery assembly is for a battery with four modules. To correct the baseline cost to a battery with a different number of modules (Mod), the cost is multiplied by the ratio of the number of modules, (Mod)/4 raised to the 0.3 power. Cost = C_{cc}*(R/R_b)^0.7*(Mod/4)^0.3.

Source Argonne. We've highlighted some good areas for improvements.

Formation Cycling and Charge Retention Testing

These two parts of the manufacturing process consume 13% of the total direct-labor charges and 20% of the factory floor area as shown in the above figure. During formation cycling, each cell is charged to 100% and then discharged and then the capacity of the cell is measured. During charge retention, the cell is charged up and left to sit for some amount of time to see if it holds a charge. If it doesn't hold a charge or have sufficient capacity, it is scrapped. It's easy to see why this process is so time-consuming.

As a far fetched example of streamlining this process, imagine if one had sufficiently high-energy-density cells or sufficiently defect-free cells that one could afford to have a certain percentage of those cells end up in the finished pack. Imagine that the cells totally skip formation cycling and charge retention testing. This process could be carried out in the pack and it would greatly speed up production.

At any rate, good food for thought, and you can see that there appears to be plenty of areas where the making of cells and packs can be streamlined. The above analysis was our own attempt to

continued next page

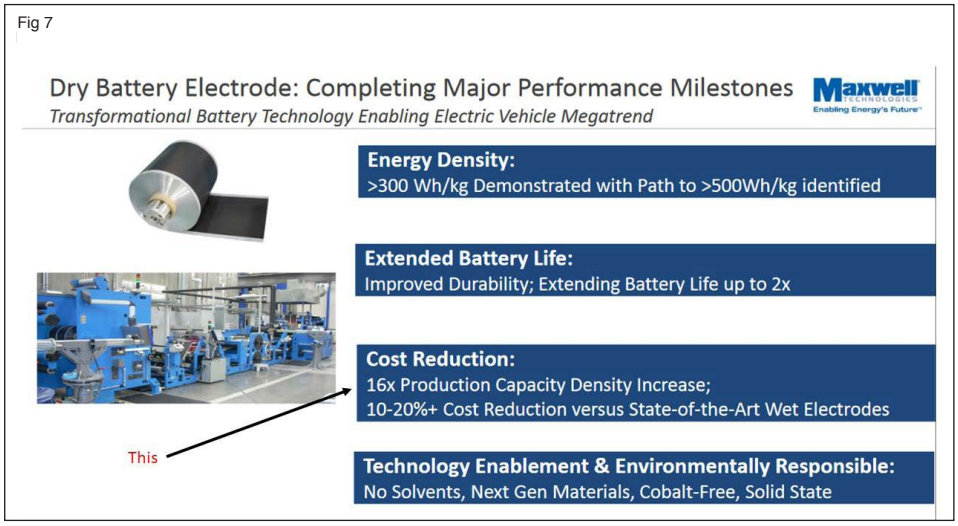
quantify how much Tesla could reduce costs with its new line of batteries.

We have another source that seems to validate our analysis: Maxwell estimates a 10-20% cost improvement as well as shown in the figure at right.

Maxwell estimates a 10-20% cost improvement with their new manufacturing process.

With all of the above being said, you may make your own take on this potential Tesla innovation.

Fig 7



https://insideevs.com/news/378928/tesla-new-battery-line-cost-savings/

New Study: 10 Percent EV Penetration Could Shift Utility's Entire Peak Load

By Charles Morris

Electric utilities around the world are exploring the potential of vehicle-to-grid (V2G) systems, which can reduce peak loads by using EV batteries to store renewably generated energy during the day and discharge it during peak consumption periods in the evenings.

A new study from Jackson Associates (*http://www.maisy.com/SCE_EV_Virtual_Power_Plant.pdf*) analyzed 5,000 Southern California Edison (SCE) customers' hourly loads and commuting behavior, and concluded that, if just 10% of them had EVs hooked up to a V2G system, the utility could shift its entire residential peak load to nighttime hours (as reported by Utility Dive here: *https://www.utilitydive.com/news/with-10-penetration-evs-could-shift-all-residential-peak-load-to-night-a/565207/*.)

The study found that using vehicle batteries to reduce peak residential load could save SCE as much as $560 per EV customer per year. "We were surprised both at the relatively small 10 percent EV market saturation required to completely clip the SCE residential peak and the large annual savings…even after paying for nighttime recharging," Jackson Associates President Jerry Jackson told Utility Dive.

The findings support the conclusions of a recent report from the Smart Electric Power Alliance (SEPA), (*https://sepapower.org/resource/preparing-for-an-electric-vehicle-future-how-utilities-can-succeed/*) which predicted that increased EV deployment could result in a "trillion-dollar EV opportunity for prepared and proactive utilities."

Key Findings:

- EV adoption presents an opportunity for utilities to increase customer engagement and be seen as a champion of positive change.
- Utilities must streamline processes and organization structures and create new business models to support EV rollouts.
- Utilities need to plan ahead to minimize grid impacts from an increasing number of megawatt-scale public, corridor, fleet, and private charging sites, and invest in infrastructure planning to prepare for EV charging infrastructure grid upgrades.
- Right-sizing EV charging infrastructure is crucial to avoiding unnecessary project delays, cost, and grid impacts.
- Expected EV infrastructure upgrade costs will drive new economic models, requiring discussions with stakeholders to begin early.
- Utilities should identify opportunities to incorporate load management, including managed charging and rate design and encourage the creation and broad adoption of open protocols.

What's in the report:

- Background information on trends including vehicle adoption, future utility impacts from EV load, and non-traditional utility solutions
- Understanding customer and stakeholder needs, roles and challenges for EV infrastructure deployment
- Opportunities to minimize EV infrastructure challenges focusing on installation timelines, cost ranges and components, and determining who pays for upgrades
- Recommended considerations for utility distribution planning tools, customer input required for utility load forecasting, available customer planning tools, and load management strategies
- The next generation of transportation electrification options, new utility business models, and opportunities for fleet electrification
- A complete list of charging infrastructure formats (levels), a list of supporting technology and grid infrastructure components, basics about utility distribution planning and infrastructure upgrades, and the latest in EV charging infrastructure safety protocols

Automakers Back Trump in California Suit Over Vehicle GHG Preemption

A coalition making up the vast majority of automakers including **General Motors** and **Toyota** is intervening on behalf of the Trump administration in litigation from California and environmentalists targeting the administration's preemption of the state's vehicle greenhouse gas and zero-emission vehicle (ZEV) rules.

The industry move appears intended to put more pressure on the California Air Resources Board (CARB) to accept a more aggressive rollback of Obama-era standards that EPA and the Transportation Department (DOT) are developing. The litigation stance comes after the industry has balked at the scope of the administration's planned rollback and urged the two sides to reach a compromise on changes to the standards — a deal that has remained far out of reach. Four auto companies that have voluntarily adopted California's "framework" for GHG rules for model year 2022-26 vehicles — **Ford, Honda, Volkswagen and BMW** — are not part of the industry's plan to intervene on the administration's behalf.

John Bozzella, president of the Association of Global Automakers, said during an Oct. 28 press call that he wants federal officials and CARB to reach a compromise on the standards to ensure there is one national set of vehicle regulations.

Bozzella is also acting as a spokesman for the Coalition for Sustainable Automotive Regulation — the new coalition of the majority of auto companies that is intervening on behalf of the Trump administration in State of California, et al. v. Elaine Chao, et al. in the U.S. Court of Appeals for the District of Columbia Circuit. That suit was brought by almost two dozen states backing California.

Environmentalists subsequently filed a very similar lawsuit in the same court — Environmental Defense Fund v. Chao.

"We don't know what the federal fuel economy rule is yet, actually," he said. "It's been the historic position of the industry, and frankly it's been federal policy for the better part of 40 years, that the federal government has the sole responsibility for regulating fuel economy standards. But it doesn't have to get to that. We can still reach an agreement that is supported by all the parties."

The administration says it preempted California's GHG and ZEV rules because they run afoul of the Energy Conservation & amp; Policy Act's bar on state rules "related to" fuel economy. But California and its allies cite several prior court rulings holding that both EPA and the state's authority over auto GHGs can co-exist with fuel economy limits.

Referencing the prior agreement between California and the Obama administration in 2010 on a set of national fuel economy and GHG standards, Bozzella said that "recent federal and California rulemakings threaten to upend this balanced approach, creating uncertainty for consumers, auto workers, retailers and manufacturers." The Trump administration's planned rollback has prompted California to no longer accept compliance with federal rules as sufficient for its own state standards. As such, if the preemption rule were to fail in court, it would force automakers to comply with two sets of standards — one for California and its allied states, and another for the remainder of the country that tracks the federal requirements.

"With our industry facing the possibility of multiple overlapping and inconsistent standards that drive up costs and penalize consumers, we had an obligation to intervene," he said. "While we had hoped to avoid this outcome, we believe that it is the best way to achieve a solution that works for all stakeholders. By participating [in the litigation], we ensure consumers, auto workers, retailers and manufacturers are part of resolving the dispute between governments."

The coalition includes all of the Global Automaker members besides Honda, as well as GM, Toyota and Fiat Chrysler Automobiles. Global Automakers' member companies include Nissan, Hyundai, Kia and Subaru.

'Hiding Behind' Trump's 'Skirts'

California and its supporters are already blasting the auto sector's move. CARB Chairwoman Mary Nichols said in a written statement: "We are disappointed in the Association of Global Automakers for hiding behind the Trump administration's skirts and its assault on public health. California will continue to carry out our mandate to meet national air quality standards and keep working with those automakers committed to a framework that delivers cleaner vehicles that benefit consumers and the environment."

Sen. Tom Carper (D-DE), the ranking

continued next page

Democrat on the Senate environment committee said: "To say I'm disappointed is an understatement, especially given the number of times these companies have told me personally that they wish to avoid costly litigation and regulatory uncertainty."

He added: "By aligning themselves with this administration's reckless and illegal proposal, these companies are actively challenging the rights of states to set their own emissions standards and tackle the climate crisis," adding that supporting the EPA and DOT preemption rule "is not in the long-term best interest of these companies — really, it's just the opposite."

Varying Stringency

Bozzella pointed out that EPA and the National Highway Traffic Safety Administration (NHTSA) still have not released their revised proposed GHG and fuel economy standards rules. Inside EPA recently reported that Trump officials will order a modest improvement in auto GHGs — a likely 1.5 percent annual rate of improvement, rather than freezing standards at MY20 levels as the agencies originally proposed.

That compares to the Obama-era rules, which require a roughly four to five percent fuel economy improvement each year through MY25.

In addition, California's voluntary deal requires the companies to improve fuel economy and emissions across their national fleets by about 3.7 percent annually — albeit with eased compliance provisions — as well as a commitment not to challenge the state's Clean Air Act authority to regulate vehicle GHGs.

The stringency of the voluntary deal's standards falls roughly "midway" between the current Obama rules and the Trump administration's proposed freeze, experts say. That accounts for the fact that one percentage point of the required annual gains can be met with "multiplier" credits for EVs and other advanced vehicles.

Other flexibilities aiding the sector include a commitment to streamline the process for granting "off-cycle" credit for technologies not accounted for by normal test cycles and ease limits on those credits.

"We support year-over-year increases in fuel economy and reductions in greenhouse gas emissions," Bozzella said, repeating the group's stance for many months. "We support a program that encourages innovation and that supports and incentivizes the shift to electric drive technologies, and we believe in a unified standard that includes California." It remains unclear what an acceptable compromise would be for the industry coalition. Bozzella said that since he hasn't seen the Trump administration's revised rule, "I don't know how big the gap is" between the federal agencies and CARB's voluntary framework agreement.

'Sole Purview'

When asked if the coalition believes California should not be able to set its own GHG standards and implement its ZEV sales mandate, Bozzella replied: "Historically, industry has taken the position that fuel economy is the sole purview
of the federal government. But as I said, we don't have to reach that question, because we can get this resolved. And that is where we hope to be."

He added that there is still an "opportunity to look at the data, and conclude from the data that there's a middle ground that supports year-over-year increases in fuel economy, that supports innovation, and a shift to electric drive technology, and that supports a national program with California as a part of it."

Asked if he hopes California will soften its voluntary framework and come back to the negotiating table as a result of the coalition backing Trump's preemption rule, Bozzella replied: "Historically, if you look at where we were in the mid-2000s, that's what happened. We were able to work through this." — Curt Barry (cbarry@iwpnews.com)

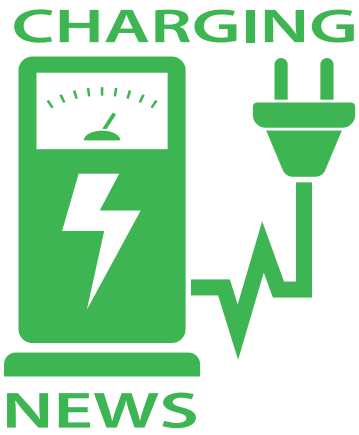
New SUVs and Electric Vehicles Highlight L.A. Auto Show

New electric vehicles, several new small SUVs, a redesigned compact car, a plug-in version of Toyota's top-selling vehicle and a futuristic electric station wagon concept car from Volkswagen are among the new models on display at the Los Angeles Auto Show.

Toyota is displaying a rechargeable hybrid version of the RAV4 — the top-selling vehicle in the U.S. that's not a pickup truck — while Ford is rolling out an all-new electric SUV that carries the Mustang performance car brand name. There also is a redesigned compact Sentra from Nissan. Check it out at the URL below.

http://apnews.com/1cbd0b8e4a4d4959a8d66e0301c945bd

With Blackouts, California's Electric Car Owners Are Finding New Ways To Charge Up



Clarence Dold used his 2013 Nissan Leaf to power his house during a four-day blackout in Santa Rosa, CA, as a result of the Kincade Fire. Photo: Vanessa Romo / NPR

By Vanessa Romo

Lawrence Levee's evacuation call came at 4 a.m. The Getty fire was just a few miles away. He and all of his Mandeville Canyon neighbors needed to evacuate.

He grabbed what he could and threw it into his bright blue electric Chevy Bolt. His car battery was only charged halfway, but that left him with plenty of power to make a quick getaway and then some.

But after driving around the next day, running errands in an area he didn't know well, he was in a pickle. He couldn't find a charging station. And he had 25 miles left to his tank.

"Where are the cheap charging stations?" Levy asked a Facebook group for Bolt owners, where members have been talking about how to charge up in a disaster situation.

Levee is one of hundreds of thousands of electric car drivers in California, many of whom are caught in a statewide struggle for electric power. As flames rip through rural and urban areas, utilities are cutting about a million customers off the grid. The blackouts sometimes last for days at a time, forcing some electric car owners to find alternative ways to charge up.

It's an ironic conundrum in a state that's home to more electric cars than any other other. California has just under half of the electric cars in sold in the U.S., according to EV Volumes, a group that tracks electric car sales.

In Levee's case, he didn't expect to be away from his house for so long. Normally, he'd pull into his garage and connect to a solar-powered battery. But that was impossible. Instead, he tried to hit up a nearby public charger that he remembered driving past a couple of times. But when he got there, it was broken.

Dreaded "range anxiety" set in. If he didn't plug in soon, he could end up stranded.

But his trusty Bolt Facebook group came to the rescue. That's where electric car fans commiserate, offer advice and do the occasional gas-car-driver bashing. Lately, they've been talking about blackouts. They pointed him to an app, and he found a free charger at a mall a few miles away.

Levee has only owned his Bolt for eight months, and already he says he'll "never go back to a regular car." Despite the brief inconvenience and the fire evacuations that are in his future, he notes California has better electric car infrastructure than any other state,

continued next page

with 18,000 public charging stations, according to the California Energy Commission.

And some electric car owners are taking advantage of these charging stations in new ways.

Clarence Dold lives in Sonoma County, which had been ravaged by the Kincade fire. Dold owns a 2013 Nissan Leaf and was left without power for four days.

But Dold found an ingenious use for his car: as a generator to power his house.

All it took was a pair of jumper cables that he connected to the Leaf's battery and an inverter about the size of a dictionary. The inverter box changes direct current (DC) power, the kind that powers electric cars, into alternating current (AC), the electrical current that powers homes.

After that, he ran a series of heavy duty extension cords into the main rooms of his ranch house. Throughout the blackout, Dold said, "were watching TV, and had a cold fridge and a couple of lights and things seemed normal."

The whole thing cost about $200 — a fraction of the price of a generator, which can run thousands of dollars.

Every few hours, Dold said, he'd make his way back into the car to check the battery gauge. He wanted to make sure the house wasn't depleting the car of too much power. If it did, he'd disconnect the cables and drive 5 miles away to recharge at a public charging station.

"The power outages are not over a broad area; this isn't like a hurricane hitting Florida," he explained.

During the blackout, the rest of the neighborhood was a cacophony of gas and electric generator rumblings. Meanwhile, his Nissan Leaf was virtually silent.

For Dold, and other enterprising electric car owners like him, that's the secret sauce to surviving what's becoming the new normal in California.

https://www.npr.org/2019/11/08/777752175/with-blackouts-californias-electric-car-owners-are-finding-new-ways-to-charge-up

Ford Is Planning a Huge North American Electric Charging Network

Photo credit: Ford

By David Grossman

- Ford will launch the largest electric charging network in North America and any electric car will be able to use it.
- Once complete, the network will nearly triple the number of Tesla charging stations currently available in the same area.
- While Ford currently has no electric cars on the market, that will change the soon: the company has been spending heavily on the technology.

Today Ford announced that it will be creating North America's largest electric vehicle public charging network. The Michigan-based automotive giant will be building out 12,000 places to charge electric cars and over 35,000 charge plugs, despite the fact that it currently has no new electric cars on the market. No set date was given on the network's completion.

"Among people who already own or want to purchase electric vehicles and plug-in hybrids, 48 percent say that a lack of charging stations is one of their main concerns," says Ted Cannis, Ford director of global electrification, in a press statement. "By offering industry-leading charging access we are dismantling those barriers, allowing more customers to confidently enjoy the benefits of owning an electric vehicle."

Ford's next attempts at all-electric vehicles, which the company calls a "Mustang-inspired SUV," will debut in 2020. Earlier this year, the company invested $500 million in the small electric car manufacturer Rivian, which has a focus on trucks and SUVs.

Read the rest of the article at the URL below as well as its original reference.

https://www.yahoo.com/news/ford-planning-huge-north-american-183900478.html
https://www.popularmechanics.com/cars/hybrid-electric/a29501539/ford-charging-network/

AC Fast Charging: The Right Fit for Medium-Duty EVs

CHARGING NEWS

By Paul Beck

What's the largest mass transit system in the United States? Is it the public transit network? Nope. Commercial airlines? Guess again. Passenger rail? Not even close. Here's a hint: the vehicles are colored yellow. Give up? It's school buses, and in terms of sheer numbers this fleet is 2.5 times larger than all other forms of mass transit combined. And therein lies a big, dirty problem.

According to a 2018 study by the US Public Interest Research Group, 95% of the nation's roughly 500,000 school buses are diesel-fueled. Numerous studies have documented the negative impact breathing diesel exhaust has on respiratory diseases like asthma. In fact, the US Environmental Protection Agency has classified diesel exhaust as a likely carcinogen. These negative effects are especially pronounced in children.

But change is on the way. The entire medium-duty vehicle market, which also includes delivery vans and other commercial vehicles, is on the edge of an electric precipice. The cost savings and environmental benefits of electrifying these vehicles can no longer be ignored.

"The medium-duty plug-in vehicle industry is definitely in the midst of a strong surge," Will Barrett, Director of Sales for EV charger manufacturer ClipperCreek, told Charged.

> AC charging that operates at the upper limits of the J1772 connector specs can provide up to 19.2 kW of power. While that's significantly less than most DC chargers, it's perfect for school buses and other medium-duty EVs.

This surge may pair well with an EV technology that many in the US seem to have forgotten about: high-power AC charging.

While ultra-fast DC charging is grabbing all the headlines in new highway corridor projects, high-power AC charging may be the perfect fit for school buses, delivery trucks, and other medium-duty fleet vehicles.

The wheels on the bus

"Public charging is now almost wholly defined as installing DC fast chargers along heavily travelled corridors," said Forest Williams, a strategic marketing consultant for charging solution provider Liberty PlugIns. "DCFC is the silver bullet for range anxiety."

However, while EV drivers and public charging networks are rapidly embracing ultra-fast DC fast charging, Williams is telling medium-duty EV fleet operators that there may be a better solution. He calls it AC fast charging, or AC charging that operates at the upper limits of the J1772 connector specs. With an output current up to 80 A, Level 2 AC fast chargers can provide 19.2 kWh of power. While that's significantly less than most DC chargers, Williams argues that it's perfect for school buses and other medium-duty EVs.

[Article excerpted from the URL below. Full article appeared in Charged Issue 45 – September/October 2019.]

Photo: Charged

https://chargedevs.com/features/ac-fast-charging-the-right-fit-for-medium-duty-evs/

Campaign Pokes Fun at Sorry State of Public Charging Signage

By Bengt Halvorson

As electric-car technology matures, and the people driving EVs aren't all patient, resourceful early-adopter types, the issues that sour people on the electric experience are evolving, too. Today the deal-breaker is increasingly likely to be the lack of charging infrastructure rather than rated range—and the idea of range anxiety is being replaced by charging anxiety.

In some areas it's entirely avoidable, as it's sometimes over simply finding chargers that we know are there. EV owners driving in unfamiliar areas sometimes find themselves sifting through apps and sites for better directions on where a charger is within a huge mall or, as a vehicle-based navigation system once took us, to the opposite side of a maze of highway ramps.

Sweden's Bee Charging Solutions is simultaneously poking fun at this need for more signage and, well, providing that makeshift signage—in the form of everything from hay bales and flags. Examples of other less-permanent ideas from ad agency Forsman & Bodenfors' campaign in their promotional video include an inflatable raft placed in a bus stop.

Bee Charging is Sweden's largest charging provider, with more than 8,000 charge points—yet it seems Sweden has some of the same issues U.S. motorists have: There are just 20 official signs leading to them.

"No wonder people are still hesitant about buying an electric car," said an introduction accompanying the video. "That's why Bee Charging Solutions, with charging stations all over the country, has made their own signs along the roads. Out of just about anything."

The goal, of course, is to get politicians, cities, and state transportation departments involved—so that charging stations are easy to find and there are fewer of those experiences that can sour would-be adopters for years. There are some good ideas on standardizing charging signage, but none have been deployed widely to highway departments yet.

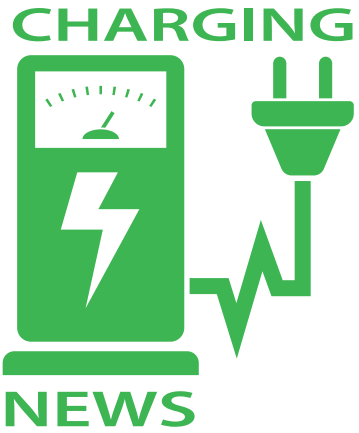
If anything, this is a reminder that state DOTs need reminders of how deficient charger signage is. Let's just say, we hope some day there are as many signs helping lead to electric-car chargers as there are signs pointing to gas stations—or to warning about parking restrictions once you get to chargers.

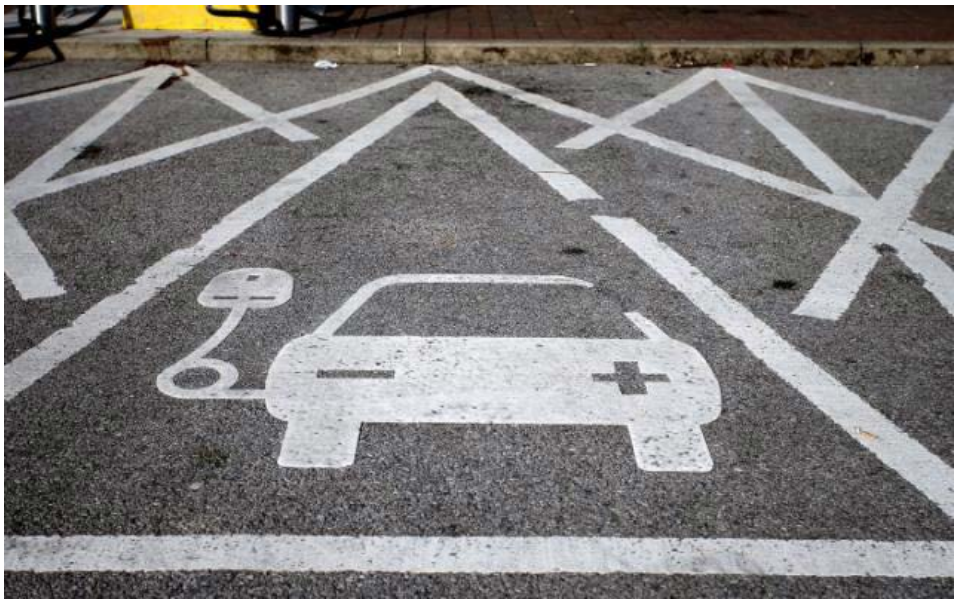
Watch the video at the top of this post in case you missed it. Swedish humor can be described as a little dark and deadpan, and plenty sarcastic. Here it's right on the mark.

EV parking sign, Portland, OR

https://www.greencarreports.com/news/1125498_campaign-pokes-fun-at-sorry-state-of-public-charging-signage

Electric Car Drivers Abusing Charging Scheme to Get Free Parking, Council Complains





By Mike Wright

Electric car drivers who are given free parking are abusing the privilege, a council has complained. Fife Council found drivers whose cars take around 55 minutes to charge were leaving the vehicles in free spaces for up to six hours.

The findings come as the council is planning to start charging electric car owners to recharge their vehicles as demand for the points is growing.

The local authority currently waives parking charges for electric vehicles that park in its car parks when using charging points as part of efforts to encourage adoption of the low-emission cars.

Derek Crowe, the council's senior manager for roads and transportation, said "Fife Council will see the number of charging points rise from 39 to 68 by the end of the financial year. However, the final arrangement of the council paying for electricity is not working.

"It's a good idea but it's not working. The infrastructure is not working as it was intended to work.

"We see cars sitting in parking spots all day, who are maybe only charging for short periods of time so they can make use of free, all-day parking."

Councils in Scotland can use devolved-government grants to fund new charging points but it is down to the local authorities to decide what perks the employ to encourage their use.

However, with maintenance grants due to run out in 2023, Fife said it intended to start charging electric vehicle owners for electricity from April.

In the last two years demand for charging spots has more than doubled in the county, leaving the council with a £60,000 bill for maintenance and electricity costs in the last fine financial year.

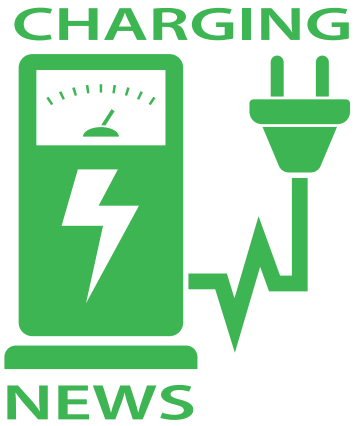
Councillor Ian Ferguson, who represents Dunfermline North, said: "Technology is also moving on with this.

"If in ten years time, the norm is 500 miles a charge and there's super fast charging in five minutes, it will be like getting petrol on a forecourt.

"You wouldn't expect to get petrol and park all day on a forecourt, so it's important to challenge the way people think."

https://www.yahoo.com/news/electric-car-drivers-abusing-charging-175134537.html

First Gas Station in America to Ditch Oil for 100% Electric Vehicle Charging Opens in Maryland



- **The first gas station in the U.S. that has been completely transitioned from a petroleum station to exclusively charging EVs opened Thursday in Takoma Park, Maryland.**
- **RS Automotives, the local gas station, has been around since 1958, made the switch.**
- **Depeswar Doley, owner of the station, was unhappy with the way oil and gasoline companies structure contracts and decided to go to 100% EV charging.**
- **There are more than 20,700 registered electric vehicles in Maryland, and the area also has an electric taxi service in need of more charging infrastructure.**

By Jacob Douglas

The first gas station in the U.S. that has been completely transitioned from a petroleum station to exclusively charging EVs opened Thursday in Takoma Park, Maryland.

RS Automotives, the local gas station, has been around since 1958.

Depeswar Doley, owner of the station since 1997, said he was already unhappy with the way oil and gasoline companies structure contracts — such as limiting the use of multiple suppliers, including clauses that extend contracts when a certain volume of sales is not met and limiting maintenance support. These business factors already were pushing him to consider other options.

A nudge from his daughter was the final step in convincing Doley to make the switch to EV charging.

"My daughter, who is 17, she is the one who convinced me after I told her that I was going to talk to the [Electric Vehicle Institute] guys," Doley said.

A public works manager for the city of Takoma Park, Maryland, first suggested to Doley a conversation with Electric Vehicle Institute.

When he told his daughter about the idea, "she said, 'Dad, that's a real good suggestion.'"

Doley said he's not too worried about how the switch will change his business income.

"You notice there are not too many electric vehicles on the road," he said. "So it's not something that I expect to become rich overnight or something like that, but it's a good cause [and] good for the environment."

There are more than 20,700 registered EVs in Maryland, and the area also has an electric taxi service in need of more chargers for their business.

The gas station conversion was jointly funded by the Electric Vehicle Institute and the Maryland Energy Administration, which provided a grant of $786,000.

[*The rest of the article continues at the URL below.*]

https://www.cnbc.com/2019/09/26/first-gas-station-to-ditch-oil-for-electric-vehicle-charging-now-open.html

Tesla Gives a Look Inside Gigafactory 3

By Tesla Motor Club Staff

Tesla has released photos inside Gigafactory 3 in Shanghai that show the production facility is poised to start pumping out Model 3 and Model Y vehicles. In its Q3 2019 earnings report, Tesla confirmed that trial production has started at the plant, and pending government approval, the factory will likely start manufacturing ahead of schedule.

"We are already producing full vehicles on a trial basis, from body, to paint and to general assembly, at Gigafactory Shanghai," Tesla published in its Q3 update.

"We have cleared initial milestones toward our manufacturing license and are working toward finalizing the license and meeting other governmental requirements before we begin ramping production and delivery of vehicles from Shanghai."

Tesla aims to make 150,000 Model 3 vehicles per year at Gigafactory 3.

Shanghai General Assembly
Shown here are three Chinese employees doing detailed assembly attachment and installation of components hidden underneath the shroud in the frunk of a Model 3. This car looks ready to roll; the annual output goal for this plant is 250,000 vehicles. The upcoming Model Y will also be made on this line.

continued next page

1 Shanghai Stamping Press
Like it's big brother in Fremont, this sheet metal stamping press appears to be doing left side door frame assemblies on two parallel lines.

2 Shanghai Body Assembly
This giant German Kuka robot does welding of the body panels to the other panels via a magical melding of electro-mechanical hydraulic control orchestrated by a network on-board computers (which has been taught by its cousins in Fremont) all working tirelessly. Tesla is using the same production line (including all the special optimizing tweaks made to increase thru-put in Fremont) in this new factory, to maximize the line bring-up speed.

3 Shanghai Body Shop
This second photo of the sheet metal assembly line shows a rather long queue, with protective dividers to prevent accidental human interference in the line movement.

SHANGHAI GIGAFACTORY

4 Shanghai Body Shop
This third photo depicts a full "body in white", referring to the manufacturing stage in which the body's components have completely joined together by welding (spot, or MIG/MAG), riveting, clinching, bonding, laser brazing etc., just before painting and before any chassis sub-assemblies, or trim (glass, door locks/handles, seats, upholstery, electronics, etc.) has been added.

5 Shanghai Paint Shop
Shown here are 7 white (and presumably 7 blue) bodies in a test production run. These units are probably a "check build" to study the completeness of the process, before they add other components.

6 Shanghai Exterior
A drone shot depicts the enormity of the plant On the left, the employee parking lot seems full, with about 100 vehicles, while the white building in the foreground houses multiple 12-bay incoming receiving docks.

7 Shanghai 10 months from Ground-breaking to Production ready
A drone shot depicts the enormity of the plant On the left, the employee parking lot seems full, with about 100 vehicles, while the white building in the foreground houses multiple 12-bay incoming receiving docks.

https://teslamotorsclub.com/blog/2019/10/25/tesla-gives-a-look-inside-gigafactory-3/

2020 Porsche Taycan 4S: Lower-priced Version Might Offer Longest Range

2020 Porsche Taycan Turbo first drive

By Bengt Halvorson

Porsche's Turbo models have always been among the more exclusive, expensive models from the German sports-car maker, and now this rings true for its Taycan electric car, too: Not all Taycans will be Turbos.

Porsche announced that soon after the introduction of the 2020 Porsche Taycan, a Taycan 4S model will slot below the Taycan Turbo S and Taycan Turbo.

With it, Porsche helps interpret what the Turbo badge signals for Porsche in the electric-car realm: Higher performance and longer range. While the Taycan Turbo and Turbo S offer 616 horsepower in normal driving and either 670 hp (Turbo) or 750 hp (Turbo S) in a 2.5-second boost mode, the Taycan 4S offers 522 hp if you go with the standard 79.2 kWh Performance Battery and 563 hp if you opt for the 93.4 kWh Performance Battery Plus.

Porsche says that the Taycan 4S can accelerate to 60 mph in just 3.8 seconds—versus just 2.6 seconds to 60 mph for the Turbo S. In initial ride-along and first-drive opportunities with the Taycan we found its all-out acceleration to be brutally quick.

That brings the total number of power outputs for the Taycan to four, with two battery capacities—with the base battery only corresponding to the lowest output.

One key difference between the two battery packs is that the smaller 79.2 kWh pack can only charge (on 800-volt-capable DC fast-charging hardware) at a peak 225 kWh, while the larger one can charge at 270 kW. Just as with the Turbo and Turbo S, DC fast charging at 400 volts only works up to 50 kWh and you'll need to check an option box to boost it to 150 kWh.

The 4S has a different motor in back than the Turbo or Turbo S; although it's also a permanent-magnet unit, its rotor is 3.1 inches shorter—saving weight, Porsche says—one of several hints that the Taycan's not-yet-released range might be a bit longer for this model than for the higher-performance models. Just as in the Taycan Turbo its inverters are 600-amp in back and 300-amp in front, respectively (the Turbo S gets 600-amp inverters at both axles).

Other than that, the 4S carries over some

continued next page

2020 Porsche Taycan 4S

The range of Taycan prices is likely to be downright shocking to those who aren't accustomed to Porsche pricing (though not surprising otherwise). That's a whopping $47,100 and $40,520 less than the Taycan Turbo, and it leaves a span from the 4S to the Turbo S of $81,200—before the potential to load tens of thousands of dollars of options.

Porsche is offering free 30-minute charging sessions at Electrify America sites in the US, as well as at Porsche dealerships, and, much like its VW Group cousin Audi it's partnering with Amazon for 240-volt home charge-point installation.

The Taycan 4S is due to US dealerships next spring, as a 2020 model.

of the same components, including the front motor, the two-speed transmission on the rear axle, and the standard electronic damper control and adaptive air suspension systems. The 4S rides on 19-inch wheels, which may bring some ride-and-handling differences over the other models' 20- and 21-inch ones. Brakes are six-piston calipers in front (red) and four-piston (red) at the rear wheels, all with vented cast-iron rotors.

Just as with the other models, Porsche says that the Taycan 4S can pull up to 265 kW (0.39g) in regenerative braking—or recuperation, as Porsche and others call it.

Appearance-wise, the front fascia has a different geometry, with black side skirts and rear diffuser. The 4S comes with ambient interior lighting, partial-leather interior, and eight-way power-adjustable front comfort seats with driver memory. LED headlamps and dynamic lamps are included.

The Taycan 4S starts at $105,150 with the Performance Battery or $111,730 with the Performance Battery Plus option.

https://www.greencarreports.com/news/1125499_2020-porsche-taycan-4s-lower-priced-version-might-offer-longest-range

How Autonomous Driving Affects Heat Loads and Component Sizing in Electric Vehicles

A simulation model can be used to correlate test data and quantify the potential change in heat generated by electric vehicles when they include the added load of a self-driving computer.

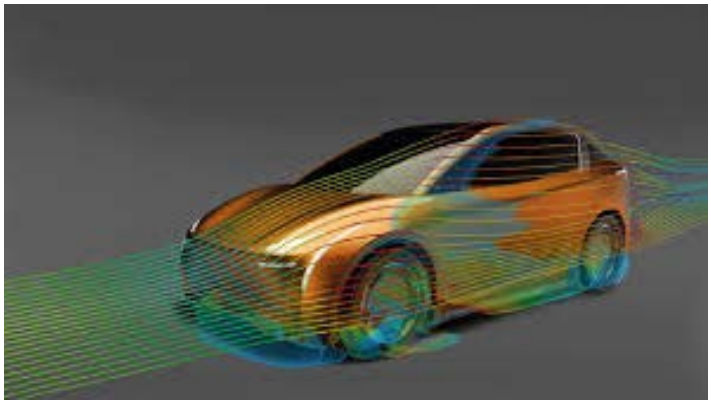
By: Sudhi Uppuluri, Gaurav Patil, Doug Kolak in Electronics & Test Automotive

Electrified vehicles present a whole new set of design challenges, and autonomous driving piles on an entire new level of complexity. For example, different levels of autonomous driving affect the power consumption, thermal management, and heat loads in an electrified vehicle and therefore the component sizing. A high-fidelity computational model can help automobile design engineers and manufacturers understand the complex interactions of the different vehicle systems to quantify the impact of upcoming developments in the field.

This article describes an approach that uses co-simulation between two system-design software tools (one at a vehicle level and another at the thermal system level). With a simulation model that is correlated with real test data, this method quantifies the potential change in heat generated from the battery, motors, and inverters for electric vehicles that result from additional load from the self-driving computer. We illustrate the effect using VW eGolf from PowertrainLive as the base reference vehicle.

There were three steps in quantifying the effect. Firstly, we quantified the baseline power consumption and head load for the battery and motors for a reference drive cycle. We picked a city drive cycle first as that is likely to be the immediate application for for autonomous vehicles in the form of robotaxis. Secondly, we added electric power consumptions and the driving behavior change of the autonomous vehicle using simulation. Lastly, we calculated the effect of the autonomous driver across many real-world drive cycles with different characteristics.

To model all of this information, we applied computational analysis using two tools: the PowertrainLive high-fidelity, vehicle-simulation model from CSEG and the 1D computational fluid dynamics (CFD) software Simcenter Flomaster from Siemens to analyze internal flow and model the thermal transients in the system. The vehicle model cumulated fuel economy, battery range, and the thermal and performance behavior of various components. The CFD simulation software allowed us to model the cooling system and to understand the effects on airflow.



Simulation tools can help to determine the extra load when an EV carries autonimous tools. (Image source: Siemens)

We modeled the battery using an RC representation to speed up the calculations but still capture the transient operation of the battery with acceptable accuracy. The voltage and the resistances and capacitances are a function of state of charge of the battery and the temperature of the battery. We developed the battery performance characteristics for the complete operating range, from fully charged to fully depleted, and ambient temperatures from -7 to 45 °C. This enables an accurate representation of battery performance under all five EPA drive cycles.

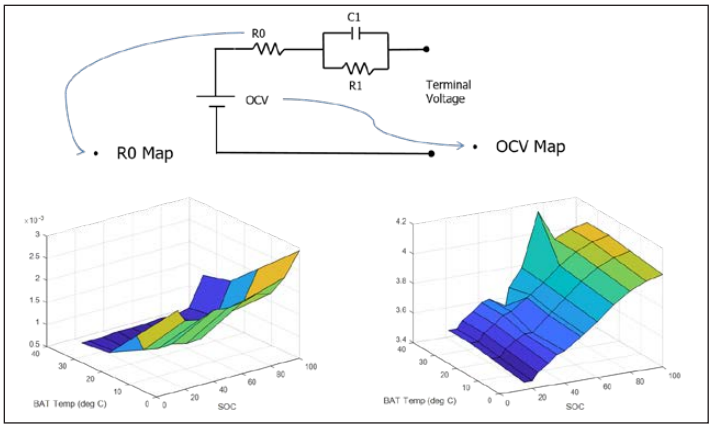


Figure 1 shows some of the battery performance maps. The open circuit voltage is a function of battery temperature and state of charge. The voltage drops slightly with battery and state of charge. (Image source: Mentor)

Figure 2 (Next Page) shows how this battery model predicted performance compared to the test data in the

continued next page

vehicle model. The correlation below shows the current demand for the USO6 drive cycle, an aggressive and highly transient drive cycle used by the EPA. The vehicle model was able to predict the peaks and transience of the current well enough to capture the sometimes subtle effects of driver behavior change.

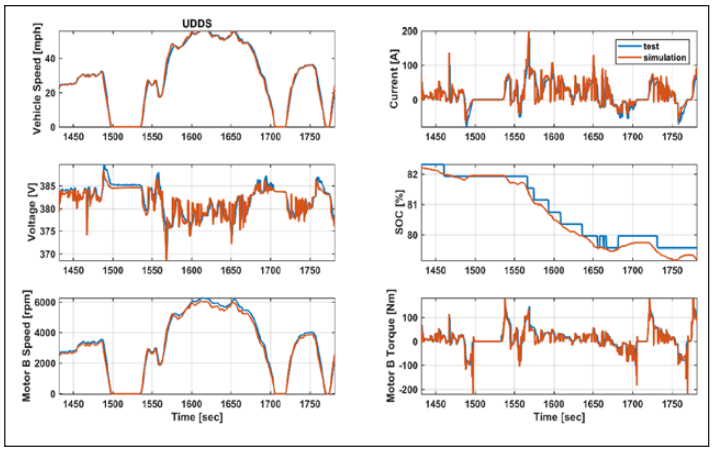


Figure 2: Overall vehicle model correlation with measurement data.
(Image source: Mentor)

Once an acceptable level of accuracy was achieved, we looked at the influence of autonomous driving features on the vehicle, namely the increased power consumption, increased weight, and less aggressive driving profile as a result of increased awareness of the surrounding.

The power consumption of autonomous vehicles (AV) varies significantly depending on the type of sensors used and the maturity of the technology. It can vary anywhere between an estimated 500 W for a Tesla to a 2.5 kW for an experimental autonomous vehicle with LIDAR and computers in the trunk. In our study, we assumed a power of 900 W for the sensors and computer based on interviews with few of AV vehicle manufacturers.

We assumed an increased weight of about 50 kg for the computer and the sensors. This is something that is widely reported as the added weight for the autonomous sensors and computers.

Finally, we looked at the effects of the driving profile change. The autonomous driving profile was slightly less aggressive and was represented with a smoother driving profile and with limited acceleration limits, which are usually in place for safety. The driver model is illustrated in **Figure 3 (above right)**. The updated driving profile was calculated by the driver model with the changes in aggressiveness factor and limits on acceleration. The model used the drive cycle, the road conditions and the grade as the input to the autonomous

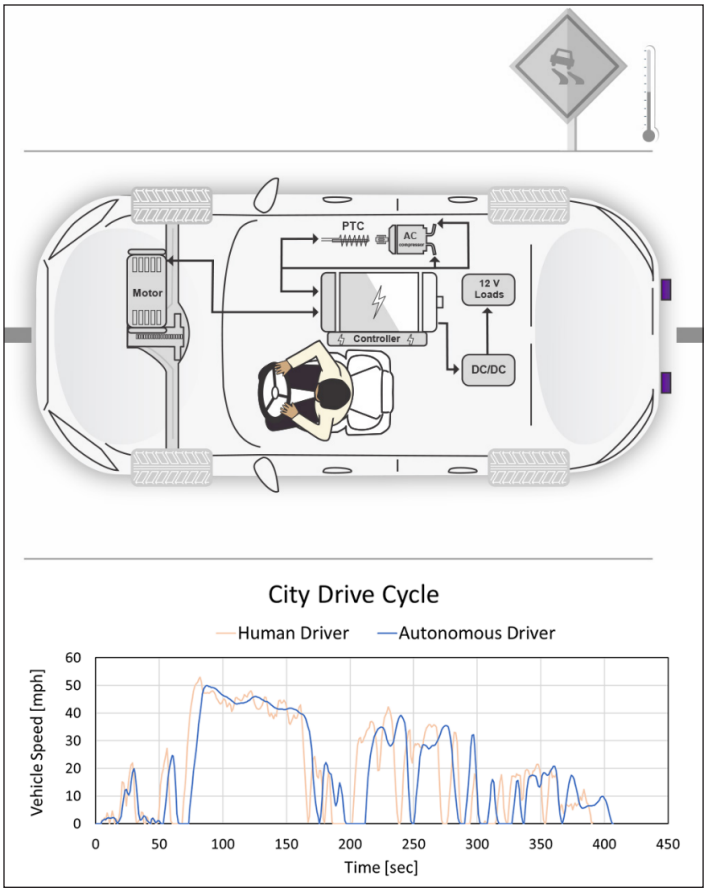


Figure 3: Vehicle architecture of EV from PowertrainLive.
(Image source: Mentor)

driving controller to determine the accelerator pedal position and the new driving profile.

With the computational models ready, we reviewed the base vehicle energy consumption reduction. The first drive cycle we considered was a city drive cycle, a typical city taxi ride (shown in figure 3b as orange line). The base energy consumption for the vehicle in this scenario is 0.47 kW/hr for an 8-minute and 2.2-mile drive. This rate of power consumption and driving profile gave us a baseline battery range of 99 miles. With the added power consumption of the AV package of 900 W, and a weight penalty of 50 kg, the battery range dropped from 99 to 62 miles. The smoother driving from the autonomous controller reduced the spikes in power consumption and thereby increased the battery range back up to 81 miles.

On thermal management, we observed some interesting trends for the battery and motor heat loads. Both peak and cycle average heat loads for the battery were down nearly 50%. **Figure 4 (Next Page)** illustrates this in the transient

continued on page 54

Autonomous Driving

Continued from page 53

profile plots. Why such a drastic reduction in battery heat load? The battery heat is caused by resistance inside the battery, which is a second-order function of the current. As the current demand drops, the battery heat load drops by the square of the drop in the current.

While the reduction in peak heat loads was expected because of limited accelerations, we were surprised to see the drop in cycle average battery heat load even with an added electrical load on the battery from the computer and sensors. This was a result of the reduced current spikes from constant charging and discharging. The cycle aberage heat load also dropped by nearly 50%. This reduction in heat load reduces chiller size for the battery thermal management system and further affects the compressor power.

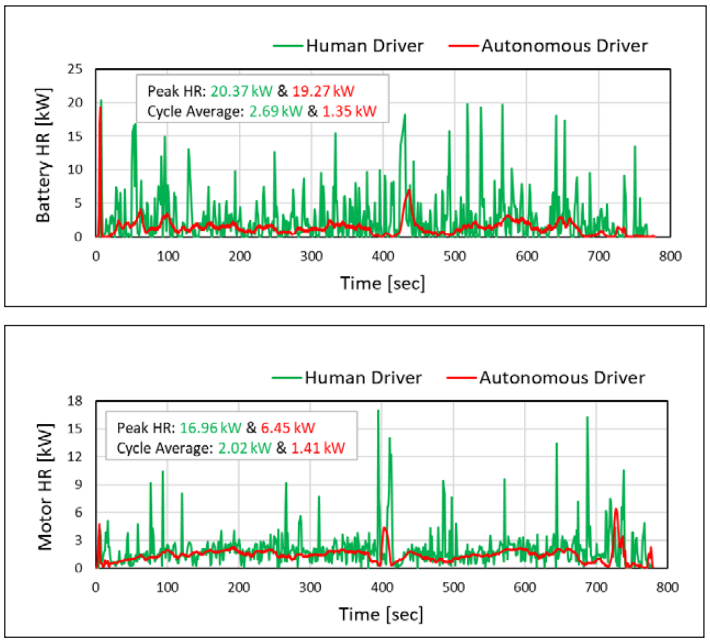


Figure 4: Difference on heat loads between the autonomous driver (red line) and human driver (green line). (Image source: Mentor)

Was this effect just for that drive cycle that we picked, or was it actually prevalent across multiple drive cycles, and, did it represent general driving? CSEG collected numerous real-world drive cycles in Michigan, and we assessed the impact on AV technology on a few of these drive cycles with different accelerations, average speeds and driving distances. The trends remained similar, with the quantity of drop varying depending on the drive cycle. **Figure 5** shows the numbers from PowertrainLive calculations for a city and a highway drive cycle.

		Human Driver	Autonomous Driver
Highway	Cum. Distance Travelled *[miles]*	14.58	14.60
	Battery Energy *[kWh]*	4.852	4.854
	Battery Range *[miles]*	64.91	64.97
City	Cum. Distance Travelled *[miles]*	2.18	2.18
	Battery Energy *[kWh]*	0.476	0.527
	Battery Range *[miles]*	98.92	89.19

Figure 5: Results from the PowertrainLive calculations. (Image source: Mentor)

From this study, we were able to analyze and compare the effects on driving range and thermal requirements of autonomous driving on electric cars. We found that the battery range dropped significantly in city driving conditions because of the power consumption of the computer. While the overall power consumption from the battery was higher, the peak and cycle average heat loads from the battery were lower due to reduced aggressiveness in the driving and the spikes in current draw.

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You can conduct similar experiments on your EV designs using these same tools. The vehicle-simulation model PowertrainLive and the correlated vehicle models can be accessed through the Internet browser and subscription. The vehicle model can be integrated with your current design tools such as FloMaster. You can also take Flomaster for a free test drive on the cloud.

For further details and data from the study, please email the author at sudhi.uppuluri@cseg.us

Sudhi Uppuluri is the technical director at CSEG, the maker of PowertrainLive. He has 20 years of experience in the automotive powertrain simulation. He is also a lecturer at University of Wisconsin Madison on Vehicle Level Modeling and has various technical publications on related subjects in SAE and AIAA journals.

Doug Kolak is a business development manager for the Mechanical Analysis Division at Mentor, A Siemens Business. He joined the Flomaster team in 2007 as a CFD engineer, during which time he has worked heavily with top companies in the aerospace, automotive, and process sectors worldwide to understand emerging challenges and develop software tools to better meet those requirements.

https://www.designnews.com/electronics-test/how-autonomous-driving-affects-heat-loads-and-component-sizing-electric-vehicles/41833506461562

First Cyber Attack on Solar, Wind Assets Revealed Widespread Grid Weaknesses, Analysts Say

New details of a denial-of-service attack earlier this year show an energy sector with uneven security.

By Robert Walton

A March fifth cyberattack of U.S. wind and solar assets is back in the news, with fresh documents helping shed light not just on the extent, but also the simplicity of the first-of-its-kind intrusion. Cybersecurity experts say it reveals a utility sector not sufficiently vigilant, and failing to employ the most simple fixes.

The North American Electric Reliability Corporation (NERC) in September revealed details about the denial-of-service (DoS) attack, urging utilities to keep firewalls patched and up to date, but held back the name of the impacted entity. E&E News last week revealed, based on documents obtained through a public records request, the victim was sPower.

Owned by AES and AIMCo, sPower bills itself as the United States' largest private owner of operating solar assets. Though there was no loss of generation, the March cyberattack impacted the company's visibility into about 500 MW of wind and PV across California, Utah and Wyoming.

The attack is widely being called the "first" on renewable generators, though it is not clear the grid intrusion was entirely intentional. Attackers exploited a known vulnerability in an unpatched Cisco firewall, causing a series of reboots over 12 hours. But intruders did not press the attack further and E&E reports it is unclear they understood the firewall was connected to the energy grid.

Security experts say the attack is a wake-up call for the electric sector and a sign that clear vulnerabilities remain.

"The news begs a bigger question about cybersecurity regulations for the energy industry," Phil Neray, vice president of security firm CyberX, said in an email. "The manner in which it was carried out was very basic — exposing some essential weaknesses in the way energy companies currently patch and monitor their network devices."

Utilities must do basic security maintenance

CyberX released a report last month that concluded utility networks and unmanaged devices are "soft targets for adversaries." Many utilities use outdated operating systems and unencrypted passwords that leave them vulnerable, the firm found.

That means in some instances utilities are not even maintaining the most basic of protection: keeping systems up to date.

"The simplicity of this attack should make generators sit up and take notice."
Jason Haward-Grau
Chief information security officer, PAS Global

Neray said the grid is made vulnerable by network appliances like the ones that were compromised in the attack on sPower: directly exposed to the internet, unpatched and with limited malware capabilities. "We've seen attackers go after unpatched network devices in the past," he said.

The March 5 attack is "one more example .... that cyber risk in the industrial space is not only real, but operant," Jason Haward-Grau, chief information security officer at cyber firm PAS Global, said in an email.

"The simplicity of this attack should make generators sit up and take notice," Haward-Grau said. "This was a 'simple' IT attack on an unpatched firewall, which was still vulnerable, in spite of the patch being available."

https://www.utilitydive.com/news/first-cyber-attack-on-solar-wind-assets-revealed-widespread-grid-weaknesse/566505/

The Battery Show Wrap-up

What we learned, what surprised us, and how the EV world is changing.

By Kevin Clemens

Spending the better part of a week with more than 9,000 attendees at The Battery Show and Electric & Hybrid Vehicle Technology Expo 2019, [*https://thebatteryshow.com/*] in Novi, Michigan gives a pretty strong impression of where electrification of transportation is today, and more importantly, where it will be going tomorrow.

With more than 700 companies exhibiting, the Electric & Hybrid Vehicle Technology Expo provides a hands-on opportunity to talk with EV and battery suppliers. (Image source: Design News)

Growing Fast

First of all the show itself has grown—the Expo is now 20% larger than last year and more than 700 companies exhibit their products and technologies. There is an incredible variety of things to see—computer simulation software, battery test systems, connectors and cabling, battery packaging and venting systems, motors and controllers, chargers, and of course, battery cells and packs are on display. But, here is the thing—the days of garage hobbyists and "mom and pop" operations are gone. The battery and EV industries have become multi-billion dollar enterprises and the commercial professionals have taken over, and it shows.

Conferences and presentations at the show were divided into eight separate tracks and there were more than 150 speakers. Basic materials science, battery chemistry, charging systems, and EV market factors all get serious and critical examination by academic and industry experts. The talks are grouped into topics such as cell design, battery materials development, and EV and hybrid industry developments to aid show-goers in their choices.

Buses, Trucks, and Delivery Vehicles Lead The Way

Although EVs are still a very small part of the total automotive market in the US (between 2-3 %), there are certain segments that are beginning to show growth. During an Industry Leader's Round Table on EV Growth, attendees learned that electric school buses are becoming popular. A school bus would seem in ideal EV application—the route is well-established, the speeds are low with lots of stop and go, and after an initial activity in the morning the bus sits unused (when it can recharge) until the end of the day. School districts are finding that the highly efficient electric buses can save, not only in fuel costs but also in reduced service and maintenance costs.

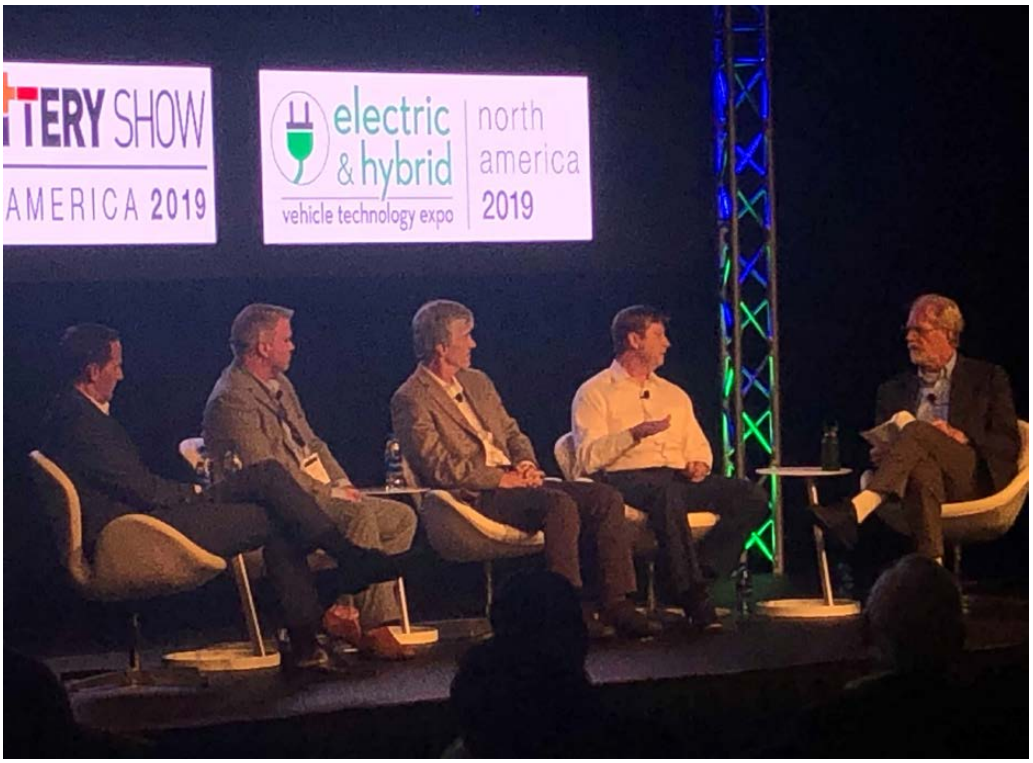
Another market that is rapidly growing is light delivery vehicles. FedEx, UPS, and others are buying fleets of electrically-powered trucks for urban package delivery. Once again, cost is the biggest driver as electrified trucks are proving themselves reliable and frugal in the field. The growing popularity of this segment was reflected in an increase in attendance in sessions dedicated to electrification of trucks and commercial and off-road equipment.

Can EVs Be Sustainable?

The growth of the personal EV market in the US is not quite as robust. Ford's Senior Technical Leader Bob Taenaka provided a Keynote Address on how carmakers will deliver on customers EV demands. The same topic was

continued next page

also addressed during an Industry Leader's Roundtable dedicated to EV Sustainability. Auto industry analysts were questioned by actor, author, environmental activist, and noted electric vehicle early adopter Ed Begley, Jr. It was a wide-ranging discussion that included battery and vehicle costs, transitioning from current internal combustion gasoline-powered vehicles to EVS and how soon that is likely to occur in the US. Of particular interest was the conversation surrounding how automakers and unions will handle the disruption caused by vehicles that are much less labor-intensive to build, requiring fewer production-line workers. In addition, auto dealers will find their business changing dramatically, as the service requirements for EVs will be significantly less than current gasoline-powered vehicles.



Actor and EV activist Ed Begley, Jr. leads a Roundtable panel discussion on EV Sustainability. (Image source: Design News)

New Materials

Research and development of new battery materials was also address in several session and during a Keynote Address by Mark Verbrugge, director, Chemical and Materials Systems Laboratory at General Motors. Verbrugge told his audience that a push toward Earth abundant materials and away from exotic elements could dramatically improve both battery performance and cost.

Another innovation that could improve battery performance was discussed during an Industry Leader's Roundtable on Solid State Batteries. With representation from the University of Michigan, two battery manufacturers, and Ford and Toyota, the panel estimated production of the first solid state electrolyte batteries was just 3-5 years away. In fact, battery maker A123 broke the news during the session that it will convert its Romulus, Michigan battery plant to produce prototype solid state batteries before the end of 2019.

A Show of Optimism

Although the future of electrification of transportation in the US is complicated and difficult to predict, Design News editors detected a shared sense of optimism among battery show attendees. If nothing else, the number of new EVs that are scheduled to reach the market in the next year or two will provide more car-buying options—particularly as SUV and light truck EVs come available. There is also a strong consensus that battery cost will continue to fall and that a cost parity between EVs and gasoline-powered vehicle is just a couple years away. These factors, combined with many billions of dollars of investments by auto makers and suppliers means that electrification has moved from the fringes into an essential core part of the automobile industry.

The dates for **The Battery Show and Electric & Hybrid Vehicle Technology Expo 2020**, in Novi, Michigan will be September 15-17, 2020.

Senior Editor Kevin Clemens has been writing about energy, automotive, and transportation topics for more than 30 years. He has masters degrees in Materials Engineering and Environmental Education and a doctorate degree in Mechanical Engineering, specializing in aerodynamics. He has set several world land speed records on electric motorcycles that he built in his workshop.

https://www.designnews.com/content/battery-show-wrap/126525544861516?

Don't Miss These Videos...

From time to time there are articles and videos we would like to bring to your attention but are not able to reproduce in this newsletter. The Electric Vehicle is continuing to be newsworthy on many different levels so when we find interesting items we will share them with you.

The Green Rock Dawg

What is it? A fully electric hydraulic leveraged spider, er, crab or just a green rock dawg! This Nebraskan built his "different" vehicle and has fun being photographed in it. He probably can roll over most obstacles he encounters. A short 4:26 snicker! *https://youtu.be/OXQZMmCvTEg*

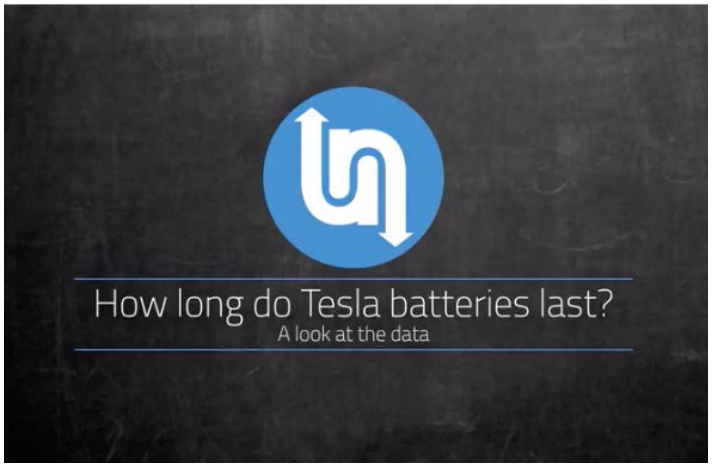
World Economic Forum

The population is low, EV sales are high with their energy source clean, and the country exports huge amounts of oil on the world market. But it's an impressive and encouraging start as seen in the short World Economic Forum video. *https://wef.ch/2G1MW9I*

Tesla Pickup Truck - Predictions and the Competition

Pickups from Ford, GM and RAM dominate the US light truck market with nearly 1.5 million nits sold every year. New EV entries into that market from Rivian and Bollinger as well as Workhorse and others have been announced. What will Tesla offer? With the high-end models for current ICE trucks unbelievably having price points (from Ford's starting at over $65K, GM's high end starting at $47K, and the RAM also starting at over $50K - these electric competitors will be pricey. Rivian and Bollinger start north of $69K and $130K respectively. So Tesla will supposedly unveil something that starts under $50K but may top out with big battery option right up there with these high-end ICE trucks. But we expect better acceleration and better hauling capability, and (of course) less maintenance costs for the EV trucks, given less moving parts involved..Check out this informative summary. .
https://www.youtube.com/watch?v=krriAeUxjMA

How long does a Tesla battery last? My Tesla is losing range!



Our 2019 EAA Award winning video maker Matt Ferrell addresses the differences between lithium batteries in cars and cell phones, using real data and a rudimentary statistical discussion. (Don't get scared, it's not math heavy!) Matt addresses the differences which are stark, and just because your primitive (by comparison) cell phone power source dies after a few years, your car's power source is not! EVs have carefully managed power sources, using sophisticated hardware and software, whereas cell phones (for the most part) don't. That makes all the difference in the world. Degradation is inevitable, yes. But there are some do's and don'ts too.
https://www.youtube.com/watch?v=UXwtlKHSefk

Don't Miss These (cont.)

FIRST LOOK: Eviation Alice All Electric Commuter Plane Tour

Eleven months after we featured a story on Eviation's Alice, here is an update. Shown at the 2019 Paris Air Show this summer, this is just a prelim interior tour. Targeted for FAR Part 135 operators,to replace turbo-props in regional commuter service for up to 650 mile capability, CEO Omar Bar-Yohay says it is an aircraft with 14,000 max take-off weight, some 8200 lbs of which is the 920 kWh usable capacity battery. It is fully composite, no cooling air inlets to minimize drag. Wing tip and tail props are used, but it has to be certified as airworthy those plans are underway. Plans are for 2021-22 release, with their first customer already for this $4M craft. *https://youtu.be/yyQaWEBGNxg*

The Ford Mustang Mach E is Ford's Biggest Gamble to Date — and it's About to Pay Off

At the LA Auto Show, Ford's unveiling of a ground-up new design Mustang Mach-e and variants. Some of the goodies include twin electric motors, with 75/99 kWh pack, starting price in the $30K (after incentives), over 300 mile range as "top spec" and sprint times 0-60 in the high 3'seconds — all coming in due time. *https://youtu.be/n4WrBeHjO9A*

Made-in-China Model 3 First Drive: the Miracle

This new video is from one of the first Asian Tesla Model 3 imported car owners, who compares his US version to the new Shanghai-built Model 3. **Warning: this is Chinese language only**, so read the sub-titles with your mouse over the pause control. The text sometimes moves very quickly. Continuous process improvement means things will be improved as deficiencies are discovered, and is practiced here at both the US and Shanghai factories as well. New Model 3's rolling out in Fremont today are different from those made in 2017 and 2018.

https://youtu.be/hGApF_uGAik

Welcome to Membership in The Electric Auto Association!

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Electric Auto Association (EAA) is *the* oldest and largest electric vehicle non-profit. EAA has a network of chapters across the United States and the globe. Our members promote and support electric vehicle acquisition and ownership to create a better future.

Membership Dues:	**Benefits and Bonuses**
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Supercharged Plus: $240	EAA Polo Shirt, "Current EVents" , Supercharged plus Personal or Business Supporter listing two issues)
High Voltage: $500	Polo Shirt, "Current EVents" listing as a High Voltage Personal or Business Supporter (three issues), "Who Killed the Electric Car?" movie

Electric Auto Association is a 501 3(c) non-profit organization.

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HAMPTON ROADS AUTO SHOW
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SOUTH CAROLINA INTERNATIONAL AUTO SHOW 01/10/20 - 01/12/20

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For this year's information and tickets:
https://fullycharged.show/events/fully-charged-live-north-america/

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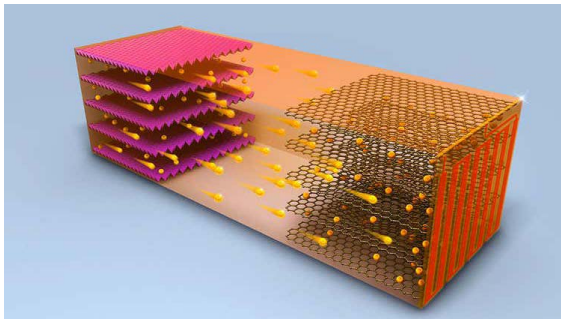
Electric Cars *Could* Charge in 10 Minutes With a New Kind of Battery



A new style of battery could let electric cars charge quickly
Photo: Yang Wang Group

By Ruby Prosser Scully

[Ed: Scientists explore the boundaries of theory, yet to make their discoveries work, real development needs to be done, and sometimes theory is just not ever going to result in an application in the real world. This article represents work done in a laboratory experiment which will, in all probability, never leave the lab, as many discoveries often don't. (It may help secure a degree for someone, or enable the winning a research grant for further work. But the implications here as described, are truly "click bait," i.e., don't hold your breath!]

Electric vehicle owners may soon be able to fully charge their cars in as little as 10 minutes, thanks to a new design that heats the battery to increase the reaction rate.

One major barrier to the uptake of electric cars is the length of time it takes to charge the battery compared with filling a car with petrol. So the key to making electric cars more commercially attractive lies in developing batteries that can reach 80 per cent charge – or a range of roughly 300 kilometres – within 10 minutes, says Chao-Yang Wang at Penn State University.

But this requires batteries to rapidly take in 400 kilowatts of power, [Ed: 400 kW for 10 minutes is only 64 kWh. That's roughly an 80% charge on a Tesla, but most other new EVs out there today can not handle that power level. and those currently on the market can't do this.] When the batteries are charged rapidly – during which lithium ions move from the positive to the negative electrode – there is a tendency for lithium to form plate-like deposits on the negative electrode's surface that can shorten battery life.

Wang and his colleagues suspected that they could minimise this problem by first heating the battery to a temperature too high to allow lithium plating to form.

To test this, they took a commercially available industrial battery and inserted micron-thick nickel foils in a stack of electrode layers. This structure allows the electrode to heat in less than 30 seconds, setting up conditions for ions to move quickly into the negative electrode without causing plating on its surface. [Ed: this is not something that could be done to any currently available batteries without major surgery! Inserting a heating element on a massive scale complicates things immensely, introducing reliability issues, not to mention impacting product cost. But given over four million cells per week on just one product line in a large scale factory gets to be unrealistic. The payback (ROI) for this kind of enhancement needs to be very steep to justify it.]

Then, they tested how well the cells worked when they were charged at either 40°C, 49°C or 60°C, and compared the performance with a control battery charging at 20°C. [Ed: Nice labratory test, indeed. But...]

They found that at 20°C, the battery could maintain fast charging for just 60 cycles before the lithium plating caused problems that significantly reduced performance. In contrast, heating the electrode to 60°C allowed the battery to recharge through 2500 cycles without forming the lithium plating that limits performance. That is equivalent to 14 years of use or around 750,000 kilometres of life, says Wang. [Ed: There is energy needed to heat a mass the size of a battery (roughly 400 kg) and then cool it back down (which takes time too!) To perform some back of the napkin estimates, get the specific heat capacity for the batteries in use today from here: *http://www.inforlab-chimie.fr/doc/document_fichier_279.pdf* This shows there is no free lunch.]

This overturns an old idea that lithium batteries shouldn't be charged at a high temperature because it will degrade the battery. Instead, the findings suggest that the benefits of a short burst of high temperature far outweigh the negatives, says Wang. [Ed: to the list of negatives, add this new heating and cooling equipment now needed in the vehicle, the energy required during the heating and cooling, and the cost for both. Any pragmatist would suggest shelving this approach entirely!]

Wang's team hopes to push the design further and create a battery that can charge in five minutes. [Ed: Preposterous! The size of the "filling pipe" would be gigantic, meaning the power source would need to be north of a megawatt. Those aren't ever just "dropped into any ol' location" around town. Installing such takes major planning and would be prohibitively expensive at scale. Keep dreaming, folks! This summary exemplifies the difference between physicists and engineers!]

https://www.newscientist.com/article/2221740-electric-cars-could-charge-in-10-minutes-with-a-new-kind-of-battery/

DID YOU KNOW?

There are now more than 100 GW (that's 100 trillion watts, or 1000 billion watts) of wind farm power capacity operating across the United States. The 100-GW milestone was first reported in the public release of the American Wind Energy Association's (AWEA) "U.S. Wind Industry Third Quarter 2019 Market Report".

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image: *www.awea.org*

https://www.windpowerengineering.com/u-s-wind-industry-hits-100-gw-milestone/

In 2018, renewable energy sources accounted for about 11% of total U.S. energy consumption and about 17% of electricity generation. (Preliminary data.) *https://www.eia.gov/tools/faqs/faq.php?id=92*