



## SchwartzReport

## Driving out of the carbon era

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In the midst of the chaos, the mass murders, the political corruption, one party attempting to transform our democratic republic into an anocracy, the pandemic, and the crisis it has revealed in American healthcare, in the midst of all that, there is a very positive trend occurring that is not getting the attention it should. Humanity is leaving the carbon era. There are a number of aspects to this transition but, since this is a paper not a book, I am going to focus on just one aspect, arguably the most important component of this transition: the end of the internal combustion vehicle. Like Eisenhower's creation of the interstate highway system, but even more dramatically, moving out of the carbon era is going to fundamentally change life and health in America and the world.

According to Bloomberg New Energy Finance, sales of internal combustion petroleum powered vehicle sales peaked in 2017 and have been in "permanent decline ever since."<sup>1</sup> Concurrently, sales of plug-in hybrid and electric vehicles (EV) have steadily increased. According to the Bloomberg report sales are projected to triple the current sales of 6.6 million to 20.6 million by 2025, probably still not a worldwide majority of vehicles sold but close.<sup>2</sup>

It needs to be noted that the United States is not the world leader in this transition, either in the technology of the transition or market penetration. We are not even close (See Fig. 1). China is the business leader, and Norway has the highest number of electric cars per person in the world –18.9 people per every electric car, and nearly 75% of new car sales in Norway were plugin electric vehicles in 2020.<sup>3</sup> Both of these facts have major geopolitical implications that are only now becoming appreciated.

As far back as 2016 India set itself the goal of having only electric vehicles on its roads by 2030.<sup>4</sup> That same year China registered at least 352,000 new electric vehicles (EV) compared to only 159,000 in the US during the same time period. Significantly, more than half of those registered were in California.<sup>5</sup> And that disparity continues. Most importantly at the 2021 United Nations Climate Change Conference, also known as COP26, which was held in Glasgow, Scotland, a coalition of nations joined together in common purpose and declared their goal is to have all electric vehicles, cars, buses, and trucks on their roads by 2040, just 18 years into the future.<sup>6</sup> Then in 2022 the European Parliament voted to ban the sale of new fossil fuel-powered cars in the European Union (EU) beginning in 2035.<sup>7</sup> The vote comes ahead of talks with EU member countries about the final law, which is part of a larger

bundle of climate change measures.

Here's the list:

Cyprus  
Denmark  
Dominican Republic  
El Salvador  
Finland  
Ghana  
Kenya  
Iceland  
Ireland  
Israel  
Lithuania  
Luxembourg  
Mexico  
Morocco  
Netherlands  
New Zealand  
Norway  
Paraguay  
Poland  
Rwanda  
Slovenia  
Sweden  
Turkey  
United Kingdom

Note the US isn't on the list and hasn't joined the declaration, although several states have, including California, New York, and Washington. But the rest of the developed world is clearly of one mind about this transition.

In 2016, Norway which then had 100,000 EVs on its road, proposed that by 2020 they would shoot for 400,000. Between 2016 and 2018 Norway was listed as the top seller of plug in EVs. By its goal date of 2020 Norway had greatly exceeded its target, and was the only country in the world where the annual sales of all-electric cars outsold the combined volume of all passenger cars with internal combustion engines.<sup>8</sup> As of 31 December 2021, the stock of light-duty plug-in electric vehicles in Norway totaled 647,000 units in use, consisting of 470,309 all-electric passenger cars and vans (including used imports), and 176,691 plug-in hybrids.<sup>9</sup> Other countries, although not as far along in their

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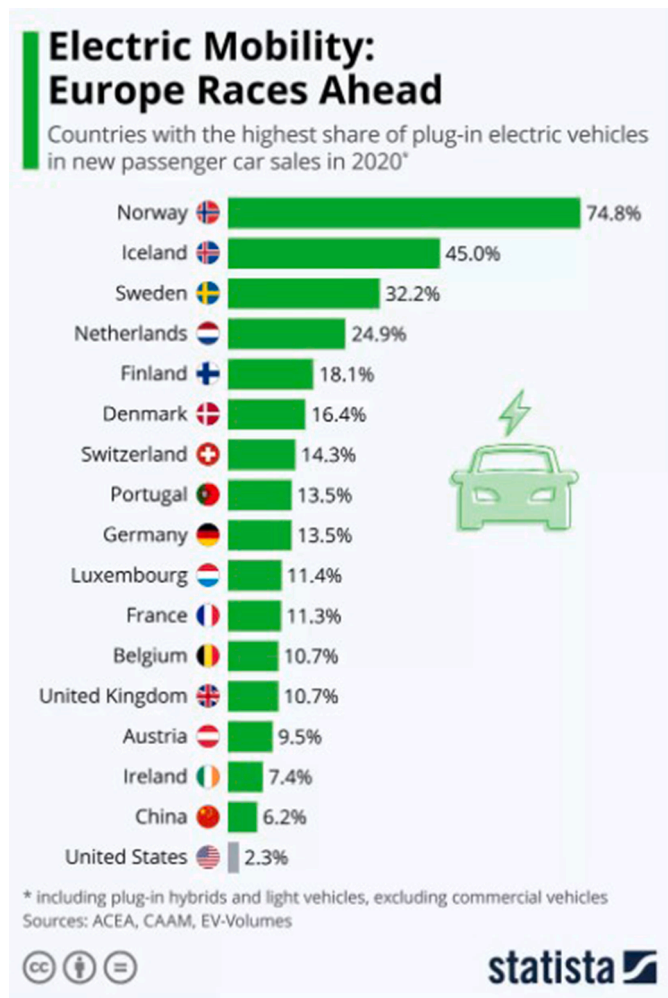


Fig. 1. Vehicles were purchased in the U.S. in 2021. This represented slightly more than 3% of all cars sold.<sup>13</sup>

transition, are on the same path as Norway.

In the U.S. the automotive corporations have gotten the message. General Motors has already made its policy a matter of public record. By 2035 GM will sell only emission-free vehicles and plans to be “carbon neutral” by 2040.<sup>10</sup> GM CEO Mary Barra said in a LinkedIn post, “For General Motors, our most significant carbon impact comes from tailpipe emissions of the vehicles that we sell – in our case, it’s 75%. That is why it is so important that we accelerate toward a future in which every vehicle we sell is a zero-emissions vehicle. The 2015 Paris Agreement, signed by almost 200 countries and which the U.S. rejoined on President Biden’s first day in office, sets a collective goal to limit global warming to well below 2 degrees Celsius, preferably 1.5 degrees Celsius, compared to pre-industrial levels, in order to limit damage resulting from climate change. To meet that goal, it is understood that we will need to reduce the net impact of carbon emissions from all human activities to zero by 2050.”<sup>11</sup>

Similarly, Ford has announced it plans to invest \$22 billion in converting the company from petroleum to electric powered vehicles.<sup>12</sup> According to J. D. Power, nearly 489,000 electric vehicles were purchased in the U.S. in 2021. This represented slightly more than 3 percent of all cars sold.<sup>13</sup>

J.D. Power said that the conversion to EVs would be happening even faster if the central reason stopping customers from buying EVs, “range anxiety,” the fear of running out of power before a driver can get to a charging station, were addressed.

This infrastructure issue is notable because the United States, once

the world leader in implementing new technologies, no longer enjoys that position. As with so many aspects of American transportation infrastructure like bridges and roads where the U.S. was once the world leader, today this infrastructure network is aged and crumbling. The good news is the Biden administration seems to understand the problem, and in November 2021 Biden signed the bipartisan Infrastructure Investment and Jobs Act (IIJA) into law, which commits to investing \$5 billion in electric vehicle (EV) charging infrastructure.<sup>14</sup> The National Electric Vehicle Infrastructure (NEVI) Formula Program is providing \$615 million in 2022. A subsequent \$2.5 billion is earmarked for building a nationwide system of charging stations.<sup>15</sup> The total \$5 billion will be distributed to the states over 5 years, and it is the hope of the Biden administration that these funds will be used by each state to build their local EV charging network. It will be interesting to see how the Red and Blue states respond to that funding, and what stands out in hindsight is why it has taken so long to overcome the petroleum industry’s natural desire to protect, and even increase its profits.

In 2008 the West Coast states of California, Oregon, Washington and the Canadian province of British Columbia recognized they had all experienced significant population growth, which meant more petroleum powered vehicles on their roads and that meant more air pollution. Having struggled with air quality issues tens of thousands more vehicles on the road, producing more climate change-causing greenhouse gases and lowering air quality across the whole region seemed a problem with which they had to deal. Thus was born The West Coast Electric Highway.

As reported in *Yes! Magazine*, “...they laid out a shared vision in two 2008 agreements for an alternative fuel corridor along I-5 and Highway 99 to promote the use of biofuels, hybrids, electric or zero-emission vehicles, and hydrogen-fueled vehicles. Federal funding from The EV Project helped kickstart the effort and the first charging station on the West Coast Electric Highway was opened in 2011.”<sup>16</sup>

Biden campaigned on the transition out of carbon powered vehicles and as soon as he was elected set a goal. Half of all cars sold in 2030 would be electric. The problem as his administration saw it, and as reported in *The New York Times* was, “In President Biden’s vision of a green future, half of all new cars sold in 2030 will be electric. But something really basic is standing in the way of that plan: enough outlets to plug in all those cars and trucks. “The country has tens of thousands of public charging stations — the electric car equivalent of gas pumps — with about 110,000 chargers. But energy and auto experts say that number needs to be at least five to 10 times as big to achieve the president’s goal. Building that many will cost tens of billions of dollars, far more than the \$7.5 billion that lawmakers have set aside in the infrastructure bill. One of the most interesting aspects of this transition out of the carbon era is whether charging stations, essentially a new manifestation of the gas station infrastructure model, are even going to be the long-term solution. For instance, supposing the road itself charged vehicles as they drove over it. Suddenly the issue of how long a battery would last would be obviated.

A roadway charging the EVs that drive over it is not a new idea. As early as 2012 the South Korean city of Gumi with a population of 375,000 had a 15 mile long roadway in operation that charged the electric buses that drove between the city and its railroad station. By 2015 the U.K. began testing the idea of creating a charging lane, and two years later, in 2017, the Israeli government working with a private company installed a charging road in Tel Aviv. As with South Korea, they started with public transport buses.<sup>17</sup> A year later, in 2018, China began seriously developing electric roadways that could.<sup>18</sup> The Chinese saw what the American Congress did not when presented with programs by the Biden administration. As was noted in *The New York Times* four years ago, “The experiment is the latest sign of China’s desire to innovate in, and dominate, the increasingly lucrative and strategically important market for renewable energy. The country already produces three-quarters of the solar panels sold globally, and its wind-turbine manufacturing industry is also among the world’s largest.”<sup>19</sup> And their research in the form of real strips or roadway taught them that a road

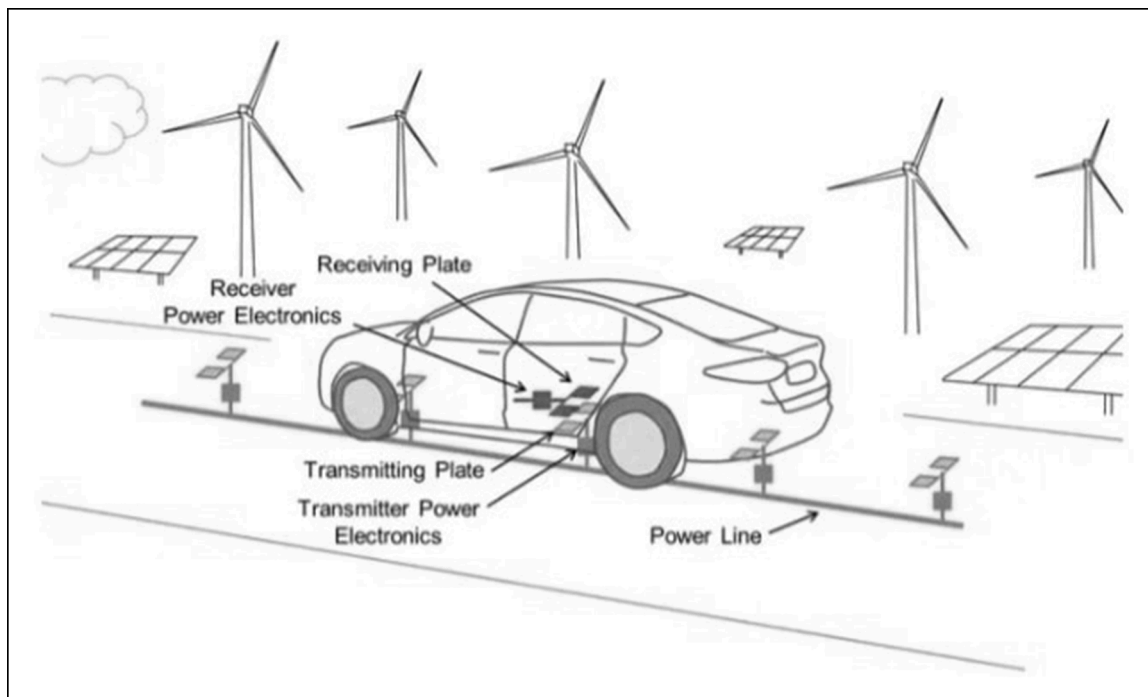


Fig. 2. A sketch of the wireless charging process credit: Khurram Afridi.

made of solar panels was not the way to go.

One of the most promising approaches has been developed in the United States, which got into the game late, but is now better focused. Although it is pursuing the gas station/charger infrastructure model, work is also being carried out that uses both solar and wind and, instead of making the entire road surface electrical, is designed with a “charging lane.” Highways would have a charging lane, sort of like a high occupancy lane,” explained Khurram Afridi, an associate professor of electrical and computer engineering at Cornell University, who has been working for seven years developing this technology. It would allow drivers to charge their electric vehicle while they are in motion but would not cost as much as building an entirely electric charging road surface .

Afridi told Grace Kay of the *Business Insider*. “If you were running out of battery you would move into the charging lane. It would be able to identify which car went into the lane and it would later send you a bill.”<sup>20</sup> (See Fig. 2)

The unanswered question is, will the system developed be for corporate profits, or federally funded for social wellbeing? Legal structures and agreements private and public are slowly emerging. Tesla has constructed a network. Ford, in conjunction with two EV charging companies, Greenlots, and Electrify America is creating the FordPass Charging Network.<sup>21</sup> But they are all centered on the gas station model. One of the things we are going to see in the coming years is how these corporate and governmental networks coordinate and interact to create a national network. I hope the U.S. has finally learned what most other developed nations already know. Making wellbeing the first priority of such a system will be the most successful policy.

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