135 GWh of EV Battery Capacity Sold in 2020, and Li-ion Starts to Look Like the Obvious Choice for EV Batteries

In another sign of the strength of the EV market, 134.5 GWh of battery capacity was sold into the worldwide passenger EV market in 2020. To put this in perspective, this represents an average of 50kWh of battery capacity per vehicle, spread across 2.69 million vehicles. These batteries also represent an opportunity through Vehicle to Grid (V2G) technology to help stabilize the power grid, both during peak hours and in emergency situations when the utility grid is disrupted (the Center for Community Energy has a great video on this subject).

Interestingly, nearly all of those batteries are lead-acid batteries, a technology that was invented in 1869 (over 150 years ago!). The reason for the popularity of these batteries is simple – they are very inexpensive (partly because of their dominance of the battery market), a reasonable power-to-weight ratio, very good surge current capacities (like when you start your gasoline-powered car, or floor your Tesla EV), and their ease of recycling. The lead-acid battery market was valued at nearly $40 billion (US) in 2018, and is expected to grow at a CAGR of over 5% between 2019 and 2026.

This all may be about to change. It is not hyperbole to state (at least today) that where Tesla goes the EV market goes. In this case, where Tesla is going is towards Lithium Ion (Li-ion) batteries. Elon Musk disclosed this new direction in a recent interview with Sandy Munro, and for Tesla it will start with the refresh to the Tesla Model S and Model X. In addition to the obvious Li-ion advantages of lower weight (lead is heavy, right? – think about the impacts on range of that weight), Musk also cited the ease of going to higher voltage batteries (48 VDC looks to be the starting point). The price of lithium ion batteries have also been dropping significantly over the past decade as they make their way further into the overall ecosystem. This trend is not unlike what happened with solid-state flash data storage, which went from high-performance niches in 2010 to the dominant data storage medium today.

To be certain, there are still a variety of concerns around Li-ion batteries. These include the (relative) difficulty in recycling Li-ion batteries (forecasters predict that 2 million metric tons of Li-ion batteries will be generated annually by 2030, and today only 3% of these are recycled. The other primary concern is the long-term availability of lithium, though the US Geological Survey
estimates that there are enough reserves worldwide to support current demand for over 300 years at current consumption rates, which are increasing rapidly – yet another reason to recycle Li-ion batteries!

**Toyota Reversing Course, Electrifying Their Vehicles**

Toyota has long a leader in hybrid vehicles (remember when the Prius was hot?) and a strong proponent of hydrogen vehicles (Toyota Mirai, for instance), but they have generally been a laggard when it comes to battery electric vehicles (BEVs), until now. This month Toyota introduced a number of electrified vehicles which will come out this year. While there have not been any definite announcements yet, the electrified vehicles are rumored to be the Toyota Rav4, possibly an electrified Prius, and possibly a Camry or Corolla. All three are available as hybrids now, so it wouldn’t be a shock to see an electric version of any of the three. Other guesses include the Toyota Highlander, or perhaps an electrified Toyota Tundra. As a leader in the general automobile market, perhaps Toyota believes they can wait, but I suspect that there are a lot of loyal Toyota customers who would welcome an electrified version of any of these vehicles into their garage!

**Port Electrification – Reducing Air Pollution in Disadvantaged Neighborhoods**

Believe it or not, drayage tractors at cargo ports (the semi-truck cabs that pull containers from shipside to warehouses or other destinations) are an outsized source of air pollution in the US.
There are over 80,000 drayage tractors in the US alone, with annual sales of roughly 26,000 vehicles. Often, these drayage tractors are “retired” long-haul semi tractors that were built before there were significant emission requirements on those types of vehicles. Add in the fact that most ports are next to disadvantaged neighborhoods (which often have other big sources of pollution), and the need to “clean up” these vehicles becomes clear. These are a few of the reasons that North American port districts have taken significant action to reduce air pollution from vehicles operating in the port. Examples of this include:

- **Port of Los Angeles/Long Beach:** They mayors of Los Angeles and Long Beach, which jointly operate these ports which are located on San Pedro Bay, have set goals to transition the drayage truck fleets at these ports by 2035.

- **The Ports of Seattle, Tacoma, and Vancouver** (all on Puget Sounds) have all had long-running programs to reduce air pollution. The first of these programs was the “Northwest Ports Clean Air Strategy” effort that started in 2008, and was updated in 2013. The original programs were voluntary programs to reduce air pollution and greenhouse gas emissions; these have morphed over the past decade into a program to eliminate all emissions from these ports by 2025.

These programs are by no means limited to North American ports – there is also significant pressure in the European Union (EU) to clean up port air pollution. These efforts have spurred a number of tractor OEMs to undertake electrification programs (some example vehicles are pictured above). These vehicles, which have to be able to handle gross weight loads up to 80,000 lbs. and work all day on a single battery charge (typical daily ranges are about 100 miles), typically incorporate battery subsystems with 300 kWh of capacity or more, putting them on the “high” side of vehicle battery capacity. With these capacities, sizing and siting chargers within the port becomes critical to reliable port operations. Finally, considerations such as whether Vehicle to Grid (V2G) makes sense for these drayage vehicles (depends on their specific use case, but it given the battery capacity of drayage tractors, it is very attractive) are also important to consider when switching to electric drayage tractors. For ports (or vehicle OEMs) looking into these markets, Rhombus is ready to help answer the charger questions.

### Electric Aircraft – Closer Than You Might Think!

Innovation in Silicon Valley is not simply limited to computer systems, social media software, and consumer electronics. Bay Area company Archer is looking to change this with their electric vertical takeoff and landing (eVTOL) aircraft. Archer has teamed up with Fiat Chrysler Auto (FCA) to take the eVTOL to production in
2023. The aircraft would have a range of 60 miles, and fly at speeds up to 150 mph. While Archer’s plans today look focused on commercial operation (think short-haul airlines operating from city parking lots or helipads as well as airports, one would think the involvement of a leading auto manufacturer telescopes an opportunity for an electric flying car as well!

Quick Notes from the Electric Vehicle (EV) / Energy Storage Ecosystem

- **New Poll: Public Supportive of Electric Vehicles Moves from both Automakers and Government**
- **Rhombus launches new bidirectional charging solutions for medium- and heavy-duty EV fleets**
- **Ford Nearly Doubles Its Investment in Electric Vehicles Through 2025**
- **Merchants Fleet to purchase over 12,000 EV600s from BrightDrop**
- **Average EV Owner Drives Half as Many Miles as Other Drivers - Study**
- **Overlooked gems in Tesla’s Q4 earnings call**
- **Kentucky bill seeks annual fees on hybrid, electric cars**
- **GM’s road to the future of electric vehicles could be bumpy**
- **Biden’s buying spree could boost the number of electric vehicles in the US by 40%**
- **Tesla to set up electric car manufacturing unit in southern India**
- **The New Electric Vehicles Now Hitting the Road**

About Rhombus Energy Solutions

Rhombus develops and manufactures next-generation bi-directional electric vehicle charging infrastructure, high-efficiency power conversion systems and energy management system (EMS) software for vehicle-to-grid (V2G) capable electric vehicle fleet charging, energy storage and microgrid applications. The high reliability of our solutions is the result of decades of experience developing high-power systems for a variety of applications and deployment scenarios, including UL-1741-SA system-to-grid solutions. For more information, please visit www.rhombusenergy.com.