Alternative Power Report

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News on Alternative Power Sources

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Moving from ICE To Alternative Power

As manufacturers continue to shift their equipment production from ICE to alternative power sources, they need the latest information. That's why analysts at Power Systems Research continue to revise our global data and forecasts to provide the freshest picture available.

Are There Enough Materials To Manufacture Needed EVs?

Recycled Materials Required To Meet Predicted Demand

Guy Youngs

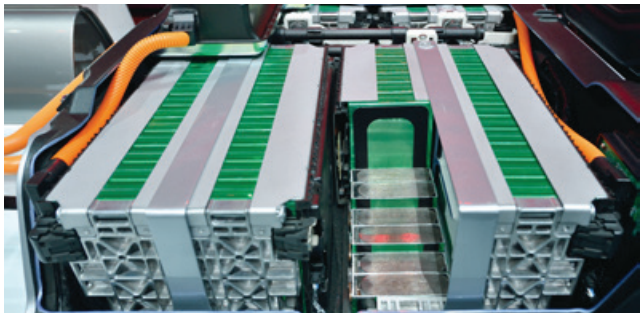
By Guy Youngs, Forecast & Adoption Lead

The transition from ICE to electric vehicles (EVs) is necessary to decrease climate-changing emissions. As deployment increases, so will the demand for EV battery materials such as lithium, cobalt, and nickel. These materials are primarily supplied through two sources: 1) newly mined or 2) recovered by recycling batteries.

Research shows there are enough explored or prospective reserves to electrify the global transportation sector using current technology if a high amount of battery recycling occurs. In this scenario, global demand for EVs in 2100 will amount to about 55% of cobalt reserves and 50% of lithium reserves. If recycling doesn't ramp up, a shortage of lithium, nickel, or cobalt is likely, and it is estimated that demand would exceed what is economically accessible to extract.

In this scenario, demand in 2060 is more than cobalt reserves and about 90% of lithium reserves

Source: *Cleantechnica* **Read The Article**



PSR Analysis: Without recycling, demand for Lithium will be such that prices (which have already risen dramatically) will continue to grow, meaning battery costs will escalate. Nickel and Cobalt cost impacts can be reduced by switching to low density batteries such as Lithium Iron Phosphate batteries, but this results in a lower range battery.

Lithium, on the other hand, is more problematic and recycling is vital. Recycling isn't a requirement yet, so recycling is done on a purely economic basis, but we should expect recycling policies to come into force soon. In fact, California is already actively exploring such policies, and a group of stakeholders recently submitted policy recommendations to the California legislature

Editor's Note: This edited material has been reproduced from the December 2022 issue of PowerTALK News. The Alternative Power Report includes includes news and analysis about EV and power sources such as batteries and fuel cells from industry reports and analysts at Power Systems Research.

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Redwood Materials To Supply Cathode Materials To Panasonic

Panasonic Energy said it has agreed to purchase cathode active materials and copper foil for lithium-ion batteries from Redwood Materials. The recycled cathode active materials will be used to manufacture batteries in the company's new $4 billion factory located in De Soto, Kansas, starting in 2025, and the recycled copper foil will be used to make batteries at Panasonic's facility in Sparks, Nevada, starting in 2024.

"Recycling and a localizing supply chain are both essential to make the best use of limited natural resources," said Kazuo Tadanobu, President and CEO of Panasonic Energy, in a press release.

This may amount to 50% of the cost of the battery and add around 900 new workers to Redwood Materials workforce once in full scale production

Source: *Cleantechnica* **Read The Article**

PSR Analysis: Without recycling, demand for Lithium will be such that prices (which have already risen dramatically) will continue to grow, meaning battery costs will escalate hugely. Previous article (***Are There Enough Materials To Manufacture All The Electric Vehicles Needed?***) points to the essential nature of the recycling for batteries, and this is a very good example of recycling on an economic basis rather than a result of policy / legislation.

Tesla Lithium Refinery Advances in Texas

Tesla is working on a lithium refinery project that would be coming to Corpus Christi, Texas, and it sounds like the automaker is in the final stretch of its negotiations with authorities.

In September, we learned that Tesla has a plan to build a lithium refining facility on the Gulf Coast of Texas. At the time, all we knew was that Tesla was planning on moving fast with the hope to start building in Q4 2022.

Tesla will process raw ore material into a usable state for battery production. The process Tesla will use is innovative and designed to consume less hazardous reagents and create usable by-products compared to the conventional process. Tesla made it clear that the final product from this new plant will be battery-grade lithium hydroxide and

shipped by truck and rail to Tesla battery manufacturing sites, supporting the necessary supply chain for large-scale and electric vehicle batteries.

Source: *Electrek* **Read The Article**

PSR Analysis: This is another positive step towards a circular supply chain for Lithium and a way for Tesla to secure a supply of battery grade lithium by vertically integrating this process. This move is significant for Tesla, but it is also significant for the industry because where EVs are concerned, Tesla often leads the way.

Here's What Container Ships Could Look Like by 2050

With pressure from regulators to decarbonize international shipping, companies big and small are racing to identify green alternatives to the gas-guzzling container ships that account for an estimated 3% of global greenhouse emissions.

Many of the ideas floating around today leverage some form of high-tech sail, a futuristic take on the wind-powered voyages that have transported goods for as long as global trade has existed.

Many factors need to be considered when designing a wind-powered cargo ship, including safety, functionality, crew comfort, and most importantly, speed.

Source: *MSN* **Read The Article**

PSR Analysis: Marine transport is a significant contributor to global carbon emissions (see article "*EV shipping is set to blow internal combustion engines out of the water*" in the September issue of *PowerTALK*), so any movement to reduce the emissions is positive, and if it happens to reduce the fuel costs for marine transportation at the same time, there is a substantial saving to be made. A real win-win situation. Further information about these can also be found **here**.

Stockholm's City Center Is Construction Testbed for 'Fossil-Free' Contracting

An area of Stockholm city center in Sweden will use electric equipment from Volvo Construction Equipment (Volvo CE) as it becomes a testbed for emission-free construction equipment when work begins on its urban transformation.

The project contracts stipulate use of fossil-free equipment wherever possible, including transport to and from the construction site. There is also a requirement that at least one of the larger excavators working on site should be electric. It is also required that all other machines be run on HVO (hydrogenated vegetable oil) – a biofuel which reduces greenhouse gas emissions by up to 90%.

Source: *International Construction* **Read The Article**

PSR Analysis: This move toward a sustainable construction site could be the map for future construction sites and civil engineering projects and will demonstrate how electric construction machinery supports the global drive to reduce carbon emissions. We should expect to see other OEMs and Construction companies follow suit as increased pressure on the industry drives change.

Caterpillar Makes Gigantic Electric Truck

The new electric truck from CAT is a zero emission version of the company's massive diesel-powered 793 mining truck. Aside from helping to accelerate industrial decarbonization, the new truck demonstrates that battery-powered electric drive can tackle some of the toughest jobs on Earth.

The Caterpillar press release was a little thin on information about the battery pack, and hence range, possibly because the new truck is still in the prototype phase

The press release makes reference to regenerative braking that underscores a key advantage of electric drive. Fossil fuel vehicle batteries are relatively small, so it is difficult to justify the expense of installing a regenerative braking system under a fossil fuel scenario. In contrast, electric vehicle battery packs are massive. They can store far more energy than a conventional vehicle battery. The bigger the vehicle, the bigger the battery pack, and the more opportunities for capturing excess energy from braking.

Source: *Cleantechnica* **Read The Article**

PSR Analysis: The key to this prototype is the battery pack, if its large enough that with the regenerative braking, the machine can operate a decent duty cycle without the need to recharge, then Caterpillar could be one to a winner here.

BYD May Begin Sodium-Ion Battery Production In 2023

Rumors are flying about in China that claim BYD plans to produce sodium-ion battery cells in Q2 2023 and use them to power some of its own EVs. The company claims those rumors are false, but they come to us via CnEVPost, which is widely viewed as a reliable source of information about what is going on in the automobile business in China. BYD battery division FinDreams is said to be responsible for the development and mass production of the sodium-ion batteries, which are currently in the sample validation stage.

Sodium batteries have a lower energy density than lithium batteries, so you need more of them to have an equivalent amount of energy available to power an electric car--lithium-ion batteries have an energy density of up to 300Wh/kg, while lead acid batteries have an energy density of around 50Wh/kg. Sodium-ion batteries are somewhere in between the two. CATL is also pursuing sodium-ion batteries for production vehicles and claims its sodium battery cells have an energy density of 160 Wh/kg so it's reasonable to assume that these batteries are close to that mark

In addition to being less expensive, sodium batteries also avoid the potential risk of fire associated with lithium-

ion batteries, which means manufacturers can use less elaborate and less expensive battery cooling systems, which will help to further lower the cost of entry level EV.

Source: *Cleantechnica* **Read The Article**

PSR Analysis: While this is possibly just a rumor, the reason for doing this is that the price of lithium has soared in the past 18 months from $5,700 a ton in June of 2020 to $84,000 a ton today. Since lithium is the primary ingredient in lithium-ion batteries, the search for less expensive alternatives is understandable.

The price of sodium is around $3,000 a ton today and this helps to keep the cost of these entry level vehicles as low as possible – for these vehicles price is the main purchase requirement rather than range.

MIT Breakthrough May Create Smaller, Lighter Batteries

A breakthrough regarding dendrites has been made by MIT researchers. Dendrites are metal growths that can accumulate on the lithium surface, piercing through the solid electrolyte, and finally cross from one electrode to the other, shorting out the battery cell. Their name is from the Latin word for branches. There hasn't been much advancement in the understanding of what causes these metal filaments or how to stop them from occurring, making lightweight solid-state batteries a problematic alternative.

The replacement of the liquid electrolyte between the positive and negative electrodes with a considerably thinner, lighter layer of solid ceramic material and the replacement of one electrode with solid lithium metal are the two essential components of this prospective advancement in battery technology. By making these changes, the battery's overall size and weight would be significantly reduced, and the flammable liquid electrolytes that provide a safety risk would be eliminated. Dendrites, however, have proven to be a significant obstacle in that pursuit.

The new study appears to answer the question of what triggers dendritic growth and it also demonstrates how dendrites can be stopped from piercing the electrolyte.

Source: *Cleantechnica* **Read The Article**

PSR Analysis: This study may finally open the way to the building of a new type of rechargeable lithium battery that

is safer, lighter, and more compact than existing models, a concept that has been pursued by labs all over the world for years. Of course, moving from a research study to full commercialization takes time, but dendrites are the main problem that has been holding back solid-state batteries, so this breakthrough holds tremendous potential for the future.

More Acquisitions Made in Light/Medium EV Segment

Chris Fisher

By Chris Fisher, Senior Commercial Vehicle Analyst

2022 has been an interesting year on many commercial vehicle fronts including the medium and light electric commercial truck and van segment. While large established OEMs such as Ford, who is expected to produce approximately 6,500 E-Transits at the **Kansas City** plant in 2022, there has been some shakeup within the electric commercial vehicle start-ups.

During the past six months, Mullen Automotive, based in Brea, CA, has acquired the assets of the now bankrupt Electric Last Mile (ELMS) company and has acquired 60% of Bollinger Motors, which has yet to start vehicle production.

In September 2022, Mullen Automotive invested $148 million into Bollinger Motors, giving Mullen a 60% share of the company. Bollinger plans on introducing their electric class 3 – 6 lineup of cargo vehicles starting in 2023 and it is likely that Bollinger will also manufacture the Mullen electric light commercial vans also starting production in 2023.

Production of the commercial vehicle lineup will take place at the Mullen plant in Tunica, MS. The Mullen light electric

vans will likely fill the void left by Ford discontinuing sales of the Transit Connect in the United States by the end of 2023 primarily due to falling sales and a dispute over import duties.

In June of 2022, Electric Last Mile (ELMS) declared bankruptcy and in October Mullen Automotive acquired the ELMS production facility in Mishawaka, IN, along with ELMS's inventory and intellectual property. Mullen plans to introduce their electric passenger vehicle crossover which will be known as Mullen Five in 2024 and ultimately introduce the Bollinger B1 and B2 pickups into production.

It appears the Mishawaka plant will be dedicated to Bollinger and Mullens passenger vehicle production.

While the class 1 – 6 last mile commercial van and truck segment is a great fit for electrification, time will tell if Mullen Automotive will have enough financing and technical capability to be a significant player in the market or will they end up being another start-up that will ultimately get purchased by another OEM in the next few years.

Source: Mullen Automotive

BorgWarner To Produce Vehicle Batteries

Fabio Ferraresi

By Fabio Ferraresi, Director Business Development South America

BorgWarner said it will start producing battery systems for electric vehicles in Piracicaba-SP, Brazil, by Q1 2023 with declared annual capacity of 1,000 electric units.

The plant in Piracicaba formerly belonged to Delphi and was acquired by BorgWarner in 2020. The plant will receive a production line from Akasol, another company acquired by BorgWarner.

The first customer of the battery plant is Mercedes Benz, which produces MHV in Brazil.

Piracicaba will receive UHE battery packs from Akasol in Darmstadt, Germany, and will add components produced in Brazil. These components include electronic modules, DCCUs, connection boxes and metallic structural components.

Source: *Automotive Business* **Read The Article**

PSR Analysis: The first destination for the batteries will be buses produced by Mercedes Benz in 2023. This national content is a requirement to provide access to low interest funding lines through FINAME, from BNDES, the Brazilian National Bank for Economic and Social Development.

Solaris Purchases 25 Fuel Cell Engines

Emiliano Marzoli

By Emiliano Marzoli, Manager European Operations

Ballard Power Systems has announced the sale of 25 hydrogen fuel cell engines to repeat customer Solaris Bus & Coach, a leading European bus manufacturer.

The 70kW fuel cells will be installed in Solaris' Urbino 12 hydrogen buses for deployment to Polish public transport operator MPK Poznań and are expected to be delivered in H2 2023.

The buses are to be partially funded by the National Fund for Environmental Protection and Water Management's Green Public Transport program. MPK Poznań requires 30% of its fleet to be zero-emission by 2028. These 25 hydrogen fuel cell buses will increase its zero-emission fleet from 18% to 25%.

Source: *Ballard* **Read The Article**

PSR Analysis: Both Ballard and Solaris are among the major contributors to the increase of fuel cells buses in Europe. While Fuel Cells have the smallest share among busses manufactured in Europe, we believe that in 2032 they will more than quadruple their volumes compared to 2021. Besides, battery powered buses will also grow at double digits, leaving the ICE buses market to shrink at a -3% CAGR in the next decade.

We expect BYD, Volvo, VDL, Scania and Daimler to be the major battery powered bus suppliers, while Solaris will be one of the most important brands for fuel cell vehicles between now and 2032.

2023 EV Sales To Hit 8.4 Million Units

Jack Hao

By Jack Hao, Senior Research Manager - China

The development trend for the new energy vehicle (EVs) market remained positive through 2022. In November, retail sales of new energy passenger vehicles reached 598,000 units, with a year-on-year growth of 58.2%. From January to November, the domestic retail sales of new energy passenger vehicles were 5.03 million units, with a year-on-year growth of 100.1%.

As for December, the Passenger Transport Federation believes that the subsidy for new energy vehicles will decline by 12,600 RMB this year, which is much more than the decline of 5000 RMB in the previous two years. In addition, some vehicle enterprises have announced a price increase for next year, which may promote strong pre-buying of new energy vehicles at the end of the year and boost sales.

This year, the new energy vehicle market is expected to achieve the annual sales of 6.5 million vehicles.

Although the subsidy for new energy vehicles will be withdrawn at the end of this year, the exemption for the new energy vehicle purchase tax will continue next year.

At the same time, the new energy vehicle market is still good under the effect of non-financial means, including the right of way. Cui Dongshu predicted that the sales volume of new energy vehicles in China would reach 8.4 million in 2023, with a year-on-year growth of more than 30%. "With a high penetration rate of 36% in November this year, the new energy vehicle market has entered a supermarket driven stage.

Source: *The Paper* **Read The Article**

PSR Analysis: At present, new energy vehicles have entered the stage of accelerated growth, and the process of replacing fuel vehicles has been accelerated. Due to the expanded sales of new energy vehicles, unit costs also have been gradually reduced. At the same time, China has gradually canceled epidemic prevention and control measures, which has injected confidence into the car market again and is expected to boost sales.

Presently, exports of Chinese independent brands to European and American markets and developing countries is accelerating. Sales of international brands to China's base is increasingly, and this growth rate will remain strong for new energy vehicles.

Car ownership in China has reached 315 million units and 223 units per 1000 people. Compared with 600 units per 1000 people in developed countries, China's car market still has a lot of room for growth. The annual sales volume is expected to reach 40 to 50 million units in the future.

Given the government's dual carbon strategy, the trend of automobile market electrification seems to be irreversible, and new energy vehicles will gradually replace the stock of fuel vehicles.

Second, maturity of the supply chain system of new energy vehicles will lead to a decline in the cost of new energy vehicles.

Third, with the progress of electrification technology and intelligent technology, the product strength of new energy vehicles will be further improved, the energy supplement facilities will be gradually improved, and the appeal to consumers will be further enhanced. The market penetration rate of domestic new energy passenger vehicles will further increase, and it is expected to reach 46% and 54% in 2025 and 2029, respectively.

Honda To Produce FCVs in the U.S.

Akihiro Komuro

By Akihiro Komuro, Research Analyst, Far East and Southeast Asia

Honda announced that it will produce electric fuel cell powered vehicles in the U.S. in 2024. They will also be equipped with a plug-in function that allows them to be recharged externally. Honda has set a goal that all new vehicles sold by 2040 will be either EVs or FCVs.

In North America, its main market, Honda will offer FCVs as an option. The new FCV to be produced is based on the CR-V SUV model and will be manufactured in small quantities at the Performance Manufacturing Center in Ohio. The plant had produced the Acura NSX sports car until November. Since the plant has not yet developed a sufficient hydrogen supply base, it will be a plug-in FCV that can also be recharged externally. This is said to be the first production vehicle in North America to adopt such technology.

Honda has been developing FCVs for some time, introducing the FCX in 2002 in Japan and the United States. In Japan, it launched the FCV model Clarity Fuel Cell in 2016. However, due to sluggish sales, the company discontinued production of this vehicle in Japan in 2021.

Source: The Nikkei

PSR Analysis: Plug-in FCVs can run on electricity, fed by plug-ins, where there are no hydrogen stations. If FCVs are to be popularized at a stage where the hydrogen filling infrastructure is weak, a plug-in that can be charged from an electrical outlet may be the best combination. After filling up at a hydrogen station, which might be located far away, the vehicle could be operated by recharging its battery, and the hydrogen could be used as a range extender in case of power shortages. Of course, if a hydrogen station were to be established in the same neighborhood, it would be possible to switch to the same operation as at a gas station. The biggest barrier to sales expansion is the price. In the price competition, FCVs will probably lose out to BEVs. The availability and scale of subsidies for FCVs will have a significant impact on sales.

Korea's SK Battery To Supply Hyundai's U.S. Plant

Korean battery giant SK Innovation announced that it will expand its supply of batteries to Hyundai Motor Group in North America, and the two companies will discuss the construction of a joint venture plant to increase supply after 2025. SK Innovation says it plans to support Hyundai Motor Group's increased EV production in North America.

In addition to EV production at its existing Alabama plant, Hyundai Motor plans to start operations of a dedicated EV plant in Georgia by 2025. Kia Motors, a group company, will also increase EV production in Georgia, as stable procurement of batteries, a key component of EVs, has become an issue.

SK On, a battery subsidiary of SK Innovation, already supplies batteries for Hyundai Motor's mainstay Ioniq EV series. In the U.S., SK On produces batteries at its existing Georgia plant, and after consulting with Hyundai Motor, the company will decide whether to expand the plant or establish a new joint venture plant.

SK, a latecomer in the automotive battery field, has been losing money due to heavy upfront investment, and will promote the construction of a joint venture plant that can share the investment burden with the car giant. With Ford Motor Company, SK is building two joint plants in the U.S. and one in Turkey.

The three major Korean battery companies, SK, LG Energy Solutions, and Samsung SDI have announced a series of battery plant construction projects in North America. The U.S. government has indicated a policy of allocating subsidies and tax credits for EVs produced in North America. The U.S. government is planning to provide tax credits for EVs produced in North America, and if the batteries are not produced in North America, the tax credit will be reduced, and the car giants are encouraging battery manufacturers to expand production in North America.

Source: The Nikkei

PSR Analysis: SK and Hyundai are accelerating their battery strategies in the North American market in order to take advantage of tax credits under the U.S. Inflation Control Act. The development of a production system in North America, a large market, will contribute significantly to the densification of the component supply chain, and will also reduce transportation and other costs. **PSR**

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