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Power Systems Research (PSR) is a world leader in providing power equipment information, whether it's pure data, analysis, forecasting or specific business intelligence. This product information ranges from IC engines to battery-electric and hybrid powertrain technologies. PSR has been providing world class business and market intelligence to industry leaders for 45 years. How can we help you? For details, call **+1 651.905.8400** or email **info@powersys.com**.
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Editor's Note: *This issue of PowerTALK News contains our newest feature, the Alternative Power Report, written by Guy Youngs. This monthly feature includes news and analysis about EV and power sources such as batteries and fuel cells.*

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Alternative Power Report

By Guy Youngs, Forecast & Adoption Lead

JCB Unveils Mobile Hydrogen Refueler

Guy Youngs

JCB has unveiled a mobile hydrogen refueler which it says will allow on-site refueling of hydrogen powered machines in the same way that fuel bowsers are used for diesel powered equipment.

The mobile hydrogen refueller is designed to provide an easy way to refuel machines, the vast majority of which have fuel delivered to them while working on site, said the company. JCB said customers are already used to a transportable fuel system.

Source: *International Rental News* **Read The Article**

PSR Analysis: A huge number of construction sites and mining sites already deliver fuel to their machines, and this truck concept is a vital part of the hydrogen infrastructure to enable machines using either fuel cells or Hydrogen ICEs to operate. Infrastructure like this is a great enabler for hydrogen machines. **PSR**

Hydrogen Fuel Truck To Help Decarbonize Mining Industry

A new hydrogen fuel truck is being tested by the mining industry in hopes of helping to decarbonize activities that have been exceptionally challenging to mitigate. The mining industry contributes 7% of the world's total carbon emissions per year, (according to McKinsey). This represents more than twice the carbon emissions from the global shipping industry, for example.

The hydrogen-powered vehicle is meant to replace typical mining haul vehicles, which pollute heavily.

Source: *Hydrogen Fuel News* **Read The Article**

PSR Analysis: The mining industry is taking significant steps toward reducing carbon emissions with the introduction of hybrid-electric, electric, and hybrid-fuel cell vehicles, and this is another step towards this goal. Haul trucks contribute approximately half of all mining carbon emissions (or about 3.5% of global emissions), and trucks of this size can use 0.9 million liters of diesel a year, so some significant savings can be made. **PSR**

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Benchmark Mineral Intelligence counts 40 lithium mines that have been in operation and producing lithium in 2022

50-Ton Battery-Powered Electric Crane Introduced

The 653 E Electro Battery from Sennebogen is a new 50-ton battery-powered electric crane that was developed with Dutch dealer Van den Heuvel. "The new crane combines the benefits of battery technology with the proven advantages of the telescopic crawler crane design," the company writes. "This means you work completely emission-free and retain maximum flexibility, thanks to the Dual Power Management system."

With a 210 kWh battery, the crane is expected to be able to operate for up to 14 hours.

Source: *CleanTechnica* **Read The Article**

PSR Analysis: In Europe there are growing emissions regulations with increasingly stringent requirements, especially in cities, for heavy-duty machinery like cranes, just like there are for passenger cars. While the market for cranes isn't huge in unit terms, especially when compared to Passenger Cars, this is another example of how the industry is moving forward to meet emissions regulations. **PSR**

World Needs To Mine 25× More Lithium By 2050

The de-carbonization of the transport industry is heavily dependent on the scaling up of electric vehicle production rapidly and massively, and this rests on scaling up battery mineral mining and refining. This means Lithium.

Benchmark Mineral Intelligence counts 40 lithium mines that have been in operation and producing lithium in 2022. But, by 2050, the company sees a need for 234 more lithium mines if there's no battery recycling underway (which, of course, is completely unrealistic but is a place to start from for such an analysis).

"The long term path for lithium is set, yet the supply chain scaling challenge has just begun," said Simon Moores, chief executive of Benchmark. "What this data shows is that we are at just the beginning of a generational challenge, not one that's going to be solved in the 2020s."

Source: *CleanTechnica* **Read The Article**

PSR Analysis: Benchmark predicts that by 2032 more Lithium will need to be mined per year than was produced in the years 2015 to 2022. This means more mines are needed (with resulting capital investment) and recycling needs to be ramped up significantly.) In fact, Benchmark forecasts that in 2040, nearly 20% of lithium chemicals will be produced from recycled batteries or process scrap.

Benchmark Mineral Intelligence sees stationary energy storage as the main driver of demand by that time — two-thirds of the 11.2 million tons expected to be needed by 2050, so the market will need to shift towards non-lithium energy storage (such as Flow Batteries and other novel technologies) for grid support and peak shaving. **PSR**

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US Increases EV Battery Recycling Capacity

A new EV battery recycling plant in Alabama from Li-Cycle has just come online. It can process up to 10,000 tons of battery waste per year, enough for about 20,000 EVs per year, and helps the US move toward a zero-emission economy.

Li-Cycle's processing method is specifically designed as a two-part system recycling battery manufacturing scrap and turns end-of-life batteries into a black mass. The black mass is then processed and used to generate battery minerals such as nickel sulfate, lithium carbonate, and cobalt sulfate, three of the most critical factors for EV batteries. According to the battery recycling company, Li-Cycle believes its new method will enable up to a 95% efficiency rate compared to the industry average of 50%.

More importantly, Li-Cycle's processing method creates a safe way of recycling lithium-ion batteries without any landfill waste while reducing carbon emissions.

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

PSR Analysis: As automakers are moving swiftly to lock up critical battery materials, the world needs much more lithium to meet demand. Demand is expected to exceed 11.2m tons of lithium per year by 2050. With battery recycling technology advancing, and investment starting to flow, plants like these will help ease this transition to electric vehicles, but if this emerging trend doesn't continue, there is little prospect of meeting lithium demand. **PSR**

Penn State Offers Smaller, Faster Charging Batteries

Researchers at Penn State say they have found a way to make batteries for electric cars that can be smaller and faster charging.

"The need for smaller, faster-charging batteries is greater than ever," said Chao-Yang Wang, the lead author of the research study that was published in the October 12 issue of the journal Nature. "Our fast-charging technology works for most energy dense batteries and will open a new possibility to downsize electric vehicle batteries from 150 to 50 kWh without causing drivers to feel range anxiety," said Wang.

Batteries operate most efficiently when they are hot, but not too hot. Keeping batteries consistently at just the right temperature has been a major challenge for battery engineers. Historically, they have relied on external, bulky heating and cooling systems to regulate battery temperature, but they respond slowly and waste a lot of energy. The team decided to regulate the temperature from inside the battery. The researchers developed a new battery structure that adds an ultrathin nickel foil as the fourth component besides the anode, electrolyte, and cathode. The nickel foil self-regulates the battery's temperature and reactivity which allows for 10 minute fast charging on just about any EV battery.

Source: *CleanTechnica* **Read The Article**

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While fast charging is certainly desirable, the elimination of bulky and expensive liquid cooling systems for battery packs could be just as important because it would help lower the cost of electric cars.

PSR Analysis: Reducing battery packs for electric cars conserves precious resources such as Lithium, which are currently seeing massive price increases and may experience a potential shortfall in the not too distant future. Smaller, faster charging batteries will dramatically cut down battery cost and use of critical raw materials such as cobalt, graphite, and lithium, enabling mass adoption of affordable electric cars.

While fast charging is certainly desirable, the elimination of bulky and expensive liquid cooling systems for battery packs could be just as important because it would help lower the cost of electric cars. It could also give a boost to battery swapping, which is being promoted by NIO, CATL, and BYD, because there will be no coolant lines to connect and disconnect. Battery swapping is fast, and it eliminates owner concerns about battery degradation. **PSR**

Liebherr Hydrogen Excavator Leads BAUMA Winners

iVT was a major winner at Bauma in Munich when it was recognized in the hotly contested Climate Protection category in the Bauma Innovation Awards. The hydrogen-combustion machine is the first ever Liebherr hydraulic excavator to be powered by a hydrogen engine

The machine's prime power source is the H966 hydrogen combustion engine, which has six cylinders and uses port fuel injection (PFI), which Liebherr employs along with direct injection (DI) for its hydrogen engines

The other four lucky winners who received their accolades Oct. 23 were:

- MiC 4.0, which won in the Digitalisation category for its Machines in Construction, which creates one common digital language for construction sites;
- Herrenknecht AG, which earned the prize in the Mechanical Engineering category for its continuous advance tunnelling machine, which can speed operations by 1.6x.
- Holcim (Germany) GmbH, which narrowly led the field in the Construction category with its new, hugely versatile, patent-pending building material, CPC (Carbon Pre-stressed Concrete)
- Research, Freiberg University of Mining and Technology Mechanical Engineering Institute, won with their Deep Sea Sampling technology – a way to facilitate the mining of sea-bed minerals and resources, with minimal environmental impact.

Source: *iVT International* **Read The Article**

PSR Analysis: What is interesting about this award is that it is another example of hydrogen powered machines in our industry. The H966 hydrogen combustion engine is said to match an equivalent diesel machine in power, dynamics and responsiveness, so that an operator will notice no difference. The engine has six

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cylinders and uses port fuel injection (PFI), which Liebherr employs along with direct injection (DI) for its hydrogen engines. **PSR**

Miners Cut CO2 Emissions by Switching To EVs

A new contract to supply battery electric vehicles to the Jansen potash project (potentially the world's largest potash mine) expects to cut carbon emissions in half compared to its peers. BHP's Jansen potash project is expected to be the largest of its kind, with initial capacity forecasts of 4.3 to 4.5 Mtpa. Potash is the most commonly used potassium fertilizer, but over 70% is based on conventional underground mining that uses heavy-duty equipment to extract it. Although underground mining releases half the CO2 emissions of open-pit mining, the company is reducing emissions further by introducing several battery electric vehicles.

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

PSR Analysis: Almost every automaker plans to scale production of its electric vehicles to meet the growing demand for zero-emission cars, and these numbers are huge. However, getting to these numbers will require mining and traditionally this causes carbon emissions.

A few companies have already begun working to build a sustainable EV supply chain; Snow Lake Lithium outlined its plans in February to develop the world's first all-electric lithium mine, one of the most critical minerals used to build EV batteries. The mining company's CEO said at the time if you are going to mine for these resources that will be used to protect the environment, then obtaining them must also be done in a sustainable matter.

Miners using electric vehicles can significantly reduce the heat and carbon exposure they typically experience with diesel-powered equipment. EV mining technology can also cost less as it requires less ventilation and cooling. The importance of this is that as the auto industry transitions to electric vehicles, companies are figuring out ways to reduce carbon emissions. If miners get on board, this will create a completely sustainable EV supply chain. **PSR**

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Global Report

By Michael Aistrup, Senior Analyst

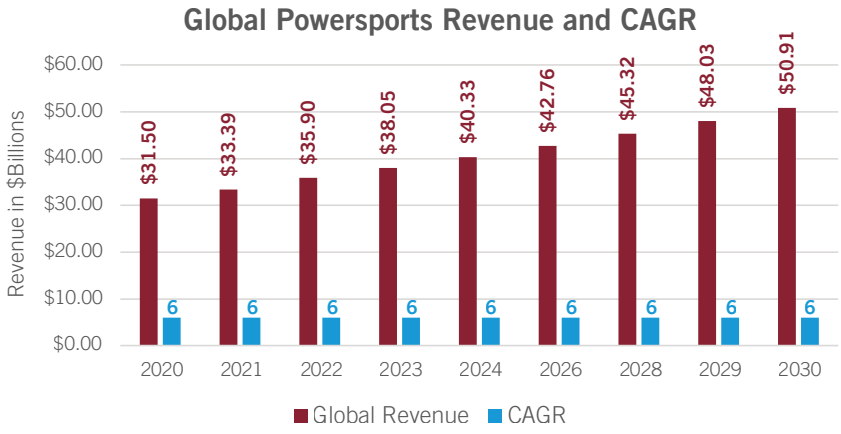
Michael Aistrup

Powersports Market Expected To Top US$ 50 Billion

Power Systems Research is forecasting global revenue for the Powersports industry to grow from $31.5 billion in 2020 to US$ 50.91 billion in 2030, a CAGR of 6% over the forecasted period.

Global Powersports Market

All-Terrain Vehicles, Side-by-Side, Powerboats, Snowmobiles and Heavyweight Motorcycles



Drivers-of-Demand. There are many factors driving the global powersports market growth:

» Increased all-terrain vehicle popularity.

- These include the rising participation in recreational activities, like surfing, off-road driving, and snowmobiling.
- According to the International Snowmobile Manufacturers Association around $36 Billion is spent directly and indirectly on snowmobiling in the US and Canada each year.
- ATVs have lesser age restrictions, lower maintenance costs, are easier to maneuver due to low vehicle weight and are more affordable
- Rise in use of powersports to boost adventure tourism traveling to new locations for gaining new experiences, with controlled risk components and personal challenges in wild & exotic environments.
- People are raising the bar for racing by introducing new terrains and challenges.
- The market in Europe is expected to showcase exponential growth backed by government policies that promote recreational and off-road leisure activities.

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Due to increasing adoption among younger consumers and cheap loan rates, the motorcycles segment held a significant market share and continues to grow.

- Global governmental initiatives to boost the tourism industry by assisting recreational clubs in enhancing their service offerings are creating a favorable environment for the market participating in the construction of dedicated infrastructure for recreational and amusement purposes.

» **Technological innovations have played a major role in developing vehicles.**

- New products have increased comfort, power, engineering, and safety.
- Utility-terrain vehicles (UTVs) have improved durability and adaptability for off-road riding.

» **Growth in investments and rapid innovations in the automotive sector have resulted in improved performance of powersports vehicles.** This has resulted in improved vehicle efficiency, reduced noise and higher power of vehicles. Companies are also focusing on developing electric products for quieter more powerful riding.

» **Growing consumer disposable incomes make it easier for customers to purchase leisure and recreational power equipment.**

» **Data prepared by the U.S. Bureau of Economic Analysis (BEA) show that outdoor recreational activities accounted for US$ 374.3 billion in 2020, which is 1.8% of the overall U.S. GPD in 2020.**

Key Powersports Market Challenge. Powersports provide many positive benefits, but there are some challenges which may hamper the market growth:

» **There are detrimental effects of powersport vehicles on wildlife, habitat, vegetation, soil, air, and water.**

- Changes in animal behavior, including the abandonment of important activities such as hunting, foraging, and mating, have been linked to the increasing adoption of off-road vehicles. Disturbances from noise, pollution, ground impact, and speed may travel beyond the actual trail surface and affect animal behavior.
- The global power sports market is threatened by restraints such as environmental issues, increasing boomer age and unfavorable weather conditions

» **The rapid expansion of the global powersports market could be hindered by rising prices of products, fuel and powersports components.**

Due to increasing adoption among younger consumers and cheap loan rates, the motorcycles segment held a significant market share and continues to grow. However, registrations of large-engine motorcycles (600cc and more) have dropped in recent years.

The all-terrain vehicles segment is expected to see high demand. This is owing to numerous advantages of ATVs, like straddle seating position and handlebar steering, the ability of ATVs to travel through all terrains, and lesser carbon emissions. **PSR**

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North America Report

By Chris Fisher, Senior Commercial Vehicle Analyst

Hydrogen Fuel Cell Truck News

Chris Fisher

During the past few years there has been plenty of talk about battery electric power replacing diesel-powered internal combustion engines in commercial trucks. At some point this might be true for short and regional haul freight carriers, but what about the long-haul heavy truck segment?

Currently, the lack of a sufficient charging infrastructure, range anxiety and the extreme weights associated with the batteries are significant deterrents to mass adoption of long-haul battery electric trucks. However, hydrogen fuel cell trucks for long-haul applications appear to be a viable option in this segment. Even though fuel cell trucks currently have a greater range and lighter weight than battery electric trucks, they have the same problem as electric trucks: a lack of refueling infrastructure.

European Outlook. According to a Hydrogen Council study, in 2019 there were approximately 170 operational hydrogen re-fueling stations in Europe with a goal of adding 3,700 stations by 2030. At the end of 2021, hydrogen re-fueling stations had increased to 228 stations across Europe. Increasing the number of re-fueling stations to 3,700 by 2030 seems like a lofty goal.

How can this possibly be achieved? The EU will likely provide subsidies for the infrastructure, but it will be the private sector that will likely drive this. The initial OEMs in the European FCEV (fuel cell electric vehicle) market are Daimler, Volvo, Iveco and Nikola. TRATON which owns the MAN and Scania brands is currently more focused on the EV market.

Last year, Shell and Daimler announced the rollout of a hydrogen-based trucking initiative in which Shell would initially establish a hydrogen-refueling network joining the Port of Rotterdam with Cologne and Hamburg, creating an infrastructure corridor. At the same time, Daimler said it plans to introduce hydrogen fuel cell trucks to customers, starting in 2025. The corridor is expected to cover 1,200 kilometers with 150 hydrogen re-fueling stations. Daimler plans to introduce approximately 5,000 heavy duty fuel cell trucks by 2030. This is a good initiative, but more of these types of ventures will be needed for mass adoption of hydrogen fuel cell trucks to take place.

In April 2021, Daimler and Volvo announced a joint venture known as Cellcentric to jointly manufacture hydrogen fuel cells for trucks in Europe, starting in 2025. It called upon European Union policymakers to boost incentives for climate-neutral

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technologies. The plan is to begin testing fuel cell trucks in 2023 or 2024 and launch mass production by the end of this decade.

Daimler and Volvo are also pushing the EU to add incentives including taxing carbon and emissions trading credits to make up for the higher cost of climate-neutral trucks. Daimler and Volvo have also cited the need for 300 high-performance hydrogen refueling stations for heavy-duty vehicles by 2025 and 1,000 stations by 2030. Both companies have stated that battery electric trucks will work for short haul applications, but hydrogen fuel cells should play a major role in the longer haul segment. It should be noted that Daimler and Volvo will continue to be competitors even though they share this joint venture.

The EU recently announced that in some circumstances natural gas will be considered a green energy which will be beneficial to the production of hydrogen fuel. Prior to this announcement it would have been very difficult to produce enough green hydrogen to support the type of fueling infrastructure required for mass adoption of hydrogen fueled vehicles.

The takeaway from these initiatives is that Europe is starting to organize and focus on the need for additional hydrogen fueling infrastructure to help meet their climate objectives for the next decade.

In North America, the path for hydrogen fuel cell vehicles is not so clear. Currently, there are 107 hydrogen fueling stations in the United States, most of which are located in California. According to the US government, the goal is to have 200 hydrogen stations in California by 2025. By 2030, a total of 1,000 stations in the state is "envisioned," according to **GLPAUTOGAS**.

The sheer size of the United States and Canada will certainly make it challenging to develop a significant re-fueling infrastructure in the near to mid-term.

Last September, Nikola signed a memorandum of understanding with Opal Fuels to build and operate hydrogen fueling stations across North America. Under the preliminary agreement, the two companies will work to co-develop the technology necessary to accelerate the adoption of fuel-cell electric vehicles.

Also last year, Nikola and Travel Centers of America agreed to collaborate on the installation of hydrogen fueling stations for heavy-duty trucks at two existing TA stations. This collaboration is a first step for the parties to explore the mutual development of a nationwide network of hydrogen fueling stations. Nikola's original plan was to develop a network of around 700 hydrogen stations in the U.S. and Canada to support its Class 8 fuel cell trucks which recently started production at their Coolidge plant in Arizona.

This year, Congress introduced the "Hydrogen for Trucks Act" to support the adoption of heavy-duty hydrogen fuel cell vehicles and hydrogen fueling stations. This act would incentivize the adoption of heavy-duty hydrogen fuel cell vehicles by covering the cost difference between these vehicles and traditional diesel vehicles and encourage parallel deployment of vehicles and fueling stations.

The act would also provide data and benchmarks for different types of fleet operations, thereby incentivizing private investment and accelerating deployment.

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Four-wheel off-road Utility Vehicles with side-by-side seating are designed to be used in a variety of recreational, industrial and military applications.

The United States and Canada are moving forward in the development of FCEV's and the re-fueling infrastructure to support them, but it is going to take some time before significant adoption in the regional and long-haul segment can occur. **PSR**

DATAPOINT: *North America Utility Vehicles*

432,700

By Carol Turner, Senior Analyst, Global Operations

432,700 units is the estimate by Power Systems Research of the number of Utility Vehicles to be produced in North America (United States, Canada and Mexico) in 2022.

Four-wheel off-road Utility Vehicles with side-by-side seating are designed to be used in a variety of recreational, industrial and military applications. When equipped with dumpers, they are commonly used for landscaping, dumping and transporting light materials. Vehicles can be customized with enclosed cabs, tool racks, dumpers and more for use on college campuses, parks, corporate campuses and airports. Suppliers offer a wide variety of gas, electric and diesel utility vehicles.

This information comes from industry interviews and from two proprietary databases maintained by Power Systems Research: **EnginLink™**, which provides information on engines, and **OE Link™**, a database of equipment manufacturers.

Exports: Canada, up to 90%; Mexico, up to 85% for NA markets, and US, up to 40% worldwide.

Market Share: With a combined plant total of 28%, Mexico/US based Polaris leads in production of Utility Vehicles in North America. In second position is Deere with a combined plant total of 12%; third is Kubota with 11%.

Trends: In 2021, annual production of Utility Vehicles in North America increased 2% and production is expected to gain another 5% in 2022. The Covid-19 pandemic fed the demand for Utility Vehicles in recreational, industrial and military applications known as the "Pandemic Paradox" (sales surged during lockdowns). The popularity of outdoor activities increased during the lockdowns as people gravitated to the outdoors and away from indoor group activities.

The increases also were driven by low unemployment, demand for products in the golf industry, federal government incentives and the desire for new equipment/ greener technology especially within the sport and utility sectors.

Side-by-Side units, also referred to as Utility Task Vehicle (UTV) models continue to grow in popularity and are edging out ATVs for preference because of their convenience and increased capacity. Most UTVs can accommodate up to six passengers and are primarily designed for off-road use. Production is expected to increase up to 5% by 2025. **PSR**

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Brazil/South America Report

By Fabio Ferraresi, Director Business Development South America

Foton Aumark Shuts Down Operations in Brazil

Fabio Ferraresi

Ten years after starting operations in Brazil with the import of Trucks and plans to have a local plant, Foton Aumark do Brasil (FAB) is preparing to go to court against the Chinese brand, claiming breach of contract. The company was created by economist Luiz Carlos Mendonça de Barros, former president of BNDES and former director of the Central Bank.

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

PSR Analysis: The volumes of Foton were always very small and the situation will not affect the market. Plans for plants and volumes were never executed and sales never ramped up. Now it is just litigation between the parties and dealers that should look for compensation after FAB.

São Paulo Partners with ENEL To Replace Diesel Buses

The City of São Paulo has announced a partnership with Enel, an energy supplier, for its bus fleet electrification project to be completed by 2024. Under the agreement, the city will get funding for the project of R $ 8 billion. The plan calls for the replacement of the fleet of combustion buses with non-polluting models.

According to the city, Enel is one of the main stakeholders in the project and should assist companies in logistics, infrastructure and the feasibility of electric vehicles based on their experience in Latin America.

The municipal management aims to increase from 2% to 20% the number of fully electric buses in the fleet by 2024, in compliance with the Climate Change Law. The promise is 2,600 electric models running on the streets of the capital of São Paulo in the coming years. Currently, there are only 219 electric buses (201 electric corded buses and 18 BEV Buses).

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

PSR Analysis: PSR had a meeting with SP Trans to discuss the movements, especially the decision to stop acquisition of new Diesel Engine Buses allowing only BEV. This is a movement that should not be effective in the short term, due to the lack of buses able to meet the criteria of SP Trans like durability and operational cost. As companies progress on product and cost improvement, the probability to succeed increase, but we do not see impact in the short term.

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Randon Acquires US Trailer Maker Hercules

Randon, an Brazil-based OEM, has agreed to invest $40 million to acquire the US-based trailer manufacturer Hercules. Randon's purchase agreement for Hercules is expected to be finalized within 120 days. Randon Implementos is the largest semi-trailer manufacturer in Latin America. The company maintains a manufacturing park in Argentina and works with partners to assemble semi-trailers at several points in Central America and Africa. It is the main Brazilian exporter in the segment, with a historical market share of 60% in exports.

Randon Companies operates in the US market, with business units from other verticals such as Fras-le and Master, through manufacturing facilities and commercial offices, to meet local demands and export auto parts from Brazil.

Source: *Global Trailer Magazine* **Read The Article**

PSR Analysis: Randon demonstrated success in brakes parts in US Market with Fras-le and with this acquisition it makes its first move in the competitive Trailer Market. Its ability for innovation and knowledge of market differences makes it able to succeed quickly in US market while bringing Brazilian products of Randon Holding, as Master Brake systems, Fras-le Brake Linings and Suspensys Axles. **PSR**

Show Report

Smaller Bauma Returns To Munich

By Emiliano Marzoli, Manager-European Operations, Christopher Bamforth, European Market Analyst, Dalibor Sablic, Senior Business Development Manager-Europe, Lorena Violante, Senior Market Research Consultant, and Guy Youngs, Forecast and Technology Adoption Lead

Summary. After more than three years, BAUMA, one of the largest construction events in the world, reopened its doors for seven days in Munich Oct. 24. Power Systems Research (PSR) had a five-person team at the event, discussing trends with industry representatives, from new products and services to topics around the future evolution of sustainable technologies.

The show was smaller than the last time it was held, in 2019. Close to 3,200 exhibitors from 60 countries (2019: 3,684 exhibitors from 63 countries) participated and more than 495,000 visitors from over 200 countries (2019: 627,603 visitors from more than 200 countries) came to Munich for the event.

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Bauma is the world's leading trade fair for construction machinery, building material machines, mining machines, construction vehicles and construction equipment.

Emiliano Marzoli

Christopher Bamforth

Dalibor Sablic

Lorena Violante

Guy Youngs

Bauma is the world's leading trade fair for construction machinery, building material machines, mining machines, construction vehicles and construction equipment. International visitors made up about 50% of the attendance. That's a change from 2019 when about two-thirds of visitors came from Germany.

The top 10 exhibitor countries at Bauma were, in order, Germany, Italy, Turkey, Great Britain and Northern Ireland, the Netherlands, France, the U.S., Austria, Spain and China.

The next bauma will be held in Munich April 7–13, 2025.

The show seemed to be very well received by stakeholders and industry players. One reoccurring topic during the exhibition was the importance of being back live, in person, at the show.

People were very interested in open discussions and knowledge sharing, compared to pre-Covid events. It seemed evident, to us and to many of the people we talked with, that people wanted to talk, to compare visions on the industry and understand what is happening, around the industry and in broader terms around fast changing geopolitical status.

Bauma 2022 was a great venue for OEMs and engine manufacturers to demonstrate the electrification that started slowly during the pandemic and now is speeding up. In 2022 we are able to see this migration from the most common power technologies (diesel, gasoline, gas) to greener technologies and alternate fuels, such as hybrids, electrics and hydrogen.

We visited many OEMs and component suppliers to identify the most important market trends, production locations, market shares, production and new models introduced.

Companies took this opportunity of Bauma to present their latest electric products and innovations. At this stage, many were still prototypes, but there was much equipment that is already in production and in the market.

According to conversations we had, some OEMs presented their most innovative alternate fuel solutions to their customers and dealers in order to get their first impressions, review feasibility and acceptance in the market, especially with electrics and hydrogen since the price and lead time at this stage is still very high.

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Other OEMs are already selling their electric and hybrid solutions. Most manufacturer product portfolio strategies consider a mix of power solutions, with a trend to make the market switch to more environmentally friendly solutions. However, some experts think that diesel will continue to dominate as one of the most preferred technologies.

The main focus at and topics is on electric drives because, just like on the roads, there are more and more construction machines and vehicles in the construction sector that rely on electric motors.

Overall, it was noticeable at the show that most of the industry wants to see where the electrification journey is going. Electromobility is on everyone's lips, the main discussion is about when the big transformation will take place.

When it comes to sales, the numbers are generally looking good across the board. Due to delivery bottlenecks caused by component manufacturers and suppliers, there are delivery problems in many cases. But on the whole, companies are satisfied with their figures.

Mergers & Acquisitions. Two acquisitions that we confirmed and that are already completely integrated to their businesses in the last months were CNH acquiring Eurocomach (2021) and Yanmar acquiring ELEO (2022). CNH Industrial's Construction Equipment business acquisition is enabling them to have Eurocomach make their mini and midi excavators at their facilities and continue with its market participation in that segment. In the case of Yanmar, and as part of their carbon-neutral electrification strategy, they acquired majority ownership of ELEO, a battery tech company based in the Netherlands.

Product Reports. We visited many stands during our time at Bauma and picked up lots of information on new products, both in production and in development. Here are 10 noteworthy new products we saw.

1. **Putzmeister / Sany** exhibited one of their iONTRON construction application 100% electric series truck (BSA 1005). It offers 6-7 years warranty of the battery. They expect to sell between 75-100 by next year. The trucks are equipped with a CATL battery (China Contemporary Amperex Technology https://www.catl.com/)

2. **Komatsu** exhibited their current product line and some electric and hybrid prototypes. They expect to start the production and sales of electric products in 2024. They confirmed they have manufacturing plants in Europe; in UK, Viena, Hannover and Duseldorff (this one is only dedicated to build the very large mining models, including PC4000)

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Liebherr exhibited their hydrogen engine prototype. The expected release date of this engine is in 2026.

3. **Honda** exhibited the eGX electric engine, which they had unveiled at the previous Bauma. It was very interesting to see the adoption rate of this electric engine for the smaller construction products had since last Bauma. Honda is still very much in a test and data collection phase to really understand the possibilities offered by electric alternatives. They were also showing what they believe would be the next step in electrification with their power station prototype. This is best described as a rack with batteries. The general idea is that people can go to these battery racks to exchange their depleted batteries for new fully charged ones. The rack would be recharging the freshly deposited batteries that would then be rented out by another user once charged. These would be found in common places such as gas stations. So far it has been estimated that electric engines are less than 5% of their total sales.

4. **Liebherr** exhibited their hydrogen engine prototype. The expected release date of this engine is in 2026. They also showed a hydrogen converter module which they plan to introduce in 2025. They also showed their fuel cell PEM prototype, 55kw They said their current product strategy to the market considers a mix of different power solutions. We talked with representatives about how the engine differs from a standard diesel engine. The main point of difference was how to handle the corrosive effects of hydrogen. Liebherr replaced the cylinder head block and redesigned the injection units (to look like an adjusted common rail diesel) but in stainless steel.

5. **Kohler** announced its new strategy from a power producer to an energy supplier. A strategy that may even replace ICE technology in some applications. Mentioned that they are working on their hydrogen solutions to be introduced in 2023. Also a hybrid tech module. They will continue offering gas, diesel, hybrid and hydrogen solutions to the market and stated that they will continue investing on diversified energy solutions to reduce environmental impact.

6. **Yanmar** introduced their carbon-neutral electrification strategy. From their press release: “Yanmar will establish itself as the all-in-one systems integrator for smart electrified power solutions tailored to the application-specific needs of individual OEMs. In its capacity as a systems integrator, Yanmar will implement system engineering, design and manufacturing of e-powertrains, while also providing control development, system evaluation, procurement, manufacturing and quality assurance.” Yanmar also exhibited ELEO batteries, in which they acquired major ownership early this year.

7. **Himoínsa** presented their 45/60 battery power generator with solar energy, which was introduced in 2021. The batteries can be charged through an electric source; however the main source of power is the use of solar panels. Himoinsa sells the genset with no solar panels, customers need to invest on that part, and the genset has the product designed to be connected to solar panels. Today, there are already 100 units in the market, and they expect to sell about 450 units by 2023.

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8. **Perkins & Caterpillar.** Perkins and Caterpillar stands were very traditional in their approach, with diesel engines predominantly featured. There were however their battery packs on display as mock ups – these were in 300 volt and 600-volt formats. The battery range uses lithium-ion chemistry and features a modular design to optimize performance and packaging. They have also been designed with sustainability in mind and are designed to be reused or recycled at the end of their life.

9. **MTU / Rolls Royce.** The MTU/Rolls Royce stand was very futuristic and clean – focus was on fuel cells and Battery power. MTU's Electric loader concept showing electric motors and battery pack lit in blue (no specs yet available). On display (left and above) was their 2nd generation fuel cell which is only suitable for stationary applications. Gen 3 is due to be released soon and details will be forwarded to me. Gen 3 is suitable for stationary and mobile applications.

10. **Kreisel** is a company that makes battery packs and chargers – they had their KPB63 battery pack on display with 63kwh, using Lithium–ion chemistry. The battery packs are module and can be stacked up together. **PSR**

Far East: Japan Report

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

Semiconductor Development Companies Set Up

Akihiro Komuro

The full details of the government's goal of a next-generation semiconductor development system have been revealed. Led by the Ministry of Economy, Trade and Industry, and in cooperation with the private sector and overseas countries such as the United States, a new company will be established to mass produce next-generation semiconductors, and a new R&D center will be launched. This is the first time that a comprehensive system for research and mass production of advanced semiconductors has been established.

The new structure has two pillars. The "LSTC (Leading-edge Semiconductor Technology Center)" will be established by the end of this year as a research and development center for next-generation semiconductors. The University of Tokyo, Tokyo Institute of Technology, Tohoku University, RIKEN, and others will participate in the LSTC, which aims to be an open R&D platform for both domestic and international use so that the results of research can be put to practical use. The company is also considering collaboration with the National Semiconductor Technology Center (NSTC), which is scheduled to be established in the United States.

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Far East Report

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A new company has also been established as a mass production base for next-generation semiconductors. The new company is called Rapidus, and is funded by Toyota Motor Corporation, Denso Corporation, Sony Group, NTT, NEC, Softbank, semiconductor giant Kioxia, and Mitsubishi UFJ Bank.

The company was established in August and is preparing to become a mass production center for advanced semiconductors, and at the end of September applied to the New Energy and Industrial Technology Development Organization (NEDO) for a contract manufacturing project for advanced semiconductors. The government has drawn up a 1.3 trillion-yen supplementary budget plan to support semiconductors, and it is possible that part of this amount will also be used to support the new system in the future. In addition, several major Japanese companies, including NTT and Kioxia, have decided to invest in the company to support the development of next-generation semiconductors.

The new company plans to focus on mass production of advanced semiconductors with computing functions, known as "logic semiconductors." The production of logic semiconductors is an area in which Japan lags behind, with Taiwanese semiconductor manufacturer TSMC holding a nearly 60% share of the global market. The new company will work with LSTC to secure mass production as early as around 2026.

Source: Yahoo! Japan

PSR Analysis: In the midst of intensifying international competition, Japan has finally begun to focus on the development and production of semiconductors.

The amount of support for semiconductors this year is 7.5 trillion yen in the U.S. and 6.2 trillion yen in Europe, while Japan currently has 1.3 trillion yen. The amount of government support for the establishment of this new company is 70 billion yen. I feel that this is an order of magnitude short of developing a 2-nanometer. The smaller the circuit width, the higher the performance of logic semiconductors. TSMC of Taiwan and Samsung Electronics of Korea have established mass production technology for 3-nanometer products and have announced plans to mass produce 2-nanometer products by 2025. Japan's current logic semiconductor production lines are 40 nm at the latest, and Japan has been lagging.

In other words, rather than participating in the money game of competing for the largest investment, Japan will focus on the development of advanced technologies and compete in the development of high-performance semiconductors, for which demand is expected to grow in the future.

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In the 1980s, Japan was the world leader in semiconductors, but the Japan-U.S. trade friction of that time led to the decline of the Japanese semiconductor industry.

In the 1980s, Japan was the world leader in semiconductors, but the Japan-U.S. trade friction of that time led to the decline of the Japanese semiconductor industry. The public-private semiconductor development reported this time may be an opportunity for Japan to regain its position of technological strength in the field of semiconductors. A very tough battle of budget and time is about to begin. **PSR**

極東 > 日本レポート:

小室 明大 – 極東及び東南アジア リサーチアナリスト

「次世代半導体」の新会社を設立　NTT・キオクシアなどが出資

政府が目指す次世代半導体の開発体制の全容がわかった。

経済産業省が主導し、民間やアメリカなど海外と連携し、次世代半導体を量産する新会社が設立され、研究開発の新たな拠点も立ち上げる。先端半導体の研究と量産の体制を総合的に確立することは初めてのことだ。

新体制は2本柱。次世代半導体の研究開発拠点として、「LSTC＝技術研究組合最先端半導体技術センター」を年内に設立する。参加するのは、東京大学、東京工業大学、東北大学、理化学研究所などで、各教育研究機関の中で留まりがちな研究成果を実用化に向け活用できるよう、国内外に向けオープンな研究開発プラットフォームを目指す。アメリカで設立が予定されるNSTC＝国立半導体技術センターとの連携も視野に入れている。

そして、次世代半導体の量産拠点として新会社も立ち上がった。新会社の名称は「Rapidus」で、トヨタ自動車、デンソー、ソニーグループ、NTT、NEC、ソフトバンク、半導体大手のキオクシア、三菱UFJ銀行の8社が出資する。この会社は8月に設立され、先端半導体の量産拠点を目指し準備を進めている。9月末にNEDO＝新エネルギー産業技術総合開発機構に先端半導体の製造委託事業に応募し、今月8日にNEDOが申請を採択、700億円の支援が決定した。政府は半導体支援策として1.3兆円の補正予算案を策定していて、今後その一部も新体制の支援に回る可能性がある。さらに、NTT、キオクシアなど複数の大手日本企業が出資を決めていて、次世代半導体開発を支援する。

新会社は「ロジック半導体」と呼ばれる演算機能をもつ先端半導体の量産に注力する方針。ロジック半導体の生産は、日本が遅れている分野で、台湾の半導体メーカーTSMCが世界で6割近いシェアを持っている。新会社は今後、LSTCと両輪となって、早ければ2026年頃の量産体制の確保を目指す。

PSR 分析: 国際間競争が激化するなかで、やっと日本も半導体の開発と生産に力を入れ始めたというニュースだが、正直に言ってもう5年ほど早くこれに取り掛かってほしかった。1年2年の時間は開発競争にとってとても大きく、早く需要を取り込んだ者が勝つと言われている世界だからだ。

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今年の半導体の支援額は、米国が7兆5,000億円、欧州は6兆2,000億円という規模だが、日本は現時点で1兆3,000億円。この新会社設立にしても国の支援額は700億円だ。これは、2ナノを開発するのには一桁足りないと感じる。ロジック半導体は回路幅が小さいほど性能が高く、台湾のTSMCと韓国のサムスン電子は3ナノ品の量産技術を確立し、2ナノ品も2025年に量産する計画を発表している。現在の日本のロジック半導体の製造ラインは最新でも40ナノで、こうしたグローバルリーダーの動きにこれまで後塵を拝していた。

つまり、日本は、投資額の大きさを競うマネーゲームに参加するというよりは、より先端技術の開発に注力し、今後ますます需要が大きくなるだろう高性能半導体の開発で勝負しようということだ。1980年代には日本が世界の半導体をけん引する立場だったわけだが、日米貿易摩擦があり、それをきっかけに日本の半導体産業は衰退してしまった。今回報じられた官民での半導体開発が、再び日本が半導体の分野で足跡を示せる立場を取り戻すきっかけになることを期待したい。 **PSR**

参考: Yahoo!Japan (一部筆者により元記事内容を改編しました)

Far East: South Korea Report

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

Korean Electric Motorcycle Maker Builds Factory in Vietnam

Zio Holdings, a South Korean company engaged in the production and sale of electric motorcycles, says it has completed an electric motorcycle factory in Bac Ninh Province in northern Vietnam.

The factory covers an area of 1,300 m2 and has an annual production capacity of 12,000 units. The factory will receive parts supplied from original brand factories in Vietnam and China and will assemble the parts at ZIO EV's factory in Vietnam.

The electric bikes to be manufactured at the new factory will be named "EDEN" and "MEVOYEZ," and will use LFP batteries (lithium-ion iron phosphate batteries). The maximum speed is 55Km/h, and the driving range is over 150km. The selling price is expected to be 30 million VND (approximately 176,000 yen).

The company's decision to establish a plant in Vietnam is due to the Vietnamese government's policy to gradually restrict or halt the production, assembly, and import of cars and motorcycles that run on fossil fuels by 2040.

Zio Holdings' chairman said the company plans to build a plant in southern Vietnam with an annual production capacity of 24,000 units in Q4 2023, followed by an annual production capacity of 400,000 units in 2025. It has an annual sales goal of 250 billion won (about 26 billion yen) in 2024.

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Far East Report

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The EV bikes are priced according to their specifications for sufficient speed and driving range, and the products themselves are considered competitive.

Source: VIETJO

PSR Analysis: The EV bikes are priced according to their specifications for sufficient speed and driving range, and the products themselves are considered competitive. This is an attempt to gain a first-mover advantage by entering the market early. Other EV motorcycle makers are expected to follow suit, and intensify their actions in the Southeast Asian region, which is a major motorcycle market. **PSR**

極東 > 韓国レポート:

小室 明大 – 極東及び東南アジア リサーチアナリスト

韓国電動バイクメーカーがベトナムに工場を新設、2023年には南部にも工場設立を計画

電動バイクの生産・販売を手掛ける韓国のZio Holdingsは10月31日、ベトナム北部のバクニン省に電動バイク工場を完成させ、竣工式を行ったと発表した。工場の面積は1300m2で、年産規模は1万2000台となる。ベトナムや中国にある相手先ブランド工場から部品の供給を受け、ベトナム工場のZIO EVで組み立てを行う仕組みとなっている。新工場で製造する電動バイクのモデル名は「EDEN」および「MEVOYEZ」で、バッテリーにはLFP電池(リン酸鉄リチウムイオン電池)を利用する。最高速度は55Km/h、走行距離は150km以上。販売価格は、3000万VND(約17万6000円)とする予定だ。同社がベトナムに工場を設立した背景には、ベトナム政府が2040年までに化石燃料で走行する自動車・バイクの生産・組立・輸入を段階的に制限・停止する方針を打ち出していることがある。Zio Holdingsの会長は「2023年10～12月中には、ベトナム南部に年産規模2万4000台の工場も建設し、その後の2025年には年産規模40万台とする。2024年には、年間売上高2500億ウォン(約260億円)の達成を目指す」と話した。

出典: VIETJO（一部筆者により元記事内容を改編しました）

PSR 分析: 韓国の二輪メーカーはこれまでは国際的なプレゼンスを獲得するには至っていなかったが、二輪にも押し寄せるEV化の波に乗じて商機を掴もうとしている。EVバイクのスペックとして、十分な速度と走行距離に見合った価格設定であり、商品自体の競争力はあると思われる。ブランディングが奏功すれば販売は成功するだろう。これは市場への早期参入による先行者利益を狙ったものだ。他のEVバイクメーカーもこのように二輪大国である東南アジア域内でのアクションを活発化させることが予想される。**PSR**

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Southeast Asia: 6 Major Countries Report

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

New Vehicle Sales Increase 33% in September

New vehicle sales in the six major Southeast Asian countries totaled 317,765 units in September, up 33% from the same month last year. The figures were compiled from new vehicle sales statistics released by automobile industry associations and other organizations in each country. This is the 12th consecutive month that sales have exceeded those of the same month last year; the economic recovery from COVID-19 continues, with sales up 8% compared to September 2019, even before the spread of the infection.

Indonesia, the largest new vehicle market in the region, saw a 19% y/y increase to 99,986 units. This was the highest single-month sales volume in 2022. The tax exemption for some models ended at the end of September, and there appears to have been a rush demand for new vehicles.

Sales in Thailand were up 16% to 74,150 units. Sales of commercial vehicles, which accounted for 70% of total sales, were up 31%, while passenger cars declined 9%. Toyota Motor Corporation, which has the largest sales share in the country, believes that the flooding that occurred in many areas due to heavy rains at the end of the rainy season had an impact on the slump in passenger car sales.

The six countries, including Malaysia, Vietnam, the Philippines, and Singapore, totaled about 2.48 million vehicles in January-September, up 30% from the same period last year, and down 3% from January-September 2019. 2022 full-year sales are on pace to exceed 3 million vehicles for the first time in three years.

Source: The Nikkei

PSR Analysis: The automobile market in Southeast Asia has been steadily recovering during the current international situation, which has been greatly shaken by COVID-19, friction between the U.S. and China, the situation in Ukraine, and other factors. This is a clear indication of the strength of demand within the region. Exports to the rest of Southeast Asia are also recovering. From a medium- to long-term perspective, demand will continue to grow as road networks are developed. **PSR**

東南アジア > 主要6カ国レポート:

小室 明大 – 極東及び東南アジア リサーチアナリスト

東南アジア新車販売、9月33%増　12カ月連続プラス

東南アジア主要6カ国の9月の新車販売台数は、前年同月比33%増の31万765台だった。各国の自動車業界団体などが公表した新車販売統計を集計した。前年

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Southeast Asia Report

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Vehicle sales, which peak during the festive season in India, account for about 40% of annual volume.

同月実績を上回るのは12カ月連続だ。COVID-19からの景気回復が続いており、感染拡大前の2019年9月比でも8%増となった。

域内で新車市場が最も大きいインドネシアは、前年同月比19%増の9万9986台だった。単月の販売台数としては2022年で最多となった。一部車種を対象にした税減免措置が9月末で終了したことから、駆け込み需要があったとみられる。

タイは16%増の7万4150台。販売台数の7割を占めた商用車が31%増と好調だった一方、乗用車は9%減少した。同国で販売シェア首位のトヨタ自動車は、雨期終盤の大雨により各地で洪水が発生したことが影響したとみている。

マレーシア、ベトナム、フィリピン、シンガポールを含めた6カ国の1～9月累計は、前年同期比30%増の約248万台となった。2019年1～9月比では3%減の水準だ。2022年通年は3年ぶりに300万台を超えるペースで推移している。

出典: 日経（一部筆者により元記事内容を改編しました）

PSR 分析: COVID-19や米中摩擦、ウクライナ情勢など、大きく揺れ動く国際情勢のなかでも東南アジアの自動車市場は着実に回復を続けている。これは域内の需要がいかに力強いものかを端的に示している。東南アジア域外への輸出も回復していると見て良い。

中長期的な視点でも、道路網が整備されていくに伴って需要は伸びていくと言える。**PSR**

India Report

By Aditya Kondejkar, Research Analyst – South Asia Operations.

Cheering Festive Season for Auto Industry

Aditya Kondejkar

This year's festive season fired up vehicle registrations but failed to match 2019 sales numbers. Vehicle sales, which peak during the festive season in India, account for about 40% of annual volume. Sales in the just-concluded season this year were better than in the past two COVID years but were far below the sales level of 2019.

"Auto Retail for October 2022 saw an overall growth of 48%," said Manish Raj Singhania, president of Federation of Automobile Dealers Associations. With most of the month under the festive period, the sentiments were extremely positive across all categories of dealership outlets."

Source: *Economic Times* **Read The Article**

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India Report

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PSR Analysis. In India, the festivals drive sentiment buying and the three-day period of Dhanteras, Choti Diwali and Badi Diwali boosts major demand. This year, starting with Dhanteras on Oct. 22 to Diwali on Oct. 24, the industry's Passenger Car volumes are estimated to be around 54,000 units, higher than the last two years but still lower than the 70,000 units sold in 2019. That's about a 10% increase over last year, but still less than 2019-sales.

Weaker rural demand was a major problem for the automobile sector. However, industry representatives believe that market sentiments have improved in the rural region. New launches and good customer schemes provided traction to the segment.

As farmers have started receiving their crop revenues, there is an overall positive sentiment and positive cashflow. To ensure high growth of vehicle sales, it is important for the two wheeler segment to consistently grow for at least 3-4 months. There will be constant growth of commercial vehicle sales due to increasing infrastructure projects and CAPEX.

Going forward, we believe there are many possible headwinds for the passenger cars and SUV segments: liquidity, inflation, high commodity prices, economic growth, and affordability. **PSR**

Russia Report

By Maxim Sakov, Market Consultant, Russia Operations

Editor's Note: *PPower Systems Research has paused all research and business development activities in Russia. We have maintained a presence in Russia since 2013 to bring important updates to our clients about the powered equipment markets within Russia. We are monitoring the current situation on a daily basis and hope to again establish this presence when the conflict with Ukraine is resolved. Please contact us at* ***info@powersys.com*** *if you have questions regarding business conditions in Russia. Thank you.* **PSR**

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