

# THE ROAD TO DECARBONIZATION

Chinese electric carmaker, NIO, outlines commitments to **TECHNOLOGICAL INNOVATIONS AND CLIMATE-POSITIVE INITIATIVES FOR GREEN MOBILITY.**

**In China**, the transport sector is the third-largest source of greenhouse gas emissions, having produced 1.1 billion tonnes in 2019 alone, with vehicles contributing to an almost 80% emission share. Policymakers are pushing electric vehicle penetration by transforming public transport and subsidizing electric vehicle (EV) manufacturing. Sales of alternative fuel vehicles reached a record 2.99 million units, or 14.8% of new vehicle sales in 2021, up by 169% on the previous year, putting the government's goal of achieving 20% EV penetration ahead of schedule.

As one of China's leading EV manufacturer, sustainability is imperative for NIO. The company's energy-saving and emission-reducing journey began right from the EV manufacturing stage. Since the establishment of the JAC NIO Advanced Manufacturing Center in Hefei, NIO has adopted photovoltaics and geothermal heat pumps for clean energy generation. Moreover, NIO's Blue Sky Lab repurposes leftover manufacturing materials, from airbags, seat belts, microfibre, and leather surplus, to make fashion items.

## SUSTAINABILITY AS A KEY DRIVER FOR INNOVATION

Renewable energy systems, storage, and battery technology will determine the potential of transport electrification. The electric drive system lies at the core of a vehicle's performance, efficiency, range and NVH (noise, vibration, harshness).

NIO uses a silicon carbide module in the powertrain of their new models. Silicon carbide is a third-generation wide-band semiconductor material with fast switching speed, high turn-off voltage, and with high temperature characteristic. Motor controllers built with silicon carbide power devices can improve the efficiency and power density of permanent magnet synchronous motor (PMSM) drive systems significantly, as well as extend their range.

For instance, the silicon carbide-based electric drive system improves the energy efficiency of the new model to 91.5%, increases the current drive capability by 30%, is more efficient and better performing than conventional 'insulated gate bipolar transistor' (IGBT)-based modules. The use of

silicon carbide modules in 180 kW permanent magnet synchronous motors (PMSM) reduces combined power losses, resulting in a smaller cooling system and greater battery autonomy, making the powertrain more reliable and sustainable.

Battery technology is a major obstacle to the replacement of petrol cars. There is always a trade-off between charging time and other factors including cost, range, lifetime, and safety. Swapping a spent battery for a charged one would eliminate long refuelling times — one of the major limitations of electric vehicles. However, with a specific station and the right technology required, they are often seen as inefficient and costly. NIO launched the Battery-as-a-Service (BaaS) subscription model and the world's first mass-produced battery swap station, NIO Power Swap Station 2.0, featuring rechargeable, swappable, and upgradeable batteries and automated swapping process, respectively.

The centralized charging solution and closed-loop management not only reduces the overall cost of batteries, but could also improve charging

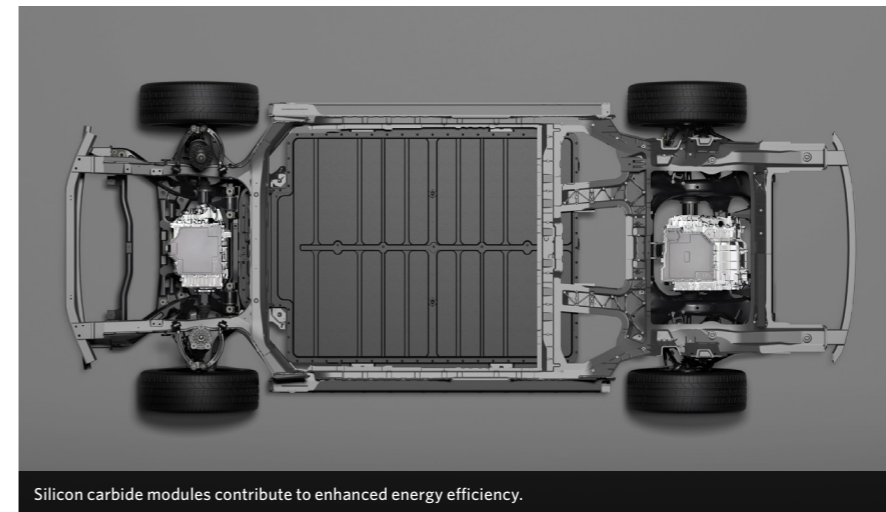
efficiency and convenience. After normal lifecycles, the batteries can be repurposed for solar and energy storage applications. After use as an EV station, a site could be readily transformed into an energy storage system for another purpose.

## PARTNER UP FOR GREATER IMPACT

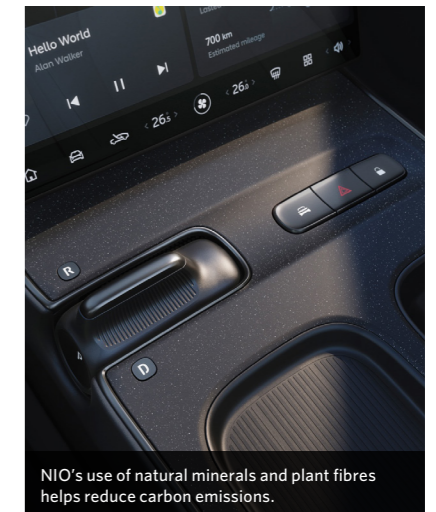
NIO signed partnership agreements with energy and petrochemical companies such as Sinopec and Shell to build more battery swap and charging stations across China and Europe. This allows the fuel retailer to adapt its existing infrastructure to a greener future.

In addition to developing a battery charging and swapping network, the collaboration has also helped to ramp up new materials production and develop smart EV technology.

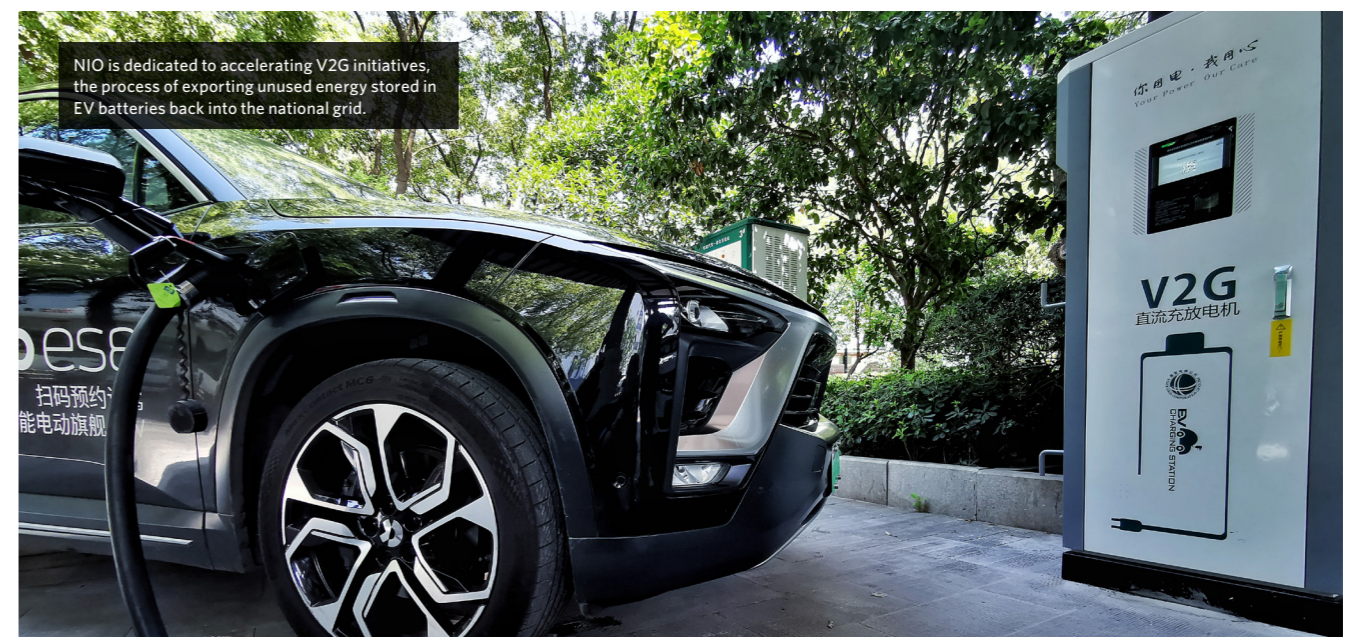
With the State Grid Electric Vehicle Service, NIO launched an initiative on Vehicle-to-Grid (V2G) technology. V2G is the process of exporting unused energy stored in EV batteries back into the national grid. This would boost the grid's energy supply during peak hours, and serve as an alternative



Silicon carbide modules contribute to enhanced energy efficiency.



NIO's use of natural minerals and plant fibres helps reduce carbon emissions.



NIO is dedicated to accelerating V2G initiatives, the process of exporting unused energy stored in EV batteries back into the national grid.

power source when weather-dependent renewable energy sources are not available.

By encouraging users to charge EVs in low demand periods, or from surplus solar and wind generation, V2G brings the benefits of load shifting and peak shaving. The coordinated and strategic model of NIO's battery swapping stations can make the V2G model even more efficient and less dependent on individual users' participation. By helping EVs consume more renewable energy and promoting the flexibility, stability and efficiency of the grid, the partnership

contributes to reducing carbon emissions.

NIO introduced the Blue Point programme that transfers emission reduction credits to their end-users in collaboration with the China Classification Society Certification Company, and the Shanghai Environmental Energy Exchange. Upon consent, the carbon emission savings of each EV user are calculated and transferred into points that can be redeemed for rewards.

NIO is the first automaker to help consumers complete such certification transactions. The programme diversifies the

participants of the country's sustainability initiative, and engages more people with plans for a net-zero emission future.

Facing growing transport demands, the decarbonization of China's light-duty vehicle fleet is a long-term undertaking and requires immediate action across the industry. To sustain the momentum of EV adoption in the fight against climate change, joint efforts need to be made in identifying all sources of emission across the supply chain and understanding their long-term environmental, policy

and economic implications.

EV manufacturing emissions, battery technologies, power supply systems, material recycling, and charging infrastructure all present challenges, as well as opportunities for innovation. It also calls for technologies that have not yet been commercialized, as well as significant public-private and inter-industry collaboration. ■



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