**Electric Vehicle Traction Motors, Belt Driven & Integrated Starter Generators**

2016-2026

**Description:**
Boost recuperation machines, motor generators, BSG, ISG for 48V MH, strong hybrid, pure electric, ELV: land, water, air.

As vehicles electrify to meet new emissions laws and improve economy and function there are added issues of cost, reliability, life and integration of the now more-complex rotating electrical machines REMs needed. Electricity handled is usually up at least fourfold. These REMs are increasingly doubling as both motor and generator in an increasingly versatile manner.

As a motor this can mean driving the wheels or propeller and both starting and boosting a downsized and downspeeded fuelled engine where there is one. As a generator it may be making electricity from the rotation of the engine and regenerative braking. It may also be receiving electricity from suspension and other recuperation and from energy storage, stopping, starting, boosting the engine with extra power when needed - a far more punishing regime than the traditional traction motor encounters though there is plenty of market for them as well.

The author explains the seven reasons for more than one REM per vehicle. Integrating other functions is another trend we analyse such as merging with power electronics and gearing, often in-wheel or in-propeller. REMs are now providing electricity for a rapidly increasing number of on-board devices as they proliferate and as existing devices are electrified for better efficiency, control, versatility and safety.

**Voltage trends in EVs**

These trends alter the value chain. It becomes tougher to sell just the motors. Markets open up for new devices. Developers have already taken $50 million at a time for proven new REM technologies. Vertical integration increases in the supply chain. It makes these systems a larger part of the cost of the vehicle and makes them contribute more to performance, consumer proposition and emission reduction so OEMs and Tier One suppliers are keener to create and own the IP and more is invested in development.

Flatter, smaller and/or more-efficient designs and smaller, cooler fuelled engines (or none at all) in the vehicles will reduce the cooling requirements. In a given REM system, mechanical parts become less of the cost and performance and electronics become more.

Advances may occur first in large vehicles because they are bought by organisations sensitive to total cost of ownership, performance and emissions. For example, most electric aircraft and tactical military electric vehicles already have more than one REM and the best-selling pure electric bus has two in-wheel motors. Now that will happen with best-selling cars. On the other hand, 48V mild hybrid cars will be commonplace with their "Boost Recuperation Machines" and "Integrated Starter Generators" before that technology migrates to vans, trucks and buses in any volume so we look widely to find best practice and see the future.

**Electric car forecast**

The author explains how REMs for converting traditional ICE powertrains to 48V mild hybrid. This is meet the onerous 2025 and 2030 emissions regulations that cannot be met by traditional ICE powertrains in C and D cars and larger vehicles but other benefits accrue. At a fraction of the cost, this gives most of the features of a strong hybrid that does not plug in, so potential is large.

To understand these complex trends, the author has used its PhD level globetrotting analysts who themselves lecture at the leading events, as respected participants in this rapidly growing industry. This report therefore has unusual insights and interviews not available to others and material just presented at events worldwide.

Only the author forecasts the global electric vehicle industry in 46 categories presented here by land, water and air. The main business is cars and buses and the emphasis of the report reflects that. Future winners and losers are identified among the powertrains and devices. The activities of over 160 participants is
detailed in what will be almost a trillion dollar EV business in ten years.

The report is in wide slide format with many new, detailed infographics aiding understanding and over 160 suppliers investigated.

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