OPPORTUNITY 43

SCOPE VISIONARY

UNCERTAINTIES

Technology, Nature

MEGATRENDS

Pushing the Boundaries on Energy

TRENDS

Advanced mobility
Mobilising Innovation
Net zero
New Materials
Transforming Energy

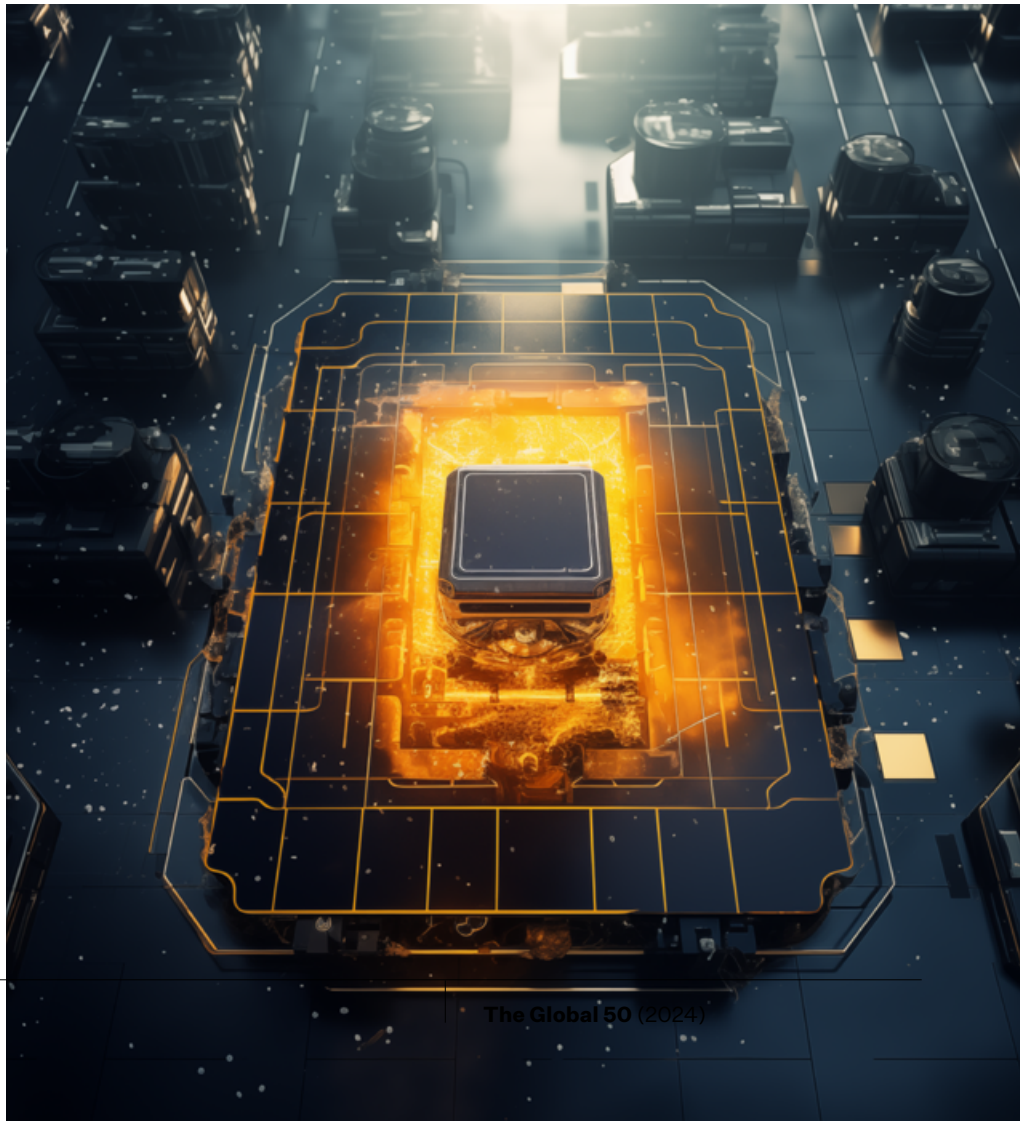
SECTORS IMPACTED

Automotive, Aerospace & Aviation
Chemicals & Petrochemicals
Energy, Oil, Gas & Renewables
Logistics, Shipping & Freight
Materials & Biotechnology
Travel & Tourism

What if fully solar-powered vehicles were everywhere?

SUNSHINE STEERING

Advanced machine intelligence – for novel materials and solar technology design – and nanotechnology enhance solar photovoltaic (PV) cells and storage and enable weather-resilient solar vehicles that rival electric ones.



WHY IT MATTERS TODAY

Despite four decades of research trying to develop a viable solar-powered car, the challenge remains.[869] Students around the world compete to try to meet the challenge (e.g. in the World Solar Challenge[870] and the American Solar Challenge[871]), while companies like Sono,[872] Lightyear,[873] and Aptera[874] face uncertainties in their attempts. Even with the current limited solar technologies, the market for solar-powered cars is expected to reach $46.11 billion by 2031. [875]

Electric cars comprised 18% of 2023's total car sales[876] and by 2030 could represent 35% of sales globally, avoiding around 700Mt carbon dioxide equivalents.[877] This growth will increase pressure on existing grid capacity and rely on the roll-out of charging infrastructure to keep up with demand.[878] Some estimates suggest that the total investment needed for worldwide charging infrastructure could be as much as $210 billion to 2030.[879]

In addition, current electric vehicles have a limited range, making them unsuitable for long-distance private and commercial transport, and manufacturers are working to improve overall system flexibility by providing extra capacity through solar panels; the panels of the hybrid Hyundai Sonata and Toyota Prius models, for example, enable nearly 1,250 sun-powered kilometres a year.[880]

Besides reducing the weight of the cars, researchers are already working on ultra-thin and ultra-strong PV weighing 100 times less than current cells but generating 18 times more power per kilogram.[881] PV paint (integrating nanoscale semiconductors known as quantum dots[882]) at an industrial scale that can be nanoprinted onto specialised surfaces, for example ultra-strong fabric known as Dyneema®, reduces the need for heavy solar panels.[883]

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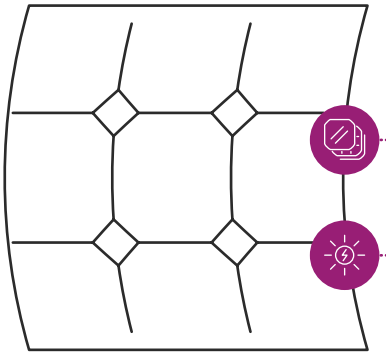
Beyond new rare raw materials and autonomous energy efficient route prediction in vehicles,[884] advanced machine intelligence enables innovative installation designs of solar PV cells through simulations, nanotechnology for energy harvesting,[885] creation of novel materials such as perovskite (a combination of titanium oxide minerals[886]), or synthetic biology[887] which lead to solar-powered vehicles that can compete with regular electric vehicles, overcoming any weather conditions, without the need for an external battery for storage. This leads to a breakthrough in decarbonised transport, reducing reliance on both grid-connected power and off-grid energy and eliminating the need for charging.

BENEFITS

Innovative solar technology enables sustainable solar-powered vehicles, advancing decarbonisation without grid reliance and offering emission-free, self-sustainable energy mobility for millions, especially in areas with limited access to electricity.

RISKS

The wide variety of solar technologies prevents any single innovation from scaling up effectively. Redesigns, including installation combinations, face supply chain challenges. Despite novel materials, solar-powered vehicles may not operate effectively in all weather conditions. Managing maintenance, recycling, and disposal of nanoparticles in these vehicles poses additional challenges.



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