

What could the roads of the future look like?

From glow-in-the-dark motorway lanes to surfaces that take harmful substances out of the air, scientists and artists believe roads offer an untapped opportunity for energy innovation.

For Daan Roosegaarde, it was the frustration of being stuck in traffic on a major dual carriageway in the Netherlands that first sparked curiosity about the role roads could play in harnessing energy.

"I was sitting in my car and it hit me," he says recalling that moment. "Why do we talk about energy-efficient cars and invest billions into their research and development? Yet roads themselves are rarely ever considered."

The Dutch artist was already known for imaginative projects fusing technology and energy.

In 2008, he created a dance floor harnessing energy generated from the impact of dancing clubbers to produce electricity. As he sat in a traffic jam, he wondered whether roads could play a similar role.

The result was his Glowing Lines project: three light-emitting lines painted along a highway in Oss, southern Netherlands. The 500-metre long lines absorbed light by day and glowed at night for up to eight hours - guiding drivers who may otherwise have relied upon overhead lighting.

"Energy is everywhere," says Roosegaarde. "We just need to know how to harvest it."

His call is to be heeded. Transport currently accounts for nearly 30% of the world's total energy use and around a quarter of global energy-related carbon dioxide (CO₂) emissions. Bringing that down will require a range of approaches, including the faster adoption of hydrogen, electricity and natural gas as lower-carbon transport fuels.

It also provides new opportunities for innovation. Today, for example, there are three million electric cars on the world's roads. That number is expected to rise to 125 million by 2030, according to industry predictions.

The road ahead

Several projects around the world have been exploring whether roads can play a greater role in the production of energy.

Electreon is an Israeli start-up developing technology to charge electric vehicles while they are in motion - relieving pressure on refuelling infrastructure. The company has designed special coils that sit beneath the asphalt surface of roads and provide on-the-go charging.

"Wireless dynamic charging can electrify the entire global transportation sector with little environmental impact," says Oren Ezer, the company's CEO. "Even heavy utility vehicles can be powered without the need for huge and expensive batteries or charging stops."

The company has two pilot programmes are underway: one involving buses in the Israeli city of Tel Aviv and the other with heavy trucks in Sweden.

Thousands of miles away, in the eastern Chinese city of Jinan, a company called Shandong Pavenergy has laid solar panels on 63,200 square feet of a major highway used by heavy trucks, log carriers and oil tankers.

Pavenergy is the latest in several solar road projects that have been trialled in the last five years with varying levels of success.

The French company Colas, in partnership with the National Solar Energy Institute, previously installed 2,800 square metres of solar panels along a kilometre stretch of road in a village near Normandy, France. But some say solar roads still remain very expensive to implement with relatively small returns of energy.

Smart surfaces

That, of course, could change. Shell's General Manager of Specialties Technology, John Read, believes the work being done on road technology could "transform the highway into smart surfaces of the future".

His team is behind a new bitumen product that will allow new road surfaces to be laid with a reduced impact on air quality.

Shell Bitumen FreshAir works by directly interacting with chemical compounds in the bitumen as well as odour-releasing molecules.

It can reduce the levels of specific gases such as sulphur dioxide, nitrogen oxides, carbon monoxide and particulate matter, which is a common air pollutant, by an average of 40%, compared to conventional bitumen. The product has been tested with road constructors and air quality experts in field trials in France, the Netherlands, Thailand (*image above*) and the UK.

Time will tell how far new road technology evolves. For Roosegaarde, the pace of progress and scale of success will depend on imagination and investment. "We need a mindset change," he says. "We need gutsy people to invest in new ideas."