MISSION

Technologies capable of slashing road transport's environmental impact may be just around the corner. Brian Tinham talks to a Cambridge-based engineering innovation firm to assess some of the opportunities

Might it be possible to build sustainable roads? Hard to imagine? The Mission Zero Corridor (MZC) project, in West Georgia, USA, believes it is, so has hired UK engineering innovation specialist Innovia to assess short- and longer-term technologies. And, while some of its ideas – such as smart solar-powered roads, moon-cycle adjusting lights and wildlife bridges – fall squarely into the category of future gazing, others are closer to the here and now than many might imagine.

Andy Milton, senior consultant at the Cambridge-based firm, explains that MZC aims to be a fitting legacy for the late Ray C Anderson – founder of US carpet manufacturer Interface and widely regarded as one of the world's greenest CEOs. The original Mission Zero framework was Anderson's brainchild, aimed initially at making his firm environmentally friendly yet maintaining productivity and profit. Its stated objective: 'to eliminate any negative impacts the company may have on the environment by 2020'.

RESTORATION MAN

However, this has since become a blueprint for sustainable business. Now, as a memorial to the great man, the Ray C Anderson Foundation is using a 16-mile stretch of Interstate 85 in West Georgia as a demonstrator for technologies capable of creating a 'regenerative, restorative and sustainable highway'. Innovia's role, says Milton, is "to evaluate technologies for viability and scalability, and to propose a strategy to make it happen". Interestingly, most are already way beyond the concept stage, and many have been developed in the UK.

So what ideas are on the table? Milton points, for example, to Siemens' e-highway system, in which electric and/or hybrid electric trucks are powered via overhead pantographs. "Fully electric heavy trucks will remain challenging for the foreseeable future, because of the sheer weight of batteries," he concedes. "But hybrids that currently pull away under electric power and recover energy from braking

Siemens e-highway system

Siemens' freight electrification eHighway system – marketed as combining the efficiency of railways with the flexibility of trucks – could make significant inroads into greening heavy transport. Indeed, the automation giant claims it will also reduce fossil fuel usage and truck operating costs, while eliminating local CO_2, NOx and particulates emissions.

Its concept involves three elements: the power supply, pantograph and hybrid drive. Siemens explains that the former harnesses a two-pole catenary system, with overhead contact lines delivering stable power transmission, even at high speeds, to eHighway-equipped trucks. Equipment includes medium-voltage switchgear, transformers, rectifiers and inverters (for feedback of vehicles' KERS – kinetic energy recovery – during braking), all Siemens' industrial heartland stuff.

Trucks are then equipped with an 'active' pantograph that transmits energy from the overhead lines to an electric motor. Siemens has demonstrated that the pantograph can be connected to and disconnected from overhead wires at speeds from 0–90kph, either automatically or under driver pushbutton control. Just as important, the system handles rapid height and positional shifts as vehicles move around, and has been designed to disconnect during evasive manoeuvres and when trucks' indicators are active.

Finally, eHighway trucks need a hybrid drive – Siemens is agnostic as to type – so that, while on electrified routes, their electric motors can be powered entirely via the system, meaning no drain on batteries. Then on conventional routes the hybrid drive (serial or parallel, with internal combustion engines, batteries, fuel cells, etc) takes over.

ZERO

"Hybrids ... could be driven in full electric mode on electrified routes"
Andy Milton

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What about pollution from power-generating facilities? Milton accepts the concern, but insists that – even with a typical mix of nuclear, gas and fossil fuel stations alongside some renewables – their environmental impact is "about half that of internal combustion engines". Why? Because of the overall scale and efficiency of electricity generation, grid distribution and consumption. "Electric motors are also far more efficient than diesel engines," he observes.

ELECTRIFYING INFRASTRUCTURE

While he agrees that constructing an e-highway infrastructure would be expensive, Milton suggests that last December's COP21 UN climate change summit, in Paris, has focused minds on what has to be done. "Transport is a huge and growing contributor to carbon emissions... You could argue that electrifying transport now, despite some of its dependence on fossil fuels, brings full decarbonisation that much closer."

And it's not just about pantographs. The Milton Keynes electric bus trial, in which buses are recharged en route, using road-mounted wireless inductive charging pads, has demonstrated a complementary approach. "Highways England is about to conduct an 18-month trial using dynamic wireless power transfer to charge hybrid and electric vehicles on motorways and 'A' roads." Taking that technology to trucks won't be beyond the wit of man.

At a simpler and more immediate level, Keele Services has been demonstrating the effectiveness of drive-through tyre pressure monitoring for several months now. Maintain correct pressures and you improve fuel – and hence also emissions – performance. You also reduce rubber consumption and the emissions involved in manufacturing more tyres than are strictly required. Highways England and technology developer WheelRight next hope to extend the system to automatically monitor tread depth, too.

Back on future gazing, Milton points to the environmental potential of driverless cars and trucks. Whereas today's smart highways depend on overhead signage to control lane usage and vehicle speeds, autonomous vehicles would render all that energy-intensive infrastructure redundant.

"All the technology will be in the vehicles, so no need for overhead gantries or even crash barriers. Also, with autonomous control we might anticipate narrower lanes. That means reduced congestion and, again, less fuel consumption so fewer emissions."

What's more, if in the future some lanes are built to exclude heavy vehicles, then thinner tarmac and lighter weight road constructions become feasible – saving more materials, energy and emissions at source.

Speaking of which, MZC is also harnessing an environmentally friendly replacement for asphalt in the form of pig manure. Yes, that's right: this is a difficult agricultural waste that not only causes watercourse contamination but also generates methane – 70 times more potent than CO_2 as a greenhouse gas.

"Chemicals which treat the manure to produce a bio-binder that replaces or reduces bitumen content are already proven. This will remove the methane problem, save the fossil fuels currently burnt to make bitumen, eliminate the water pollution problem and boost the economics of pig farming." A win, win, win, win. "Once this has been demonstrated and procurement attitudes changed, the flood gates will open," predicts Milton.

Clearly, a future encompassing environmentally friendly road infrastructures is not as whacky as it might at first seem. And with the Ray C Anderson Foundation providing philanthropic financial support, the future looks bright – and green. TE