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August & September 2018

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Welcome to the August & September 2018 issue

The future of sustainable urban transport is our subject this month. With recent suggestions that the UN may have radically underestimated the extent of urbanization, the drive to come up with solutions to ensure the long-term sustainability of cities has gained fresh urgency.

The advent of autonomous vehicles has been hailed by some as the “holy grail” of sustainable mobility in cities, but as Mark Hillsdon reports, without careful management self-driving cars could just lead to more vehicles on the road.

Meanwhile, Michael Levitin reports from California, where the focus has been on mass roll-out of electric vehicles to address stubbornly high levels of transport emissions. With the state playing host to the Global Climate Action Summit in September, Governor Jerry Brown is hoping to mobilize the combined buying power of cities and states around the world to create a mass market for EV.

One of the biggest barriers to electric vehicle roll-out is investment in charging infrastructure. Giles Crosse evaluates plans for charging infrastructure in the UK’s Road to Zero Strategy to decarbonize transport by 2040. He also looks at how Oslo became the world’s electric vehicle capital, with Norway on track to fulfil its target of all new vehicles being zero-emission by 2025.

But zero-emissions is not only about EV. Angeli Mehta reports on the CEO-led Hydrogen Council, a collaboration of companies across the hydrogen value chain, which has a roadmap for the fuel to power 15 million cars and 500,000 trucks by 2030. Finally, Mark Hillsdon reports on how China has been experimenting with new models of clean urbanization, including in transport, in its eco-cities.

By the way, subscribers need not worry that this month’s combined issue will mean you get less of Ethical Corporation this year: you will still get an issue every month, with January’s magazine forecasting the top sustainability trends of 2019 published in December. Next month we are taking an in-depth look into the ethics of doing business in the digital age.

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Are autonomous vehicles the answer to cities' transport woes?

AVs have been hailed by groups such as the WBCSD as the answer to sustainable mobility, but unless they are part of new shared public-private transport models they could just lead to more cars on the roads. Mark Hillsdon reports

The day our cities finally grind to halt could be approaching a lot more quickly than we ever dared believe. According to the European Commission, global urbanization is rampant, with the way in which figures have been historically provided by the United Nations now thought to be fatally flawed.

The UN method has relied on data compiled by individual countries, but without ever using a common standard. Now researchers at the European Commission have used geospatial technology and high-resolution satellite images to determine the number of people living in a given area. And the figures are shocking.

While the widely accepted UN figures predict the world's urban population will grow to 70% by 2050, from 55% at present, the new statistics estimate that 84% of the world's population already live in urban areas – that's almost 6.4 billion people.

“Everything we've heard about global urbanization turns out to be wrong,” says lead researcher Lewis Dijkstra. “If this is true, the impact is going to be massive.”

‘Cities will need to embrace a regulatory framework that nudges us towards an AV heaven scenario and away from AV hell’



30 SECOND READ

- Gridlock is fast approaching as urban populations grow. New statistics suggest 84%, almost 6.4 billion people, already live in urban areas with toxic air killing nearly 4.5m city dwellers each year.
- Autonomous vehicles (AVs) have been touted as a way to make urban travel more sustainable, and the market is projected to grow to \$96bn by 2025. But AVs could lead to more congestion by encouraging quick trips and filling streets with ‘zombie cars’.
- Shared autonomous electric vehicles (SAEVs) could be the solution and already run in several cities – Navya’s Arma is operating in France and Australia. SAEVs are designed for shorter distances and are ideal for people with reduced mobility or for taking residents in outlying areas to their nearest public transport hub.
- The key to sustainable transport is all stakeholders working together as well as encouraging active mobility, such as walking and cycling. Meanwhile, mobility-as-a-service is increasingly being embraced for on-demand ride sharing.

Bad air

As urban areas grow, they also become more congested and unhealthy. Transport is already blamed for producing a third of all pollutants in our cities, with [recent data](#) showing that toxic air prematurely kills nearly 4.5 million city dwellers each year. The need to move even more people around will only increase the figure.

A range of solutions is needed to make urban travel more sustainable, with one possible answer being autonomous vehicles (AVs), the new darling of the transport sector. The market for AVs is projected to grow to \$96bn by 2025, from just \$3bn back in 2015, but as a [recent report](#) from the World Economic Forum, in collaboration with the Boston Consulting Group, concluded: “Cities, nations and the world will need to embrace a regulatory and governance framework for AVs that nudges us towards an ‘AV heaven’ scenario and away from ‘AV hell’.”

The fear is that AVs run the risk of exacerbating the very problem they have set out to solve, and unless their development and implementation is carefully managed, they could actually lead to more cars on the road.

For an AV developer, Robbert Lohmann, chief commercial officer at Utrecht-based 2getthere, takes an unusual stance in bemoaning the fact that AVs are now considered “the holy grail” of transportation.

“The only way to create accessible and sustainable cities in the future, that people actually want to continue living in, is to reduce the amount of vehicles,” he says. “If I’m honest, the autonomous car is not going to do that. On the contrary, they’re going to increase the number of vehicles.”

The World Business Council for Sustainable Development (WBCSD) is a global, CEO-led organization of over 200 leading businesses that are working together to accelerate the transition to a sustainable world. A key aim, says WBCSD’s sustainable mobility manager Irene Martinetti, is to transform mobility “so that it is safer, more accessible and inclusive for everybody and that it’s also cleaner and more efficient; autonomous vehicles come into play across all of these aspects”.

‘The only way to create sustainable cities in the future, is to reduce the amount of vehicles. The autonomous car is not going to do that’



Pollution is driving cities to cut transport emissions

The worry is, however, that AVs could become an all too easy option to make a quick trip to the shops or commute to work, she continues. This will create a whole new problem around “zombie cars”, AVs that have dropped off their owners and then trundle around the streets looking for somewhere to park.

Caroline Watson, network manager for zero emission vehicles at megacities network, C40 Cities, agrees with the need to reduce absolute car numbers. “Even if all the vehicles were zero tailpipe emissions, you’d still have congestion and some air pollution from the tyres and the brake wear, so we also need to reduce the number of vehicles on the road.”

Where these driverless vehicles could win, however, is as SAEVs, or shared autonomous electric vehicles.

All aboard

Autonomous, electrically powered shuttle buses are now seen as a crucial building block of future urban mobility. These range from buses that operate in a zone defined by a perimeter, such as business parks and airports, to Navya’s autonomous shuttle, which is already running, with a safety steward on board, on public streets in several countries, including France and Australia.

Dutch automated vehicle maker 2getthere is currently taking what Lohmann calls “small, incremental steps” to gain more experience about operating SAEVs safely on the open road. The company’s autonomous shuttle buses have been connecting the Rivium business park in the Dutch city of Capelle aan den IJssel with the local subway station for nearly 20 years. A new system, dubbed Rizium 3.0, will be launched in 2020. Lohmann says it will be “the world’s first autonomous vehicle that will operate in mixed traffic without a safety steward”.

‘Even if all the vehicles were zero tailpipe emissions, you’d still have congestion and some air pollution’



Helping people to travel that crucial first and last mile, and taking residents of sparsely populated areas that aren't served by traditional means to their nearest public transport hub is perhaps the most important role SAEVs can perform.

“When you look at the urban sprawl, very often the downtown area has very good public transport options,” explains Martinetti, “but as you go into the outskirts those options diminish, and very often people have to walk longer distances to get to public transport.”

According to Sophie Carval Stone, director of communications at Toulouse-based AV developer EasyMile, SAEVs “are designed for shorter distances and are especially appreciated by those with reduced mobility – disabled people, the elderly or young families with pushchairs.

“Self-driving shuttles can also easily be configured in an on-demand mode, adapting closely and optimally to the exact journey of the different passengers.”

In another [report](#), the Boston Consulting Group (BCG) estimates that by 2030, 25% of all passenger road travel in the US will be in an SAEV. “Such a change will have an enormous impact on health, safety and quality of life in cities,” the authors say. “Traffic accidents and fatalities will be reduced by nearly two-thirds. Pollution will be drastically curtailed. Cities can repurpose millions of square feet once used for parking to new green spaces or commercial uses while securing more affordable mobility and accessibility for elderly, disabled and low-income people.

“In short, the advent of SAEVs will usher in the most sweeping change in American urban life since the invention of the automobile itself.”

So what needs to happen to make sustainable urban transport a reality?

“If we want to see sustainable transport with fluid multi-modal mobility, we need private companies, public transport operators, and different parts of government to all start working together,” says Robin Chase, co-founder of Zipcars, who has recently helped the World Resources Institute (WRI) Ross Center develop its new [Shared Mobility Principles for Livable Cities](#).

“Governments are in control of parking requirements, kerb access, lane use, and tax and regulatory regimes,” she continues. “Public transport companies



SEBASTIEN DURAND/SHUTTERSTOCK

Navya's autonomous shuttle Arma is running in several countries

Taking residents of sparsely populated areas to their nearest transport hub is the most important role for shared AVs



ensure low cost access for all, which includes running high-volume transport options that efficiently move large numbers of people and make sure that all geographies and people are served.

“The private sector provides vehicles, services, and technology that permeates the entire system. If we are to reach our goals, every single stakeholder has to co-ordinate. This is one of the reasons we initiated the Shared Mobility Principles, to get all stakeholders joined together under one common vision for cities with shared principles about what it is going to take to get us there.”

Electric vehicles have shown what’s possible, says Watson, who agrees that cities need to encourage businesses to get involved, pointing to the work that has been done in London, where all the city’s 20,000 taxis must now be, at the very least, hybrid vehicles. This has created a new market for a charging infrastructure that simply wasn’t there before, and which the private sector, with one eye on the bottom line, is happy to support.

C40 Cities, which supports a global network of 96 cities to fight climate change, has also recently launched its [Fossil Free Streets](#) declaration, with signatories committing to only buy zero emission buses from 2025, and ensuring a major area of their city is zero emissions by 2030. (See [California looks to boost EV market through shared purchasing power](#))

As well as raising ambitions in cities, says Watson: “It also gives a clear market signal that there is a demand there for these products ... there’s now a big onus on the car manufacturers to step up to the plate.”

Cities also have the power to introduce financial incentives that discourage single-occupancy journeys, while in Madrid, says Watson, the city owns much of the land where petrol stations are sited, and is starting to stipulate that in order to keep selling petrol, they must also install charging points, too.

Active mobility

Another element of urban transport is active mobility, and in the rush to embrace the AV it’s important not to forget the essential role that encouraging people to walk and cycle can play.

‘It is important to recognize that the status of individual cars is rapidly changing, especially among younger generations’



ROBINCHASE.ORG

Robin Chase, co-founder of car-sharing firm Zipcars



“This keeps the population healthy, and is low cost, small footprint, non-polluting, and accessible for most of the population,” says Chase.

“Making walking and cycling safer and more attractive benefits everybody. It’s about accessibility,” says Watson. “If you introduce cycle super highways, or segregated cycle lanes, then that’s a very cost-effective cheap way for people to travel.”

Digitally connected

There is common agreement that a digital mobility platform that brings together all forms of transport needs to be at the heart of a sustainable urban mobility system. It should help make using public transport as attractive as possible, and, through the use of devices such as smartphones, simple and easy to use.

A [report](#) by the New Climate Economy summarized that: “Innovative, technologically sophisticated operations of ride-hailing networks, car- and bicycle-sharing systems, mobile trip planning and ticketing apps, and other new mobility services are winning users in cities around the world.”

In Chicago, for instance, Mastercard recently teamed up with CityTech to test how personalized communication would affect travel demand during the rush hour. The results showed that passenger levels dropped by 17.5% between 5-6 pm when commuters were sent a text offering them a fare rebate to travel earlier or later.

As Nicolas de Crémiers, head of marketing at French AV developer Navya, explains: “It is important to recognize that the status of individual cars is rapidly changing, especially among younger generations ... What this group is really interested in is mobility as a service (MaaS) which is a fast-emerging model pioneered by popular on-demand ride sharing and car-pooling providers.”

Watson agrees, and says that C40 Cities’ research suggests that bike and lift-share schemes have changed the way in which people think about travel: “It’s given them more options. They’re more confident about leaving their house without their car because they know they’ll [still] be able to get home,” she says.

And of course, once fewer cars are on the road, they become safer, air quality improves and cities can move closer to realizing a low carbon urban future. ■



POZNYAKOV/SHUTTERSTOCK

Cycling infrastructure shouldn’t be overlooked in the rush to AVs



Mark Hillsdon is a Manchester-based freelance writer who writes on business and sustainability for Ethical Corporation, The Guardian, and a range of nature-based titles including CountryFile and BBC Wildlife.

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SEAN PAVONE/SHUTTERSTOCK

California looks to boost EV market through shared purchasing power

With increasing EV ownership failing to make a dent in transport emissions, Governor Jerry Brown is hoping that next month's Global Climate Action Summit in San Francisco will unlock solutions.

Michael Levitin reports

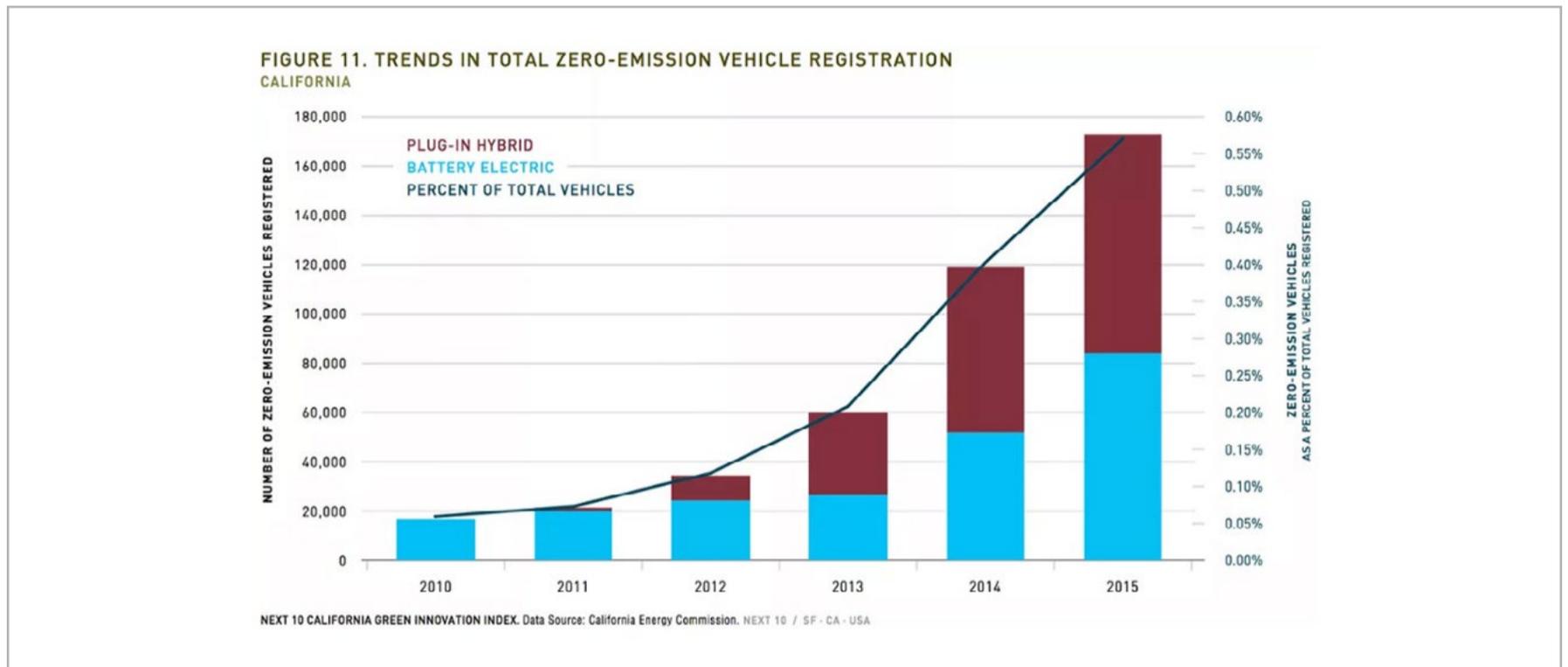
California has long been a global leader in clean energy technologies and the most aggressive policies to tackle climate change. Its cuts in emissions from buildings and power plants have even put it ahead of schedule to meet its 2020 climate goal of no increase in CO₂ emissions compared with 1990 levels.

But there are concerns that unless the Golden State makes greater inroads on decarbonizing transportation, which accounts for half of California's heat-trapping emissions, it will not meet its goals, set this year, for a further 40% decrease in emissions by 2030, and 80% by 2050.

Last year 350,000 electric vehicles were sold in California – about half of all zero emissions vehicles (ZEVs) in the US, which is itself the second biggest market for EVs after China. Numerous regulatory efforts since 2012 have helped to boost the number of ZEVs in the state, which have grown from 25,000 in 2012 and now account for about 5% of all new California car sales.

But according to the California Air Resources Board (CARB) that number is not nearly enough to make a dent in transport emissions.

'California needs millions of zero emission vehicles on our streets and highways to meet our clean air and climate goals'



New vehicle registration in California

“California needs millions of zero emission vehicles on our streets and highways to meet our clean air and climate goals,” CARB says.

Few places are better suited for rapid EV expansion than California, where so much renewable energy is being produced for the grid that the zero-emissions electricity isn’t even being fully exploited. “By electrifying trucks, buses and cars we can balance the grid better with the surplus of renewable energy [that we produce],” said Danny Kennedy, managing director of the California Clean Energy Fund.

“Mobility and electricity are now the same.”

Earlier this year Governor Jerry Brown signed an [executive order](#) setting a target to put five million ZEVs on the roads by 2030, alongside an eight-year \$2.5bn initiative to install another 250,000 vehicle charging stations and 200 hydrogen fueling stations across the state by 2025.

Meeting the challenge

Brown, who is the driving force behind next month’s Global Climate Action Summit in San Francisco, is hoping that the [Zero Emission Vehicle \(ZEV\) Challenge](#), one of a series of challenges ahead of the 12-14 September event, will help put California’s transition to EV into even higher gear.

The challenge, which is being led by The Climate Group and C40 Cities, aims to amplify collective EV purchasing power by bringing together existing programmes, such as The Climate Group’s [EV100](#) programme, and C40’s [Fossil-Fuel-Free Streets Declaration](#) to procure only zero-emission buses.

Since businesses purchase 50% of all new vehicles – some three million cars, vans and trucks are expected to be sold to commercial and government

‘We call on all manufacturers to join us in the race that will leave old-style pollution-spewing engines in the dust’



fleets in 2019 — EV proponents see a great opportunity to shift buying power and drive the market toward mass demand for EVs.

The challenge also calls on automakers to commit to setting targets for ZEVs as a percentage of their sales by 2025.

“We call on all manufacturers to join us in this historic transformation, to be leaders in the race that will leave old-style combustion-driven inefficient, pollution-spewing engines in the dust,” Mary Nichols, chair of CARB, said at the launch of the [ZEV Challenge](#) in July.

The challenge is backed by the [Under2 Coalition](#), a grouping of more than 200 sub-national governments and cities in 43 countries – from Queensland, Australia, and Quebec, Canada, to Baden-Württemberg, Germany, and Catalonia, Spain – as well as two dozen cities and states across the US committed to keeping global temperatures below a two-degree Celsius rise, and carbon emissions below two tons per capita. Together, the coalition represents 1.3 billion people and accounts for nearly 40% of the global economy.

The challenge has also been endorsed by leading companies, including EDF Energy, LeasePlan and Unilever.

Buying power

Tim Ash Vie, director of the Under2 Coalition at The Climate Group, which is secretariat of the coalition, said:

“We’ve got to work the two ends of the system to close the gap between governments and businesses so that governments are putting their money where they mouth is, and those with the purchasing power significantly increase the uptake. The challenge is trying to mobilize business and state action [to get the] buying power to allow the EV market to grow and expand at the rate that is required.”

One of the biggest supporters is Los Angeles Mayor Eric Garcetti, whose city is rolling out the nation’s largest electric bus fleet and has installed 1,500 EV charging stations – the most in the nation – as part of the city’s aggressive EV procurement plan, which requires all new vehicles to be at least 50% electric.

Garcetti was among a dozen US mayors who have signed the C40 Fossil Fuel Free Streets Declaration, which mandates procurements of only



EO NAYV/SHUTTERSTOCK

Combined buying power could cut the cost of electrifying school buses

‘The challenge is trying to mobilize business and state action to get the buying power to allow the EV market to grow’



zero-emission buses in their cities by 2025.

New York City Mayor Bill de Blasio is another big supporter. New York City currently has 1,500 ZEVs in its 30,000-vehicle fleet, and earlier this year committed \$10m toward expanding its EV charging network.

Last year, 30 cities in the [Climate Mayors](#) grouping, which boasts 400 members across the US, alerted auto-makers of their plans to spend more than \$10bn on electric cars and trucks.

More than anything, climate leaders envision the ZEV Challenge as the next definitive step to help transform the auto industry through sheer market power. According to Angie Fyfe, executive director of local government network ICLEI US, which co-ordinates climate action by cities, sustainable public procurement is “a big tool in the toolbox of things local governments can and should be doing, because collectively they have huge purchasing power”.

The goal, she says, is “to rally the number of mayors across the US to demonstrate to vehicle manufacturers that there is a demand for EVs and EV infrastructure”.

Joel Levin, executive director of Plug In America, a national advocacy organization based in Los Angeles, says: “The ZEV Challenge is a unique opportunity because everyone’s looking at California. This is where EVs come from – this is the place where it all started.”

In addition to encouraging companies and governments to purchase more EV fleets, he added, corporations need to see the value in increasing workplace charging stations.

“We can’t keep EVs in the showrooms. Automakers say, ‘if a lot of people want these cars, we’ll build them’. We want to show that there’s demand, the cars are pouring out, and that they need to build more of them.”

He adds: “There are lots of examples of companies that put in charging stations at work and suddenly more people are buying EVs. This drives demand and makes automakers want to produce more. The EV market in California is way ahead of anyone in the country, but there’s far more that can be done.”

Kennedy of the California Clean Energy Fund agrees: “The writing is on the wall: The internal combustion engine is gone. In the next couple of decades, the car will no longer run on pistons and gas, it will run on batteries.” ■



ONEINCHPUNCH/SHUTTERSTOCK

Californians have a love affair with their cars

‘The writing is on the wall: The internal combustion engine is gone’



Michael Levitin is a journalist based in Berkeley, California, covering climate and clean energy financing among other topics. He has written for The Atlantic, The Guardian, Time and Newsweek.

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ROLEC

Bumps in the UK's road to zero

Giles Crosse looks at how slow roll-out of charging points could put the brakes on the UK plan to decarbonize transport by 2040

New registrations of electric vehicles hit a record in 2016, with more than 750,000 sold worldwide, according to the latest statistics from the International Energy Agency. Precipitous growth of 50% a year since 2010 has been driven by falling costs of production and incentives to consumers from policy makers.

This is most notable in the world's biggest and fastest-growing EV market, China, which is determined to tackle rising air pollution as its burgeoning middle class trade two wheels for four.

Climate change concerns are also a big driver for policy makers, who see electric vehicles as key to tackling transport emissions, which in the UK account for some 28% of greenhouse gas emissions, according to the [Committee on Climate Change](#).

National Grid's latest [Future Energy Scenarios](#) concludes that a third of transport-related emissions could be cut if 36 million EVs were on the streets by 2040, adding 8GW to UK peak electricity demand.

But charging infrastructure in the UK isn't anything like ready for the leap, with only 16,500 charging points to service 150,000 registered EVs, and only one rapid charging connection for every 43 cars.

In May Emu Analytics forecast an 83% shortfall in the 83,500 charging points that will be required to meet anticipated growth in the EV market to 2020.

'London's 33 boroughs are grappling separately with the issues, leading to a piecemeal approach to installation and operations'



Experts say it's down to policymakers and stakeholders alike to get infrastructure moving, and time is short.

Government Strategy; a telling EVs intervention?

Last month the UK published its roadmap to roll out mass EVs infrastructure. [The Road to Zero Strategy](#) includes ambitious measures to require charge points in newly built homes and a £40m programme to develop on-street charging technology in street furniture such as lamp posts.

Further, a £400m Charging Infrastructure Investment Fund will accelerate roll-out, with funding for the private sector to produce and install charge points. EV owners will get £500 to retrofit a charge point in their home.

Nick Molho, executive director at the Aldersgate Group, welcomes the strategy but says there are “critical gaps”, one problem is the uncertain costs of connecting new charge points to the electricity network, with an inconsistency of payment systems, tech specs and connectors. “In London all 33 boroughs are grappling separately with the issues surrounding charging infrastructure, which is leading to a piecemeal approach to installation and operations,” Molho says.

He explains that UK-wide electricity balancing will become increasingly complex due to smart charging, vehicle-to-grid charging technologies and the use of car batteries as energy storage.

Not only is there a lack of coherent standards and specs on actual infrastructure, but wider policy and regulatory changes to better manage data sharing and a flexible, evolved grid are also behind schedule.

So even if all the infrastructure joins up and gets there on time, without the right grid balancing, the juice to power EVs won't flow to it.

“Government should work closely with industry and Ofgem to set common standards on charge points at the earliest possible opportunity, including technical specifications and requiring all charge points to be smart and interoperable.”



30 SECOND READ

- Over 750,000 EVs were sold worldwide in 2016. Policymakers see electric vehicles as key to tackling greenhouse gas emissions and air pollution. The National Grid predicts that if 36m EVs were in the UK by 2040, transport emissions would be cut by a third.
- Currently there are not enough charging points. Emu Analytics forecasts an 83% shortfall in the 83,500 charging points required to meet anticipated growth in the EV market to 2020.
- Experts warn it is crucial that policymakers work with private industry to standardize technology and create a competitive market. The UK government outlined plans to require charge points to be installed in new homes and a £40m programme to develop charging in street furniture such as lamp posts.
- However, experts say there are ‘critical gaps’, including the uncertain costs of connecting new charge points to the grid. Lamp posts have drawbacks as these charge points would be less powerful and likely lead to cables running around pavements.

‘Government should work closely with industry and Ofgem to set common standards on charge points’



UFFINDELL

Source London has committed £100m to improve EV charging in London

The trouble with lamp posts

Christophe Arnaud is managing director of Source London, a private firm that has committed £100m to improve London's EVs charging infrastructure.

Arnaud recently carried out a major public consultation to determine where demand is and make sure charge points are efficient, safe, user-friendly and accessible.

He is concerned about a pivotal element of the government's strategy: lamp post-mounted chargers, which "have a number of drawbacks when compared to street charge points and should not therefore be considered a full substitute".

Arnaud explains that lamp post charge points are less powerful; 2 kilowatts per hour (kW/h) versus at least 7kW/h for most on-street charge points, with big implications on charge time.

There is more: "They do not come with dedicated parking bays and cannot be pre-booked. It means users would have cables running around to the nearest possible parking space, creating potential hazards on the pavement.

"The government's strategy is a welcome step in the right direction, but falls short of what London truly needs: a dense, user-friendly, sustainable and homogeneous charging infrastructure."

Ben Hayman, managing partner of brand purpose consultancy Given London, whose clients include EON and SmartestEnergy, says collaboration will be key to success. "We need to see organizations, public and private,

'Consumers can only truly be motivated and changed if something is effortless and slots conveniently into their daily lives'



aligning so that they have a shared goal,” he says.

“Consumers can only truly be motivated and changed if something is effortless and slots conveniently into their daily lives, and so we need the foundation of infrastructure in order to facilitate that change.”

Hayman says the UK should follow Norway’s lead (see [How Oslo became the world’s EV capital](#)), and align vested stakeholders within a standardized, joined up technical approach to infrastructure installation.

“Government should play a role, but everything speeds up and gets more interesting when private sector investment comes into play. If companies can establish the investment case for first mover advantage this will help to accelerate the change,” says Hayman.

Adrian Del Maestro, director of research at PwC, agrees that a joined-up strategy between government and industry is essential.

“In the long run we believe a competitive market is likely to drive the best outcome, although we recognize near-term challenges on returns, and acknowledge that government support is likely to be needed perpetually to ensure the network is truly country-wide.”

He adds that demand for EVs, which has been growing at a 60% compound annual rate since 2007, will be critical for success.

“If demand is to grow further a number of elements need to be addressed; greater choice of EVs and further education for drivers on the economic benefits.”

EDF Energy says drivers should have wide access to charging options and locations, and be encouraged to charge their cars in a smart way wherever possible.

It also says the government should support early trials of vehicle-to-grid technology, which it sees as “a potentially valuable opportunity to further enhance the electricity system benefits of EVs through provision of large volumes of cheap storage and flexibility”.

Arnaud of Source London is optimistic the barriers can be overcome, though in infrastructure development terms the government’s 2040 deadline is short.

“We are convinced that in the next 15 to 20 years the number of EV users will surge,” he says. “Most families already know the benefits of choosing them.” ■



CHARGEMASTER

The UK will require charge points in all new homes



Giles Crosse writes about sustainability, environment, and development issues. He has contributed to the BBC, Economist, Edie, The Guardian and the United Nations Environment Programme.



How Oslo became the world's electric vehicle capital

When the Norwegian city of Oslo formulated its CO₂ emissions reduction plan in 2008, electric vehicles were a major part from the start. There was a clear plan to roll out charging stations to encourage EV ownership in the city, with the goal of having 400 on the road by 2011.

Today, Oslo is the biggest per capita market for EVs in the world, with 62,754 EVs registered in the greater Oslo area, and 1,300 charge points, with a goal of adding another 600 in each of the next three years. A whopping 39.2% of new cars sold in Norway in 2017 were EVs or plug-in hybrids.

Consumer demand throughout Norway has been driven by a raft of generous incentives introduced by the Norwegian government since 2009 to make owning and operating electric vehicles cheaper than their polluting equivalents.

These include no import tax, no VAT, free parking, free passing through the toll rings, access to bus lanes, and free transport on ferries.

The Norwegian government also embarked on a programme to establish of at least two fast-charging stations every 50 km on all main roads. While the UK is targeting 2040 for all new car sales to be zero emission, Norway has set 2025 as its deadline.

Marianne Mølmen, project manager of EV charging infrastructure for the city of Oslo, explains that charging has been free to users to date, as implementing a payment system would be more costly than the cash raised in revenues.

But this year the city will introduce semi-fast charging stations, up to 22 kilowatts (kW), as a paid service.

“Our politicians have guaranteed electricity on normal chargers will remain free until the election next year,” says Mølmen.



ANDREY ARMYAGOV/ SHUTTERSTOCK

In Norway fast-chargers are on every 50km of main road

But she believes the market is now ready for a payment-based system.

Oslo looked at using lamp posts as charging points, but they were situated too far back to serve more than two cars, while charging cables would obstruct pedestrians. Crucially, Oslo standardized charging point operation.

“Our newer charging stations can be opened by any RFID [radio frequency identification] card, or by SMS,” says Mølmen. “We don’t register users; this may change if charging becomes paid for.”

Mølmen commends elements of the UK’s strategy; she suggests updating building codes and regulations to help deliver charging points in new buildings. She also points to fiscal incentives; this way charging points will more likely be established on private grounds, helping businesses convert their fleets.

“It’s important to implement EVs in public procurement; switch the city fleet to EVs, and make sure zero-emission vehicles are specified when procuring services,” she says.

She says the strategic focus should remain on the long term benefits for cities, including better air quality and a healthier environment.

Giles Crosse

[View online](#)

RIVERSIMPLE

Hydrogen hits the road in bid to speed energy transition

Angeli Mehta reports on the Hydrogen Council's roadmap to power 15 million cars and 500,000 trucks by 2030

Cities across the planet are focusing on electric vehicles as they make commitments to phase out the most polluting vehicles, but that's putting a lot of eggs in one basket. Nationwide roll-outs will require investment in expensive grid infrastructure and smart-charging technology, while battery technology remains inefficient for heavy vehicles covering long distances.

There is, however, another fuel capable of sharing the load: hydrogen. According to the [Hydrogen Council](#), a CEO-led coalition of companies from across the hydrogen value chain – co-chaired by Toyota and Air Liquide – the fuel could power 10-15 million cars and 500,000 trucks by 2030.

But transport is only one of hydrogen's uses. A roadmap for scaling up the use of hydrogen unveiled at last year's UN climate summit in Bonn said the fuel could abate as much as a fifth of emissions needed to limit global warming to two degrees Celsius by performing seven roles in the energy transition, including providing power to buildings and industry processes, and storing excess energy from renewables that would otherwise be curtailed.

Hydrogen can be transported as a pressurized gas, or used to make other compounds such as ammonia, that can be reliably shipped around the world, before being reconstituted where it's required.

Transport is only one of hydrogen's uses. It can perform seven roles in the low-carbon energy transition



As a transport fuel, one of hydrogen's advantages is that fuel cell electric vehicles take minutes to fill, and currently have a range of more than 250 miles.

Battery electric and fuel cell vehicles both rely on electric motors, but a fuel cell vehicle gets its power when hydrogen – stored at pressure in tanks – is combined with oxygen from the atmosphere in a fuel cell stack (with water as the byproduct). It's more than twice as efficient as the combustion engine.

The UK government's [Road to Zero Strategy](#), which envisages that at least 50% of new car sales will be low emission vehicles by 2040, says the UK is “well-placed to be a global leader in hydrogen and fuel-cell powered transportation”.

But the refueling infrastructure and vehicle numbers are far behind battery electric: with perhaps 250 vehicles on the roads by the end of the year. There are 15 hydrogen filling stations, mostly in the south of England, while a £14m government funded competition for another 10 – together with associated fleets of cars and vans – will close this autumn.

The [Hydrogen Council](#) estimates that building sufficient hydrogen refueling infrastructure to decarbonize the transport sector would require investment of the same order of magnitude as for battery electric vehicles – around £1,200-1,500 per vehicle until 2030. Indeed, it points to a German study that suggests that once grid investments are taken into account, the total cost for fuel cell vehicles may actually be less than for battery electric vehicles.

Early adopters

Earlier this year London's Metropolitan police and taxi firm Green Tomato Cars began road-testing Toyota's hydrogen cars in London. The project partnership will analyze how the fleets perform under heavy mileage conditions – and crucially, help create much-needed demand for hydrogen.



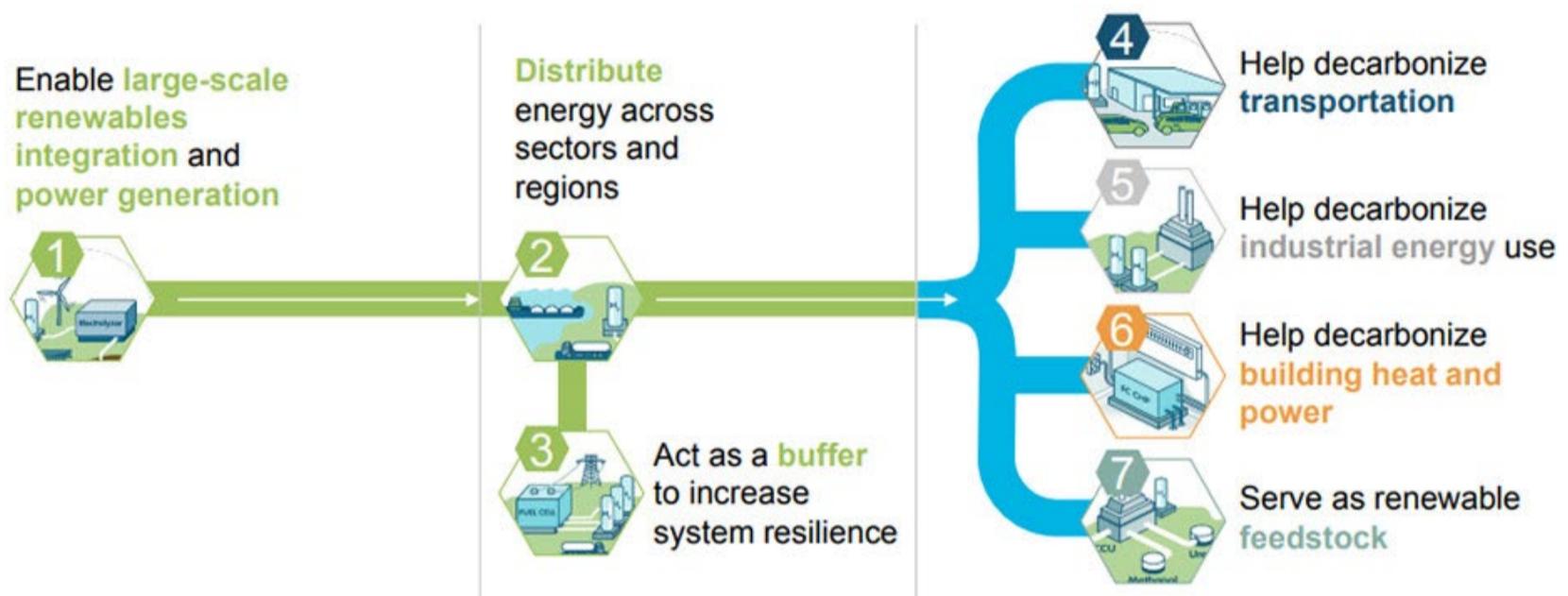
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- A fuel cell vehicle gets its power when hydrogen is combined with oxygen from the atmosphere in a fuel cell stack – with water as the by-product. It's more than twice as efficient as the combustion engine.
- According to the [Hydrogen Council](#) the fuel could power 10-15 million cars and 500,000 trucks by 2030. It could also perform other roles in the energy transition, including providing power to buildings and industry, and storing excess energy from renewables.
- But the infrastructure and vehicle numbers are lagging: there will be just 250 vehicles on UK roads by the end of 2018 and 15 refueling stations. However, UK and European cities are expanding their bus networks, while Japan, California, Germany and China are racing ahead with the technology.
- Riversimple has produced the Rasa, a lightweight two-seater with a range of up to 300 miles on 1.5kg of hydrogen. The Welsh firm is innovating with a mobility-as-a-service business model whereby its customers lease their cars on an all-inclusive basis.

Hydrogen fuel cell electric vehicles take minutes to fill, and currently have a range of more than 250 miles

**Exhibit 3: Hydrogen can play 7 roles in the energy transition**

Enable the renewable energy system → Decarbonize end uses



Hydrogen could abate as much as a fifth of emissions needed to limit global warming to two degrees Celsius

Aside from cars, UK and European cities are expanding their bus networks thanks to the EU's Fuel Cells and Hydrogen Joint Undertaking, an umbrella for a series of collaborative projects aimed at making hydrogen buses commercially viable without subsidies. (See [Creating a hydrogen economy in Aberdeen](#))

Japan has raced ahead with the technology, aiming to showcase hydrogen at the 2020 Tokyo Olympics. It anticipates having thousands of hydrogen fuel cell vehicles, a network of refueling stations, and a hydrogen-powered athletes' village. Carmaker Toyota plans a factory to make the fuel cells stacks for its vehicles.

California's cities too, are embracing hydrogen, with almost 5,000 vehicles on the roads, supported by 35 filling stations, and another 29 in development. The programme is underpinned by an extensive partnership between industry players and the state government, which has legislated for action to put at least five million zero emission vehicles on the roads by 2030. (See [California looks to boost market for EVs through shared purchasing power](#))

Today carmakers cover California motorists' fuel, as hydrogen cannot yet compete with rock bottom US petrol prices. Keith Malone, public affairs manager for the California Fuel Cells Partnership, describes a symbiotic relationship: "You need the stations to build the confidence of drivers; and the

The government's Road to Zero Strategy says the UK is 'well-placed to be a global leader in hydrogen and fuel-cell powered transportation'



plans and long-term funding that says to consumers, hydrogen producers and stations that there is a commitment to making it happen.”

A similar partnership in Germany envisages a network of 400 filling stations by 2023: 56 were operational by the end of 2017, and 100 are anticipated by 2019. Recently China has embarked on a hydrogen programme – and that will no doubt drive volume.

Hydrogen may be the most abundant element but it doesn't exist on its own freely. So while there are no greenhouse gas emissions at the tailpipe, how much is avoided all depends on how the hydrogen is made. The most widespread process today is steam reforming of methane, but this produces carbon dioxide, which must be captured, and preferably used. A cleaner, but less efficient, process is to use energy to split hydrogen from its partner in water, oxygen.

Sheffield-based ITM Power makes electrolyzers for this purpose, and is providing many

of the refueling systems across the country, including one that opened on Shell's Beaconsfield service station on the M40 earlier this year, the first hydrogen pump in the UK to sit on a forecourt alongside petrol and diesel.

Riversimple's mobility-as-a-service model

Welsh hydrogen fuel cell carmaker Riversimple thinks there might be greater traction if fueling stations were in the towns and cities where most people fill their cars at present.

Riversimple has produced a lightweight two-seater, called the Rasa, that has a range of up to 300 miles on 1.5kg of hydrogen. Business development director Fiona Clancy points out that even if the electricity used to split water is being produced at a gas-fired power station, the associated carbon emissions of the Rasa will be 40 grams per kilometer, the lowest carbon emissions for any vehicle wheel-to-wheel on the market today.



Germany envisages a network of 400 filling stations by 2023

SHELL

Once grid investment is taken into account, the total cost for fuel cell vehicles may actually be less than for battery electric vehicles



“We’re all agreed green hydrogen must be the end game. But green electricity displaces more coal if it’s put into the grid, rather than replacing petrol, so there’s less CO₂ overall,” Clancy says.

With the help of crowdfunding and €2m in EU funding, the company is currently building 20 of its two-seaters at its Monmouthshire factory with a view to beginning a rolling programme of beta testing from October, and going into commercial production in 2020-21. It had hundreds of applications from members of the public keen to get behind the wheel of the sports car.

“Our plan,” says Clancy, “is seeing the cars used in everyday tasks by everyday people – essentially an operational dry run before we come to market with mass-produced cars, to ensure the service is viable.”

With Japanese car companies Toyota, Hyundai and Honda already producing hydrogen fuel cell cars, Riversimple’s greatest innovation may be in its mobility-as-a-service business model: its customers won’t own their cars but lease them on an all-inclusive basis – covering insurance, fuel, tyres, repairs and pre-emptive maintenance. Telematics will monitor every aspect of a car’s performance to enable Riversimple to keep them in the best shape.

“It’s as much about the service as the cars themselves – almost more so,” Clancy says.

The company also wants to explore taking its sale-of-service model upstream to its suppliers. If Riversimple was to pay for the use of components such as fuel cells, rather than buy them, that would mark a fundamental change in relationships, suggests Clancy. “Because both parties want the car or equipment to last as long and work as well as possible ... It’s a good test case for pushing the envelope on circular economy thinking.”

Such innovation in business models, and joined up thinking and collaboration between policy makers, companies across the value chain, and investors, will all be required if the Hydrogen Council’s bold vision is to be fulfilled. ■



PAJOR PAWEL/SHUTTERSTOCK

Cities across the globe are adopting hydrogen buses



Angeli Mehta is a former BBC current affairs producer, with a research PhD. She now writes about science, and has a particular interest in the environment and sustainability.
@AngeliMehta



JAMES BATHOS

Creating a hydrogen economy in Aberdeen

The Scottish city of Aberdeen is capital of the UK's oil industry, but it wants to gain new life by becoming a centre for hydrogen energy in Europe. "We need to diversify our economy and, for me, hydrogen is the best energy vector," says Councillor Philip Bell, Aberdeen's spokesman on the city's £19m hydrogen bus project.

Funded through Europe's Fuel Cells and Hydrogen Joint Undertaking, together with national and local government and industry, the city is operating 10 single-deckers made by Belgian bus manufacturer Van Hool. London and Birmingham are other beneficiaries of the EU programme; Dundee joins them next year. Project co-ordinator Element Energy says the aim is to overcome the current barriers of vehicle-ownership costs, and to establish low-cost and reliable sources of hydrogen fuel.

Already the price of buses has halved, thanks to economies of scale; the first cost €1.2m. Aberdeen's hydrogen buses have carried over 1.6 million passengers and travelled almost a million miles in the past three years. The city will get another 10 next year – double-deckers made by Northern Ireland-based Wrightbus.

And it's testing hydrogen more widely across the city with cars, vans, waste trucks and even a road sweeper.

What Aberdeen has learned so far is that while its workforce has the technical skills, creating a supply chain for spare parts is paramount if its vehicle fleet is to be kept on the road. A key aim now is to encourage third parties to hold essential parts. It also needs to bring down the cost of hydrogen.

The bus project is part of a much wider strategy to develop a hydrogen economy in the city: a new exhibition and conference centre, due to open next year, will be powered and heated via hydrogen fuel cells. Bell anticipates that excess heat from a planned waste-to-power plant for 10,000 homes could be used for steam reformation of hydrogen with an associated carbon capture and storage project. The latter is being scoped, with a view to injecting carbon dioxide for offshore storage early next decade. Bell describes the hydrogen economy as "a shimmering mirage – but you have to join the dots to get there".

Angeli Mehta

[View online](#)

HELLORF ZCOOL/SHUTTERSTOCK

China innovates to address urban transport woes

Faced with ballooning congestion and pollution, China has been testing new models of clean urbanization in its eco-cities.

Mark Hillsdon reports

In the early 2000s China began to plan a new generation of conurbations, cities that placed a new emphasis on improved public transport, renewable energy, and waste reduction.

Since then several hundred have been designed, often in co-operation with foreign governments. Many, including high-profile Dongtan on the outskirts of Shanghai, never really left the drawing board. Others, however, have found an important role as testing grounds for new technologies, from electric buses to flood protection, as well as being home to hundreds of thousands of people.

“Eco-cities were experiments,” says Peter Head, chief executive of the UK-based [Ecological Sequestration Trust](#). When he was at built-environment specialists Arup, Head worked on the master plan for Dongtan, which was intended to house 500,000 people, but was abandoned after key officials in the Chinese development company were arrested for graft.

The eco-cities are a response to rapid urbanization, which saw China’s urban population double to 52% between 1991 and 2012. Today the figure is 57%, and it’s expected to reach 70% by 2030, or some two billion people. President Xi Jinping has made creating a new “ecological civilization” the main policy of central government as it set out on a war to tackle pollution.

‘China has an ambition to make better cities than the ones thrown up to merely house people in the rush to urbanization’



“China has a simple ambition, to make better cities than the ones thrown up to merely house people in the rush to urbanization,” says Austin William, director of the Future Cities Project and author of “China’s Urban Revolution: Understanding Chinese Eco-Cities”.

There is an element of people power too, with an emerging urban middle class demanding good housing, schools, health-care and other public services, says Jaya Skandamoorthy, the outgoing general manager of BRE (Building Research Establishment) China, which is currently extending BREEAM standards of green building into China’s construction industry.

Clean, compact and connected

There’s no set definition of an eco-city, and while some do actually involve the construction of whole new cities, others are bolt-ons to existing conurbations, and more still focus on retro-fitting old buildings.

The Guangming Eco-city in southern China is a flagship project that can now count a 100% fully electric bus fleet among its achievements. “They’ve built it amazingly well,” says Sean Kidney, CEO of not-for-profit Climate Bonds Initiative, who has been working with the People’s Bank of China to develop the green bonds that are now funding some of the innovation in China’s eco-cities.

“There are shared block air conditioning units, which reduce energy costs down to 30%,” he continues. “There is a metro system within 300m of wherever you stand in the city. There are amazing water recycling systems.”

Shenzhen is also one of seven cities that are set to benefit from World Bank funding to reduce traffic and improve air quality. Last year, China received a grant of \$32m to support pilot projects for transit-oriented development (TOD), an urban planning concept that integrates land use and transportation.



30 SECOND READ

- China’s eco-cities are a reaction to urban population growth, which stood at 52% in 2012. The country is facing environmental boundaries, including water, congestion, and food, and President Xi Jinping has made creating a new “ecological civilization” a main policy.
- Several hundred eco-cities have been designed, which emphasize renewable energy, waste reduction and improved public transport. Success stories include the Tianjin Eco-city, a joint project with Singapore. Skills learnt from the project are being used to help reclaim parts of the Gobi Desert.
- The Guangming Eco-city in southern China is another flagship project that can now count a 100% fully electric bus fleet among its achievements.
- Another important innovation is China’s sponge cities, urban areas where the infrastructure is designed to stop flooding and save water. Initiatives include semi-permeable walkways, urban wetlands, and green roofs.
- The green building sector offers opportunities for western tech companies. One idea attracting Chinese attention is the concept of “building as power station”, being developed by Specific, a UK project based at Swansea University, which uses the outer surface of buildings to harvest energy.



According to Wanli Fang, an urban economist at the World Bank: “This pilot project focuses on compact, mixed-use, pedestrian and bicycle-friendly development around transit stations that can help reverse the trend of a car-dependent city sprawl, improve air quality, reduce road congestion, and make it easier for people to get to jobs and access other opportunities.”

One of the best-known eco-cities is Tianjin, a joint project with the Singapore government that started in 2008. Set on the coast around 150km from Beijing, its priorities are conservation of energy and water. But land remediation has also proved important, with around one third of the city located on a former salt field.

William of the Future City Project said the skills learnt through the project are now being used to train farmers and engineers in western China, and help them to reclaim parts of the Gobi Desert.

Soaking it up

Another important innovation is China’s new legion of so-called sponge cities, where the fabric of the city has infrastructure to stop flooding and save water.

There are now around 30 pilot cities, the result of the Sponge City Initiative launched in 2015, which have received \$12bn to fund projects that have seen concrete pavements replaced with semi-permeable walkways, so that rain soaks into the soil rather than being channelled into storm drains.

Urban wetlands and green roofs have proliferated, while in the city of Kunshan rainwater collection tanks where water can be purified, have been installed under a new central elevated expressway. The aim of the initiative is to see 80% of urban areas in China re-use at least 70% of their rainwater by 2020.

Although technically not classed as an eco-city, Xian’s skyline now includes a new 18 metre smog-sucking chimney, which uses sunlight to filter out noxious particles and then emit clean air. While the results have still to be peer-reviewed, initial findings suggested a 15% improvement in air quality within a 10km radius of the tower.

While Chinese companies are world leaders in producing technologies such as wind turbines, solar panels and electric vehicles, many of the technologies in the green building sector are from western companies.



TESTING/SHUTTERSTOCK

President Xi Jinping has pledged to tackle air pollution

‘The fact that cities are growing so rapidly means China is facing environmental boundaries to do with water, air, noise, congestion, food and energy’



In Nanjing, Italian architect Stefano Boeri's two forest towers are due for completion this year. Festooned with trees and cascading plants, the vertical forest will be capable of absorbing 25 tons of CO₂ a year, while producing around 22 tons of oxygen.

Boeri, who hopes to create a series of sustainable mini-cities across China, has also received the go-ahead to scale up his plans with the Liuzhou Forest City. Set in the mountainous southern province of Guangxi, the city will be home to around 30,000 people and more than a million plants, and will be fuelled entirely by renewable energy.

Another idea that has also attracted attention in China is the concept of "building as power station" that is currently being developed by Specific, a UK government-funded academic and industrial consortium project based at Swansea University, in partnership with Akzo Nobel, NSG Pilkington, Tata Steel and Cardiff University.

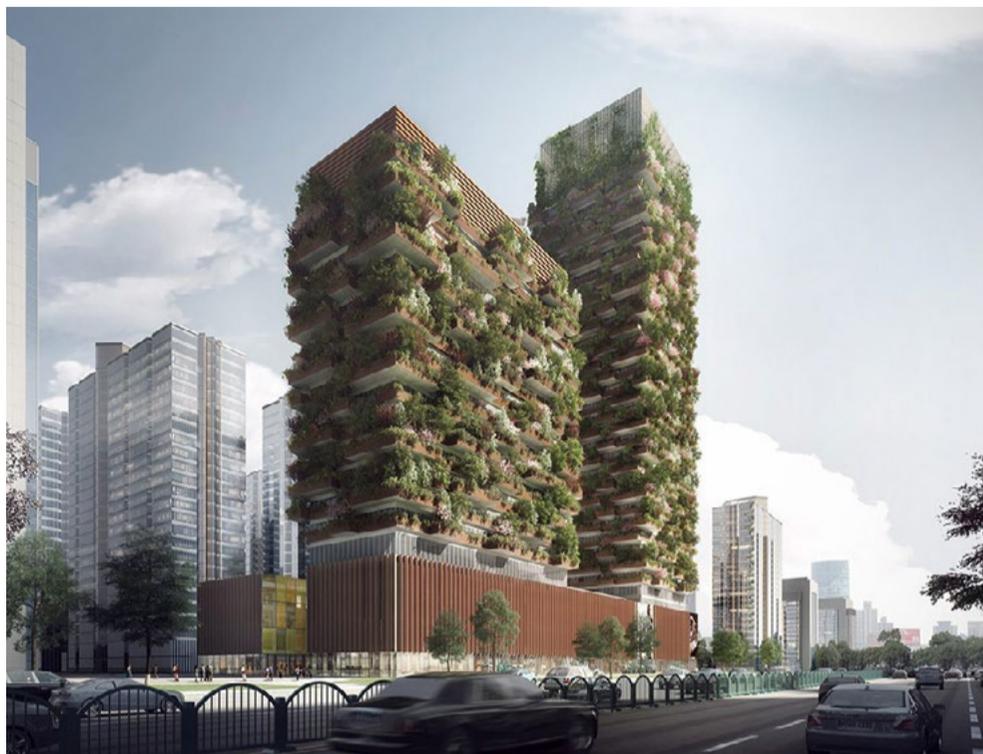
The basic idea, explains the project's technology director Dr Justin Searle, is to use the outer surface of the building to harvest energy, primarily solar. Importantly, the energy is stored in a new generation of salt water batteries, which are designed to be resilient and robust, unlike smaller, portable lithium-ion batteries. In its first 18 months, the classroom generated one and a half times more energy than it used.

Searle says next up are, are "solar windows that are semi-transparent and also generate power – for things like high-rise buildings that could be a good option".

Another technology that is set to appeal to the Chinese market is inter-seasonal heating, which uses phase-change materials. "You take excess heat from the summer and store it via a chemical reaction and then you can discharge that heat in the winter," says Searle.

Kidney of the Climate Bonds Initiative believes there are still plenty of opportunities for foreign businesses in China. "They are shopping the world and I keep saying to European manufactures that this is a huge opportunity. Everyone in Europe with a good energy-efficient, green city technology needs to be in China hawking their services now, because they have lots of local products but there are so many gaps.

"They are trying to do what it took London 40 years to do, but in five years." ■



An artist's impression of Stefano Boeri's forest towers in Nanjing

STEFANO-BOERI-ARCHITETTI



Mark Hillsdon is a Manchester-based freelance writer who writes on business and sustainability for Ethical Corporation, The Guardian, and a range of nature-based titles including CountryFile and BBC Wildlife.



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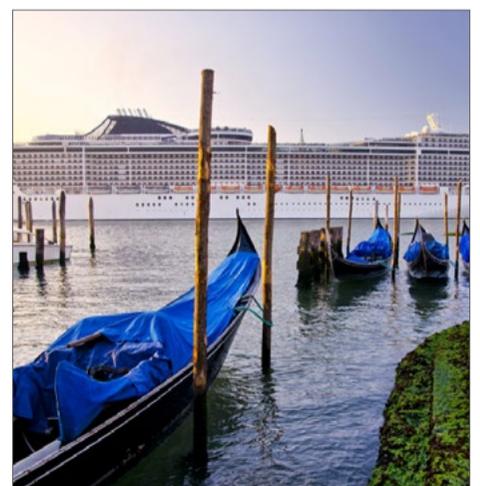
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