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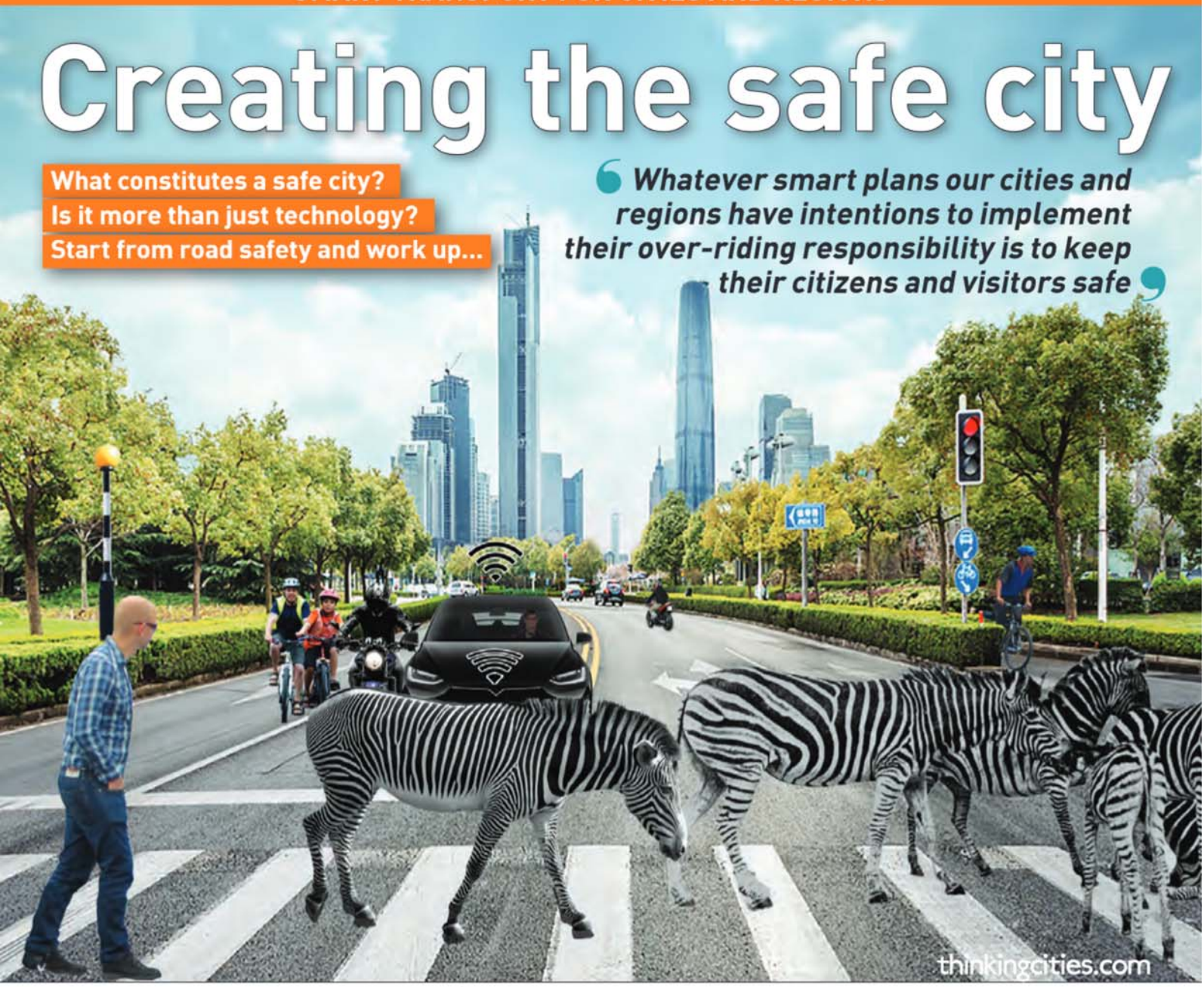
THINKING cities

SMART TRANSPORT FOR CITIES AND REGIONS

Creating the safe city

What constitutes a safe city?
Is it more than just technology?
Start from road safety and work up...

"Whatever smart plans our cities and regions have intentions to implement their over-riding responsibility is to keep their citizens and visitors safe"



● AMSTERDAM ● BARCELONA ● BOGOTÁ ● BOLOGNA ● BRUSSELS ● CATALONIA ● DUBLIN ● GRAZ ● LONDON
● MADRID ● MANCHESTER ● MILAN ● NEW YORK CITY ● PARIS ● ROME ● SÃO PAULO ● TURDA

Electric dreams

SEEV4-City: Towards a mobile, clean energy grid in the City

Maintaining sustainability principles and tackling energy management challenges are crucial tasks for cities today. Florinda Boschetti and Hugo Niesing wonder how transport policies can contribute to solve the problem

In European cities renewable energy production is hampered because large installations are limited by their intermittency. Energy production and consumption do not fit seamlessly

In the coming years, Europe is committed to reducing its carbon footprint in the energy and transportation sector by cutting greenhouse gas (GHG) emissions by 20 per cent by 2020 and by 40 per cent by 2030 compared with 1990. While the EU as a whole is on course to meet its 2020 targets and seeks to have a 20 per cent share of its gross final energy consumption from renewable sources by 2020, some Member States are at the forefront in expanding the numbers of electric vehicles. Enabling clean and green transportation by increasing the number of electric vehicles powered by renewable energy sources is a top priority for Europe's public authorities, companies and concerned citizens.

However, an increase in the number of electric vehicles and demand for renewable energy production creates a challenge. The growing number of EVs is causing a new energy demand in cities that needs careful planning. Also, most of the time a significant amount of renewable energy supply does not match EVs' demand for electricity. Due to this mismatch between demand and supply, EVs aren't always charged with renewable energy and this impacts the existing large energy demand peak in a city, leading to undesirable effects on the electricity grid.

CHARGING SMARTLY

A number of cities across Europe are piloting solutions to tackle these challenges by optimising the use of electric vehicles and renewables (PV) through Information and Communication Technologies (ICT). When implemented effectively, smart charging mitigates CO_2 emissions, increases clean kilometres driven and results in less impact on the grid, which may consequently reduce grid investments which would be otherwise needed, increases the matching of energy demand-supply and improves energy autonomy.

The implementation of Smart Charging (where the timing of EV charging is controlled to benefit network operation), V2G (where EVs are used as energy stores, enabling a better balance to be achieved between energy supply and demand) and the other 'ancillary' services they can provide are collectively known as "Vehicle 4 Energy Services" or V4ES.

Smart charging is applied by coordinating EV charging demand with the varying output of locally generated renewable energy, with the aim of minimising grid impacts and battery degradation, whilst maximising energy autonomy and economic benefits. Different operational environments and levels for smart charging or V2Gintegration exist, these are known as Vehicle 2 Home (V2H), Vehicle 2 Business (V2B), Vehicle 2 Street (V2S) and Vehicle 2 Neighbourhood (V2N).

As all cities are struggling with the transition towards clean mobility and more energy independence while reducing their carbon footprint, what can Energy Management Systems (EMS) do for clean energy and mobility? EMS can determine energy fluxes and optimise the use of energy generated locally, can help storage and integrate energy in an electric vehicle battery.

Current initiatives in this field exist on a small scale and address only a particular theme, mobility management or energy consumption systems. In European cities renewable energy production is hampered because large installations are limited by their intermittency. Energy production and consumption do not fit seamlessly. Large scale renewable energy creates peak production when demand is low, resulting in energy transport, conversion and related losses. Energy demand is more predictable and can partly be adapted to production.

Here are some city case study examples.

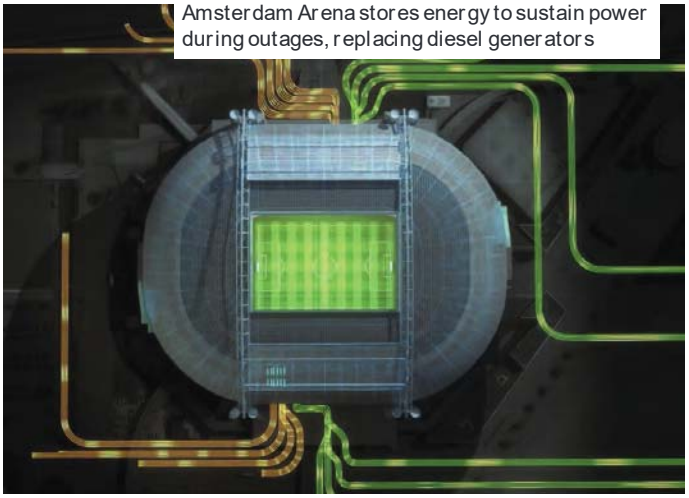
Amsterdam is preparing for an increase of electric cars and more renewable energy generated locally in the city. With its strategy the city wants to optimise the interaction at district level between prosumers and EVs. Any excess in PV energy production will be diverted to smart charging stations and an increase in network demand will reduce the power supply to the charge points. Households will not experience any change in the way they use electricity, but their excess of production will be diverted - when possible - to charge EVs parked in the district.

Amsterdam prepares for an increase in electric cars

In March 2017 the city started a "flexible charging" project with partners Nuon, Liander and ElaadNL. By steering the charge flow of electric cars' peak, loads can be avoided and the demand can be matched to the availability of locally produced sustainable energy.

The design of the current electricity grid has not taken into account the arrival of electric cars. At this stage, there is no direct problem, but an uncontrolled increase of chargers on the low voltage grid might lead to peak demands that exceed grid capacity. Therefore, it is necessary to start testing how smart charging helps to overcome this. By monitoring the charging data, Amsterdam wants to make sure cars are always full enough for the next trip. The pilot begins with 200 public charge stations with two sockets each in the centre, the West, New West and South of Amsterdam. The charging speed is adjusted on the basis of the use of the electricity grid. At the start of the test, charge speed for electric cars is increased during outside peak hours. This means they will be charged faster than normal at this time of the day. Only during peak hours (between 16.30 and 19.30), when other devices demand more power, the cars are charged more slowly and with less power. With this method, more e-drivers can use the same charge point and less public charge points are needed.

Another pilot in the city is located at the Amsterdam Arena. This is a V2B that includes an Intelligent Energy Management system along with RES and Primary control reserve services. This pilot presents a different magnitude of the V2G experience with an energy consumption comparable to 270 households. Amsterdam Arena is carbon-neutral; currently, 10-15 per cent of its annual consumption is generated from its own 4200 solar panels, with the other 85-90 per cent coming from wind energy supplied by the Arena's energy provider (green electricity). The renewable energy



Amsterdam Arena stores energy to sustain power during outages, replacing diesel generators

produced ensures a supply of clean energy to charge EVs, which translates into reduced CO_2 emissions, as well as an increase in clean kilometres. Moreover, Amsterdam Arena is interested in energy storage and V2G applications; thus, they have installed stationary 2nd life batteries (to phase out diesel-fuelled backup generators in case of black-outs), and V2G bidirectional chargers on the premises. Furthermore, the Arena has potential to contribute to a reduction of 1500 tonnes of CO_2/year through PCR services.

Vulkan in Oslo is one of the most advanced charging garages in Norway and indeed in the world. The Vulkan project represents the future mobility house for professional EV users; it exemplifies the fusion between the building and transport sectors, most needed to boost the electrification of transport. During the day, the Vulkan site operates as a 'Centre for professional users of EVs' like taxis, electric freight vehicles and EVs for crafts and services. Vulkan allows for the pre-booking of charging timeslots, flexible charging, battery storage, smart grid systems and quick charging. At night, Vulkan offers free residential parking for dwellers in the neighbourhood. This creates a flexible and cost-efficient site for the promotion of EVs. Currently, Vulkan is equipped with 100 AC chargers, 2 DC quick chargers, battery storage, smart grid systems, flexible charging and V2G functionality. The next stage will include super quick chargers, battery storage with second-hand batteries, V2G solutions for both AC and DC charging, and possibly, inductive charging.

"Use our electric vehicles as energy buffers!" That is exactly what the city of Kortrijk, Belgium wants to do in the future. Kortrijk, with 76,000 inhabitants, strives to be the first city in Flanders to become energy neutral. The local pilot site consists of municipal sport facilities, a depot for city services, a PV-installation roughly three-quarters of the size of a football pitch (yearly producing enough green energy to cater for 22 families all year round), a smart charging station and currently one Nissan E-NV200, an electric delivery van: the pilot aspires to become a small power plant. The energy produced by the PV-installation is used by the depot and sport facilities, but any excess energy will be injected into the EV, stationary battery or e-bikes on site to be used when necessary.

By means of a smart charging station, the electric delivery van will not only be charged, but also discharged. The regular driving hours of the mailman and his daily predetermined trajectory provide clear boundaries to implement smart charging algorithms. A rise in energy autonomy is expected to save 33.4 tons of CO_2 emissions. These numbers will only increase when more EVs will be purchased by the city of Kortrijk. Plans for expansion to other city service buildings are already being considered and fit in the ambitious plan of being the first Flemish energy neutral city.

Moving north to Loughborough, UK where a small pilot is running with a single household, with a single EV, equipped with PV panels, which regularly produces more energy than it consumes due to a demand/generation misalignment. Through ICT integration, when the EV is parked at the house, it will charge or discharge in response to the household's electricity demand and solar energy production forecast. As a result, it is expected that the distance travelled by the EV using zero emission PV generation is expected to increase dramatically.

Finally, Leicester, UK is piloting Vehicle to Business. This pilot studies the pros and cons of controlled and bi-directional charging at an office location. Between June 2016 and June 2017, the EVs used 2,996kWh; around 15 per cent of annual PV production. The EVs travelled 10,587 miles. EV utilisation is expected to increase; leading to an increase in ultra-low emission kilometres.

These six pilots are receiving financial support by the Interreg North-Sea Region SEEV4-City project. The main aim of SEEV4-City is to develop this concept into sustainable (commercially and socially viable) business models and well-established city planning. Energy and mobility are separate domains, but SEEV4-City aims to integrate these field into city-oriented Sustainable Urban Mobility and Energy Plan (SUMEP).

FYI
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For more information about the project visit www.northsearegion.eu/seev4-city or contact the SEE4-City project coordinator Hugo Niesing: h.niesing@hva.nl