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Sustainable Low Carbon Transport Infrastructure & Smart Energy Systems

An Integrated and Autonomous Future ?



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Why This, Why Now ?

- As the impact of climate change becomes ever more apparent – the calls to do something about it become ever more urgent.



- CO₂ and other green house gas emissions are at their highest levels for anytime in human existence.



- We will soon be reaching a tipping point where climate change impacts will become more severe and less stoppable.

- We must act now !



End of the Road ?



- Transport systems are a significant proportion of current CO₂ emissions



To combat climate change we must address the sources of CO₂ and other GHG emissions to decarbonise our transport systems, buildings and economies.

It is time for Action !





Low Carbon Targets

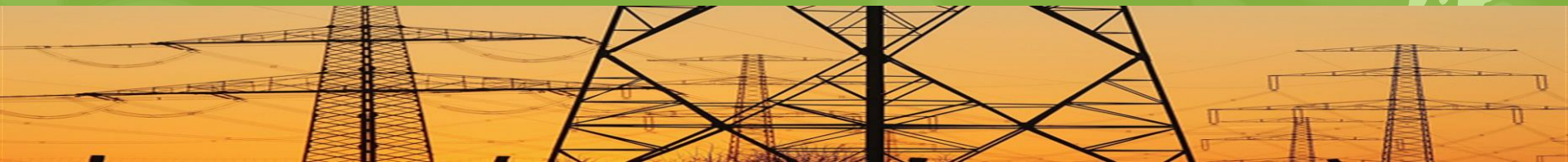


- Scottish Government – Not require fossil fuelled vehicles by 2032 - Note – this is not a ban !
- UK Government – Fossil fuelled vehicles banned by 2040
- Requires a Transport Transition of a little over 12 years in Scotland and around 20 in the rest of the UK
- Buildings to be net-zero carbon emission by 2045
- Planned EPC Building ratings from now till 2040



Issues with a transition to low carbon transport

- At present there is
Scotland approx. 7,400 people per EV charger,
Rest of the UK approx. 17,000 per EV charger.
- Growing EV charging support in urban centres – but little coverage in rural areas
- EV charging systems for densely populated areas
- The Grid reinforcement work required to support EV charging systems is estimated to be in the hundreds of millions for Scotland alone – more than a billion across the UK.

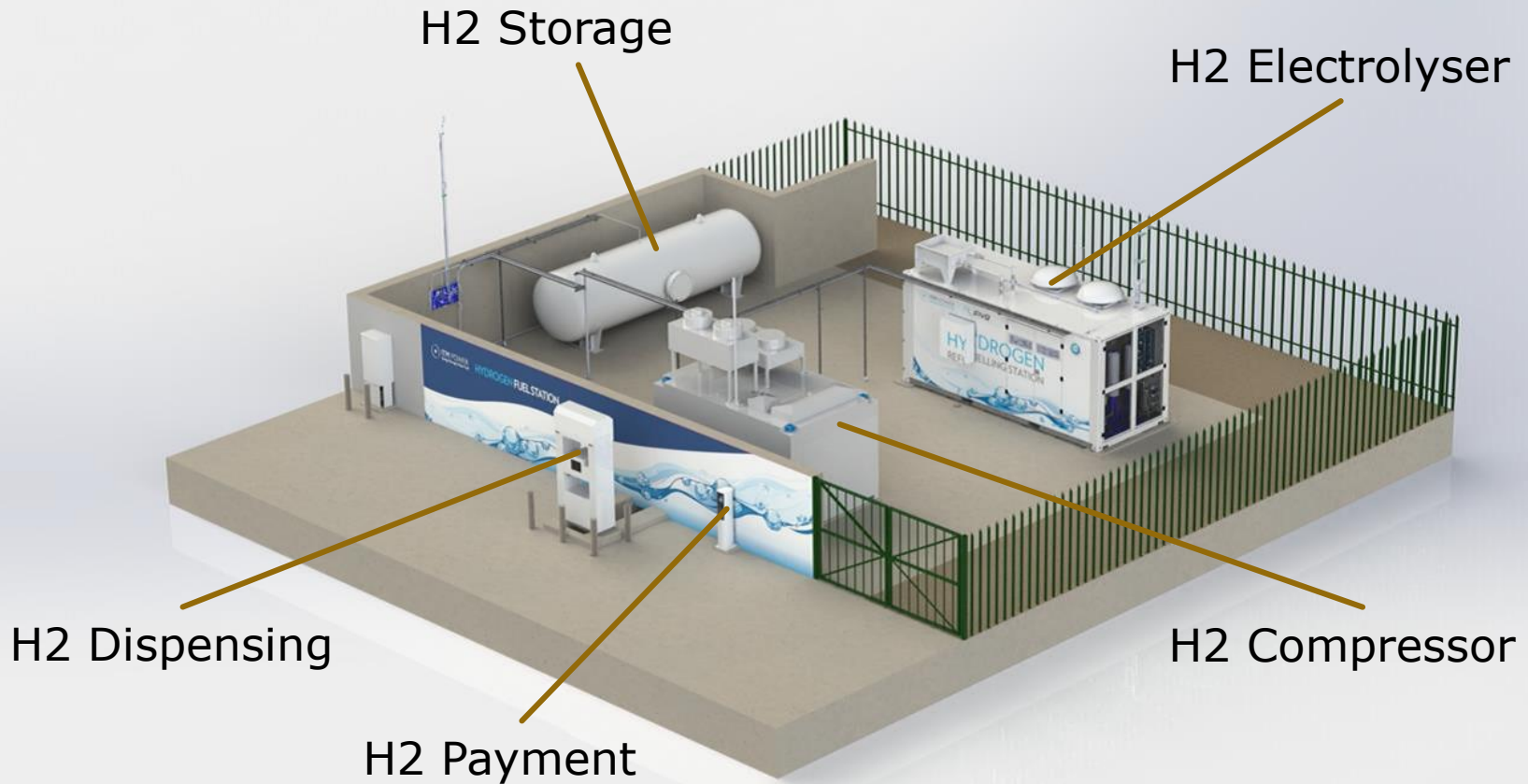


Broxden – Low Carbon Transport Hub

- Hydrogen Refuelling Station
- Upgrading of electrical sub-station
- 6 x 50kW Rapid chargers
- 8 x 7kW Long-stay EV chargers
- Solar Array – 75kW + 25kW canopies
- Battery Storage unit – approx. 150-200kW
- Private bike storage units
- Public Information mobile web app
- Development of a virtual on-line hub



Broxden - Low Carbon Transport Hub Hydrogen Refuelling Station



Low Carbon Vehicles – HEVs, PHEVs, BEVs & FCEVs

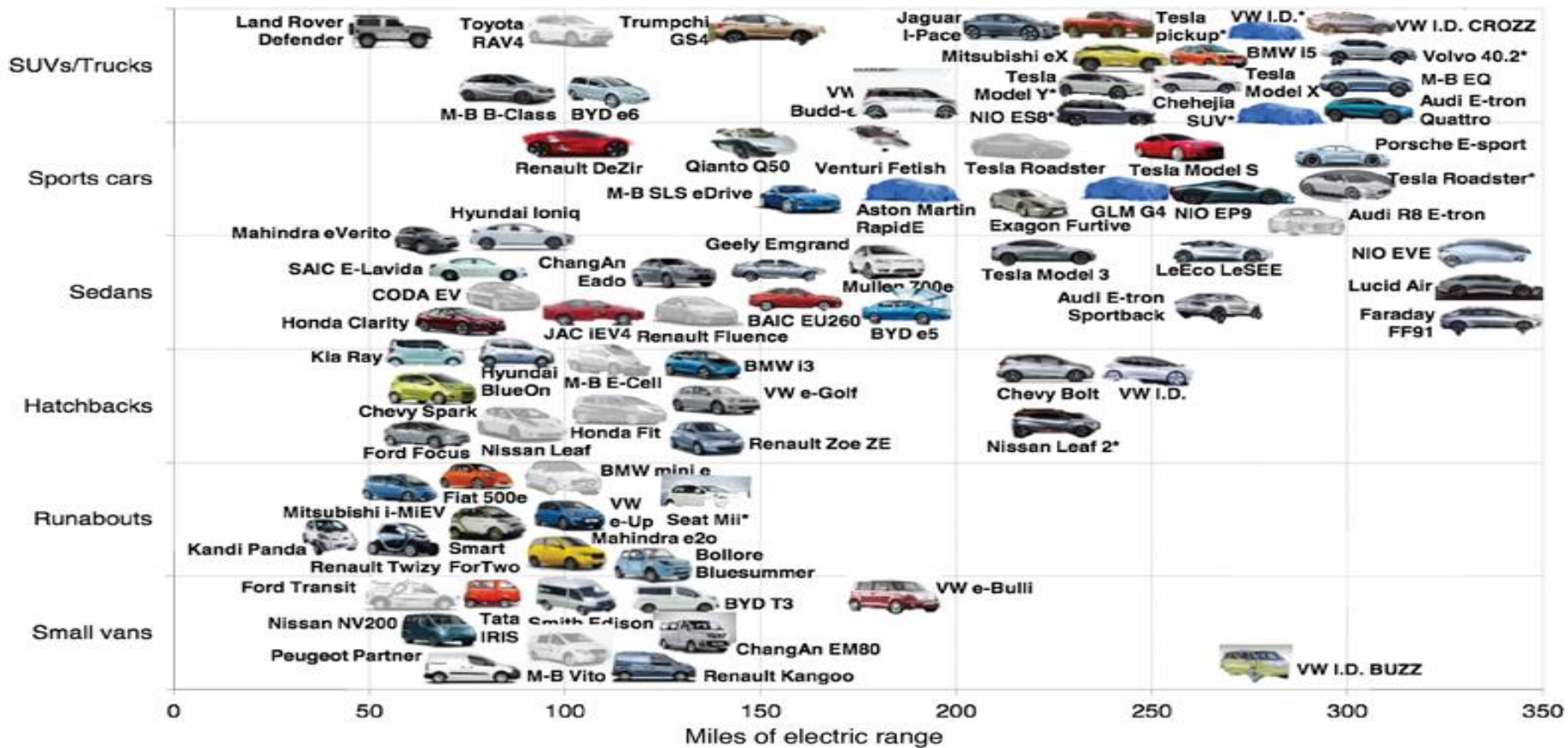
- HEV – Hybrid Electric Vehicle
- PHEV – Plug-in Hybrid Electric Vehicle
- BEV – Battery Electric Vehicle
- FCEV – Fuel Cell Electric Vehicle
- HEVs and PHEVs both retain a petrol engine – produce CO₂, Toxins
- BEVs and FCEVs are Zero Emission vehicles



What's the difference: H2 v EV

Electric-Car Boom

Models by style and range available through 2020



Meeting the demand for EV charging



- At Broxden demand for EV charging sessions has increased by 1,295% from 2014 – 2018
- In the last three years 2016-2018 it has increased on average by 65% per year
- The amount of electricity consumed by EV's has increased by 1,826% from 2014 – 2018 in kWh used
- In the last three years 2016-2018 it has increased on average by 83% per year.
- In PKC EV charging is costing over £80,000 per year



What is a sustainable EV charging hub

To support the provision of EV charging systems through the use of renewable energy generation and battery storage systems.

At Broxden we will initially set up with a 75kW solar array and 25kW solar car canopies – will provide approx. 80-90,000 kWh per year.

A 150 – 200kW battery storage system to hold on-site generated electricity and Energy Management system to manage the flow of energy.

Provision at site for 250kW solar array and over 500kW of solar car canopies



Smart Energy Systems



- The UNECE definition of a Smart Grid -

- "A smart grid is an electricity network that uses digital and other advanced technologies to monitor and manage the transport of electricity from all generation sources to meet the varying electricity demands of end-users. Smart grids co-ordinate the needs and capabilities of all generators, grid operators, end-users and electricity market stakeholders to operate all parts of the system as efficiently as possible, minimising costs and environmental impacts while maximising system reliability, resilience and stability"



Perth – Smart Energy Network Project

- Perth-SEN – PKC / Can Do Innovation Challenge Fund / Innovate UK
- Development of a smart energy management system that will manage the flow of energy within the PKC estate, to form the core of a Smart Energy Network in which renewable energy production, energy storage and consumption are integrated and coordinated.
- The ability to generate, store, use and trade energy at distance, between unconnected council sites within the PKC estate.
- To enable the management of energy across the PKC estate to optimise its usage and maximise its value





Perth-SEN project goals

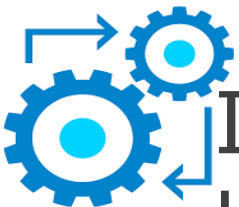
1. **Develop renewable energy generation capacity and energy storage capacity, within the PKC estate – to reduce PKC’s carbon footprint;**
2. **Maximise the value of renewable generated energy by storing, using and trading energy between council sites (and ultimately outside the council’s energy network) – to reduce PKC’s energy costs;**
3. **Develop new income streams for PKC through utilisation of energy storage assets;**



Perth-SEN Development

- **5 Project teams (consisting of 14 companies).**
- **Phase 1 - Developing a Smart Energy system design suitable for a large public organisation. (2019)**
- **Phase 2 - Best 2 designs will be prototyped in the PKC estate. (2020-21).**
- **Phase 3 – Integration of test sites and existing low carbon energy assets. Gathering of performance data from installed system. (2021-22).**
- **Phase 4 – Once OFGEM has confirmed the new energy market regulations in 2022/23 – PKC large scale roll-out across PKC estate and adaption for social housing. For Project Team – market ready smart energy system product ready for new OFGEM regulations.**





Integrated Low Carbon Transport hubs and Smart Energy Systems

- **Over the next few years there will be a significant increase in demand for low carbon infrastructure.**
- **The Renewables and Battery installations being deployed by public bodies across the UK to sustainably support EV charging assets; would also be prime energy assets in a Smart Energy Network.**
- **Were energy generation, management and use could be viewed at an organisational level as a resource that could be used to maximise the value of energy within the network or even provide a direct mechanism for tackling such social issues as fuel poverty.**



What about Autonomous Vehicles?



○ The Autonomous revolution is coming

- Which will radically change the urban built environment
- Will radically change our relationship with transportation
- Herald an end to mass transport ownership
- Bring in an era of Mobility as a Service



Future Transportation Developments – 2020 to 2032 and beyond

- Short-term
 - Expansion of EV charging Hubs
 - Coupled with the sustainable support of EV charging hubs through renewables and battery storage systems.
 - Integration of EV charging energy assets into Smart Energy Networks
- Medium to Long-term
 - Adoption of Mobility as a Service operations utilising Autonomous low carbon vehicles
 - Radical re-working of roads and urban spaces as car ownership falls



Sustainable Low Carbon Transport Infrastructure & Smart Energy Systems

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- Thank you !



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