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Chief Executive

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The revolution starts here: the future of transport

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Ed Thomson

Head of Low Emission Vehicle Policy
Transport Scotland

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TRANSPORT SCOTLAND

SCOTTISH RENEWABLES TRANSPORT CONFERENCE 2020

Wednesday 19 February 2020

TRANSPORT SCOTLAND
CÒMHDHAIL ALBA

SCOTLAND'S CLIMATE EMERGENCY RESPONSE

- Scottish Parliament has passed ground-breaking legislation:
  - Net-zero CO2 emissions by 2045
  - 75% reduction in CO2 emissions by 2030

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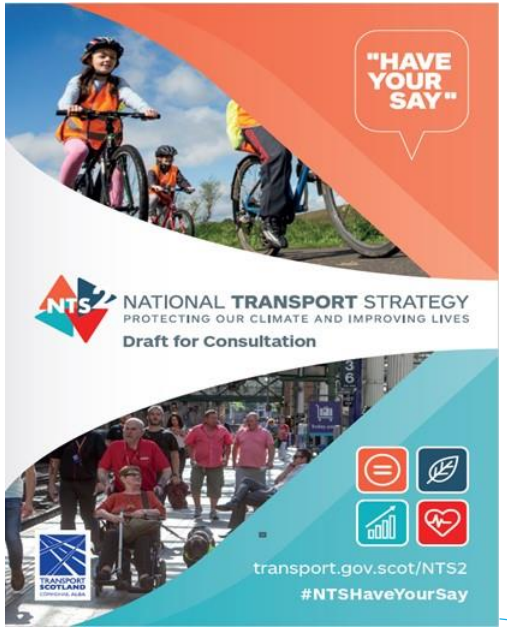
OUR VISION FOR TRANSPORT



Promotes equality

- Will provide fair access to services we need
- Will be easy to use for all
- Will be affordable for all

Takes climate action

- Will adapt to the effects of climate change
- Will help deliver our net-zero target
- Will promote greener, cleaner choices

Helps our economy prosper

- Will get us where we need to get to
- Will be reliable, efficient and high quality
- Will use beneficial innovation

Improves our health and wellbeing

- Will be safe and secure for all
- Will enable us to make healthy travel choices
- Will help make our communities great places to live

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TRANSPORT SCOTLAND'S RESPONSE

We have committed to:

- Enabling the decarbonisation of scheduled flights within Scotland by 2040, and support trials of electric aircraft within the next 2 years
- Decarbonising the rail network by 2035, through a combination of electric, battery-electric and hydrogen
- Removing the need for new petrol and diesel cars and vans by 2032
- Phasing out petrol and diesel cars in Scotland's public sector fleet by 2025, and the need for all new petrol or diesel vehicles by 2030
- £500m in bus priority measures and commitment to help sector transition to zero emission fleet

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Timetable for Public Sector Fleet Decarbonisation

2025

Cars

From 2025

Van & LV

From 2030

Everything else

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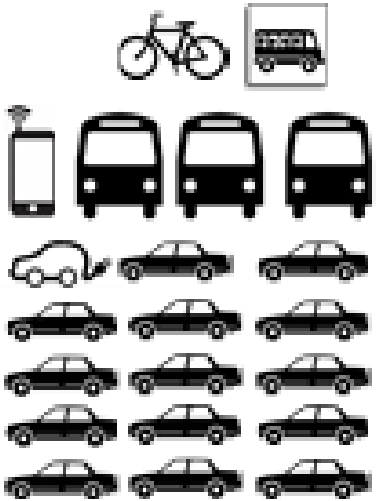
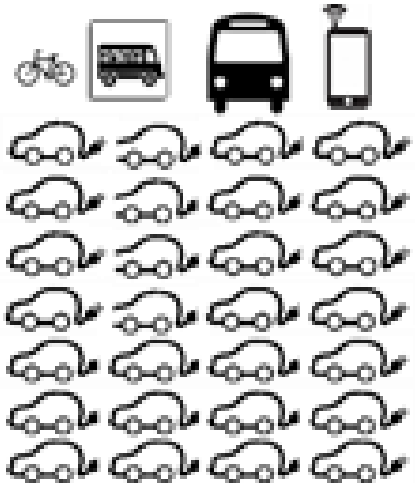
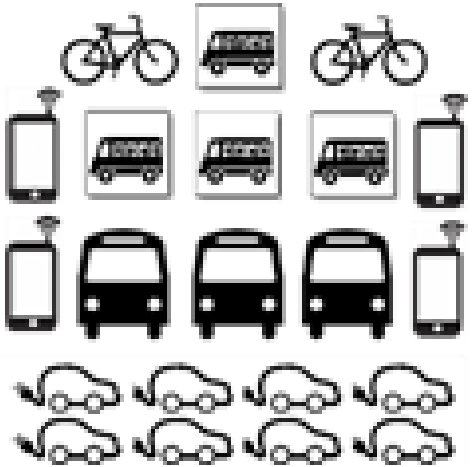
NOT JUST ABOUT ELECTRIFICATION……



Today



EV dominated future, slow CAV and MaaS progress.



A more sustainable future

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PAST YEAR

- Supported over 700 ULEV across the public sector vehicle fleet, with 1250 soon to be in operation
- Financed over 700 ULEV through our Low Carbon Transport Loan, and 1500 in past 5 years
- ChargePlaceScotland now exceeds 1000 charge points. 70% outside of cities. 3.2 miles average distance between chargers
- launched round 3 of our ERDF funded Low Carbon Travel and Transport Challenge fund to promote active and low carbon travel (£18M).
- Launched our Plugged in Households Scheme with 8 Housing Associations receiving a total of over £500k to provide shared access to EVs

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LANDSCAPE CHANGING QUICKLY

- 29 new EV models in coming year – multibillion restructure in automotive OEMs
- Price parity EV batteries v's combustion engine 2023-25 (cars)
- 100+ new EV car companies (most in china)
- Radical new business models emerging (power companies and automotive OEMs)
- Hydrogen power trains for heavier vehicles
- The new ICE (Integrated, Connected, Electric)

Expect surge in EV growth by 2023, and already have indicators of exponential growth in Scotland

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ECONOMIC OPPORTUNITY

- Hydrogen for transport
- Niche vehicles
- Electric vehicle supply equipment
- Smart systems
- Energy
  - Batteries & Fuel Cells
  - Second life
  - Vehicle to grid

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CONTACT

Ed Thomson

Head of Low Emission Vehicle Policy

Low Carbon Economy Directorate

Transport Scotland

Edward.Thomson@transport.gov.scot

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Paul Minto

Head of Low Carbon Transport GreenPower

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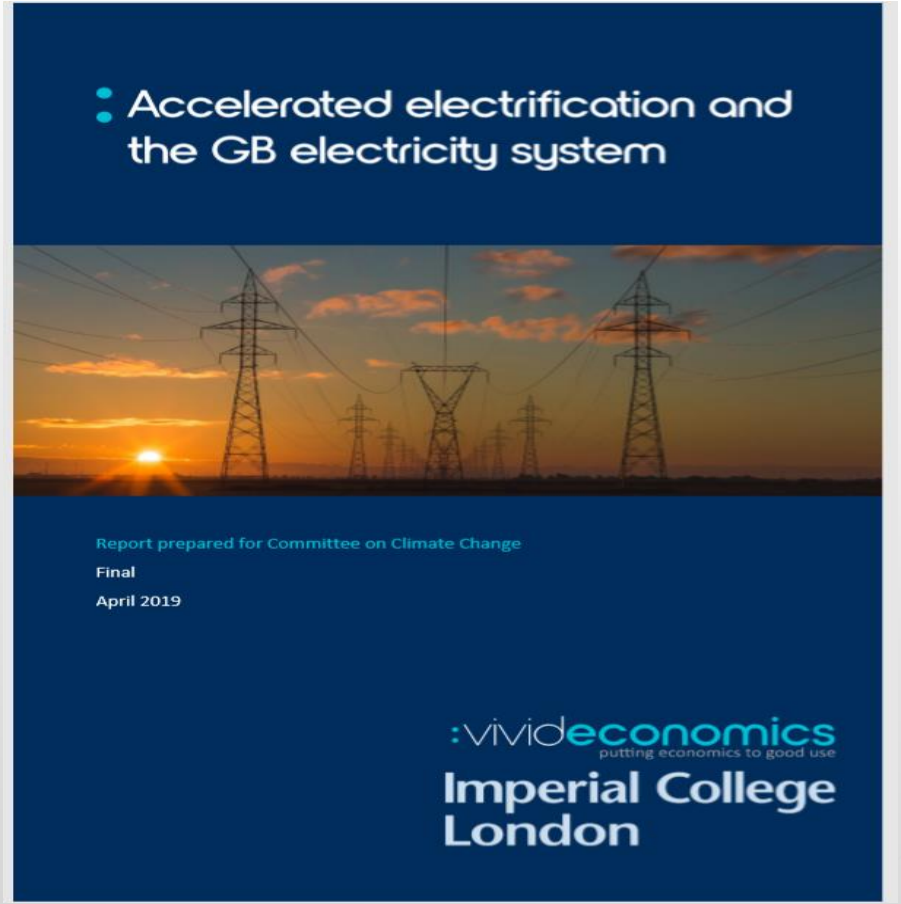
Paul Minto

Head of Low Carbon Transport

078 3456 9552

PMinto@greenpowerinternational.com


Accelerated electrification and the GB electricity system
Report prepared for Committee on Climate Change
Final
April 2019
vivideconomics
putting economics to good use
Imperial College London

Accelerate Electrification of Transport and Heat

- “To deliver the necessary low-carbon generation at current build rates, sustained build of new onshore wind, offshore wind and solar PV are needed.”

- “Large-scale policy reform and market design are needed to deliver a flexible electricity system.”

Regulation

- Automated and Electric Vehicles Act 2018
- Transport (Scotland) Act 2019
- Electric Vehicle Trading Scheme and Road Usage Duty (Consultation) Bill [HL] 2019-20


5G

Brand


ROMNEY'S
KENDAL
MINT CAKE
GEORGE ROMNEY LTD. IN KENDAL


HarrisTweed


LAPHROAIG
10
1815
LAPHROAIG
10
1815

Paul Minto

- Head of Low Carbon Transport
- 078 3456 9552
- PMinto@greenpowerinternational.com

Jess Pepper

External Affairs Manager

Transform Scotland

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JESS PEPPER

TRANSFORM SCOTLAND

SCOTLAND'S ALLIANCE FOR SUSTAINABLE TRANSPORT
Web: transform.scot
Tel: +44 (0)131 243 2690
info@transformscotland.org.uk

NEW CLIMATE STATUTE

- Climate Emergency declared April 2019

New statute:

- 75% reduction in greenhouse emissions from the baseline by 2030; Net-Zero by 2045

2. TRANSPORT & CLIMATE

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EMISSIONS FROM TRANSPORT = 37%

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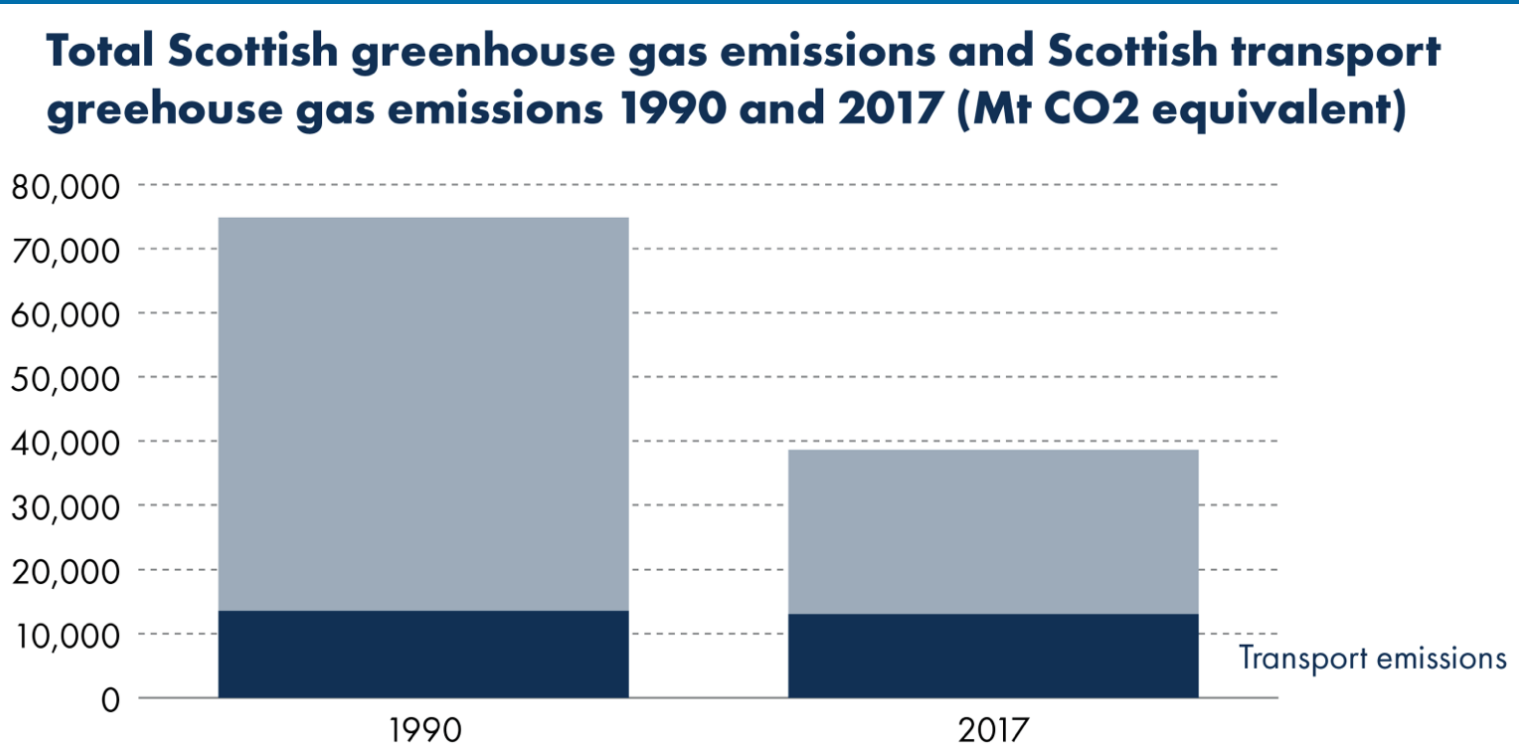

EMISSIONS BY TRANSPORT MODE

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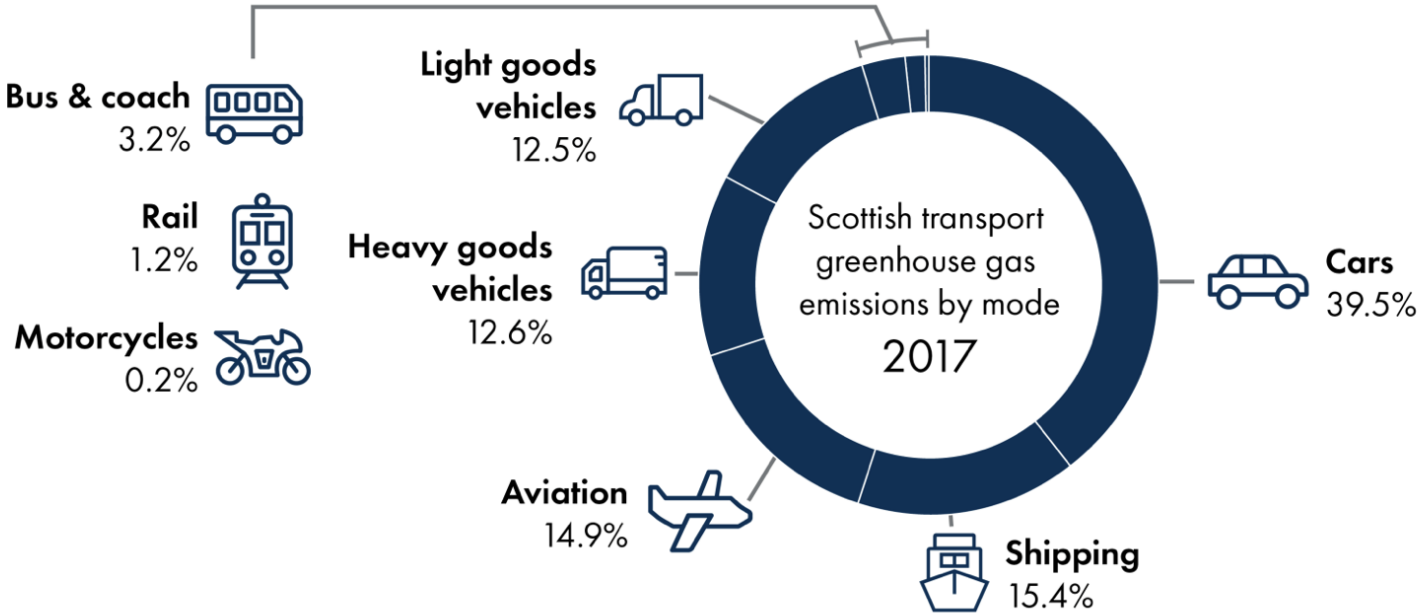
Scottish transport greenhouse gas emissions by mode 2017



TRANSFORMING TRANSPORT

transform scotland

To tackle transport emissions we need:

- Modal shift
- Decarbonisation

TRANSFORM SCOTLAND VISION 2030 SERIES

Transform Scotland have launched the vision 2030 series to advise how sustainable transport can contribute to achieving net-zero.

transform scotland

RAIL — VISION 2030

Decarbonise the entire rail network by 2030 for £2.5 billion.

This needs urgent action now:

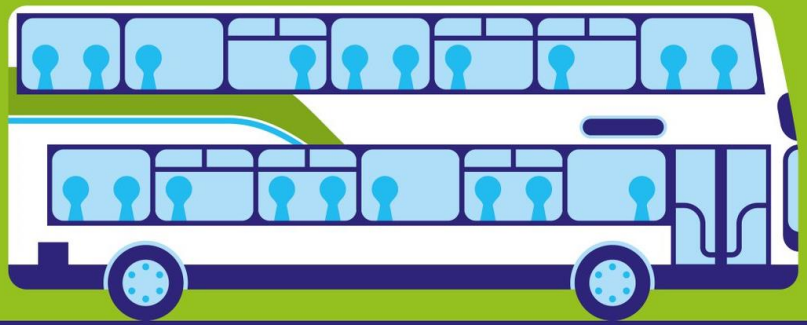
- Rolling programme to deliver by 2030
- 96% of passenger journeys could be zero emission by doing key routes; intercity Perth to Inverness and Aberdeen.

BUS — VISION 2030

transform scotland

Vision 2030: Bus

Global leadership from Scotland to tackle the #ClimateEmergency



This Vision will:

- excite and encourage engagement with buses as a solution to the *#ClimateEmergency*
- **inform** and **inspire** strategy & policy processes, **investment** and **action**
- set out a **pathway** with clear **milestones**, roles and responsibilities to reach this vision.

An opportunity to showcase industry leadership to the world in the run up to COP 26 in Glasgow

BUS — VISION 2030

One Bus Forum working on a Vision for Bus 2030. With a:

- Pathway
- Key milestones
- Recommendations

Simple, clear vision to inform national debate.

PLANNING FOR INFRASTRUCTURE

- To achieve Vision 2030 have to start NOW.
- Strategic conversations about investment, infrastructure and planning for energy & transport.
- e.g. Vision for our cities and towns - lots of charging points for private EVs or inclusive system prioritising active & sustainable transport?
- Congestion, inactivity, inequalities, health, efficiency - need modal shift.

5. STRATEGIC/GOVERNMENT PROCESSES

transform scotland

Climate change plan

Strategic Transport Projects review 2

National planning framework 4

Infrastructure investment plan

CHOOSE BUS FOR PLANET!

*Choosing to **travel by bus** instead of **car** can significantly **reduce climate emissions***

transform scotland

#lovemybus

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Smarter Choices, Smarter Places
Supporting Sustainable Travel

Stagecoach

transform scotland

for sustainable transport

Let’s talk about vision..

Get in touch:

jess.pepper@transformscotland.org.uk

SCOTLAND'S ALLIANCE FOR
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Building and financing net-zero transport

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Simon Gill

Head of Whole System and Technical Policy
Scottish Government

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Cllr Philip Bell

Hydrogen Spokesperson
Aberdeen City Council

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Councillor Philip Bell
Aberdeen City Council

Hydrogen Fuelled Transport in Aberdeen

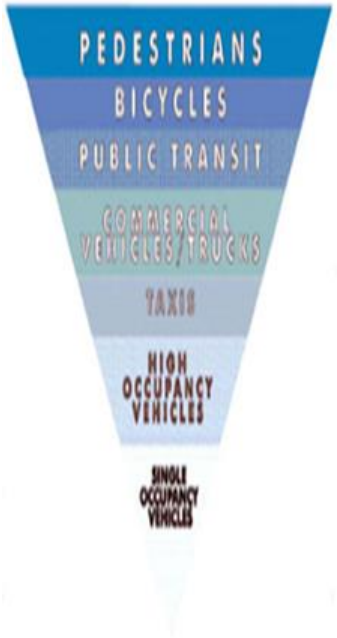
Why Hydrogen?

- **2014 / 2015 oil downturn and severe effect on the Aberdeen economy**
- **FCH JU**
- **Commitment to reduce Aberdeen's carbon footprint**
- **Complimentary to Offshore Wind Initiatives**
- **Ambition to become the energy transition capital of the world!!**

ABERDEEN CITY COUNCIL

Low Carbon Transport & Emissions Reduction Target

- **EU Covenant of Mayors for Climate and Energy (2009) - Reduce Aberdeen's carbon emissions by 20% by 2020**
- **Local Outcome Improvement Plan - Reduce Aberdeen's carbon emissions by 30% by 2021**
- **Powering Aberdeen: A sustainable Energy Action Plan (2016) – Reduce Aberdeen's Carbon emissions by 50% by 2030**
- **Local Transport Strategy (2016) - Facilitate the uptake of ultra-low and low emission vehicles**
- **Hydrogen strategy and forthcoming EV Action Plan**
- **Scotland Decarbonisation of Transport Sector (2018) – Halt to New Sales of Petrol & Diesel Vehicles by 2032**
- **Climate Change (Emissions Reduction Target)(Scotland) Bill (2019) – Target of Net-Zero for Scotland's Greenhouse Gases by 2045**



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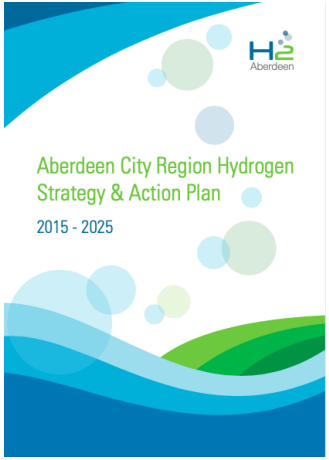
Strategy & Action Plan

- **Ensure the city as a leader in the emerging hydrogen and fuel cells sector**
- **Outlines actions required over 10 years**
  a. **Opportunities to diversify activities**
  b. **Develop the supply chain**
  c. **Develop supporting infrastructure**
  d. **Deploy first generation vehicles**
  e. **Support Aberdeen City as early adopter after London**



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FUTURE
COMMUNITIES:
apse
GREENER,
CLEANER,
SMARTER

Switched On Scotland

- No collective, unified document for 2032 Target
- No roadmap for BEV / complementary H2
- Infrastructure
- How to increase demand?
- Japan subsidise H2 cars

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Power from Hydrogen

- SMR
- Electrolysis
- Tube Trailer
- National Grid
- Burn-it. Fuel Cell
- H2 vs Petrol / Diesel
- Fast-Refuelling
- Low weight penalty
- Environmental temperature

ABERDEEN CITY COUNCIL

How Do Hydrogen Vehicles Work?

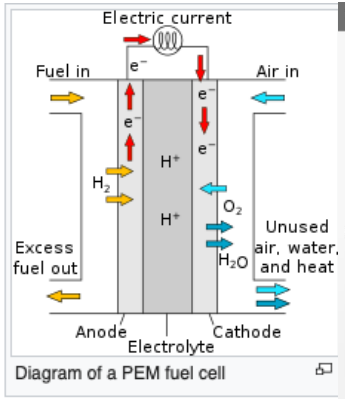
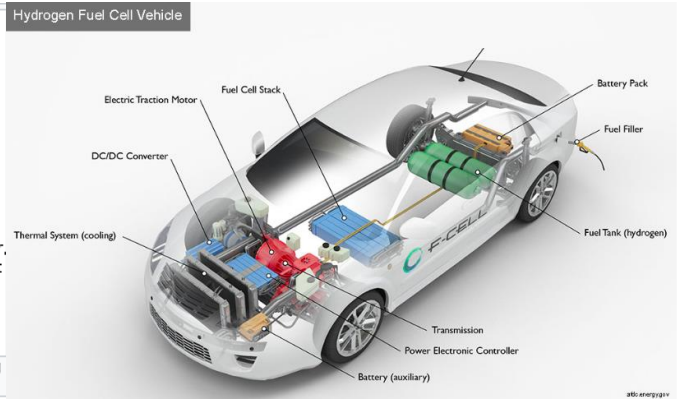


Diagram of a PEM fuel cell



- **Electric vehicle**
- **Battery / ultra-capacitor**
- **Low amounts of platinum in fuel cell**

ABERDEEN CITY COUNCIL

Bus Project

- The most successful bus fleet in Europe
- 1st generation vehicles
- 5 Year project ended in January
- 1.1million passenger miles

BON ACCORD
ABERDEEN
CITY COUNCIL

Hydrogen Vehicles

- 10 x Hydrogen buses, 2 x waste trucks, 1 x road sweeper, 25 x cars and 2 x vans
- 15 Wrightbus Double deck buses Q3 this year
- 20 x H2 Fuelled cargo bikes this year.
- Additional 120 vehicles planned to 2032
- Hydrogen trains 2023/24 ?

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Users

- ACC. Grow demand with council fleet
- Grampian health board
- Fire services
- Co-wheels car club
- Police Scotland in talks

ABERDEEN CITY COUNCIL

Where is Refuelling Available

- **Kittybrewster and ACHES Refuelling Stations, producing & dispensing H2 on a ‘green’ tariff**
- **TECA?**
- **Hydrogen hub - Commercial hydrogen**

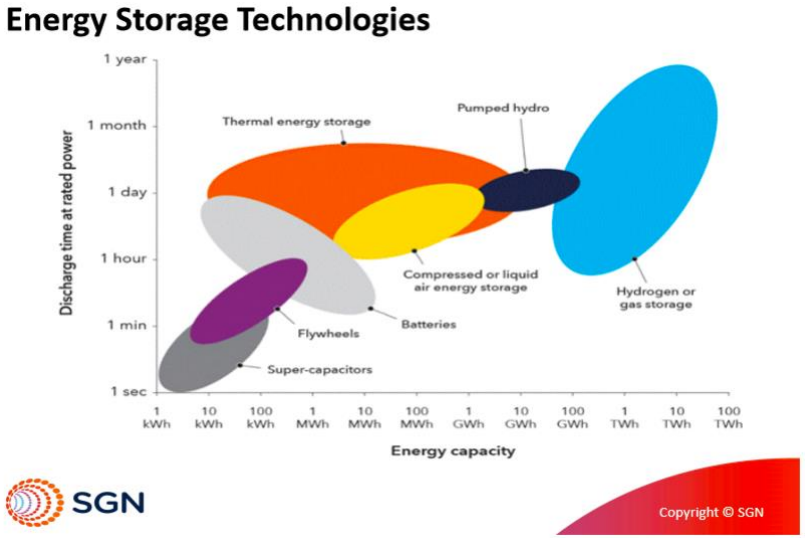
ABERDEEN CITY COUNCIL

Hydrogen Hub

- Elementenergy
- Survey prediction: 145 buses, 800 cars & 70 HGVs
- H2 requirement 3.5tonnes per day by 2030
- Increased pressure from Scottish Government; public sector fleet by 2025
- 50MW wind farm, 6,600 kg/day
- Export to other regions

ABERDEEN CITY COUNCIL

Energy Storage



SGN

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CITY COUNCIL

Claire Addison

Head of Regulation

Flexitricity

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New revenue opportunities through aggregation

Electric vehicles in the new energy economy

Flexitricity

Flexitricity in a nutshell

- First, largest and most diverse **demand response aggregator**
- First energy supplier to bring a DSR asset into the **Balancing Mechanism**
- **11,000+** demand response events
- **24-hour** operations
- Fully **automated**
- <1s to 30m response
- Flexible load, CHP, hydro, energy storage, UPS, standby
- **Positive and negative reserve**
- Industrial, commercial, public sector

Flexitricity

Bringing smaller customers into Flexitricity's Virtual Power Plant:
BEIS non-domestic Demand Side Response demonstration project, Quickturn

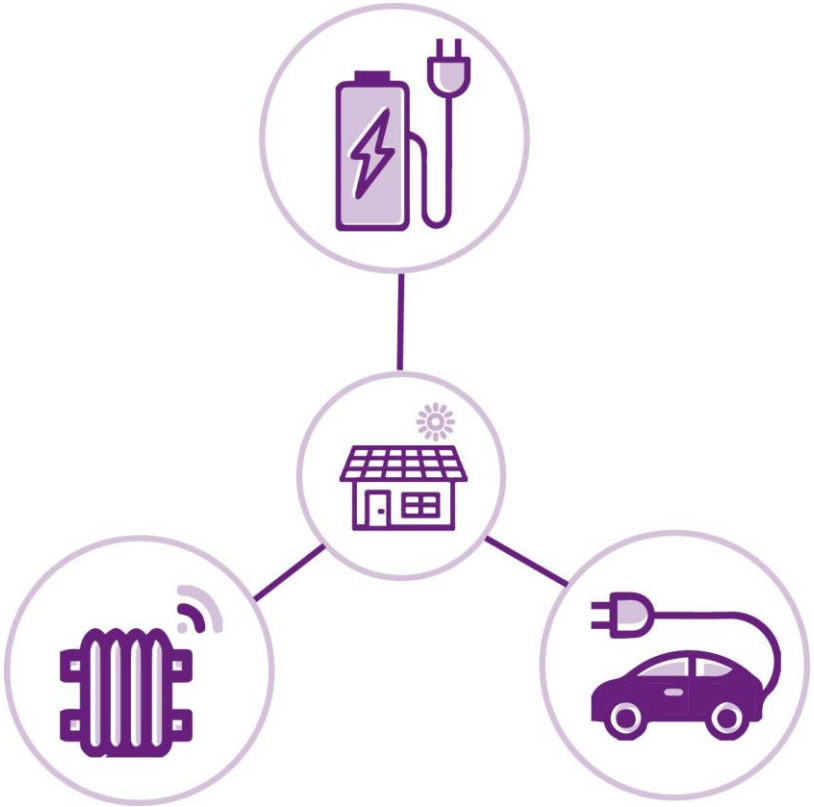
- Eight non-domestic companies flexing assets previously too small to be economical, inc Glasgow City Council and Scottish Water Horizons sites

- Reducing cost and size of outstation unit and trialling 'no visit' site commissioning, enabling us to flex smaller loads including EV fleets and building control assets (lighting, HVAC)

- Flexitricity in the process of becoming a Virtual Lead Party to bring smaller domestic customers into the lucrative Balancing Mechanism

Flexitricity

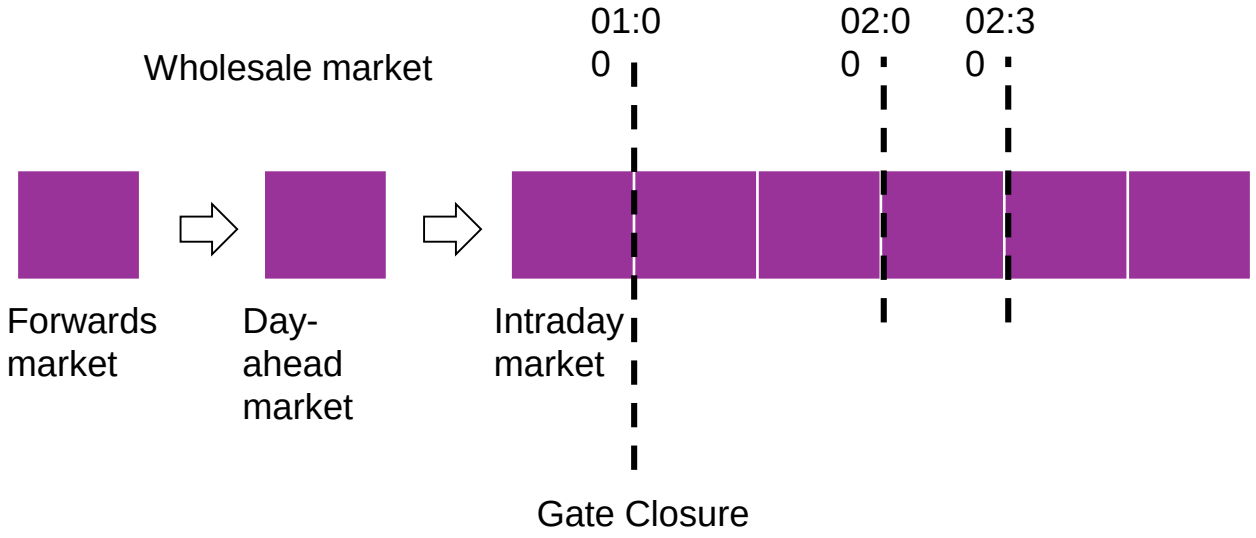
Bringing smaller customers into the Balancing Mechanism



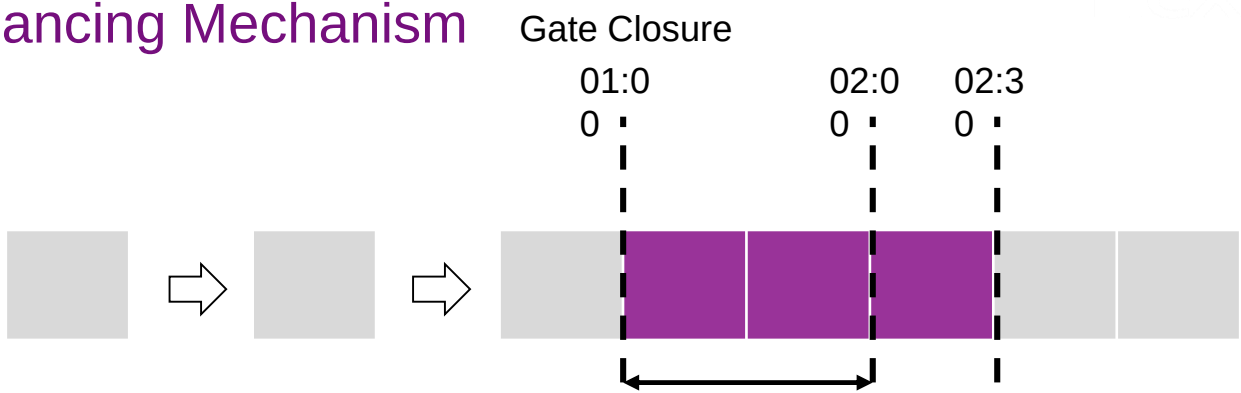
- Wider Access to the Balancing Mechanism (Q1 2020) and TERRE (summer 2020)
- Keep your own supplier and flex with your Virtual Lead Party (VLP)
- Requirements:
  - 1MW minimum within a Grid Supply Point Group (14 in GB; 2 in Scotland)
  - Half Hourly Settlement – Smart Meter or CoP11 ready meter in charge point
  - Customer parameters – when can we flex; what % charge do they need by when; minimum price for doing so etc

Flexitricity

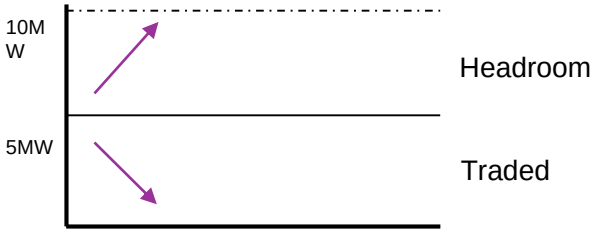
The Balancing Mechanism



The Balancing Mechanism



National Grid ESO view PNs, and B/O Data from flexibility.



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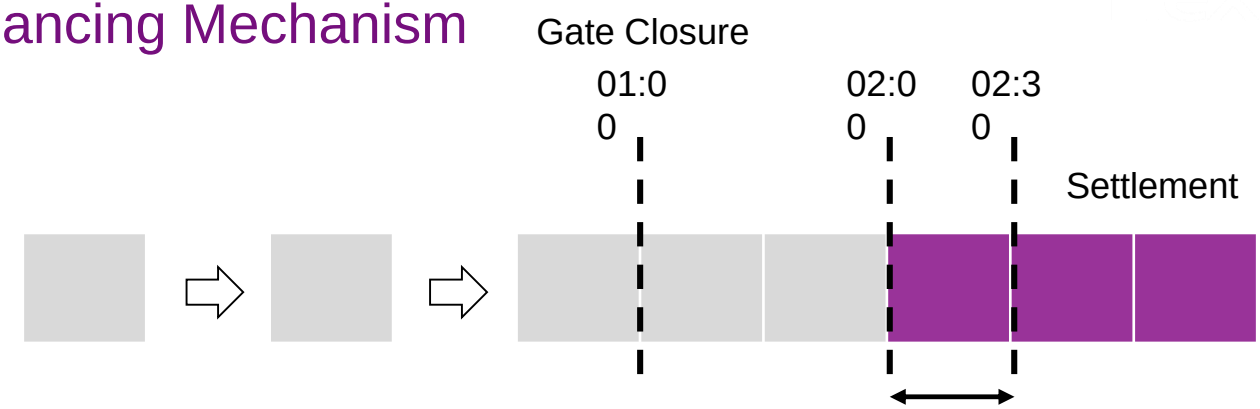
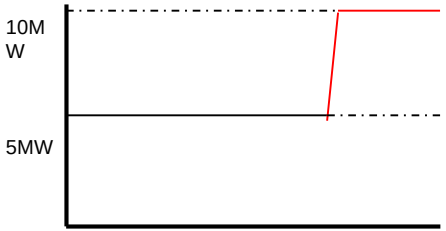
The Balancing Mechanism



B/O Acceptance



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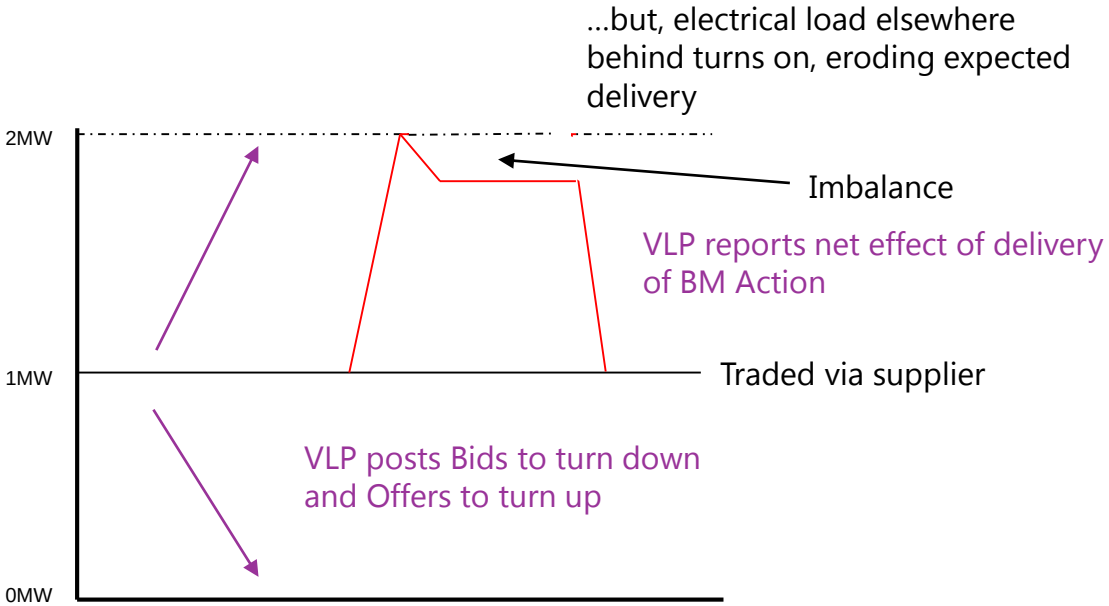
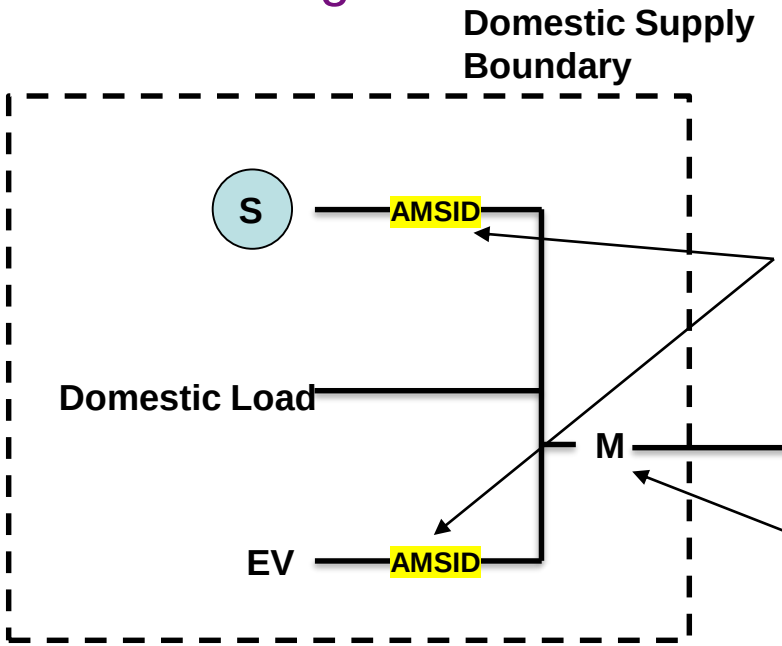
Wider BM Access



Flexitricity

P375: Metering Behind the Boundary Point



- P375 allows unit metering, "asset metering system identifier"
- Currently, BM requires reporting of settlement meter

Flexitricity overview

From our 24-hour control room in Edinburgh, Flexitricity runs the most complete set of demand response services in the industry.

Flexitricity brings revenue to British businesses, increase asset reliability, reduce national CO_2 emissions and helps to secure energy supplies.

We are Britain's demand-response leader.

Andrew Green

Programme Manager

Connected Places Catapult

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Transitioning to Zero Emission Heavy Vehicles: Choices, Challenges and Scaling

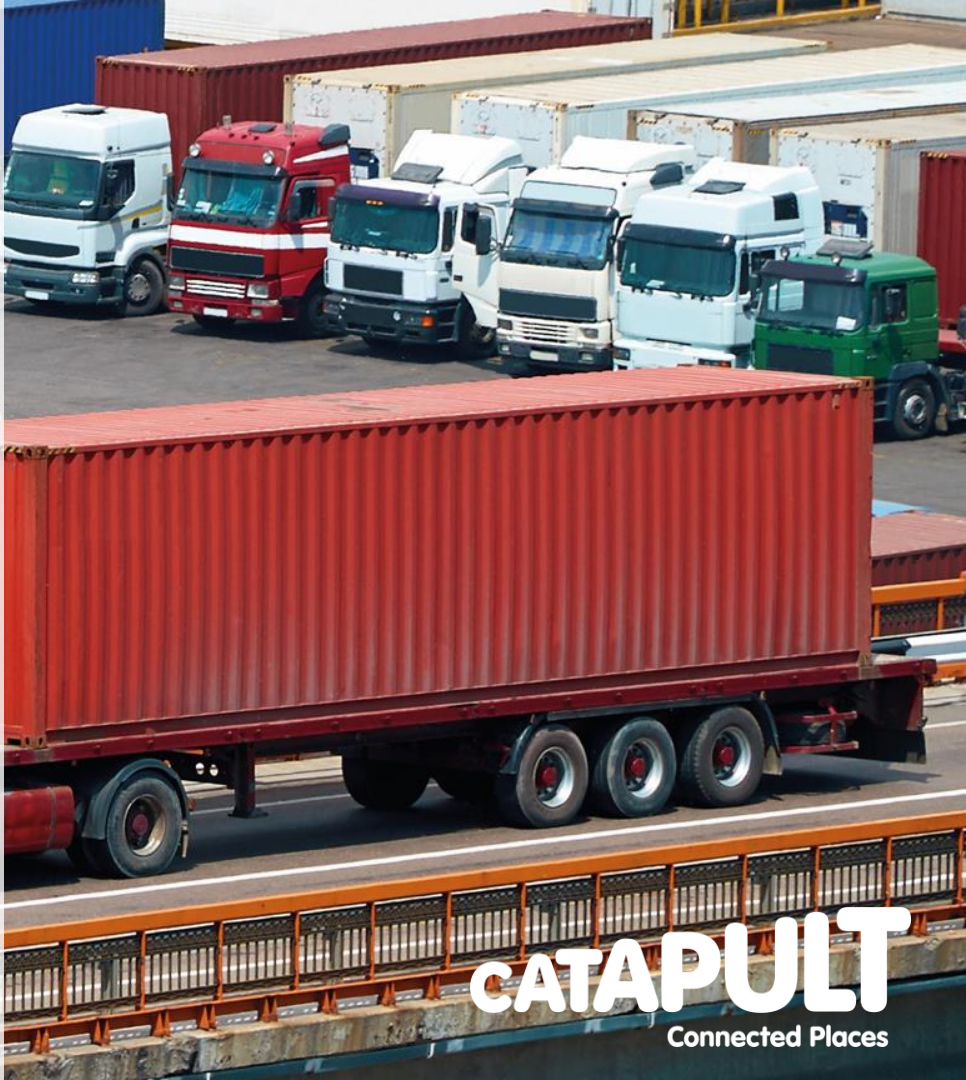
Scottish Renewables Transport Conference

Andrew Green
Programme Manager – Connected Places Catapult
24th January 2020

CATAPULT
Connected Places

Contents

- Brief Introduction to Connected Places Catapult
- Why focus on heavy vehicles?
- What are the choices for decarbonising heavy vehicles?
- Challenges and opportunities from the transition
  - Vehicle technologies
  - Refuelling Infrastructure
  - Whole systems issue
- Conclusions



Connected Places Catapult

Increasing the SUPPLY of innovative products and services that meet market demand
by helping companies to commercialise innovation through demonstration, testing, development of standards and market exposure

Boosting DEMAND for innovation from intelligent customers
By improving methods of modelling demand, and supporting tools, resources and platforms that cultivate confidence and capability among buyers

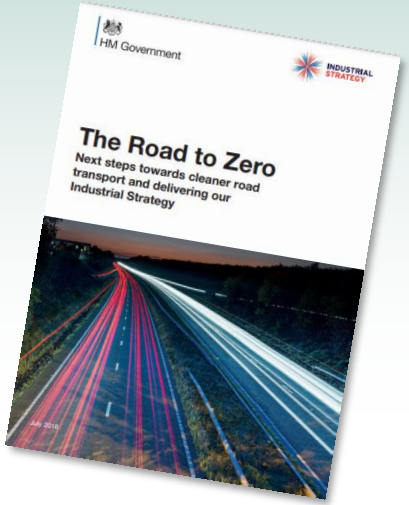
Identifying new areas for MARKET MAKING and DISRUPTION
by stimulating richer engagement between academics and businesses, access to data and partnerships with government and regulators

CATAPULT
Connected Places

Why the focus on Heavy Vehicles?

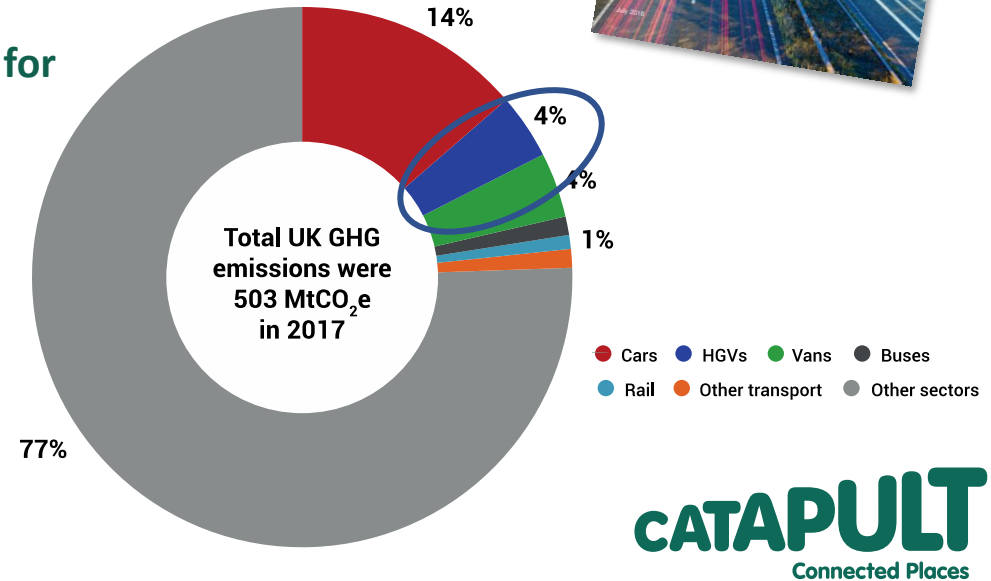
Most light vehicles can be electrified (using batteries only)

- Vehicles close to achieving sufficient range and reaching cost parity with petrol/diesel
- Plans for recharging infrastructure developing
- Natural partner with low cost, intermittent renewables – low asset utilisation with potential for grid-scale energy storage



Heavy vehicles (road, rail and sea) are critical for decarbonisation, but are more challenging

- High range requirement
- High utilisation
- Weight critical



"To reach net-zero emissions by 2050 it will be necessary for HGVs to move away from combustion of fossil fuels and biofuels to a zero-emissions solution"

Committee on Climate Change

CATAPULT
Connected Places

Decarbonising Heavy Vehicles – the Options

CATAPULT Connected Places

Hydrogen

- Long Range (> 500 miles)
- Rapid refueling
- Lowest infrastructure costs
- Valuable at system level (energy storage)
- Low W2W(*) efficiency ~ 30%

Battery Electric

- Moderate range, heavy batteries
- Recharging time may reduce utilisation
- Similar infrastructure cost to electric roads
- Heavy recharging loads at depot/ on road
- High W2W efficiency ~ 70%

Electric Roads

- Long range on the wires, low off
- Recharging on the go
- High Infrastructure cost
- Needs ‘just in time’ energy – challenging for supply
- Highest W2W efficiency ~ 85%

(*) Windmill to Wheel

Pictures courtesy of HV Systems, Tesla and Siemens

Challenges and Opportunities for Scale Up – Vehicle Technologies

Generic

- The three options have many common components – electric drive, power electronics, batteries (of differing sizes): start common platform development and optimisation now
- All the technologies are there – but room for cost reduction/performance improvement

Hydrogen

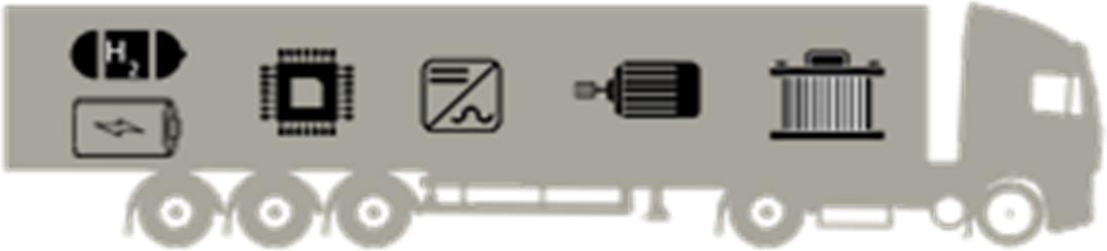
- Cost reduction for fuel cells: expect to be driven by volume

Battery Electric

- Energy density improvements to increase range: at least doubling needed (for the same cost) for practical European spec vehicles

Electric Roads (Pantograph)

- Cost-effective hybridisation (with conventional engine – need to work off wire while infrastructure in built)



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Challenges and Opportunities for Scale Up – Refuelling Infrastructure

Generic

- Align development of ‘refueling’ infrastructure with roll out of vehicles, so that infrastructure has high utilisation and vehicles are able to refuel easily

Hydrogen

- Conducive to applications which are back to base, with hydrogen station at the base (e.g. bus fleets, freight movement from ports) or regular ‘A to B’ with station at each end
- Build hydrogen supply in cost-effective way: ‘brown’, ‘blue’ and ‘green’

Battery Electric

- Depot charging for ‘back to base’ fleets, supplemented by rapid chargers to top up at strategic locations (e.g. motorway services)
- Will need very high power rates to avoid loss of vehicle utilisation

Electric Roads (Pantograph)

- Need substantial level of coverage before users will switch:
  unless maintain diesel hybrid (risk of unintended consequences?)
- Risk of stranded assets if battery or fuel cell innovation moves faster than expected

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Challenges and Opportunities for Scale Up – Whole Systems

Generic

- Availability of ‘fuels’ will depend on wider developments in the energy system: transport energy requirements small compared to heat. Does transport lead or lag?

Hydrogen

- Need for hydrogen is robust across a range of energy system scenarios: can provide significant, grid-scale storage
- Lowest cost hydrogen if Carbon Capture & Storage is implemented: most beneficial use of biomass at system level is to make hydrogen – and store CO_2 produced
- Caution around arguments that hydrogen can be made with ‘free’ excess renewables: there will not be enough ‘spilt wind’ and will result in low utilisation of expensive capital

Battery Electric

- Challenge of getting sufficient electricity to large depots or rapid chargers
- ‘Grid support’ opportunity for light vehicles does not hold for high utilisation vehicles

Electric Roads (Pantograph)

- Strategic road network is reasonably well aligned with main grid – could work together
- Little energy storage, so energy will always be needed in the right place at the right time

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Conclusions

- Several options remain in play for decarbonisation of heavy vehicles – each have significant benefits but potential drawbacks
- Not likely to be a winner until commercial scale trials are undertaken: this is likely to need significant policy (and financial) support
- Given the need to develop both vehicle and fueling infrastructure, and interdependency with other changes in the energy system, the transition will need long term, consistent policy support before fully market-led commercial deployments are possible

Fraser Crichton

Corporate Fleet Manager

Dundee City Council

Tweet @ScotRenew
#SRTRANSPORT20

Dundee City Council: “Transforming a City”

70,0000 Hub Charging Sessions

20% Electric Taxis

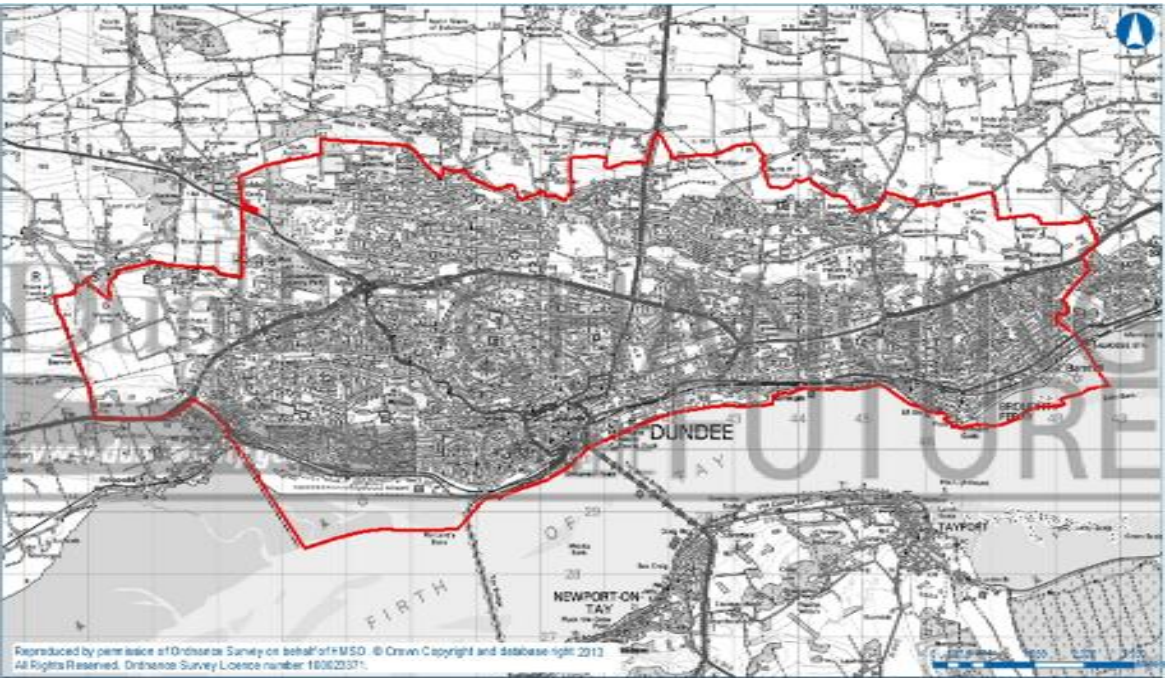
Largest Council EV Fleet

DUNDEE'S POLLUTED STREETS

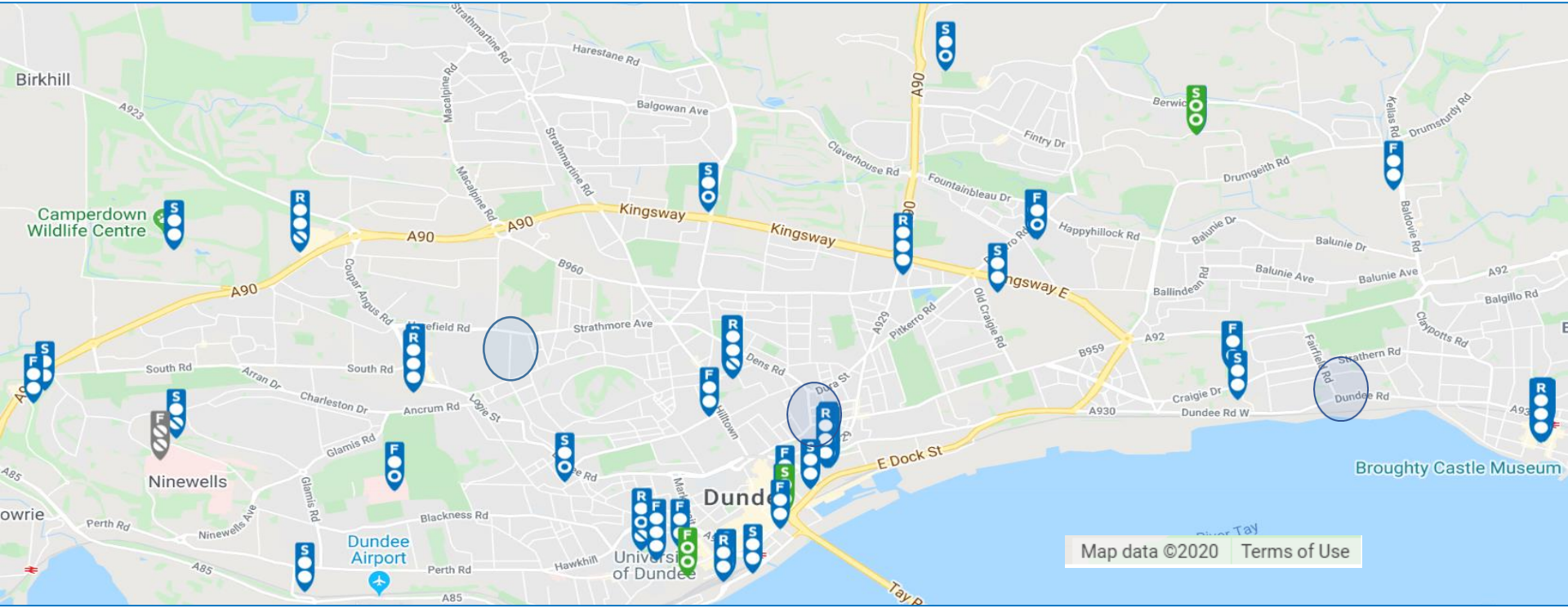
*"By **2032** all new petrol and diesel cars and vans to be phased out in Scotland - eight years ahead of targets set by the UK government"*

Dundee declared the whole city an "Air Quality Management Area"

"Worst MOT failure rate"

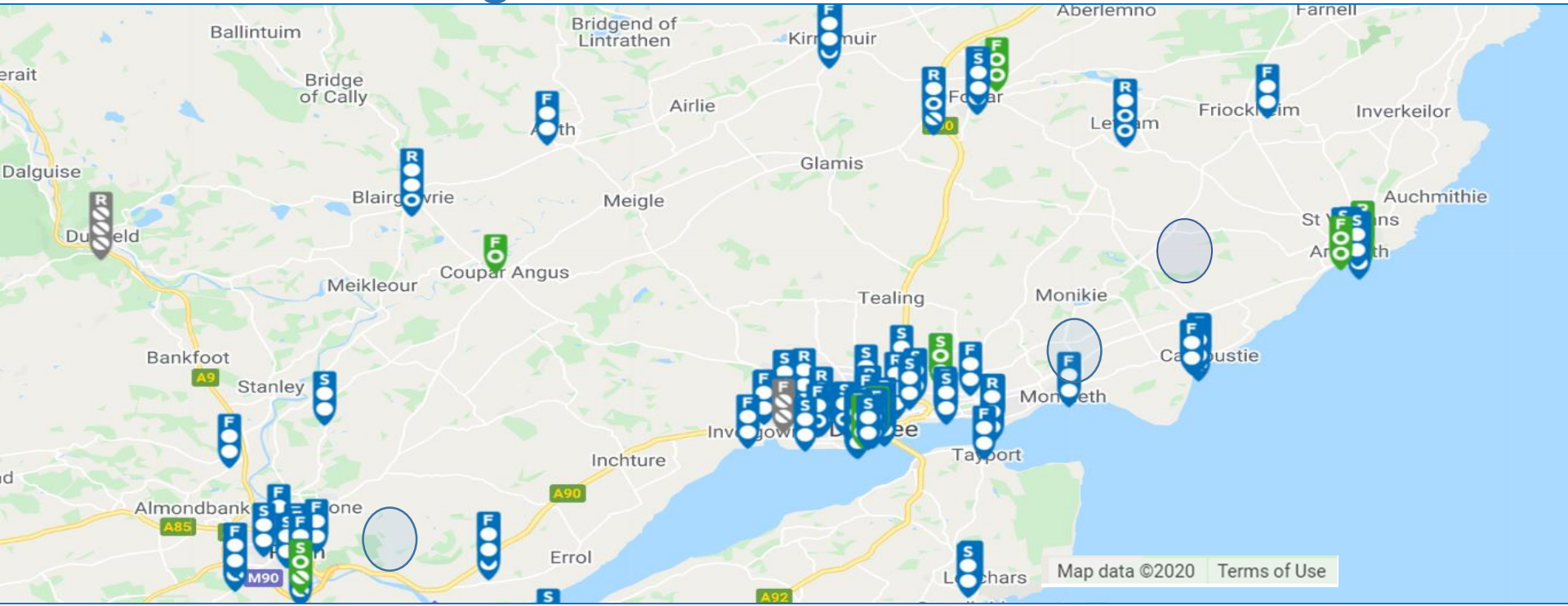


Dundee EV Charging Infrastructure



3 x Rapid Charging Hubs

Regional EV Infrastructure



Regionally supported infrastructure

Princes Street Hub

3 EV hubs across the city, 4th hub built in 2020

Princes Street Hub

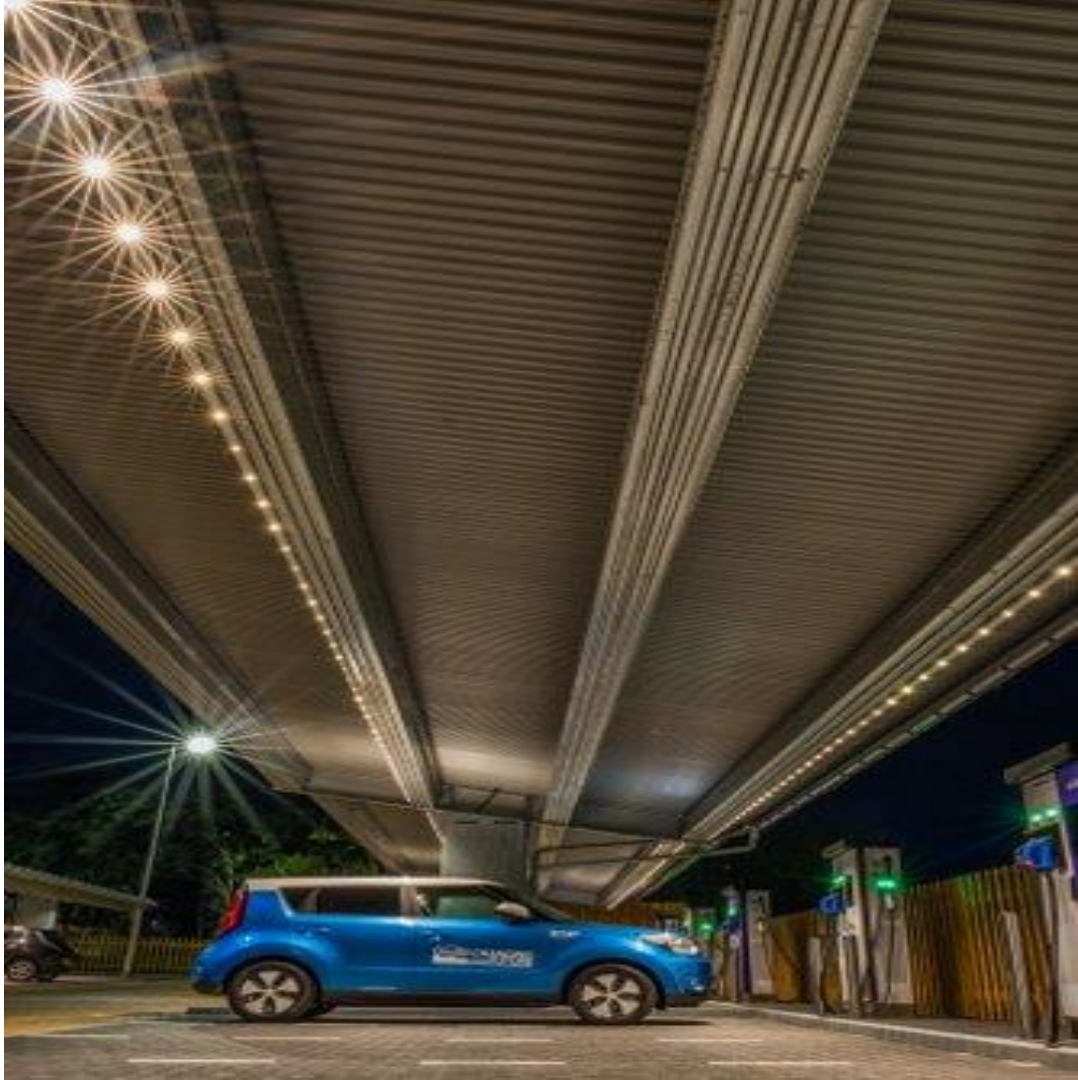
Figures for 2018 – 19

20,000 Sessions in Year

31.58MWh Solar generation

444.03MWh Charging demand

Storage has increased the solar utilisation for the year from 88% to 97%

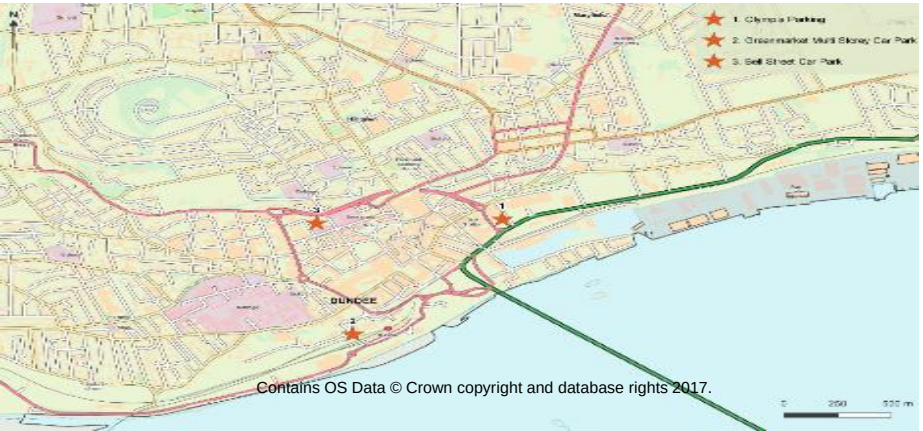


EV Tariff Charging

Element	Price / %	Funding 2019/20
Electricity Cost	Average12p per kwh	Customers & Air Quality & DCC
DNO Capacity Charges	5.4p per KVA per day	Transport Scotland
Back Office Admin Fee	3.7%	Transport Scotland
Transaction Fee	£0.36 per transaction	Customer
Banking Fee	2.95%	Customer
Merchant Fee	1.5%	Customer
Maintenance Costs	Variable	Transport Scotland

Electric Charging Car Parks

Residential parking/Low emission zone



Integrated Mobility

The MILL

A new innovation partnership to make Dundee an international test bed for smart mobility solutions.

Dundee City Council

EUROPE & SCOTLAND

Urban Foresight

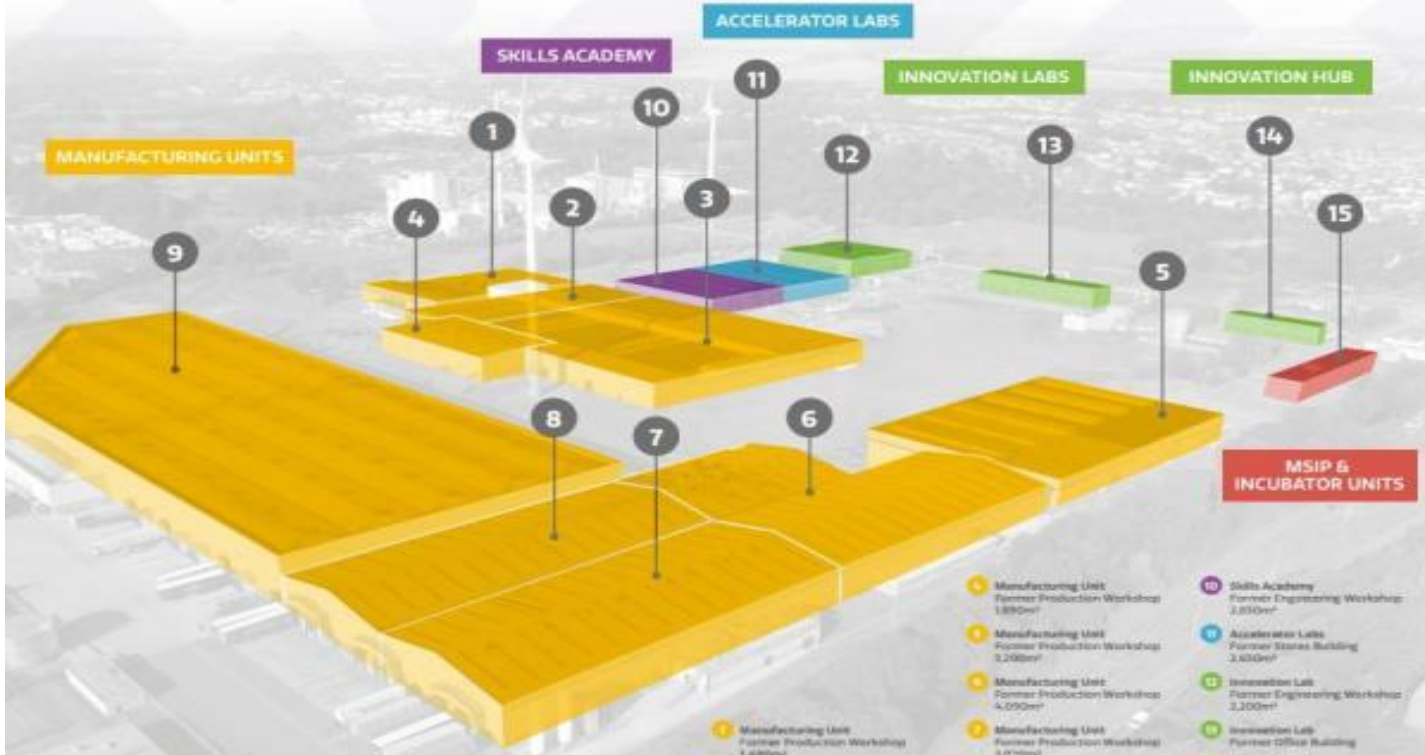
smart cities scotland

Share MORE Platform

Integration of mobility services into a single user-centric mobile application focusing on low carbon transport.

SCOTLAND'S HOME FOR INNOVAT!ON

MICHELIN–SCOTLAND INNOVAT!ON PARC



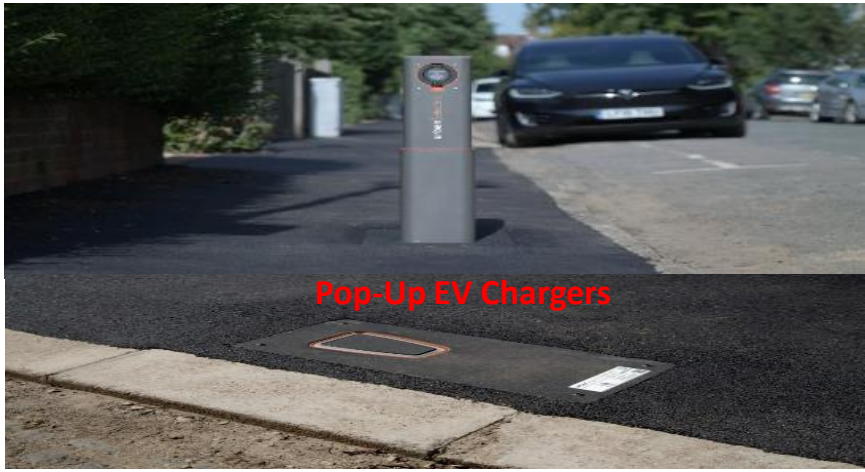
Future Projects

1st Electric Intercity Coach in UK

The Coach

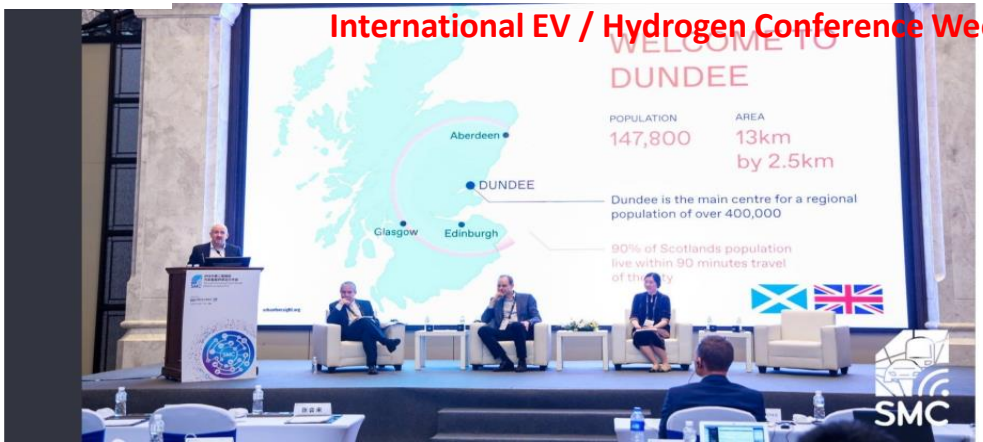
We'll be using the Yutong TCe12, the only right-hand drive electric coach available today

- **281kWh liquid-cooled battery**
  Real-world range of over 300km
- **120kW CCS charging**
  Full charge within three hours
- **High spec interior**
  Leather seats, USB points and wifi
- **Fully accessible**
  40-45 seats and a wheelchair space



Pop-Up EV Chargers

ELECTRIC RCV



International EV / Hydrogen Conference Week

Dundee has been named the "coolest little city in Britain'

by GQ Magazine

Dundee is Europe's most visionary EV city

Simon Gill
Head of Whole System and Technical Policy,
Scottish Government

Fraser Crichton
Corporate Fleet Manager, Dundee City Council

Cllr Philip Bell
Hydrogen Spokesperson, Aberdeen City Council

Claire Addison
Head of Regulation, Flexitricity

Andrew Green
Programme Manager, Connected Places Catapult

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scottish renewables

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TRANSPORT CONFERENCE

19 FEBRUARY 2020 **GLASGOW**

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ice Scotland

EVENT SUPPORTER

energy technology partnership

OFFICIAL MEDIA PARTNER

reNEWS

Watt to do?
Grid, technology and EVs

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Hannah Smith

Director

ICE Scotland

Tweet @ScotRenew
#SRTRANSPORT20

Neil Swanson

Director

Electric Vehicle Association Scotland

Tweet @ScotRenew
#SRTRANSPORT20

Electric Vehicle Association Scotland

Neil Swanson
info@eva.scot

EVA Scotland
Electric Vehicle Association Scotland

EVA Scotland
Electric Vehicle Association Scotland

About EVA Scotland

- Formed in 2011 by 7 electric vehicle drivers
- Became a non-profit Community Interest Company (CIC) in 2017
- Aims to be the voice of the electric vehicle movement all over Scotland
- Supports the electrification of all forms of transport
- Affiliated with AVERE (European Association for Electromobility)

Demanding Consumers…

- Early adopters (now):
  - More tolerant and understanding
  - Often engaged with whole system thinking concepts
  - Willing to experiment
  - Financial benefits clearer
- Early Majority(April onward):
  - Financial benefits biased in 0% Benefit in Kind
  - Less awareness of potential whole system role
  - Mainstream expectation of technology performance

Charging need or charging want?

Journey (rapid) charger (50 kW DC, 43 kW AC)

- Simple to use, public or private
  - One card to rule them all?
- Public networks
  - Interoperable
  - Reliable
  - Available
  - Visible
- Home
  - Simple smart charging, set and forget

Smart Charging considerations

Integration with domestic solar or wind.

- Lifestyle Charging
  - No requirement for a dedicated journey to charge the car for most people.
  - Charge at the shop, cinema, gym, work, leisure.
  - Average daily mileage in Scotland is <30 miles per day (Transport Scotland and DfT MOT data correlated)
  - Controlled grazing, not guzzling
  - Behaviours driven by price point
- Winning trust to manage charging
- Early engagement to win public confidence
- Managing user expectations
- Charging power control has impact
  - Lower power= lower efficiency (Forman,Glitman,Roberts 2013 Codani et al 2017)

Rural Community Engagement

- Development of charge infrastructure to encourage visitors to visit
  - Possible involvement through existing community funds
  - One size will not fit all.
  - Provision of battery storage in such projects, either independently or in partnerships:
    - Local network support, reducing/mitigating need for network reinforcement.
      - Supports the local charge point
      - Supports the local community
      - Grid services
    - Energy aggregator involvement

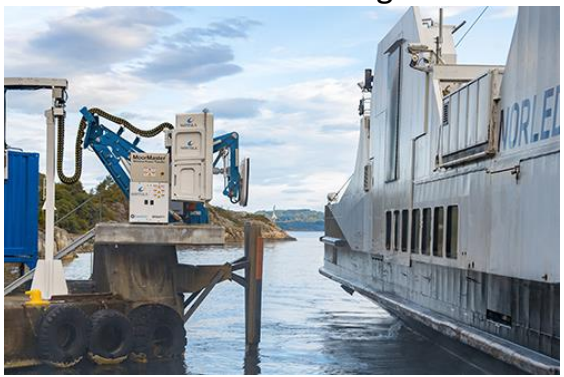
Communities and people

- Getting the mix right.
  - Integration with active travel and public transport
  - Pricing to encourage appropriate behaviours by drivers
    - Higher speeds, higher costs, shorter dwell time, improving turnaround and revenue
    - Slower speeds longer dwell time, potential spend in local economy
  - Grid impact
    - Users appreciation of infrastructure addressed by price point.
    - Business models which push toward fastest charging speeds will *increase* the cost of driving
      - Greatest impact likely on the least affluent members of society, not equitable

Everything else?

- Vehicle to Grid
  - Clarity on benefits for consumers
- Bus and Taxi
  - En-route charge infrastructure
- Rail
  - Increase freight & electric freight
  - Further electrification-already outlined
  - Hybrid motive power with en-route charging

- Freight
  - Charging infrastructure will be significant
  - Business model change required
    - Inter-motive and intermodal interchanges
    - Impact on people
  - Maritime
    - Electric and hybrid ferries
    - Electric and hybrid freight
    - Huge infrastructure undertaking.



Wärtsilä Inductive ferry charging

Euan Norris

Stakeholder and Community Engagement Manager
SP Energy Networks

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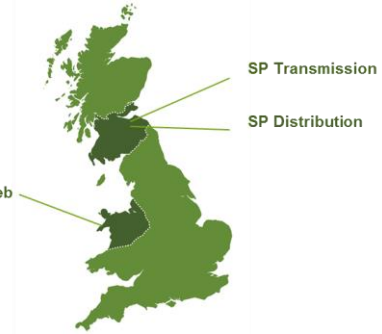
ScottishPower Group

Scottish Renewables Transport Conference 2020:

Watt to do? – Grid, Technology & EVs

Euan Norris
Stakeholder & Community Engagement Manager

SP Energy Networks



2million
customers in Central and Southern Scotland

£7billion
Distribution and Transmission investment plan

Safe and reliable electricity supply
24hours
a day
365
days a year

Distribution Network:
30,000
substations
40,000km
overhead lines
65,000km
underground cables

65%
of our customers rate our service 9 or 10 out of 10

Transmission Network:
Over
4,000km
overhead and
320km
underground lines
132
substations

1.5million
customers in Merseyside, Cheshire, North Wales and North Shropshire

Workforce:
2,972 employees **2,500** contractors

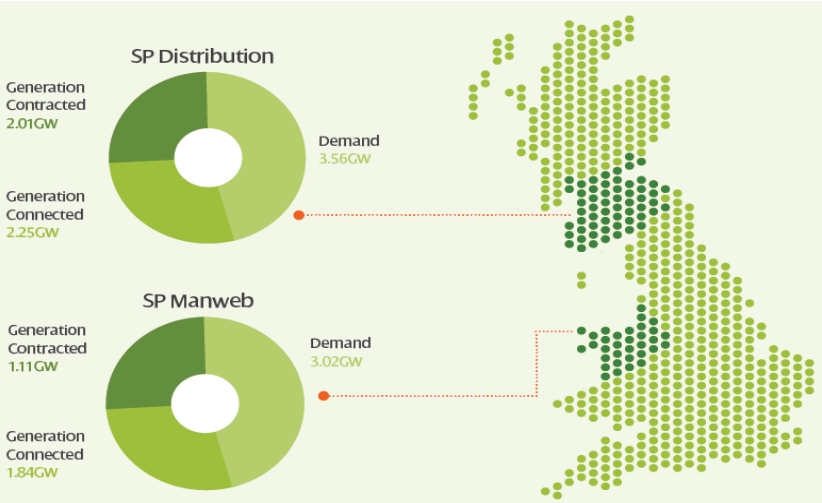
As a regulated monopoly we:

- **Provide an Inclusive Universal Essential Service**
- **Recover our costs from all customers . Fairness of charges is a priority.**
- **Prioritise customer service with a particular focus on vulnerable customers**

Recruiting over 100 Apprentices and Graduates every year

Our Experience

SP Energy Networks has connected more Renewables than any other Network Operator as a direct result of collaborative working with Scottish, Welsh & UK Governments and Ofgem



- ~£100bn investment in grids since 1990
- A 17% reduction in the cost of transporting electricity since 1990's
- Record levels of customer service
- Power cuts halved since 2001
- £8bn of benefits could be achieved by innovation schemes

Investments in networks enable much wider environment and economic benefits

SP ENERGY NETWORKS
ScottishPower Group

Better future, quicker

Smart Communities

We have a unique opportunity to build on our industry expertise and international experience to deliver smart communities that meet our customers needs

Social: Increase social capital

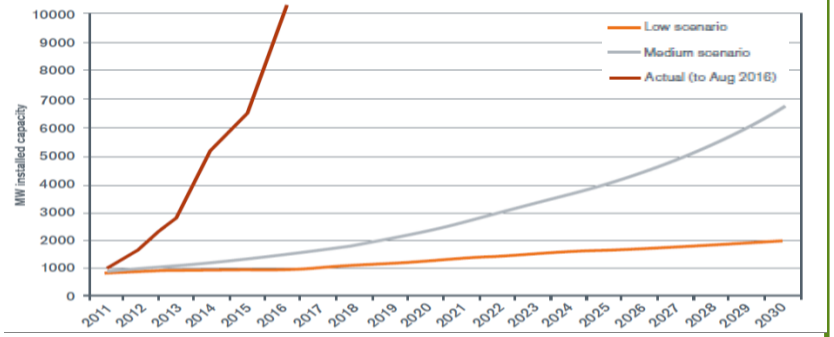
Economic: Direct Impact (jobs, infrastructure investment) and indirect impact (healthier lives)

National & Local Government: Increase participation

- Efficiency, mobility and connectivity
- Fiscal Savings & Economic Growth
- Quality of Life
- Greater powers and responsibility
- A process not an event

Accelerating Pace of Change

BEIS/Ofgem 2030 PV uptake estimated in 2012 was reached in 4 years!



Source: Ofgem's Future Insights Series

EV uptake forecast to accelerated into the 2020's

	2019	2025	2032	2040
EV penetration (cars)	0.75%	6.5%	35%	75%
UK EV Stock	250,000	2.5m	11m	25m
Annual Energy Consumption	0.7 TWh	5 TWh	22.5 TWh	50 TWh

Increasing need for anticipatory investment in network upgrades to facilitate the pace of change

Network companies need to be at the heart of our Low Carbon future

SP ENERGY NETWORKS
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Working In Partnership

Networks are a key enabler to decarbonisation of transport and heat through electrification

TRANSPORT SCOTLAND

SP ENERGY NETWORKS

Scottish & Southern Electricity Networks

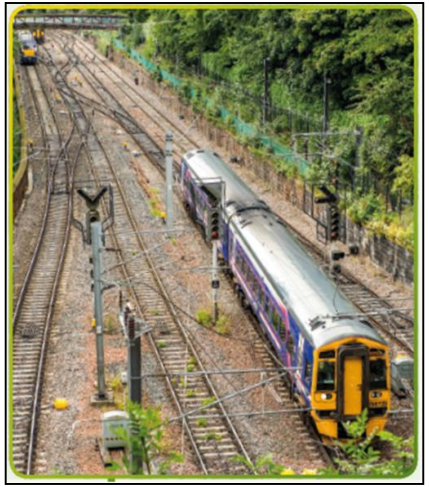
- Each new domestic EV purchased is the equivalent to adding a new house onto Scotland's electricity network
- Forecast 2032 EV uptake is equivalent to doubling Scotland's peak electricity demand
  - *If they all switched on at the same time e.g. when storms & power cuts are forecast!*
- This will require up to **£500 million** to be invested in the electricity network across Scotland by 2032 to support this uptake
  - *Innovation and flexibility are essential to satisfy pace and could enable savings up to 40%*

Networks will distribute Scotland's growing renewable energy resource to meet this new demand

Beyond Electric Vehicles

Networks are a key enabler to decarbonisation of transport and heat through electrification

- Domestic heat pumps could have more than double the impact of EV chargers
  - *Impacting off-gas-grid rural and suburban customers first*
- SPEN's RIIO-T2 transmission investment plans include £15 million for two rail electrification projects (by 2026)
  - *Could rise to more than £60 million if four other proposed projects progress*
  - *SSEN transmission & both Scottish distribution networks will need equivalent investment*
- Scottish Government planning **100% rail electrification** by 2035
- Need to consider all modes of transport in this transition



Working together to deliver Scotland's Low Carbon and wider societal ambitions

Accelerating Smart Communities

1. **Smart Solutions and Innovation are essential to ensure lowest cost solutions**
   - however the physical limits of the network need to be maintained in order to ensure the safe and reliable operation of the network

2. **Continued investment is key but needs to be fair and equitable for all**
   - anticipatory investment in network upgrades key to facilitate the uptake of electric vehicles
   - “Low Regrets” investment will future proof the network enabling greater electrification

3. **The Smart, Low Carbon Economy will only be possible with a strong and reliable Distribution and Transmission Network providing the backbone**
   - Societal and individual reliance on electricity will increase through the low carbon transition

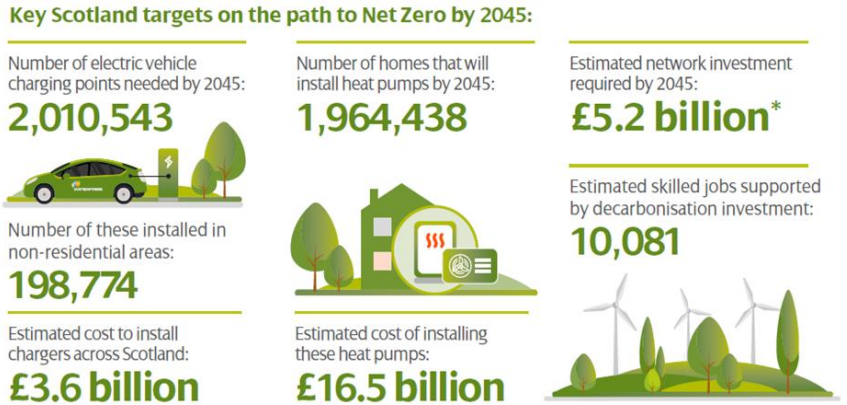
Helping deliver universal access to the benefits of decarbonisation

Better future, quicker

Whole System Approach

Networks are a key enabler to decarbonisation of transport and heat through electrification

- **Costs in one area enabling savings and benefits in another**
  - *Increased EV electricity costs < savings in diesel/petrol*
  - *Investment in smart network systems can enable greater volumes of renewable generation to connect*
- **Greater certainty will drive commitment and pace**
  - *Enabling opportunity for efficiency across different modes of transport and heat*
- **Opportunity to future proof when investing in 40-80 year assets**
  - *Efficiency recognised by UK Infrastructure Commission*



* Based on SPEN analysis, the co-ordinated and strategic use of SMART planning and active management techniques has the potential to reduce overall network reinforcement costs by 30%-40%.

https://www.spenergynetworks.co.uk/pages/zero_carbon_communities.aspx

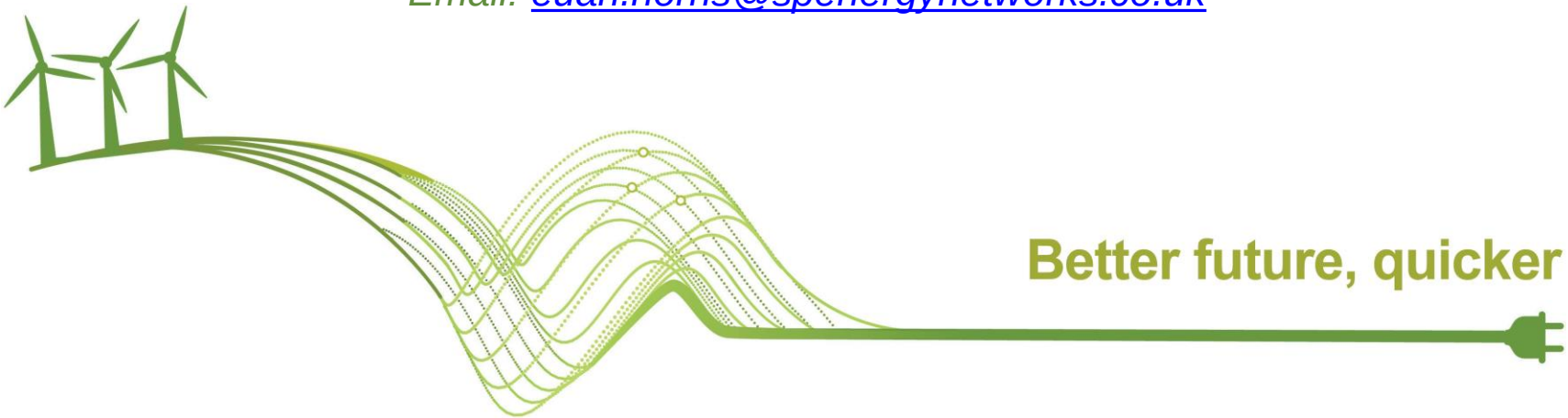
Working together to deliver Scotland's Low Carbon and wider societal ambitions

Better future, quicker

SP ENERGY NETWORKS
ScottishPower Group

Euan Norris
Stakeholder & Community Engagement Manager

Email: *euan.norris@spenergynetworks.co.uk*



Jim Gibson

Chief Operating Officer

AFC Energy

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AFC Energy

Hydrogen Power for a Better World

Hydrogen: Fueling the Growth in Battery Electric Vehicles

Scottish Renewables Transport Conference 2020

Glasgow
19 February 2020

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Introduction to AFC Energy

Jim Gibson – Chief Operating Officer

Emergence of the Hydrogen Economy

In September 2018, AFC Energy was invited to join the global “CEO led” Hydrogen Council alongside several of the world’s leading energy, industrial and automotive brands. The Hydrogen Council summarised the global opportunity across the Hydrogen sector as:

MEET **18%** OF THE WORLD’S ENERGY DEMANDS

SUPPORT AVOIDANCE OF **6 Gt. OF CO2** EMISSIONS

GLOBAL REVENUES OF **USD 2.5 TRILLION** ANNUALLY

30 MILLION JOBS CREATED ACROSS THE VALUE CHAIN

AFC Energy - Introduction

Who We Are:
Recognised global leader in Alkaline Hydrogen Fuel Cell technology

Our Core Vision:
To be a leading provider of low-cost clean energy solutions across the Hydrogen Value Chain

Key Short-Term Market Focus:

- Electric Vehicle Charging
- Distributed Power Generation

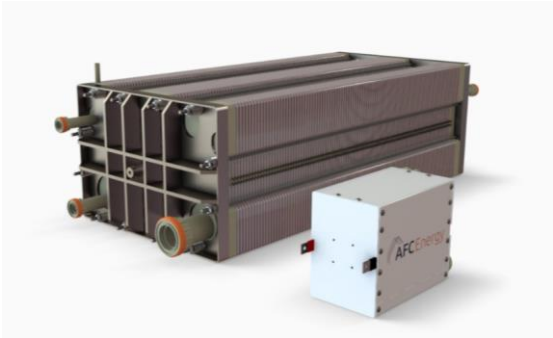
Our Technology has been developed to:

- be modular, scalable and easily transportable
- have high efficiency (~60% at fuel cell module)
- can utilise ammonia as hydrogen feedstock to fuel cell
- support glide path to net zero emissions when used in portfolio technology setting
- integrate with energy storage for fast response / rapid power dispatch
- be grid independent or grid supportive, and
- enable flexible siting – outdoor, enclosed, containerised

AFC Energy's Technology Platform

HydroX-Cell(L)™ Alkaline Fuel Cell	HydroX-Cell(S)™ Alkaline Fuel Cell
Modular Stack 10kW	
Scalable to multi MW applications	
Accepts Low grade H_2	
Zero Greenhouse emission	
Liquid Electrolyte	Solid Membrane
Stationary	Stationary and mobile
Operation density 220mA/cm^2	Operations density >1000mA/cm^2
Available now	Available 2022

AFC Energy's Technology Scalability



HydroX-Cell(L) 10kW stack (left) and HydroX-Cell(S) 10kW stack (right)

72kWh (scalable) Hydrogen Fuelled EV Charger Unit

40ft ISO Container – 160kW (June 2020) / 400+kW (June 2021) / 1-2MW (2022)

Multi-MW Rendered Off Grid Fuel Cell Installation

So Why EV Charging?


RAC

Breakdown Cover Insurance Route Planner Sho

DRIVE News Car reviews Travel Advice and guides Features Search

Home > Drive > News > Motoring news > Concerns raised about UK power cuts - how ready are we for electric vehicles?

Concerns raised about UK power cuts - how ready are we for electric vehicles?

1st Aug 2019

Share

The UK's readiness for a future without traditional fuel has caused some debate in recen weeks – but should you be concerned?

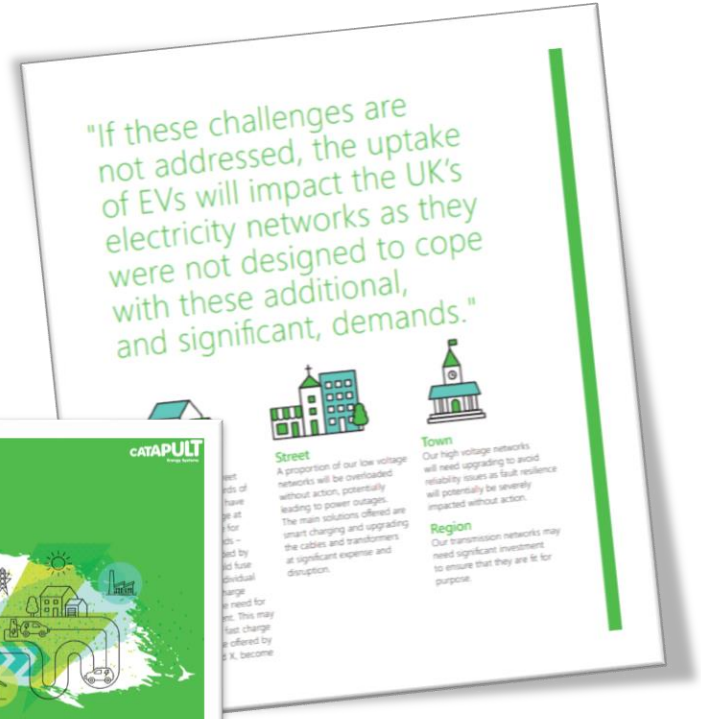
Mark Salt, chief executive of SaveMoneyCutCarbon, recently warned that a potential surge in EV sales in the U could lead to widespread power cuts, as the National Grid struggles to cope with demand.

But with EV sales already growing, ahead of the UK's 2040 ban on petrol and diesel cars, are we ready to go green or is the UK still on the EV starting grid?

In a recent MailOnline article, Mr Salt claimed there might not be enough energy to power the switch to EVs, particularly if the technology generating the power is not upgraded.

'A rapid upsurge in hybrid and full electric vehicles could create real concerns,' he said.

The warning comes off the back of a series of power outages that struck various parts of the UK earlier this


"If these challenges are not addressed, the uptake of EVs will impact the UK's electricity networks as they were not designed to cope with these additional, and significant, demands."

Street

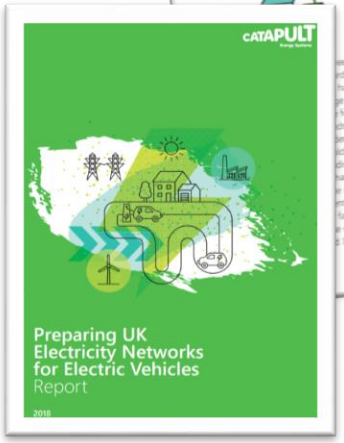
A proportion of our low voltage networks will be overloaded without action, potentially leading to power outages. The main solutions offered are smart charging and upgrading the cables and transformers at significant expense and disruption.

Town

Our high voltage networks will need upgrading to avoid reliability issues as fault resilience will potentially be severely impacted without action.

Region

Our transmission networks may need significant investment to ensure that they are fit for purpose.



So Why EV Charging?

THURSDAY
JANUARY 2020

Do we need introducing new words? Probsolutely
Susie Dent
P10

Electric car surge risks national grid overload

» Report warns of potential for mass power cuts with increased demand on electricity suppliers if not managed properly

» Sales of zero-emission and hybrid vehicles expected to soar in next two years

» Task force urges ministers and industry to introduce 'smart charging' system

P6

Y64 HLX

'At times I completely disrespected myself'
Aimee Lou Wood on sex and Uncle Vanya
P36

Putin's

Minsters warned Britain's electricity network needs URGENT upgrade to cope with increased demand from electric cars or risk future blackouts

- Electric Vehicle Energy Task Force says urgent network investment is needed
- It warned that without upgrades to cope with the demand from electric cars, blackouts could be more common
- In August, the network went down due to imbalance, leaving 1m without power

By ROB HULL FOR THISISMONEY.CO.UK
PUBLISHED: 12:38, 16 January 2020 | **UPDATED:** 13:03, 16 January 2020

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The need for urgent investment in Britain's electricity network to cope with the rise in popularity of plug-in vehicles has been highlighted once more in a new report.

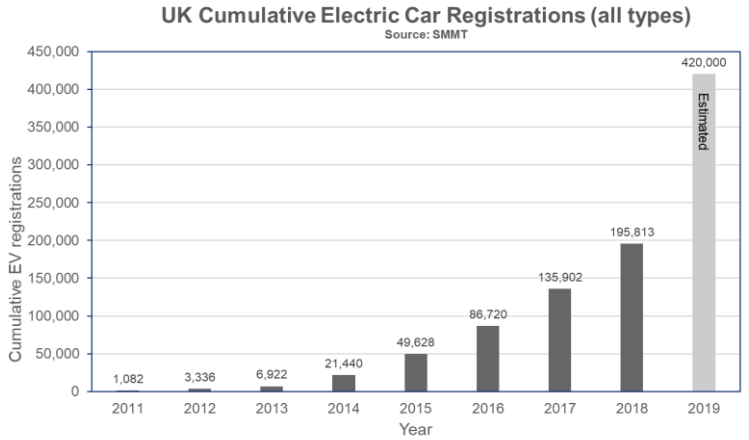
With pure-electric passenger car registrations rising by 144 per cent in 2019 and due to soar in the coming years, the Electric Vehicle Energy Task Force claims the

AFC Energy's H-Power™ EV Charger

The Electric Vehicle Revolution

The EV has arrived and is an increasingly large proportion of the market.

- By 2025 an estimated 100 million EV's will be on the road worldwide.
- In 2019 UK EV sales are up by 378% (SMMT).
- Doubling total number of EVs on the UK roads.
- The market will continue to grow rapidly to meet Government targets.
- To resolve consumer concerns over range battery performance and charging infrastructure will increase



EV Charging: The Current Paradigm

Currently…

Most EV's are charged at home, or at a third party, network connected charging point.

Need to grow en-route and destination charging infrastructure to improve usability and eliminate range anxiety

There are six risks for EV charging operators

- Can my DNO supply the power needed?
- When can my DNO upgrade its supply and how much will it cost?
- How fast will EV grow?
- What proportion of charging will be made en-route or at destination?
- How will battery size and technology change?
- Will government policy change?

With so much uncertainty can you afford to

- Estimate demand, finance and wait for a grid upgrade now
- Wait for demand to grow and potentially lose control and revenue

AFC Energy's solution - low entry cost which can grow with demand

Risk – Network Reinforcement

Some context to these points:

This year, a large Council approached their DNO to reinforce their power supply…

They were told that a realistic time frame for works to start was …

7–10 years

Waiting this long would mean failing to meet policy makers expectations.

Why could this happen, because there are :

- Technical constraints,
- Planning constraints,
- Environmental constraints,
- Political constraints, and
- Financial constraints…amongst many others.

Context : One Car = New Housing Estate

Early electric cars had low charging rates:

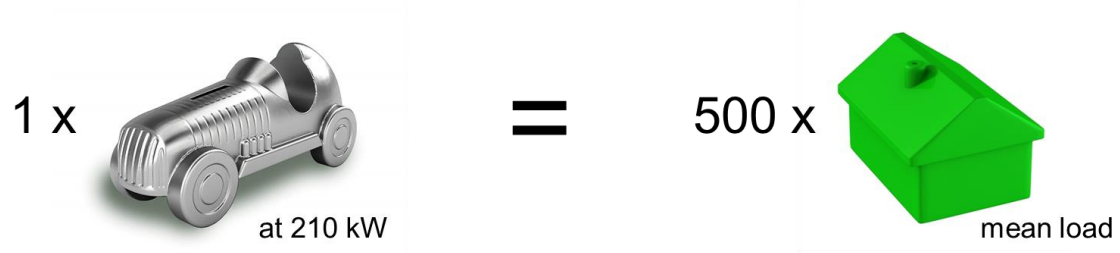
- A typical electric car (Nissan Leaf) has an overnight charge rate of 3.6 kW, and a fast charge rate of 46 kW
- Industry is already launching vehicles with faster charging rates
- The current fastest charger is ~350 kW, and the current fastest charge rate acceptable by a car is 210 kW
- All constrained by network supply infrastructure

Example:

To give context the average UK house has a mean load of 0.430 kW

A single car charging at the 210kW rate is equivalent to the load of nearly 500 houses!

Additionally, few electric cars are used for long battery draining journeys… which is all set to change



EV Charging: An Opportunity.

Customer service = availability, speed of charge, convenience and ease of use

- Car Parks are, of course, the ideal “away from home” charging location both for…
  - Consumers, and
  - Fleets
- Need to upgrade traditional car park power supply infrastructure which may be limited.
  - cost – may vary from £ 000s to £ millions...
  - timing – may vary from months to years...
  - Investment decision - do I upgrade for demand today, 2030 or 2040?

The need is for an appropriate solution which can be deployed and scaled rapidly to match demand and overcome constraints.

EV Charging: The Solution

Introducing the AFC Energy H-Power™ EV Charger solution…

H-Power™ EV Charger : What are our customers asking for?

Needs	AFC Energy Product spec	
End users		
Fast and rapid charging	✓	
DC and AC supply	✓	
Availability (24/7)	✓	
Competitive pricing	✓	
No emissions	✓	
Operators		
Availability (deployable now)	✓	
High utilisation	✓	
Health and Safety Compliant	✓	
Low grade H2 fuel	✓	
Low financial risk	✓	
Low commercial risk	✓	Scalable modular design can grow with demand
Site agnostic	✓	Redeployable

H-Power™ System : Timeline for Delivery

Standard modules – increasing capacity as market grows

H-Power™ EV Charger	20kW	available now for delivery in 2020
	160kW	available now for delivery June 2020
	480kW	available for delivery from 2021
	1MW+	available for delivery from 2022

Tailored solutions

- Non-standard sizes available
- Battery and fuel cell size can be varied to manage availability
- Bespoke solutions available including local private micro grids.
- We can find operating partners to take off balance sheet.
- We will procure fuel if customer desires

AFC Energy

Thank you for your kind attention.

www.afcenergy.com

Gareth Davies

Managing Director

Aquatera

Tweet @ScotRenew
#SRTRANSPORT20

ReFLEX ORKNEY

INDUSTRIAL STRATEGY | UK Research and Innovation

Transport & mobility solutions for the future

Gareth Davies, MD Aquatera & ReFLEX Partner
(Gareth.davies@Aquatera.co.uk)

EMEC | solo energy | aquatera environmental services and products | DOOSAN | HERIOT WATT UNIVERSITY | Community Energy Scotland Empowering Communities | ORKNEY ISLANDS COUNCIL

Project location

How has Orkney earned this opportunity?

- **Unique blend of natural resources** (wind, wave, tide, oil, hydrogen, solar, heat…)
- **Vision:** Oil 1970's; Wind 1980's; Marine 1990's; Efficiency 2000's; Hydrogen & Storage 2010's; Integrated energy solutions 2020's; Large scale developments 2020's & 2030's
- **Commitment:** People, money, sites, demand, ideas
- **Knowledge & expertise:** Unrivalled experience, facilities and cluster of experts & specialists
- **Willingness to share know-how and success**



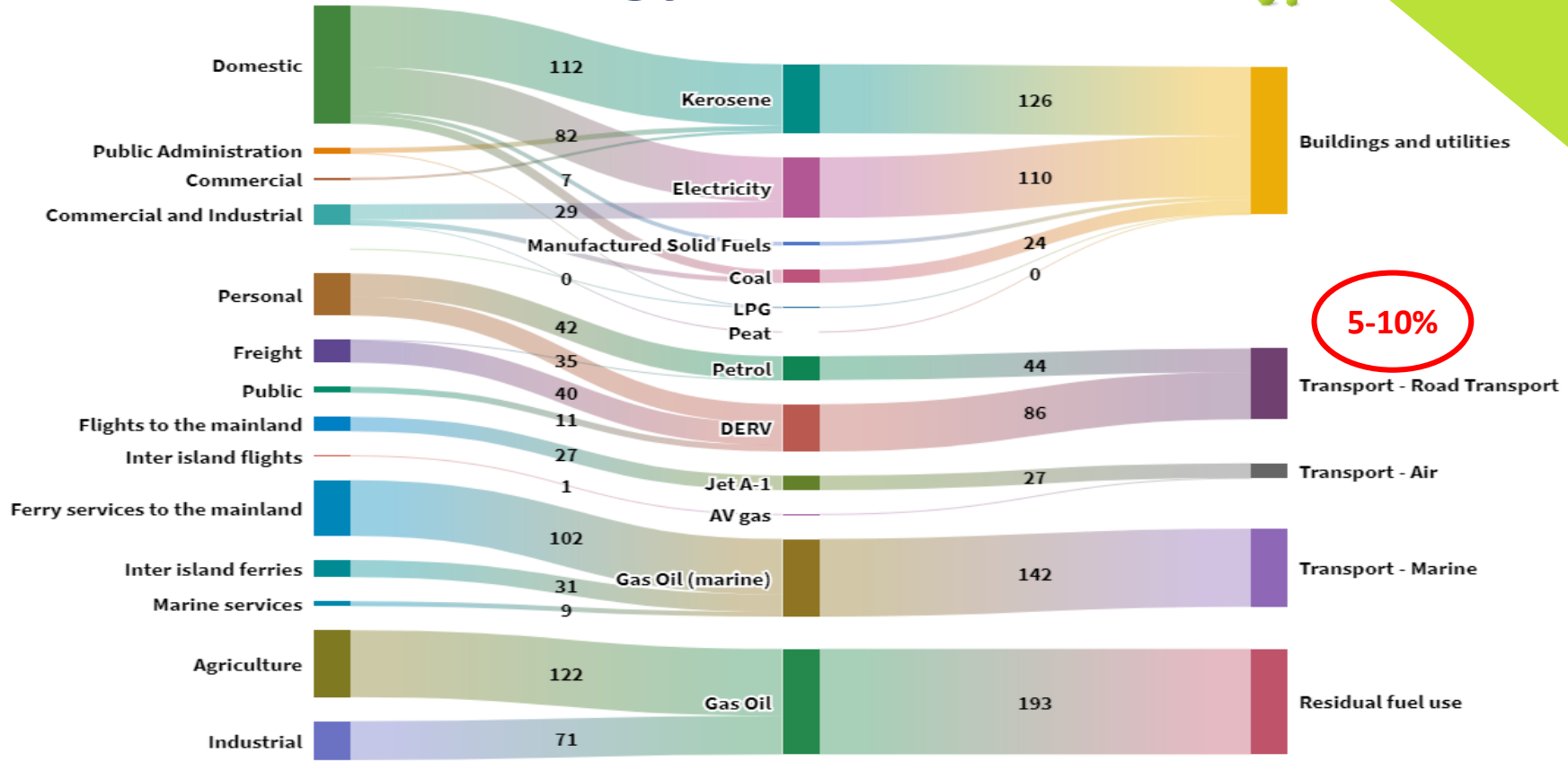





At its simplest level!

Digitally linking renewable generation with associated flexibly, to variable demand, via a replicable community-based Integrated Energy System

Our current energy status



Sankey diagram showing Orkney's energy use by sector and end use in 2018 (GWh)

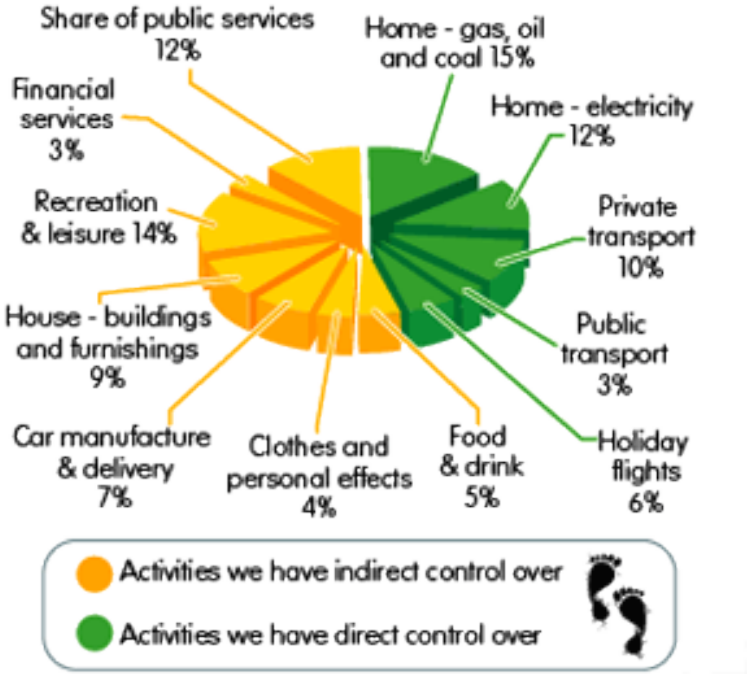
Value of household energy (ref Orkney)

Value of sectors

- **Home heating (oil) - £1500**
  - Capital – 10,000 for 20 years = £500/yr
  - Ops – 1000/yr
- **Home heating (electricity) - £1750**
  - Capital – 5,000 for 20 yrs = £250/yr
  - Ops – 1500/yr
- **Home electricity (non-heating) - £750**
  - Ops – 750/yr
- **Private vehicles (owned 1.5) - £4000-4500**
  - Capital – 15,000 for 5 years = £3000/yr
  - Ops - £1000-1500/yr
- **Public transport (bus/taxi - family) - £200**
  - Bus/taxi £200/yr
- **Travel (ferries and air - family) - £2500-£5500**
  - Ferries £500/yr
  - Air £2000-£5000/yr
- **TOTAL – £9000-£12,000**

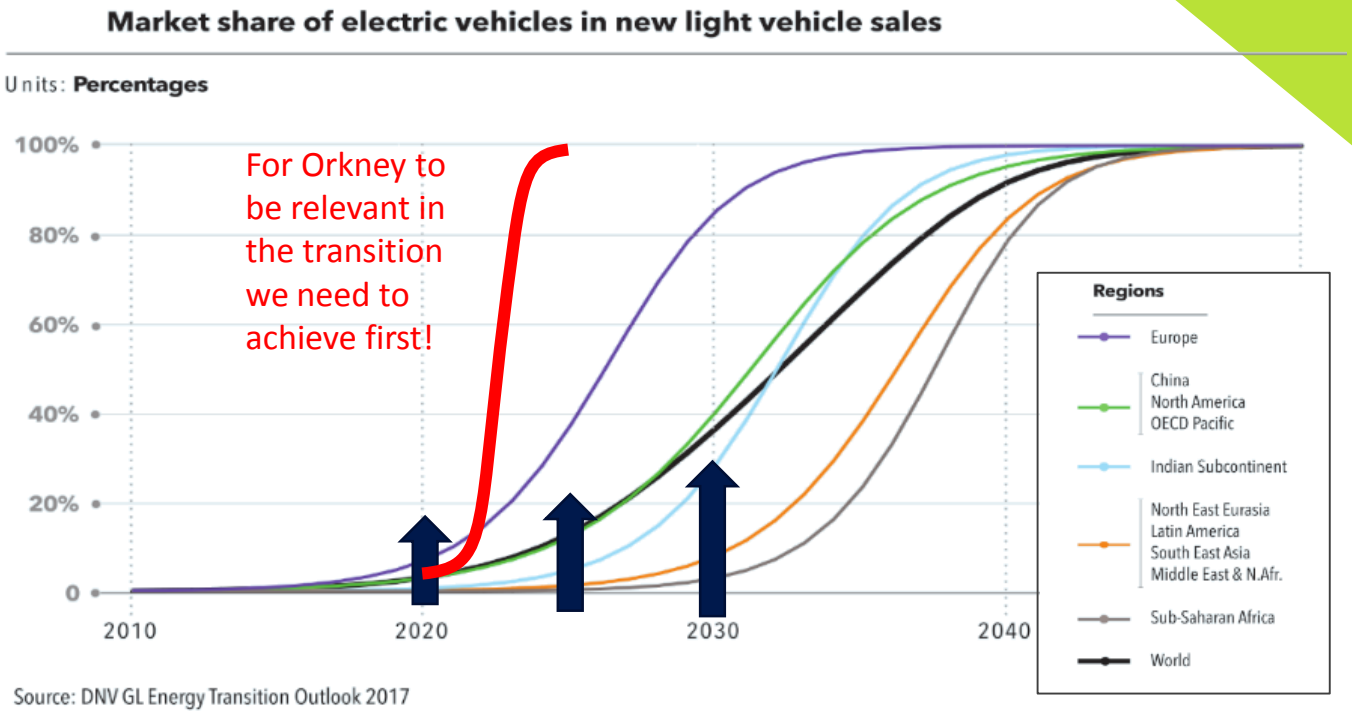
40-50%

UK average situation



EV market growth

- EVs are set to make major advances over the next 10 years in Europe
- For Orkney to lead it needs to go faster and further than this average
- Perhaps 100% by 2025/27
- Other ‘lighthouse’ communities can achieve similar targets



FlexiTRANS – Progressive land based mobility & mobile storage services

Short term over 500 new mobility solutions need to be financed and leased to customers

Over 5,000 required in longer term if 50% redundancy is achieved

Considering pool ownership model and introduction of autonomous vehicles ASAP

Linked to smart charging and V2G

Autonomous vehicles

- Within the timescale of the ReFLEX project, before 2022, autonomisation is set to progress rapidly and the ReFLEX project and ReFLEX plus activities need to be aware of possible opportunities in this space. Such developments may lead to much greater use levels for each vehicle, therefore reducing its flexibility service capacity. There will, however, still be night-time reductions in use.

Chargers

- Chargers and electric transportation are not chicken and egg
- The charging infrastructure is needed to support the vehicles
- Charging can come in many shapes and sizes

FlexiTRANS – Advanced and smart charging infrastructure

- Grid scale battery backed charger (location to be determined)
- Other charger locations?
  - Households
  - Place of work
  - Urban car park and street parking
  - Visitor attractions and amenity spots
  - Supermarket
  - On board ferry and ferry car parks
  - Isles' ferry terminals
  - Airport car park
  - Mobile 'rescue packs'
  - Black spot packs

Major expansion in the distribution and number of smart chargers

1-2 Tesla Powerpack batteries each with 10 associated EV charger connections

EV rescue pack and emergency charging locations

- As the use of EVs increases additional services will be required such as EV recharge rescue packs.
- These would need to be available for deployment to vehicles which had discharged their batteries and were marooned away from charging locations.
- Having public facilities, households, businesses that are willing to give emergency charges to EV users may also be a useful part of the EV support network

Integrated mobility

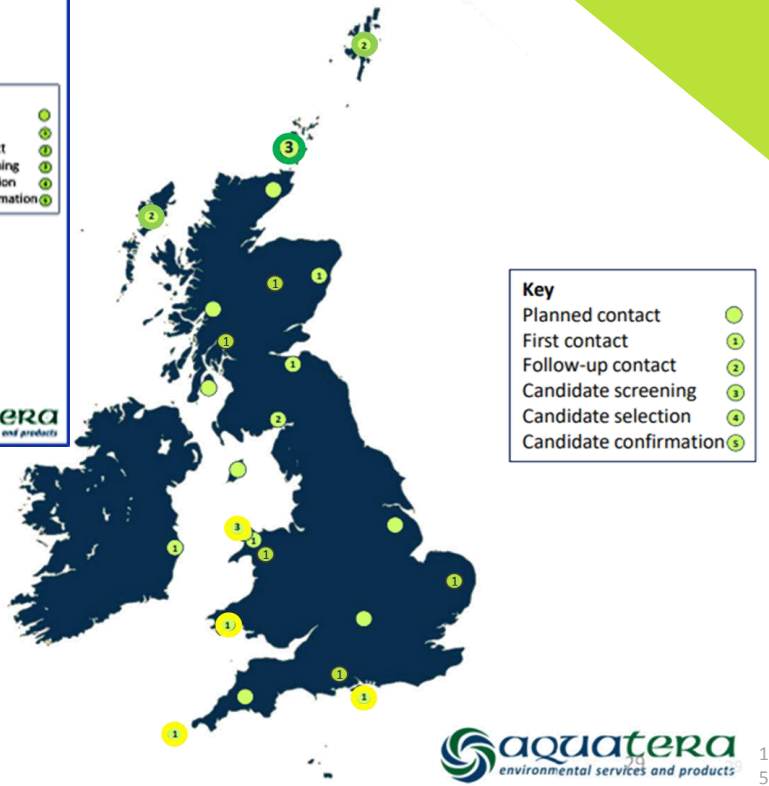
- Transportation obviously links different areas
- There need to be common ‘basic’ service standards for E mobility
- Until then inter-regional mobility mat require special solutions
  - Plug in hybrids
  - High capacity Evs
  - Possibly even ICE back-up
- Need to think about mobility hubs
  - Airports
  - Ferries
  - Bus stations/stops
  - Rail stations/stops

ReFLEX deal USPs

What can't be got from other suppliers

- Pay as you use commercial model
- Support decarbonisation of local area
- Become a member of a social enterprise
- Access to latest models and upgrades
- Added vehicle and household/business/organisation services
- Access to an excellent charging network at affordable costs
- Options for saving or earning from pooling
- Flexible terms, bundled packages
- Added mobility solutions
- **LOCAL ADVICE AND SUPPORT**

International & national replication



How new transport technologies might interact with networks?

- Altered need for petrol and diesel
- Sustainability of filling stations
- Time fillers as well as pocket fillers
- Destination charging rather than journey charging
- Grid
  - Increasing electrical demand
  - Changing demand locations
  - Influencing load patterns
  - Rethink network layout
    - decentralised design,
    - refocussed generation locations
  - New network ownership models
  - New regulatory framework

Facilitating technological innovations

- Not just any EV – this is a ReFLEX EV
  - High uptake, flexible and adaptable customer packages, pre-financed, part of IES, VPP, access to multi- model….
- Charging infrastructure
  - Right capacity – numbers ad rate, works reliably, right locations
- Integrated Energy Systems (IES)
- Virtual Power Plant (VPP)
- Better batteries
  - charging time, capacity, reuse and recycling potential
- **ATTITUDES and BEHAVIOURS**

ReFLEX EV role in providing grid services

- Stimulus for major change
  - Rapid
  - Large scale (rural area focus)
  - Widespread (through replication)
- Providing responsive load balancing services as batteries
- Providing frequency support service through controlling demand
- Planned load shifting between peaks and troughs in demand
- **Reducing overall energy demand**

Hannah Smith

Director, ICE Scotland

Neil Swanson

Director, Electric Vehicle Association Scotland

Euan Norris

Stakeholder and Community Engagement Manager, SP Energy Networks

Jim Gibson

Chief Operating Officer, AFC Energy

Gareth Davies

Managing Director, Aquatera

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Steering culture change

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Morag Watson

Director of Policy

Scottish Renewables

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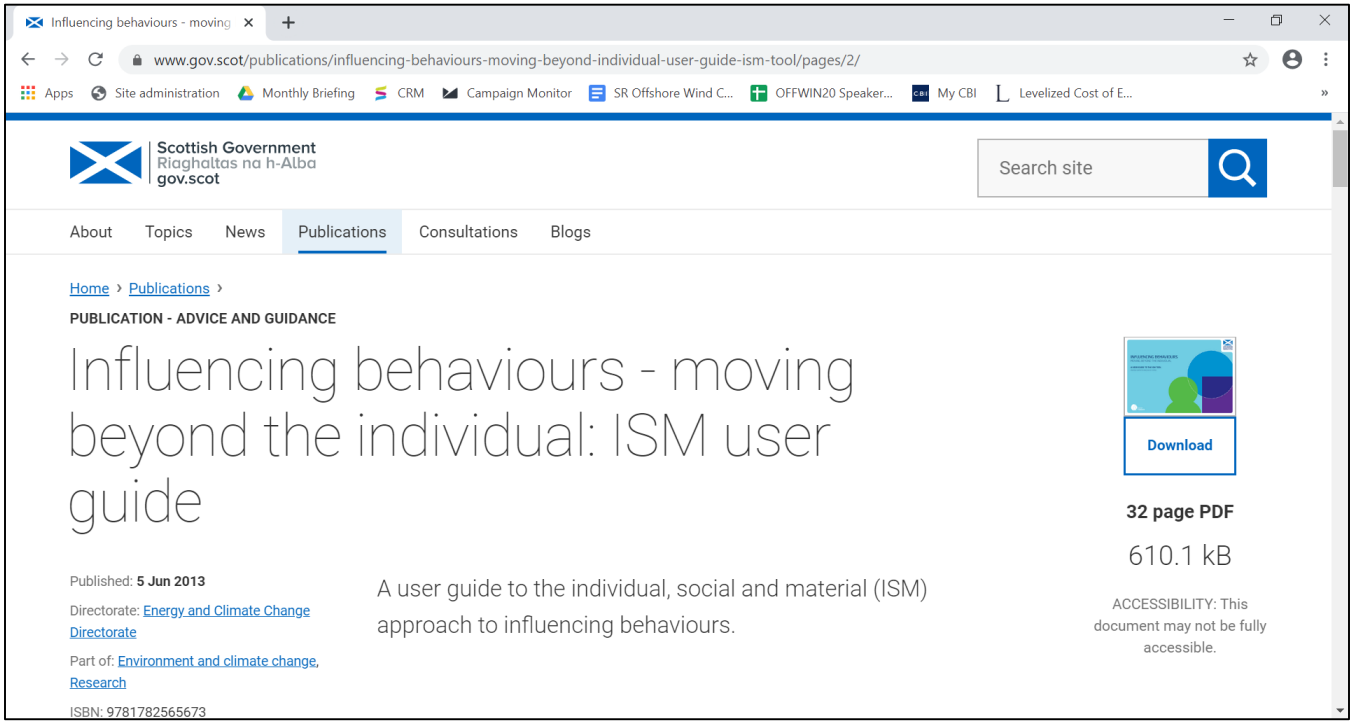
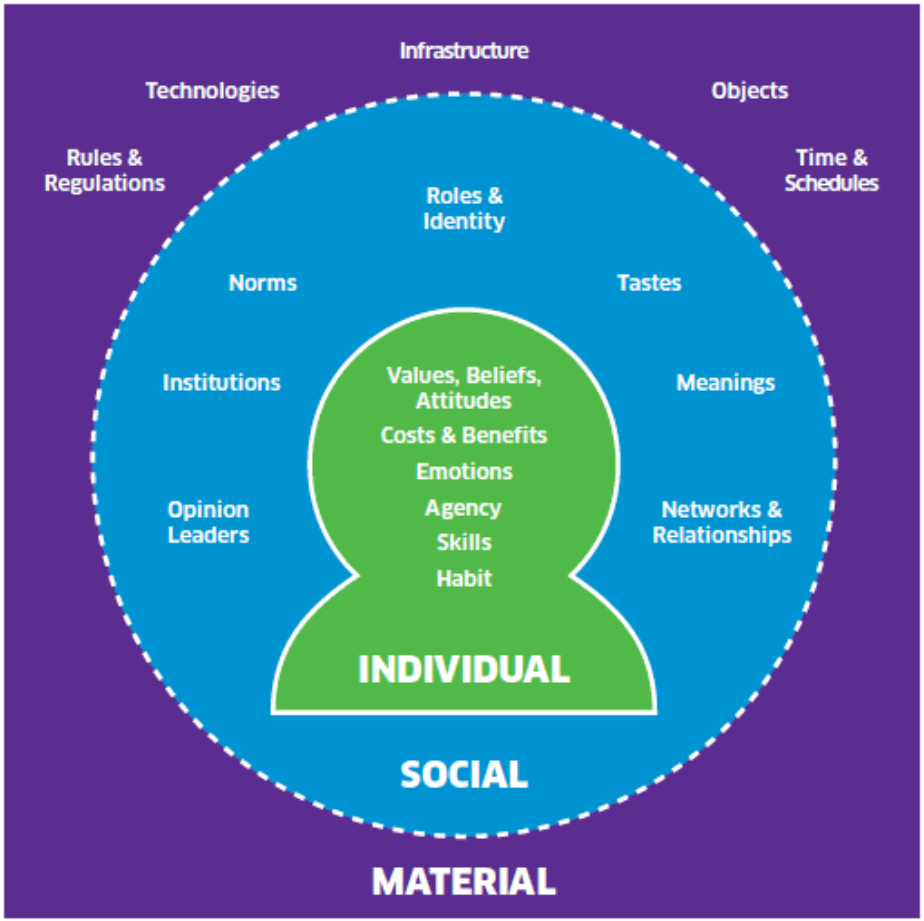
Designing Behaviour Change





ISM Toolkit

Individual

Social

Material

Thank You

T. 0141 353 4005

mwatson@scottishrenewables.com

Daisy Narayanan

Director of Urbanism

Sustrans

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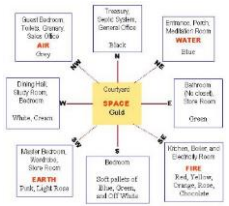
Cities have the capability of providing something for everybody, only because, and only when, they are created by everybody.

Jane Jacobs



Buildings and urban environments should provide healthier environments for *everyone* to live, work, rest and play.

Why is architecture relevant?
We spend 90% of our time indoors

In the UK:

- 30 million people are overweight/obese
- 40,000 die from air pollution each year
- 4 million people have diabetes
- 1 in 6 adults have anti-depressants

Dr Louis Rice
Senior Lecturer in Healthy Architecture & Cities.

The policy context

Our Vision

We will have a sustainable, inclusive and accessible transport system, helping deliver a healthier, fairer and more prosperous Scotland for communities, businesses and visitors.

Promotes equality

- Will provide fair access to services we need
- Will be easy to use for all
- Will be affordable for all

Takes climate action

- Will adapt to the effects of climate change
- Will help deliver our net-zero target
- Will promote greener, cleaner choices

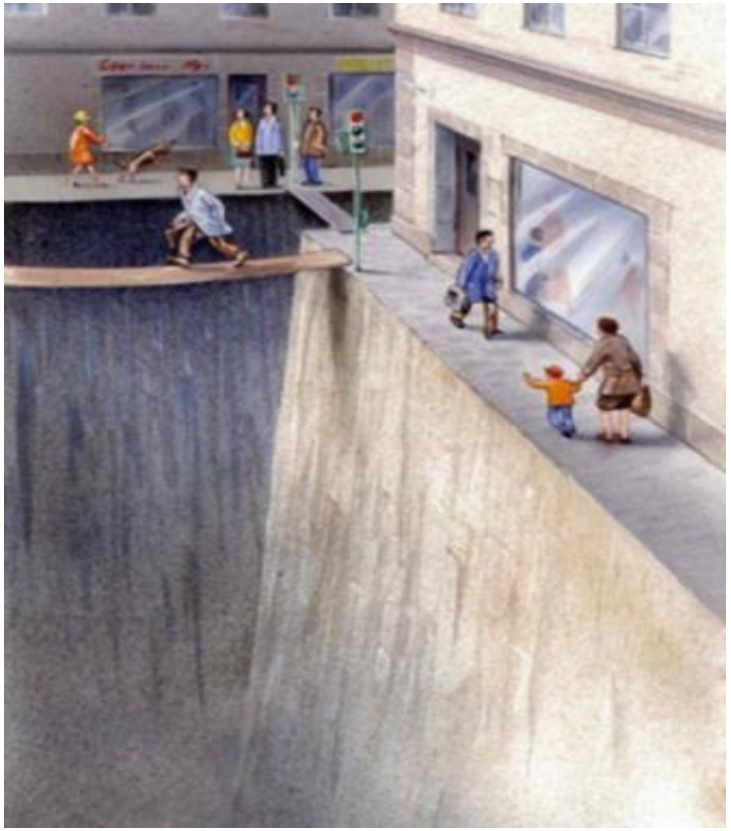
Helps our economy prosper

- Will get us where we need to get to
- Will be reliable, efficient and high quality
- Will use beneficial innovation

Improves our health and wellbeing

- Will be safe and secure for all
- Will enable us to make healthy travel choices
- Will help make our communities great places to live

But what about our local streets?



Transformation

Making change happen

Edinburgh

Edinburgh

Edinburgh

Edinburgh


BERTIES
BERTIES
Quaker Meeting House
Questions?

Moira Nicolson

Senior Behaviourial Insights Manager

Ofgem

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ofgem Making a positive difference for energy consumers

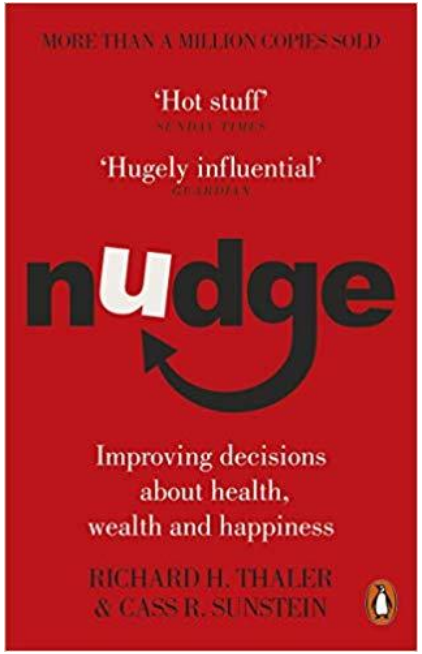
Behavioural insights and electric vehicle usage

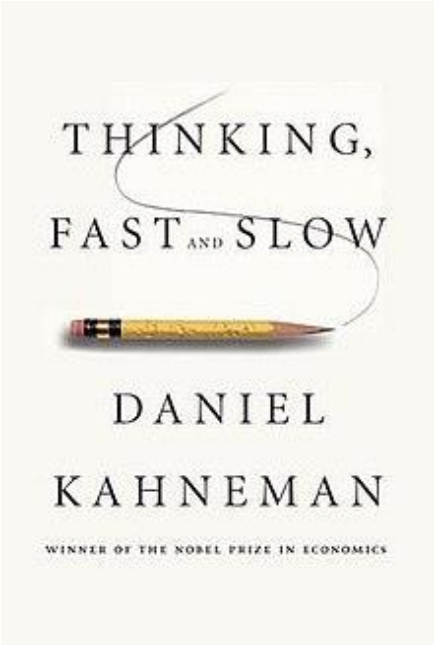
Changing the system not the people

Dr. Moira Nicolson, Ofgem Behavioural Insights Unit

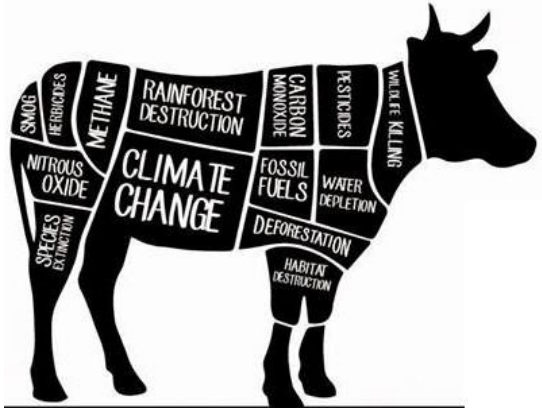
19/02/20

Nudges influence behaviour without affecting the underlying incentives and whilst respecting freedom of choice – in contrast to taxes, subsidies and mandates





What is the role of behavioural change in climate change mitigation?

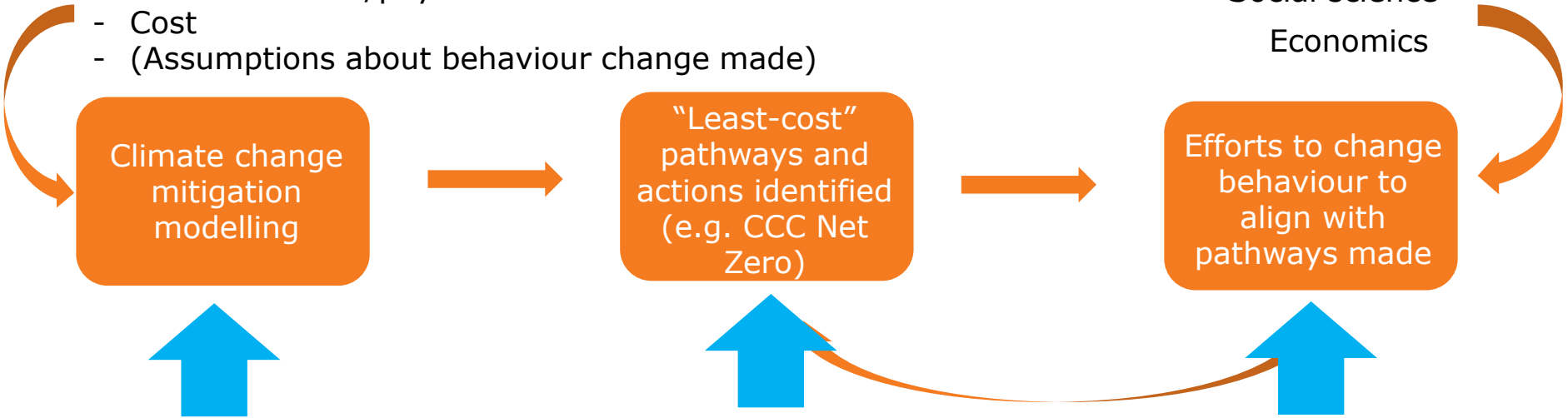


"People tend to respond in x, y, z ways; how can we design a climate change mitigation strategy that works with rather than against the grain of human behaviour?"

Constraints:
- Climate science/physics
- Cost
- (Assumptions about behaviour change made)

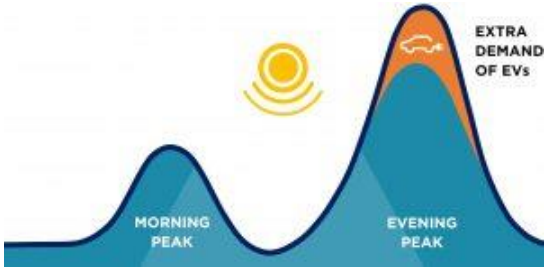
Social science

Economics

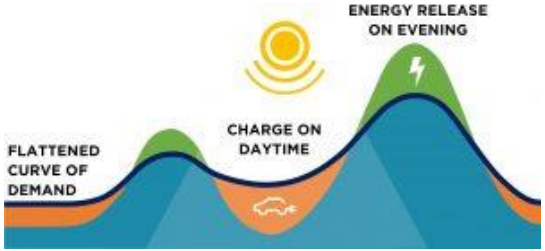


Change purchase choices

Change EV charging behaviour



What EV owners do now



What EV owners are 'expected' to do

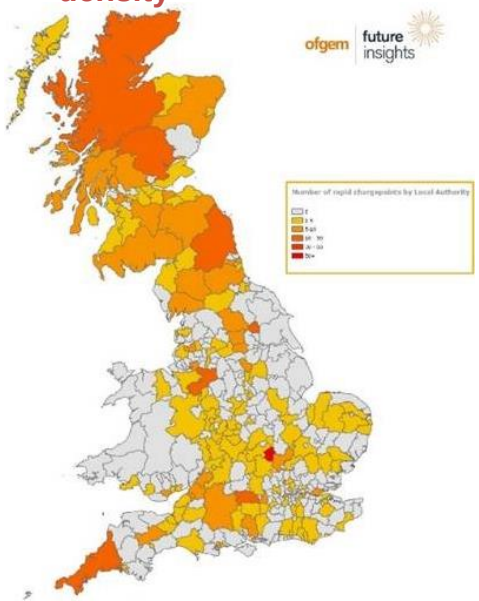
Range anxiety is the concern that an electric vehicle will not have enough charge to complete a journey. Other than their ***price***, surveys suggest it is the ***greatest barrier*** to mass EV adoption.

Is range anxiety real?

Right now**, going electric** means losing the opportunity to **drive 400 miles in one go**

Although there's ~1 public chargepoint for every EV in the UK**, some regions have much fewer rapid chargers** than others as you can see in the map alongside

UK Chargepoint density



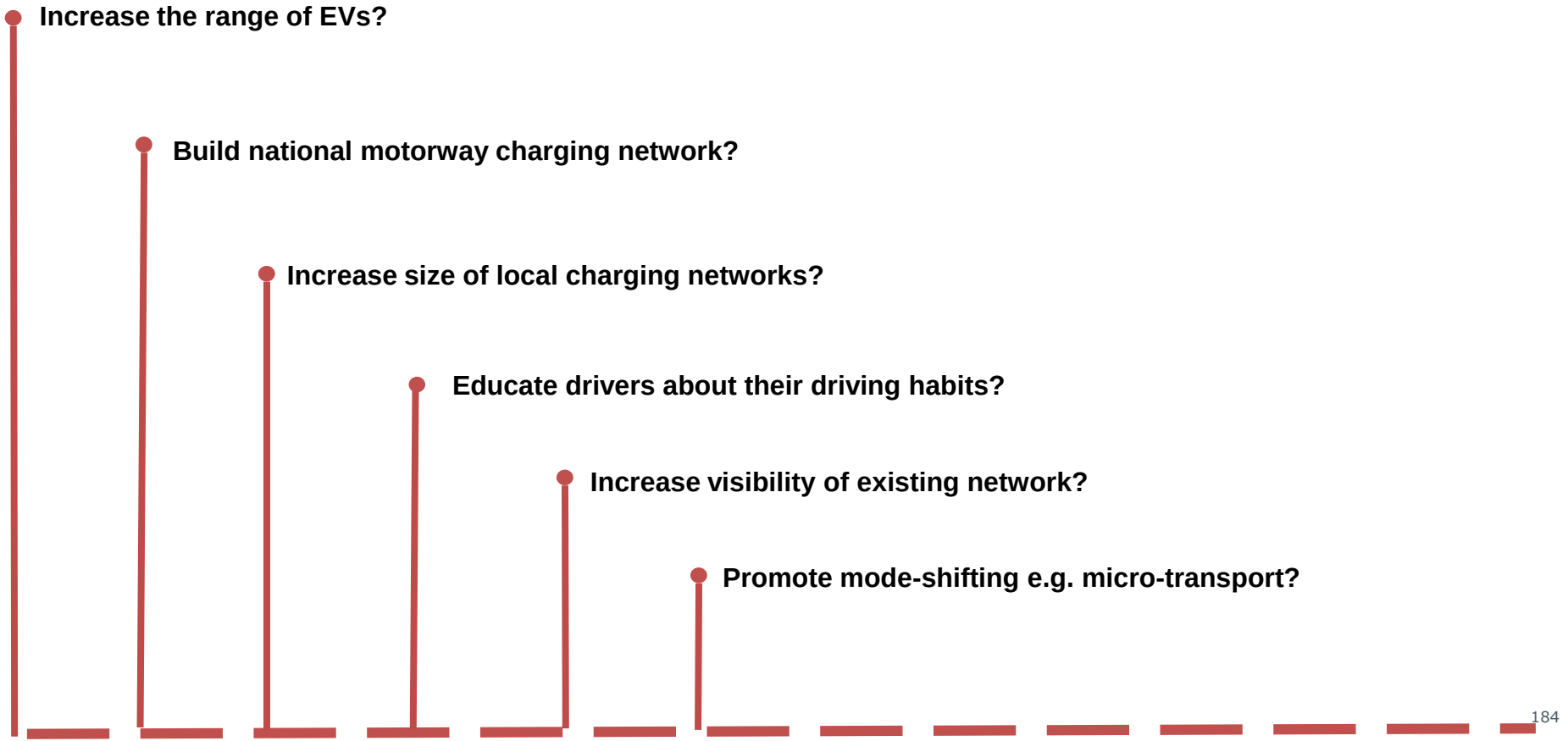
Or is range anxiety Imagined?

Most EV batteries are already WAY oversized for most car/van trips:

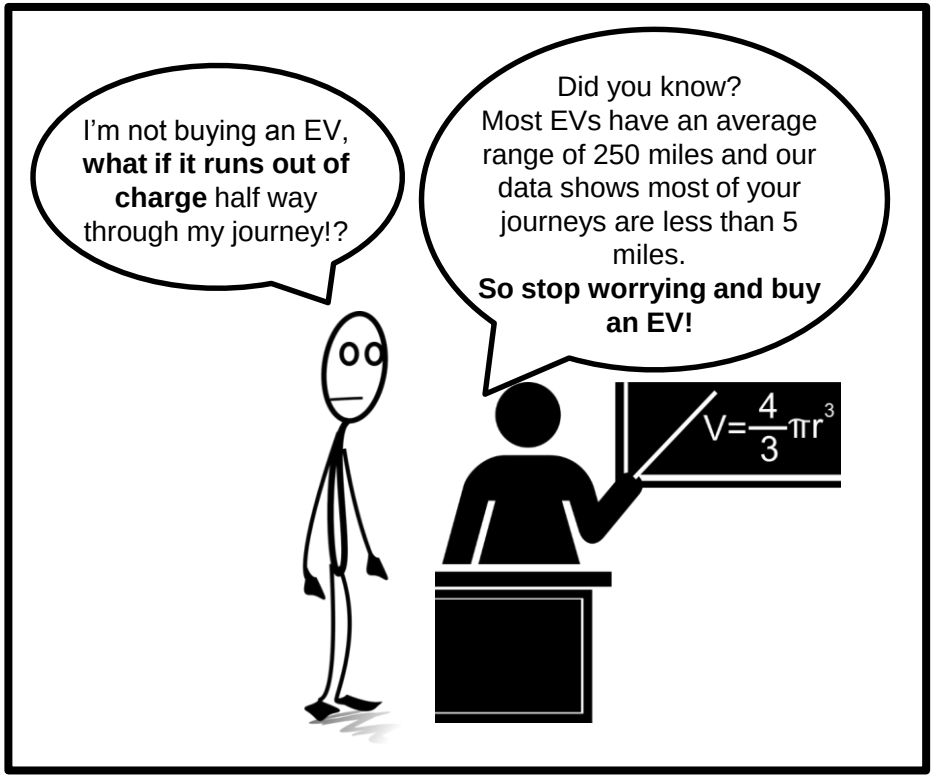
Average EV battery range is **~250 miles…**

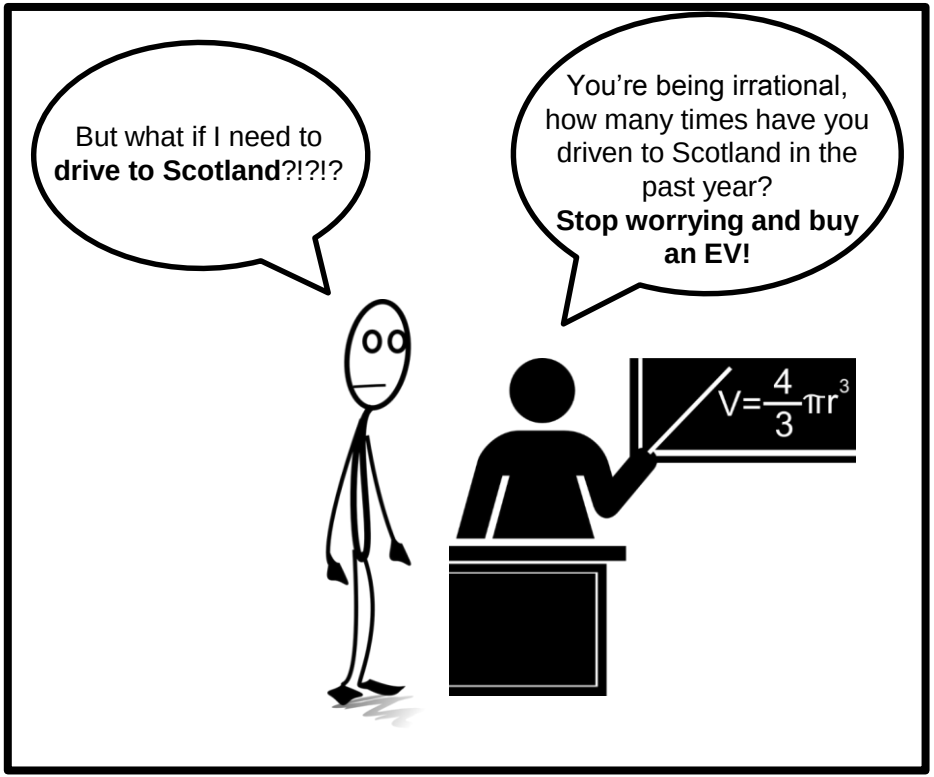
…but 50% of trips taken by car/van are **under 5 miles** in distance

How can we overcome **range anxiety**?



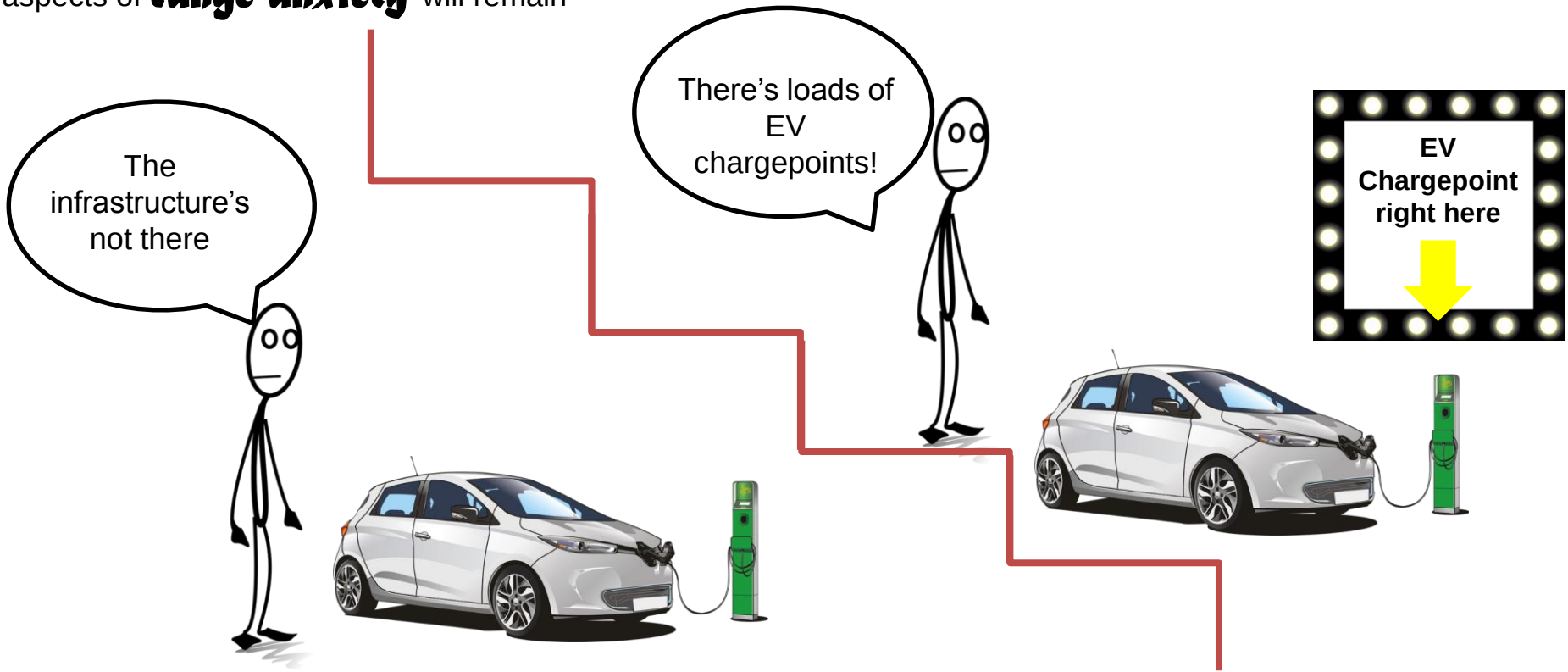
It’s really hard to change people’s minds with mass education campaigns…





Behavioural insights shows us that **people tend to overweight low probability events that could have a big impact on their lives**, however unlikely they are to happen. A prominent example is people’s tendency to overweight the fear of being involved in a terrorist attack relative to being involved in a road accident, even though car accidents are far more common. **This tendency is very hard to change.**

Behavioural insights suggests that **increasing the visibility of charging infrastructure** could be **just as important as ensuring that the infrastructure is there in the first place** – unless people know it's there, the **Imagined** aspects of **range anxiety** will remain



Once you account for how hard it is to change people's beliefs and opinions using reasoned arguments, **it could be quicker and cheaper to change the system, not the people**

- Behavioural insights can be used to encourage people to behave in a more environmentally friendly way

- Behavioural insights shows that you can do this without fundamentally altering people's preferences, opinions or beliefs (which is hard)

- How? By designing solutions that work with rather than against the grain of human behaviour (change the system not the people)

- A good example of this is the uptake of electric vehicles, for which range anxiety could be potentially much more easily addressed by changing the design of the charging infrastructure rather than by 'correcting' public perceptions about driving habits

Ofgem Behavioural Insights Team

Moira.Nicolson@ofgem.gov.uk

ofgem Making a positive difference for energy consumers

Our core purpose is to ensure that all consumers can get good value and service from the energy market. In support of this we favour market solutions where practical, incentive regulation for monopolies and an approach that seeks to enable innovation and beneficial change whilst protecting consumers.

We will ensure that Ofgem will operate as an efficient organisation, driven by skilled and empowered staff, that will act quickly, predictably and effectively in the consumer interest, based on independent and transparent insight into consumers' experiences and the operation of energy systems and markets.

Morag Watson
Director of Policy, Scottish Renewables

Daisy Narayanan
Director of Urbanism, Sustrans

Moira Nicolson
Senior Behaviourial Insights Manager, Ofgem

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