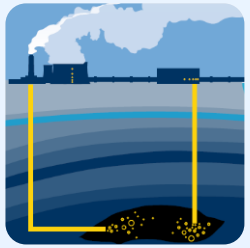




Alternative Fuels Strategy and Action Plan for East Anglia

Cambridgeshire and Peterborough Combined Authority

New Anglia Local Enterprise Partnership

Technical Evidence Report

23rd February 2022

elementenergy
an ERM Group company

Katherine Orchard
Richard Riley
Edward Wilson
Abigail Willis
Celine Cluzel

The Alternative Fuels Strategy and Action Plan for East Anglia has been commissioned to enable the transition to net zero emissions while supporting recovery objectives

Background

- The Cambridgeshire and Peterborough Combined Authority (CPCA) and New Anglia LEP are undertaking work to decide informed action to mitigate and adapt to climate change
- A key component of this is to establish an integrated and sustainable transport network that continues to support residents and businesses, and contributes to recovery from the COVID-19 pandemic
- CPCA/New Anglia LEP have commissioned an Alternative Fuels Strategy (AFS) for East Anglia, being developed alongside CPCA's Local Transport and Connectivity Plan (LTCP) and the work conducted by the Norfolk and Suffolk Clean Growth Taskforce. The AFS aims to:
  - **Support clean growth** by providing the necessary infrastructure for businesses, residents and commuters
  - **Support the decarbonisation aims of Local Authorities** that have declared climate emergencies
  - **Accelerate the uptake of AFVs in the region** which has historically been behind the national average
  - **Improve air quality** through uptake of zero emissions vehicles
  - **Provide a combined vision** across the region to result in greater impact
  - **Support the creation of commercial opportunities** and develop an innovative supply chain

Objectives and scope of the technical evidence report

This technical evidence report is one of three documents which together make up the Alternative Fuels Strategy:

1. **Technical evidence report:** details the current policy and funding landscape for alternative fuels at a local and national level; different scenarios for alternative fuels vehicles uptake; a review of opportunities to support AFV uptake. More details here
2. **Action plan:** extensive detail on the actions local stakeholders can take to decarbonise transport, supported by the technical evidence report
3. **Public facing strategy:** a 16-page summary of the key themes set-out in both of the above two documents, designed to be accessible to a wide audience

The vehicle scope includes all surface transport (road vehicles and rail) out to 2050. Non-road mobile machinery, marine transport and aviation are outside the scope of this work but opportunities for synergies between modes (e.g. refuelling infrastructure at ports) are considered where appropriate

This report presents the results of a detailed assessment of the current landscape for Alternative Fuels in East Anglia and opportunities for action to drive future uptake

Following the Executive Summary, **the structure of the report** is as follows:

- **Current situation** - a review of local and national transport policy and existing AFV uptake and associated infrastructure in East Anglia
- **Future uptake of AFVs** – a review of current options to decarbonise by mode and quantitative modelling under different scenarios of future AFV uptake and infrastructure requirements throughout the region
- **Opportunities to support the uptake of AFVs** – a review of best practice to support AFV uptake, local opportunities for innovation and key funding opportunities to support the AFV rollout
- The **Appendix** contains supporting information and underlying assumptions

Acknowledgements

A collaborative approach was used to develop the AFS, with input from several local stakeholders

All work undertaken for the Alternative Fuels Strategy was done so with input from local stakeholder groups. This included workshops where stakeholders were able to provide verbal feedback, which were also used to establish communications channels through which further feedback and data could be provided on an ongoing basis. The workshops held for developing the AFS are listed below:

- Four workshops with local authorities, two for Norfolk and Suffolk and two for Cambridgeshire and Peterborough. One workshop was held to initially feed into the technical evidence base and begin to develop a long-list of recommended actions. A second workshop was held to refine this long-list, for each of the two sets of LAs
- Discussions with sub-national transport bodies (also invited to the LA workshops)
- Workshops with other relevant stakeholders, including: the Cambridge Norwich Tech Corridor, the Greater South East Energy Hub, New Anglia Transport Board, Norfolk and Suffolk Clean Growth Taskforce

Representatives of the groups below attended at least one workshop held for developing the Alternative Fuels Strategy.

Cambridge City Council
Cambridge Norwich Tech Corridor
Cambridgeshire and Peterborough Combined Authority
Cambridgeshire County Council
East Cambridgeshire District Council
East Suffolk Council
Fenland District Council
Great Yarmouth Borough Council
Greater South East Hub
Huntingdonshire District Council
New Anglia Local Enterprise Partnership
New Anglia Transport Board
Norfolk and Suffolk Clean Growth Taskforce
Norfolk Broads Authority
Norfolk County Council
North Norfolk District Council
Peterborough City Council
South Cambridgeshire District Council
South Norfolk and Broadland District Council
Suffolk County Council
Transport East
West Suffolk Council

Glossary

Term	Definition
AD	Anaerobic digestion
AFS	Alternative fuels strategy
AFV	Alternative fuels vehicle
AT	Active travel
BEV	Battery electric vehicle
Capex	Capital expenditure
CAZ	Clean air zone
CCS	Combines charging system
CNG	Compressed natural gas
CO_2e	Carbon dioxide equivalents
CPCA	Cambridgeshire and Peterborough Combined Authority
DfT	Department for Transport
E10	Petrol containing up to 10% ethanol
EE	Element Energy
EEH	England's economic heartland
EV	Electric vehicle
EVCP	Electric vehicle charge point
FCEV	Fuel cell electric vehicle
GCP	Greater Cambridge Partnership
GHG	Greenhouse Gas

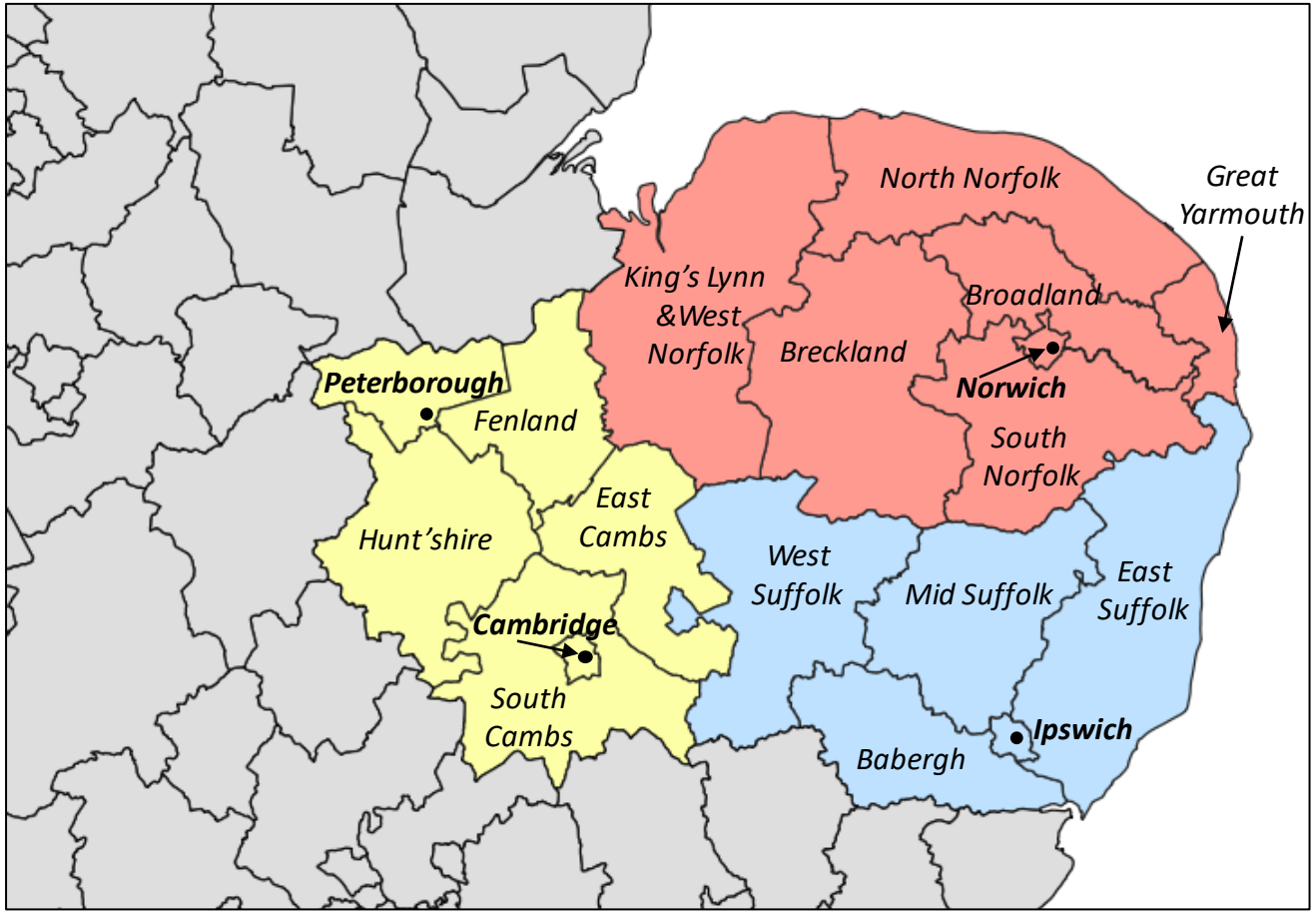
Term	Definition
GVW	Gross Vehicle Weight
H_2	Hydrogen
HDV	Heavy duty vehicle
HGV	Heavy goods vehicle
HRS	Hydrogen refuelling station
HVO	Hydrotreated vegetable oil
ICCT	International Council on Clean Transportation
ICE	Internal combustion engine
km	Kilometre
kW	Kilowatt
kWh	Kilowatt hour
LA	Local authority
LDV	Light duty vehicle (cars, vans, taxis)
LEP	Local enterprise partnership
LNG	Liquified natural gas
LSOA	Lower layer super output area
MSOA	Middle layer super output area
Mt	Megatonnes
MW	Megawatts
MWh	Megawatt hours

Term	Definition
ONS	Office for National Statistics
Opex	Operational expenditure
ORCS	On-street residential charge point scheme
OZEV	Office for zero emission vehicles
PHEV	Plug-in hybrid electric vehicle
PHV	Private hire vehicle
PP	Purchase price
PT	Public transport
RNG	Renewable natural gas
RTFC	Renewable Transport Fuel Certificates
RTFO	Renewable Transport Fuel Obligation
SRN	Strategic road network
t	Tonnes
TCO	Total cost of ownership
TWh	Terawatt hours
UKPN	UK Power Networks
V2G	Vehicle to grid
WTW	Well-to-wheel
ZEB	Zero emission bus
ZEBRA	Zero emission bus regional area scheme
ZEV	Zero emission vehicle

Contents

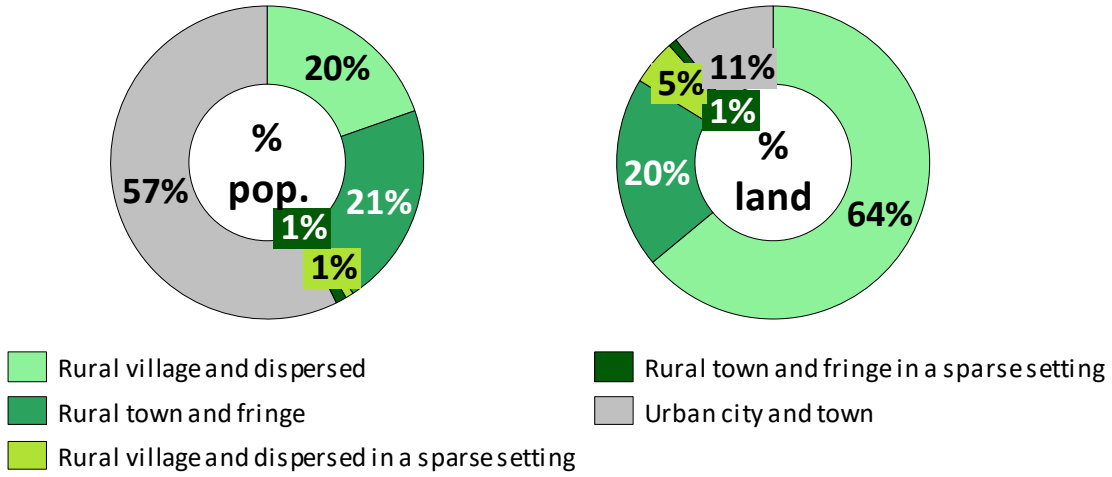
Geography: the study region includes 18 local authorities and 4 major settlements

Map of in-scope study region



Key features of the study region

- The East Anglia study area includes **18 local authorities** spread across the **3 counties** of Norfolk, Suffolk and Cambridgeshire
- Spatially, the region is **predominately rural** (88% of land[1])
- However, the region includes the **4 major settlements** of Norwich, Cambridge, Peterborough and Ipswich and many other **urban areas which together host 57% of the population**[2]
- The area is covered by two sub-national transport bodies (Transport East and England's Economic Heartlands) and has links to wider organisations such as the Oxford-Cambridge Arc and the Greater South East Energy Hub[3]



Sources/notes: 0 - All rural/urban classifications are per ONS 10-fold classification by LSOA, and are used to derive the population and land based rural/urban split. 1 – ONS Standard Area Measurements for 2011 Census. 2 – ONS LSOA mid-2020 population estimate. 3 – Soon to become a Net-Zero Energy Hub.

Setting the scene: the current policy landscape and existing AFV infrastructure in East Anglia provides a good basis for decarbonising transport, however more needs to be done

Summary

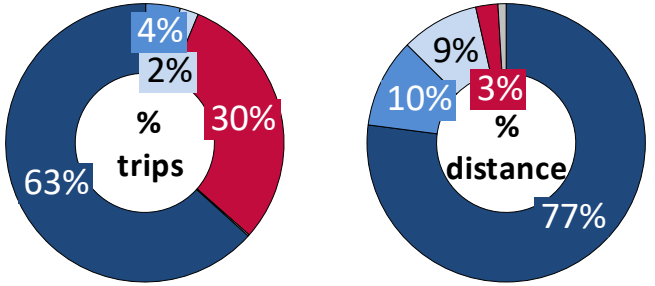
Overview: current policy landscape

- **National transport policy has a strong focus on accelerating the shift to ZEVs**
- Several funding schemes, trials and other policy have been launched by the UK government to support this shift

- **Regional transport policy is also conducive to a decarbonised transport system**
- The two subnational transport bodies – Transport East and England's Economic Heartland – are both aiming for **net zero transport in 2040**

- Transport policy at a local level is also favourable for a transition to low carbon transport, **however does not go far enough or cover all bases**
- **A greater degree of co-ordination, specificity and ambition** is required

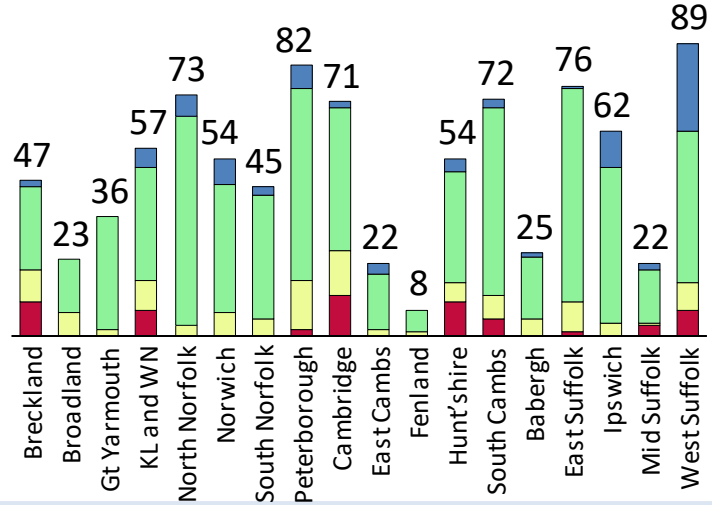
Current transport system and AFV uptake in East Anglia



- **Transport currently contributes 33% of overall emissions** in the study region
- **63%** of trips are made by car, compared to **54%** across England
- Although walking and cycling make up **30% of trips**, active travel only accounts for **3% of distance** travelled

- There are around **8,600 electric cars and 800 vans i**n East Anglia
- These EVs are supported by a network of **918 public chargers**
- There is **limited uptake of other AFVs** – there are currently only 2 BEV buses (in Cambridge) and only 45 known RNG HGVs

Electric vehicle chargers in East Anglia



Sources: for full details on current transport system and AFV uptake, including sources, see the relevant section

Future uptake of AFVs (1/2): A significant increase in AFV infrastructure will be required to decarbonise the East Anglia Transport system

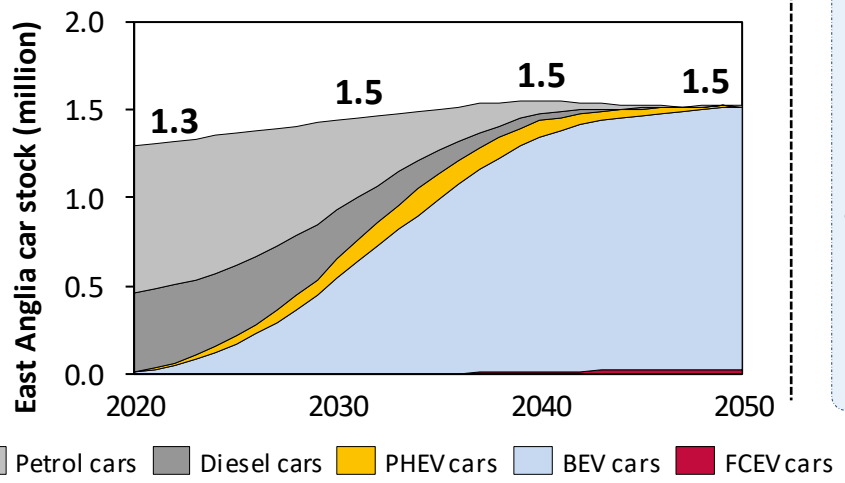
Summary

Overview: there are two main decarbonisation pathways for surface transport

- Across surface transport modes, there are an emerging number of possible options available for decarbonisation
- For light-duty vehicles, vans and motorcycles the pathway is clearly heading towards electrification; however, for heavy duty vehicles and rail, a mixture of electric and hydrogen fuel cell electric vehicles is expected in the future
- Two core scenarios have hence been modelled, focused on high-electrification and high-hydrogen futures[1]

Vehicles

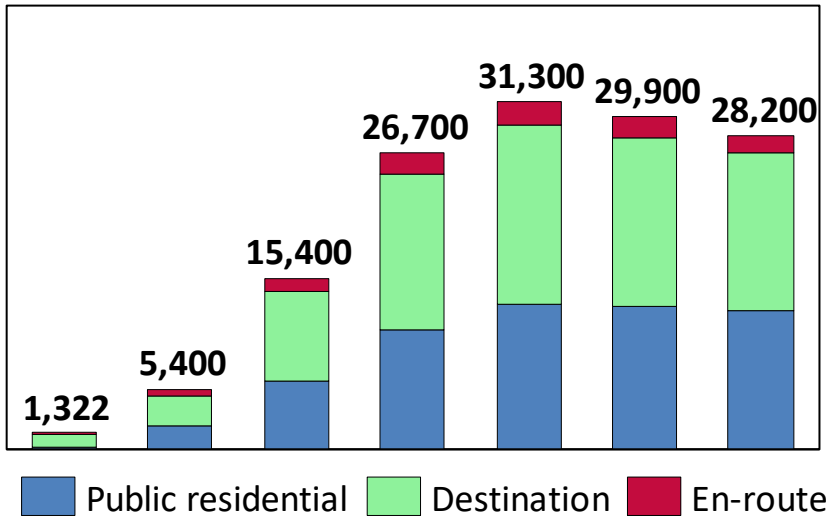
- Under both scenarios, **BEVs would make up over half the regional car stock from 2033**, ultimately making up 98% by 2050



Infrastructure

- A **significant increase in the number of EVCPs** installed will be necessary
- An **increase in refuelling infrastructure for HGVs** will also be needed – up to 5 times more hydrogen refuelling stations would be needed in 2050 in the high-hydrogen than high-electrification scenario, with up to 30 needed in 2050
- RNG use as a bridging fuel for HGV decarbonisation is forecast to peak in 2035, with a peak of 7-12 RNG refuelling stations required in the same year

Forecast EV charge point demand in East Anglia out to 2050 (in core scenarios)



Notes: 1 – The high-electrification and high-hydrogen scenarios are based on the DFES Consumer Transformation and System Transformation scenarios respectively

Future uptake of AFVs (2/2): Policy should go beyond encouraging AFV uptake and target behaviour change and a modal shift

Summary

Overview: A policy focus on behavioural change and modal shift would achieve the greatest emissions reductions

- Whilst AFV uptake is paramount to decarbonising transport, technology alone can only go so far in achieving emissions reductions, and due to a number of factors such as technology readiness, current high purchase prices for AFVs, and slow stock turnover, can only achieve limited emissions reductions by 2030
- Three further scenarios using the high-electrification (Consumer Transformation) as a baseline have hence been modelled out to 2050
- These scenarios look at how a policy focus on modal shift and behavioural change (as well as AFV uptake) can bring about quicker, more significant, emissions reductions than policy that focuses on technology uptake alone
- Findings in the Max ambition scenario are given below[1]

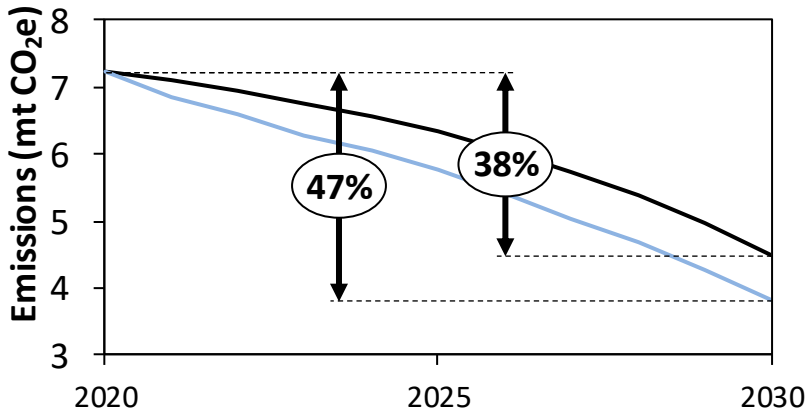
Max ambition scenario narrative – objectives for 2030

Max ambition

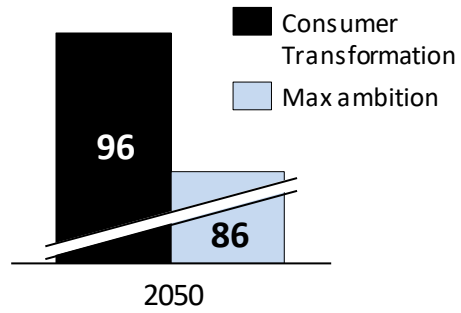
- Policy targets a **modal shift** in passenger transport away from private cars towards bus and rail, and a shift in freight transport towards rail freight and cargo bikes for last-mile delivery. A much more significant shift is achieved in urban areas.
- Policy ensures **demand for passenger and freight transport reduces per person**[2]. This is achieved by supporting place based solutions to improve and reinstate services in communities, allow average trip distances to become shorter.
- **Freight consolidation** increases efficiency in the movement of goods by HGVs and vans.

Impact on emissions

- **An extra 11% emissions reduction is achievable** by 2030 in the Max ambition scenario compared to the Consumer Transformation scenario, allowed by the additional policy focus on modal shift/behaviour change
- **10 Mt CO_2e less would be emitted between now and 2050** in the Max ambition scenario than in the Consumer Transformation scenario



Cumulative emissions 2020-2050 emissions (mt CO_2e)



Notes: 1 – For findings in the other scenarios, please see here. 2 – Total demand is kept at current levels, which with population growth means that demand per person reduces.

Action to support uptake of AFVs: Action to support transport decarbonisation must target reduction in travel demand alongside a shift to alternative fuels

Summary

Overview: Actions and strategic decisions need to take into account best practice projects and innovative opportunities

In order to take appropriate actions best practice example of reducing travel demand, shifting to sustainable modes, and accelerating alternative fuels uptake have been considered. Best practice finding from other projects should be fed into any strategic decisions and actions. Alongside this opportunities for innovation locally have been considered, including multimodal hubs and hydrogen projects. These innovations will help support and future proof East Anglia wider transport systems.

Best practice has been reviewed:

Key best practice examples include:

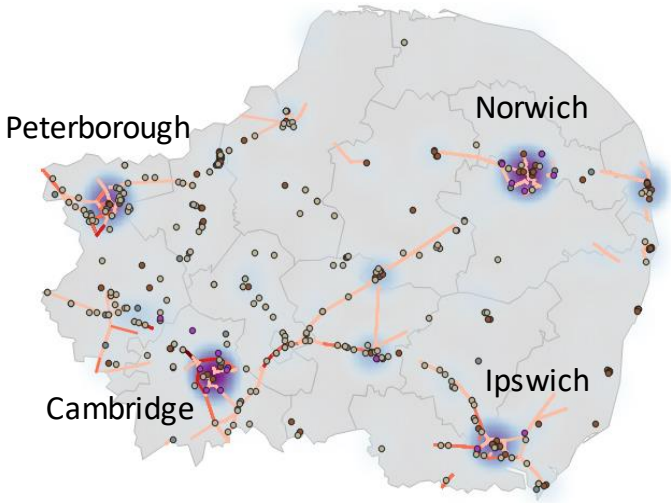
- Workplace charging levies
- Scrappage and mobility incentives, Integrated public transport networks and active travel schemes
- Freight consolidation
- EV charging frameworks deployment approaches

Local opportunities for innovation:

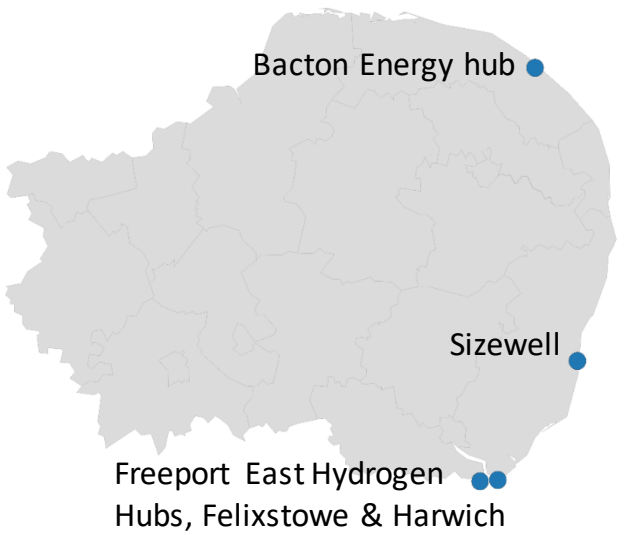
Opportunities in the region have been highlighted for two areas of innovation:

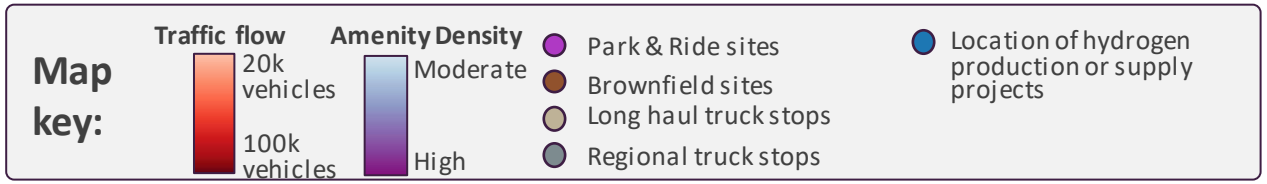
- Development of multi-modal hubs that co-locate multiple transport modes with refuelling and on-site renewables (Key locations around city centres and major traffic routes)
- Hydrogen for transport, with links to local hydrogen projects in Norfolk and Suffolk (currently projects at 4 sites in East Anglia)

Opportunities for multi-modal hubs



Map of hydrogen projects in East Anglia





- Executive Summary
- **Current situation**
  - Current policy landscape
  - Existing AFVs and infrastructure
- Future uptake of Alternative Fuels Vehicles
- Opportunities to support uptake of AFVs
- Appendix

AFV uptake in the region is currently low, however policy and local opportunities can be leveraged to significantly improve on this

Summary of findings:

Policy overview

- Both **national and regional policy** are conducive to a decarbonised transport system, and there are a significant number of ongoing funding schemes, trials and other policy to support this
- **Local policy is a good starting point** for the transition to low carbon transport at a more local level **but does not go far enough** or cover all bases, and would benefit from coordination and alignment
- **There are many local transport activities, incentives and innovation projects that the Alternative Fuels Strategy can leverage** – including experience in integrated renewables projects, smart energy grids, and local hydrogen projects

East Anglia AFV uptake and infrastructure

- **Current uptake of vehicles and infrastructure is low** but there are opportunities for growth:
  - Uptake of electric cars and vans in the region is slightly above average for the UK, although remains at below 1% of the total stock, and electric vehicle (EV) charging is limited outside of major towns and cities, with the majority of chargers slow to fast
  - Uptake of low emissions buses and HGVs is very limited as is supporting natural gas and hydrogen refuelling infrastructure, however, electric bus deployment will increase through ZEBRA applications
- Decreasing AFV prices, improving products (for example BEV ranges), policy support, and an increased range of models have all contributed to an accelerating uptake at a national level, and will continue to do so in the future

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Overview – transport policy is set at a national, regional and local level

National

- **Net zero by 2050**
- Details for transport decarbonisation have been set out in the 10-Point Plan, Energy White Paper, and Transport Decarbonisation Plan
- Key objectives include:
  - Accelerating the shift to ZEVs by funding charging infrastructure and trialling zero emission HGVs
  - Investing in green public transport, including the electrification of railways and bus routes
- Government proposing phase out of internal combustion engine (ICE) vehicles across several segments through possible sales ban

Regional

- The two subnational transport bodies active in East Anglia have developed strategies that provide a good basis for transport decarbonisation
- The strategies however lack rigid targets
- The CPCA Independent Commission on Climate have set rigid targets for decarbonising regional transport, which will be effective if fulfilled

Local

- All county councils and most local authorities have set net zero dates by 2050, with many being as soon as 2030
- Transport plans at a county level, and at a local authority level, provide some basis to increase public transport usage and active travel
- The plans, however, are limited in actions to boost EV and other ZEV uptake, as well as in actions to provide the necessary infrastructure
- Road building and improvements were also identified as a priority, which is not necessarily consistent with decarbonisation targets

The national vision for the transport sector is firmly on zero emission vehicles, defined as zero tailpipe emissions (battery electric and hydrogen fuel cell electric)

Summary of UK transport policies and ambitions from 10-point plan, Energy white paper, Transport Decarbonisation Plan, Net Zero Strategy

Accelerating shift to zero emission vehicles

- **£582m** to **extend the Plug-in** Car, Van, Taxi and Motorcycle **grants** to 2022–23
- **£0.5bn** to develop and mass scale production of electric vehicle batteries (Gigafactories)
- **£1.3bn to aid charge points deployment** in homes, workplaces, streets and on motorways
- All new **private (home-based) EVCPs** must be **smart by 2021**
- Consultation on new building regulations to **require EVCPs** in **all new homes and non-residential buildings**
- **£20m** invested in hydrogen and **zero emission freight trials** in 2021

Fossil fuel vehicle phase outs

- **Ending the sale of new petrol and diesel cars and vans by 2030, and to be zero emission by 2035** – consultation ran from February 2020 to July 2020
- **Consultation to end the sale** of diesel HGVs by 2035 and 2040 depending on GVW – consultation ran from July to September 2021 – outcome confirmed
- **Consultation to end the sales of diesel buses by 2030** – consultation ran from March – April 2021 – awaiting outcome

Green Public Transport and Active Travel

- **£4.2bn** invested in **city public transport**
- Electrification and expansion of **railway lines**, including **£500m** reopening lines closed during Beeching cuts by **2023/24**
- **£120m** to build **4,000 zero emission buses** (12% of local bus fleet), finance two 'all-electric bus towns' (Oxford and Coventry)† in 2021
- Launch of **National bus strategy,** part of PM's £5bn funding to improve operating efficiency and costs
- **£2bn** invested across 2021-2026 to improve walking and cycling infrastructure

Target Milestones:

Early 2021	- National Bus Strategy starts and first electric bus town
2021	- Zero emission and hydrogen freight trials start
	- First of 4,000 new zero emission buses
2023/24	- Rail lines electrification
2030	- End of sales of new petrol and diesel cars and vans
	- 2,500 HPCs along motorways and major A-roads
	- Half all journeys in towns and cities cycled or walked
2035	- All new cars and vans will be zero emission
	- Approx. 6,000 HPCs along motorways and major A-road

Sources: Energy White Paper: powering our Net Zero Future, The Ten Point Plan for a Green Industrial Revolution, Government consultations, Transport decarbonisation plan

* compared with 1990 †https://www.gov.uk/government/news/coventry-and-oxford-set-to-be-uks-first-all-electric-bus-cities HPC = High powered charger

Personal and business grants are available for the purchase of both an EV and charge point

Grant for low emission vehicles:

Plug-in vehicles grant

- OZEV grant - gives a discount on the purchase price (PP) of a low emission vehicle if the model meets eligibility requirements (outlined in table)
- Eligible vehicle types: moped, motorcycle, cars, van, taxi, large vans / trucks
- Total funding of £400m initially running from 2016-20 but **extended to March 2023**

Vehicle:					<2,500 kg	>2,500 kg	
Emission requirements to be eligible[1]:	Zero CO_2 e + 30km range	Zero CO_2 e + 50km range	<50g CO_2 /km + 112km range with zero CO_2e		<50g CO_2 /km +96km range with zero CO_2e		50% less CO_2e than equivalent vehicle + 96km with zero CO_2e
Number of models:	51	40	33	2	8	19	5
Grant amount:	35% of PP up to £150	35% of PP up to £500	35% of PP up to £1.5k[1]	20% of PP up to £7.5k	35% of PP up to £2.5k	35% of PP up to £5k	20% of PP up to £25k[2]

Grants for electric vehicle charge points:

These schemes will change in 2022 Q1

EV home charge scheme:

- Grant gives a discount on the purchase price and installation of a home EV charge point
- 75% contribution up to £350 per device - up to 2 devices per household
- Eligible to customers must:
  - Own or lease an eligible electric vehicle
  - Have dedicated off-street parking
- In Feb 21, an additional £50m was made available to expand the home charge and workplace charge schemes
  - The scheme has been **expanded to target people in rented and leasehold accommodation**
- **Eligible vehicle types**:

Workplace charging scheme:

- Grant supports the upfront costs of purchase and installation of EV charge points at a registered business, charity or public sector organisation
- 75% contribution up to £350 per socket up to 40 sockets per organisation
- Eligible organisations must:
  - Have dedicated off-street parking for staff or fleet
  - Each socket have a supply of 3-22kW
- In Feb 21, at additional £50m was made available to expand the home charge and workplace charge schemes
  - The scheme was **opened up to small to medium enterprises and the charity sector**, this will allow small accommodation businesses to apply boosting EVCP accessibility in rural areas

1. Cars must have a total purchase price <£32k – changed 15th Dec 2021 from up to £2.5k<£35k; 2. For trucks >12t (£16k for trucks <12t), For large trucks, this applies to the first 100 orders with maximum order of 5 per customer (for small trucks, it is limited to first 250 orders and maximum 10 per customer), after this has been reached a maximum grant rate of £6k will apply

Additional incentives include rapid and on-street EVCP schemes and tax breaks on low emission vehicles

Tax incentives: for individuals and businesses

Vehicle Excise Duty (Road Tax) is banded by CO_2 emissions, and **zero emission cars are exempt.** A VW e-Golf would save £175 on vehicle excise duty compared to a VW Golf in its first year and £150 annually subsequently.
The 2020 budget has now removed VED tax for luxury electric cars defined as those with purchase price >£40k

Company car tax is banded by CO_2 emissions, and the **BEV tax rate is 0% for 2020-21**. A VW e-Golf would save ca. £1,700 on company car tax.

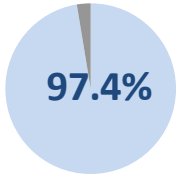
There is a **100% first year allowance** for expenditure incurred on EVCP equipment for businesses which has been extended to March 2023

Rapid Charging Scheme: Highways England

- Highways England aims to ensure 95% of all motorways and major A roads are within 20 miles of a public, rapid charge point with sites <5m drive from the strategic road network
- They awarded a contract worth £2.8m to bp pulse and Swarco UK to install more than 50 EVCPs across the UK in 2019/20 focusing of 'gaps' along the strategic road network

Current deployment:

Rapid EVCPs installed



Network coverage

Local Authority Grant: On-street Residential Charge point Scheme (ORCS)

- Funding is available to **local authorities** to help with the costs of **procurement and installation** of on-street charge points for residential use
- To date 140 local authority projects have received funding from the scheme
- Funding is available for **75% of the capital costs up to £13,000 in cases where connection costs are high** – can be located **on-street or car parks**
- It is anticipated that local authority applications will vary in size, there is no longer a constraint on project size.
- Projects must have a completion date **no later than 31st March 2023**
- Funding has increased a number of times since the scheme was launched in 2017 with **total funding of £28.5m to date**
- **Funding breakdown:**
  - £1.5m in 2017 (initial funding)
  - £4.5m in 2018/19
  - £2.5m in 2019/20
  - £20m in 2020/21

Eligibility Requirements:

- Charge points must be located in **residential areas** and have a charging speed of **3.5-22kW but not above 22kW DC or 23kW AC**
- Car park charge points must be available to residents for **free overnight** and a minimum 'maximum stay' time of 4hrs in the day
- Local authorities will need to **demonstrate home charging is not an option** for the residents where the charge points are to be located
- The locations must meet **current or anticipated future demand**

Alternative fuels are also supported by schemes to provide revenue streams and tax breaks

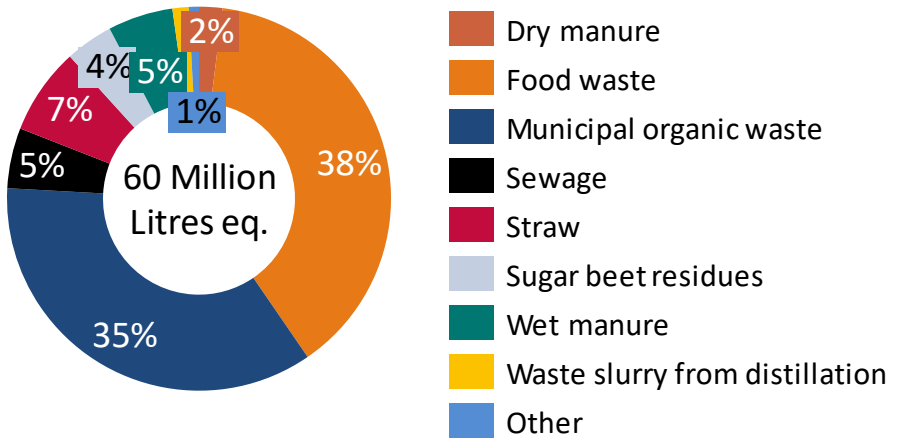
Renewable Transport Fuel Obligation (RTFO)

- Originally introduced in 2010, the RTFO provides an incentive for producers of renewable fuels, by requiring that fuel suppliers sell a proportion of renewable fuels in their mix (increasing obligation out to 2032, then constant after 2032)
- Provides a market for producers of low carbon fuels that would otherwise be uneconomic due to their higher cost compared to fossil alternatives
- Producers must redeem a certain proportion of Renewable Transport Fuel Certificates (RTFCs) within a reporting period to meet their obligation
- Biomethane is double-counted (1.9 RTFCs per kg) and hydrogen is classed as a development fuel and is double-counted under certain production methods

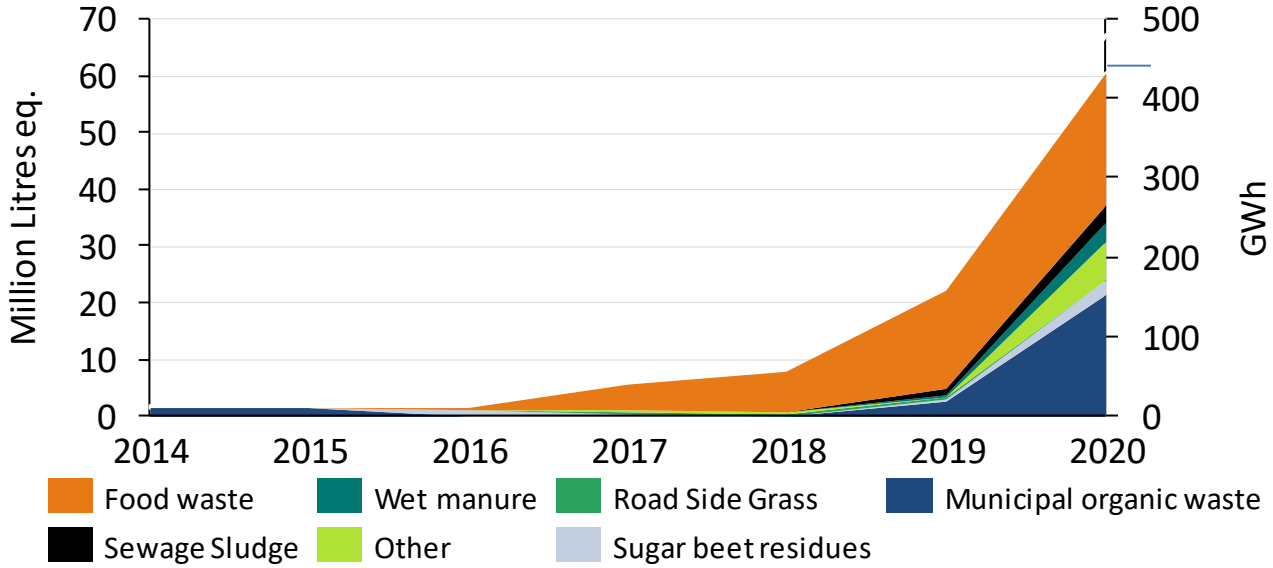
Fuel duty differential

- Petrol and diesel used in transport is subject to fuel duty of 59.75p/l
- Natural gas attracts a reduced fuel duty rate (24.7p per kg) which was frozen until 2032 in the 2018 budget – this provides certainty for fleets and the fuel savings mean that operators can recover the additional cost of the more expensive gas vehicles in under 2 years
- Hydrogen and electricity used in transport do not attract fuel duty

Qualifying biomethane by feedstock under the RTFO in 2020[1]



Qualifying biomethane by feedstock under the RTFO in 2014-2020[1,2]



1. Renewable fuel statistics 2020: Fifth provisional report RF_01. 2: Renewable fuel statistics 2019: Final report data tables RF_01

Subnational transport bodies have set out strategies for decarbonising transport in their respective areas

Summary of transport policies and ambitions set out by Transport East and England's Economic Heartland

Transport East (Norfolk and Suffolk)[1]

- Have set the **target of net zero transport by 2040**
- To achieve this target, the strategy sets out 4 key goals:

1. 'Zero carbon growth' – locate and design new developments that reduce the need for carbon-intensive trips

2. Improve access to jobs and services, either locally or by digital means, reducing demand for trips

3. Instigate a modal shift away from private cars towards active travel and public transport, and freight towards modes such as rail

4. Switch all passenger and freight vehicles to low carbon fuels at the earliest opportunity

- To fulfil these goals a 'place-based approach' will be adopted, with more focus on an extensive EV charging network in rural and coastal areas, and greater focus on fast and efficient public transport networks in urban areas
- Connectivity along six strategic travel corridors has also been identified as a priority
- An investment and delivery programme has been set out to deliver the ambitions set-out in the strategy

England's Economic Heartland (Cambridgeshire & Peterborough)[2]

- Believe they can reach **net zero carbon for the entire transport system by 2040**
- EEH's transport strategy sets out a five point action plan for decarbonising transport, supported by an investment pipeline of how each action will be delivered:

1. Decarbonisation by harnessing innovation and supporting solutions with economic opportunities
2. Promote investment in digital infrastructure to improve connectivity (leading to reduced travel)
3. Deliver East West Rail and mass rapid transit systems (such as the Cambridge Autonomous Metro)
4. Promote active travel and shared transport
5. Decarbonise freight and logistics, by for example increasing rail capacity

- Both sub-national transport bodies aim to decarbonise transport by 2040, whilst also ensuring the transport system continues to deliver economic opportunities
- The key to achieving this is highlighted as offering improved public transport and active travel infrastructure as alternatives to private car use, whilst also limiting overall travel demand by advancing digital connectivity

Sources: 1 –Draft Transport Strategy, Transport East, November 2021.
2 – Connecting People, Transforming Journeys, England's Economic Heartlands, July 2021.

The Cambridgeshire and Peterborough Independent Commission on Climate has several specific recommendations that can lead to a sustainable transport system

In 2020, CPCA set-up a commission to provide independent advise on recommendations to help Cambridgeshire and Peterborough mitigate and adapt to the impact of climate change. The first full report of the commission was released in October 2021 and has been considered within this study and will also feed into the LTCP. Recommendations by the commission with respect to transport include:

Vehicle	Target
	• Develop a plan for charging infrastructure rollout out by 2022 • All new residential and non-residential developments with parking should be equipped with EVCPs
	• 30% of taxis to be zero emission by 2025, 100% by 2030 (achieved through licensing conditions)
	• Diesel vans and trucks to be excluded from urban centres by 2030
	• All buses on CPCA subsidised routes should be zero emission by 2025, and all routes by 2030
	• Improve cycling infrastructure (segregated cycle lanes) and encourage e-bike uptake for longer trips
	• Alternatives to road investment to be prioritised for appraisal and investment such as opportunities for light rail
	• Home deliveries should only be made by ZEVs by 2030

Source: Fairness, nature and communities: addressing climate change in Cambridgeshire and Peterborough, Cambridgeshire & Peterborough Independent Commission on Climate, October 2021

Local policy is a good starting point for a transition to low carbon transport but does not go far enough or cover all bases

We have reviewed all available transport plans published by county councils and local authorities [1]

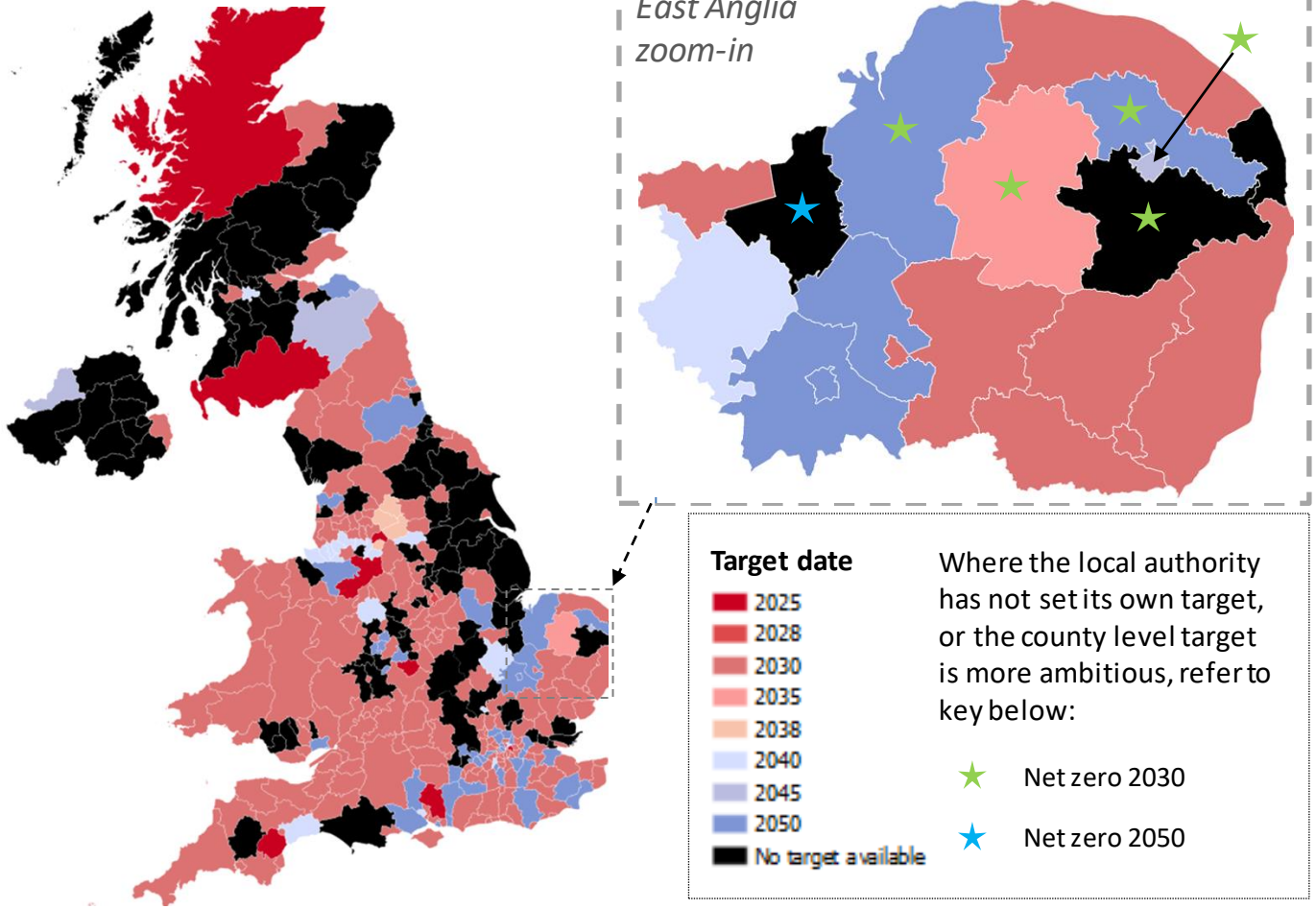
Council	Active travel targets	Public transport targets	Freight targets	Decarbonisation targets	EV charging targets/strategy
County/Unitary Authority level					
Cambridgeshire	Targeted increase in walking and cycling routes (specified routes)	Improving links between rural towns and large urban centres	Shift towards rail freight; re-routing of road freight to minimise traffic	Net zero 2050	Supporting EVCP roll out but with unquantified targets
Peterborough	Use of AT to alleviate City Centre and linkage with villages	Improve PT; new developments must prioritise bus access		Net zero 2030	Encourage incorporation of charge points at car parks
Norfolk	Dedicated cycling lanes in urban areas; prioritising funding for cycle and walking route upkeep	Dedicated bus lanes; improvements of specific rail links e.g. Kings Lynn to Cambridge		Net zero 2030	Have proposed a county wide EV strategy which includes specific EVCP deployment targets
Suffolk	Targeted improvements in walking and cycling infrastructure	Targeted improvements in bus and rail infrastructure	Expansion of rail freight capacity	Net zero 2030	Plug in Suffolk project to create charging network throughout Suffolk

= specific targets backed with actions = unspecific targets/no supporting actions = no targets or actions

1. See appendix for review of local plans set out by the local authorities within each council

Many local authorities have declared "Climate Emergencies", with many net zero targets set as early as 2030

Climate emergencies by local authority in UK and East Anglia



- In addition to the national-level targets and policies, there is a growing call to action at a more local level
- Many cities/local authorities in the UK have declared a "Climate Emergency"
- Some have pledged to meet a net zero target within the next decade i.e. by 2030 (and in some cases even earlier), including 7 of the local authorities in East Anglia
- There are outstanding questions relating to whether such bold declarations will be backed up with policies and other actions required to meeting the stated objectives, and in many cases there remains a gap between somewhat targets and actions on the ground

Sources. Climate Emergency UK and local stakeholder engagement

Local policy is a good starting point for a transition to low carbon transport but does not go far enough or cover all bases

Encouraging behavioural change

- **All councils recognise the need for behavioural change away from private car usage towards sustainable transportation modes** (public transport, walking and cycling)
- Each plan thus identifies improving bus, rail, cycling and walking infrastructure and services as a top priority
- However, all councils also identify road building as a priority area. While it must be recognised that many communities are rural and depend on private cars, new roads generally contribute to increased private car use and investment should be encouraged elsewhere

Encouraging alternative fuels uptake

- Due to the release year of some plans relative to the pace of change, detailed targets for alternative fuelled vehicle uptake (in particular BEV uptake and infrastructure) is limited
- The intention to support uptake is fairly unanimous, but often vague and un-coordinated
- More specific and pro-active EV charging point targets and roll-out is necessary, in particular to cover areas not profitable for the private sector

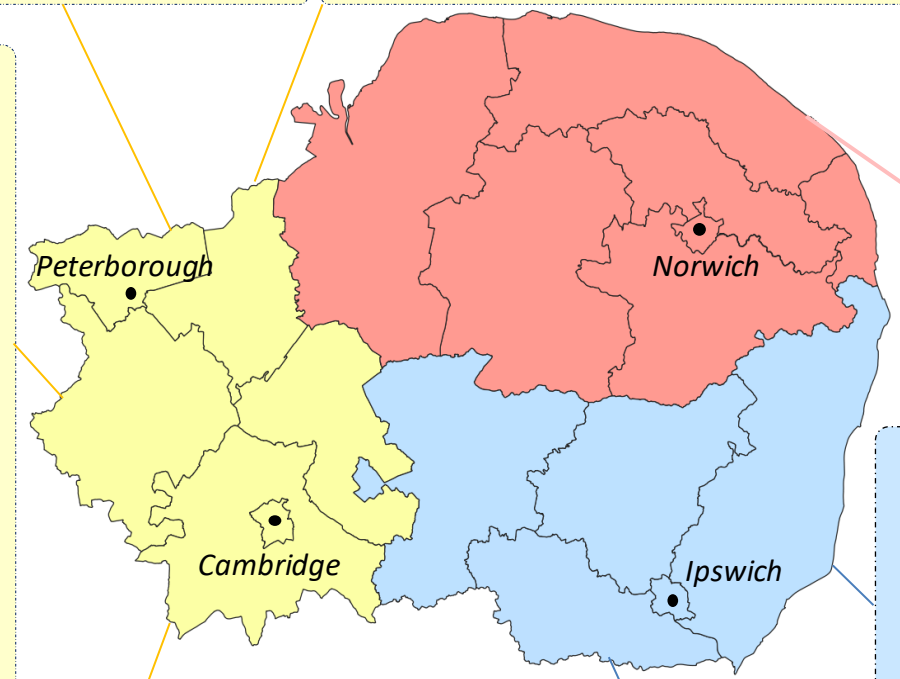
- Going forwards, transport development in East Anglia can build on the existing ambition of local plans to decrease private car use and improve active and public transport offerings
- Greater focus will need to be placed on AFV uptake to ensure a transition to a fully sustainable transport system

There are many local transport incentives and innovation projects that the Alternative Fuels Strategy can leverage

- **Connectivity:** The Connecting Cambridgeshire programme supports local smart energy system projects, including infrastructure – such as working with partners to deliver multi-purpose street lighting columns – and projects, such as freight decarbonisation[4]

- **Smart energy grids:** Cambridgeshire County Council, in partnership with Bouygues E&S, are delivering smart energy grids on two Park and Ride Sites through solar generation and battery storage
- The sites will provide local renewable energy generation to supply clean electricity for local customers and deliver EV charging, as well as the potential for future bus opportunity charging[3]

- The **Peterborough Integrated Renewables Infrastructure** project will combine a heat network, electricity network and contribute to electrifying transport in the area
- The project will include 3 main transport developments:
  1. Installing a 50 EVCP rapid hub at Bishop's road car park in Peterborough. This will be one of the biggest rapid hubs of its kind
  2. Converting Peterborough City Council's fleet to EVs. This is a 3-phase process that must conclude by 2030, as 2030 is PCC's net zero deadline
  3. Electrifying parts of Stagecoach's bus fleet in Peterborough.



- **Travel incentives:** Norfolk county council's 'AtoBetter' sustainable travel incentive encourages residents in certain developments to cycle or use public transport to commute to work, funded by housing developers
- Incentives include cycle shop vouchers (£70), cycle course vouchers (£30), bus travel vouchers (£80), train travel vouchers (£90), with residents eligible for one cycle and one public transport incentive[3]

- **EV charging:** Plug in Suffolk, in partnership with Suffolk County Council, is a pilot project seeking to establish universal access to an interoperable public EVCP network
- Priorities include filling-in gaps in rural areas, as well as encouraging local businesses to host an EVCP without the capital outlay[1]

- **Micromobility:** CPCA have been trialling Voi e-bikes (50) and e-scooters (300) in Cambridge since October 2020, supported by the DfT's wider e-scooter trial programme
- The trial is due to end in March 2022 and its success would see e-scooters and e-bikes legalised in Cambridge, which could greatly contribute to reducing private car use[2]

- **Smart technology:** Suffolk County council recently secured £4.4m of DfT funding for communicating to residents how SMART technology could improve local services (through the ongoing Live Labs project)
- The Live Labs project involves installing road side sensors and leveraging BT's Data Exchange platform to deliver data to the Council on how to improve its transport and highway based services[2]

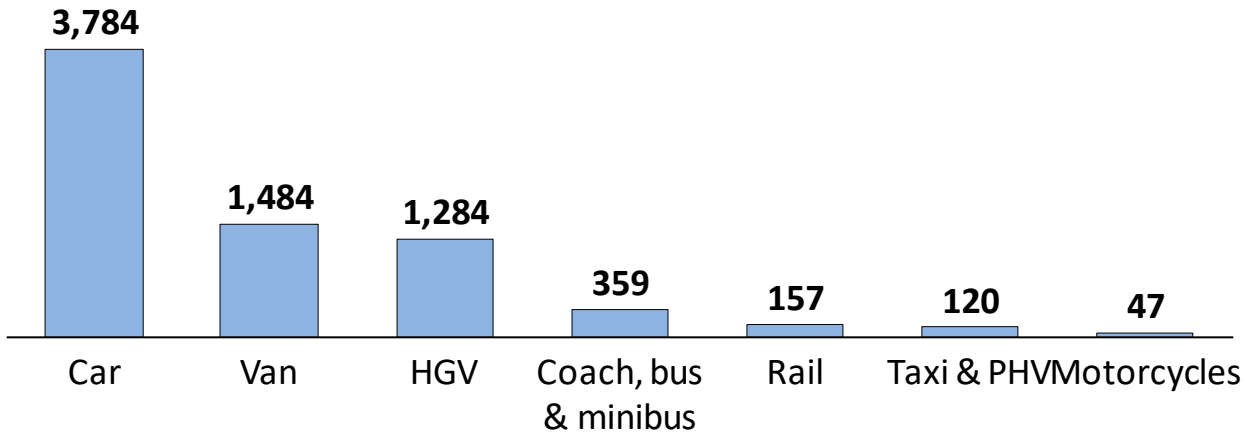
The Cambridge City Deal allows the Greater Cambridge Partnership to deliver more sustainable means of accessing Cambridge city centre

- In June 2014, the UK government signed a deal to invest up to £500 million in transport infrastructure, housing developments, and apprenticeships in the Greater Cambridge area, aiming to deliver:
  - 44,000 new jobs
  - 420 new apprenticeships
  - 33,500 new homes
- The funding is used to deliver projects managed by the Greater Cambridge Partnership (GCP) (Cambridge City Council, Cambridgeshire County Council, South Cambridgeshire District Council, and the University of Cambridge)
- The first £100 million of funding was made available from April 2015 – 2020, leading to the delivery of city cycleways and better public transport services through to Cambridge
- The 'Gateway Review' conducted by the Government in 2020 was hence passed, leading to the release of a further £200 million worth of funding to 2025, at which point another review will take place to release the final £200 million from April 2025
- The GCP has a number of ongoing transport projects, including its 'cycling quick wins' package, which has already delivered improvements to several cycleways around the city, and will continue to resurface a number of other roads to facilitate cycling into Cambridge city centre, such as Fen Road and Walnut Tree Avenue
- The GCP also has four ongoing public transport schemes, aiming to improve access to the city centre:
  1. Cambourne to Cambridge: A project to deliver a new dedicated public transport route between Cambourne and Cambridge, to ease congestion and private car trips into the city centre, especially on the A1303/Madingley Road
  2. Cambridge Eastern Access: Aims to deliver improved public transport, cycling and walking infrastructure into Cambridge centre from the East, for example by upgrading the Newmarket to Cambridge railway line, and relocating the Newmarket Road Park & Ride
  3. Cambridge South East Transport: A project focusing on improving public transport, walking and cycling options into Cambridge for those who currently travel in by car on the A1307 and A1303. For example, a planning application to extend the Babraham Road Park & Ride has been submitted to Cambridgeshire County Council
  4. Waterbeach to Cambridge: Aiming to deliver improved public transport access to Cambridge from the north via the A10 corridor

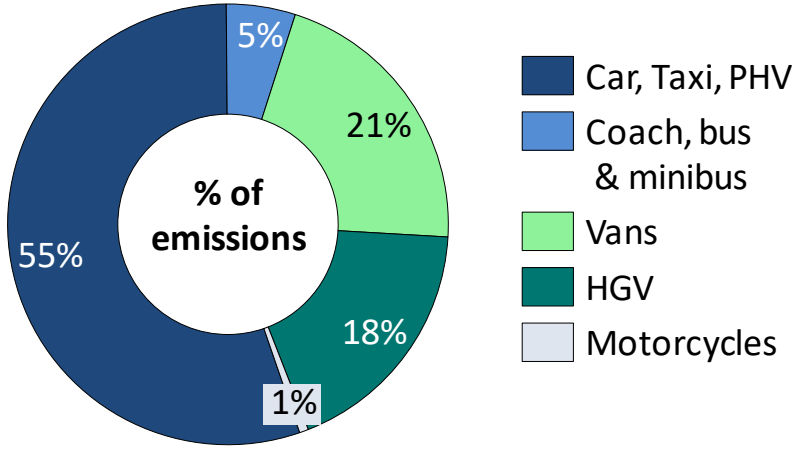
- Executive Summary
- **Current situation**
  - Current policy landscape
  - **Existing AFVs and infrastructure**
- Future uptake of Alternative Fuels Vehicles
- Opportunities to support uptake of AFVs
- Appendix

Overview of current transport system in East Anglia

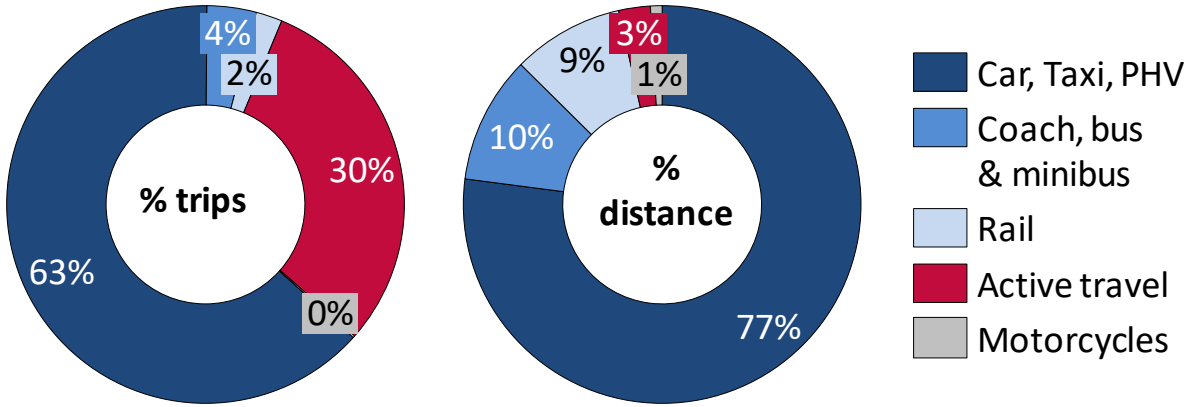
Current transport emissions in East Anglia ('000 tonnes CO_2e)[1]



Road transport emissions by vehicle and fuel type[1]



Passenger travel by mode[2]

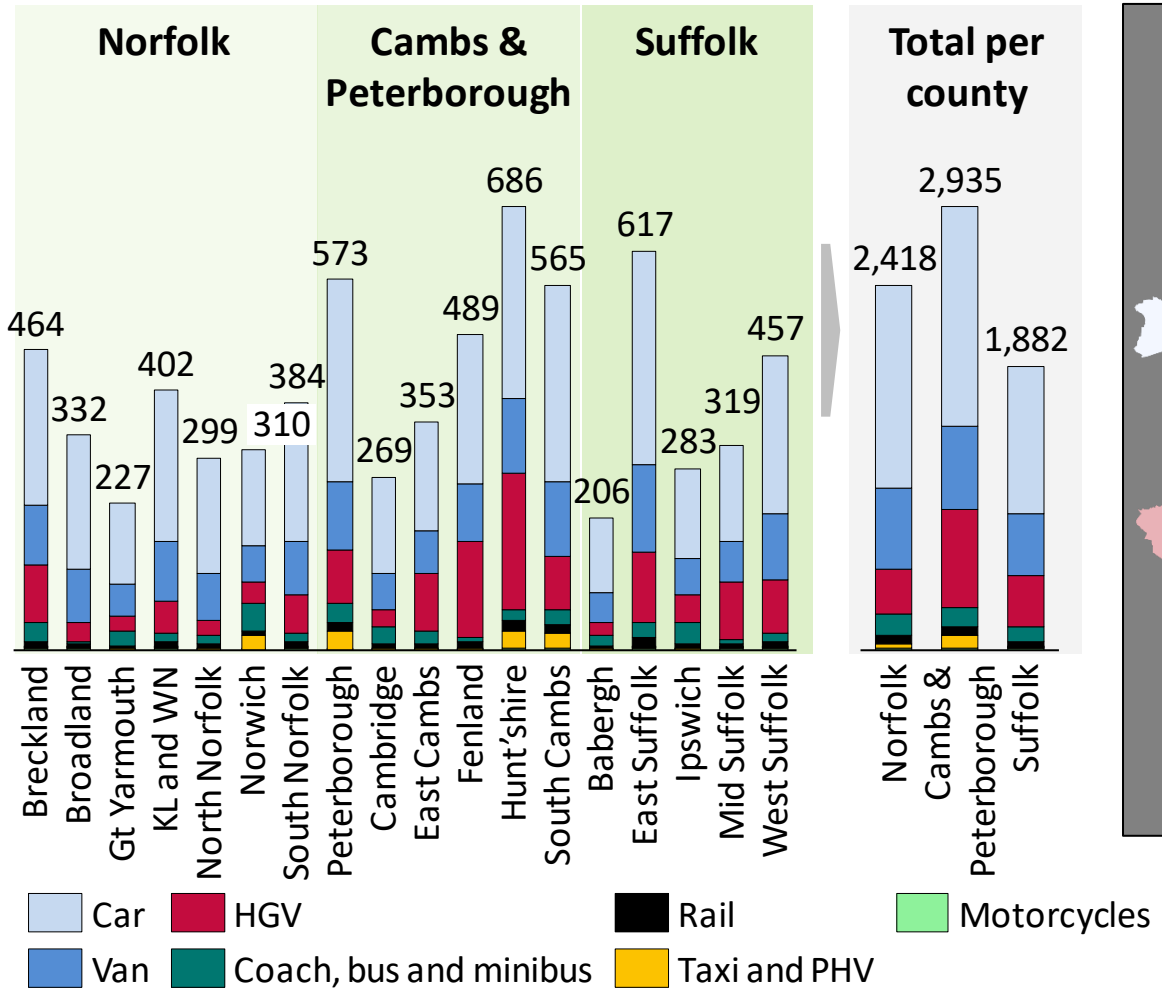


- **Transport contributes 33% of emissions in the region**[3]
- 95% of transport emissions in the region come from road transport[3], and 76% of road transport emissions are due to cars and vans[1]
- **63% of journeys in the region are made by car**, compared with 54% across England
- Although active travel (walking and cycling) makes up 30% of all trips, it accounts for only 3% of the average distance travelled per passenger

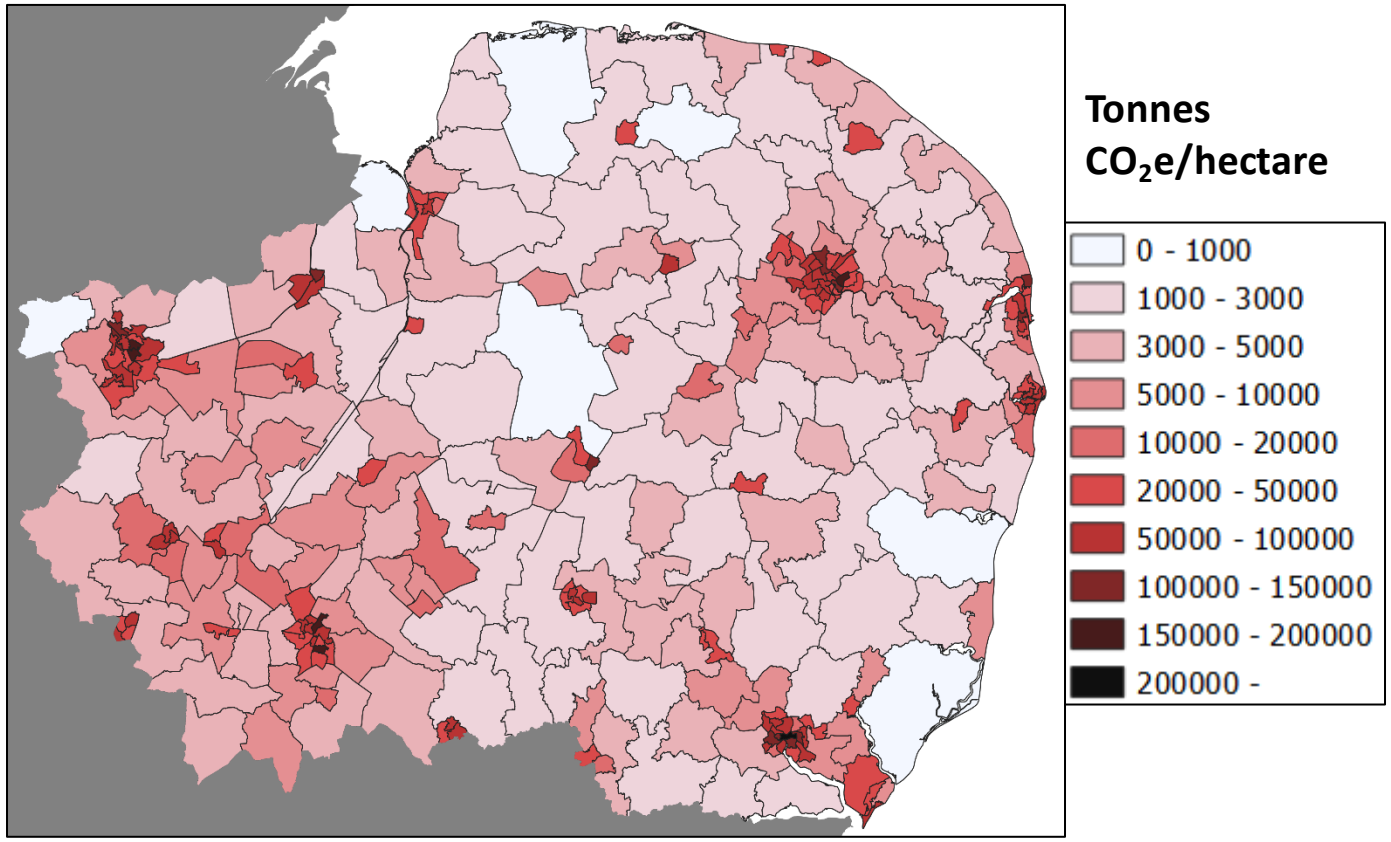
Sources: 1 – EE Modelling. 2 – National Travel Survey 2019. 3 - UK local authority and regional carbon dioxide emissions national statistics: 2005 to 2019. Note that this includes transport modes not modelled by EE.

Distribution of current transport emissions across East Anglia

Current transport emissions ('000 tonnes CO_2e)

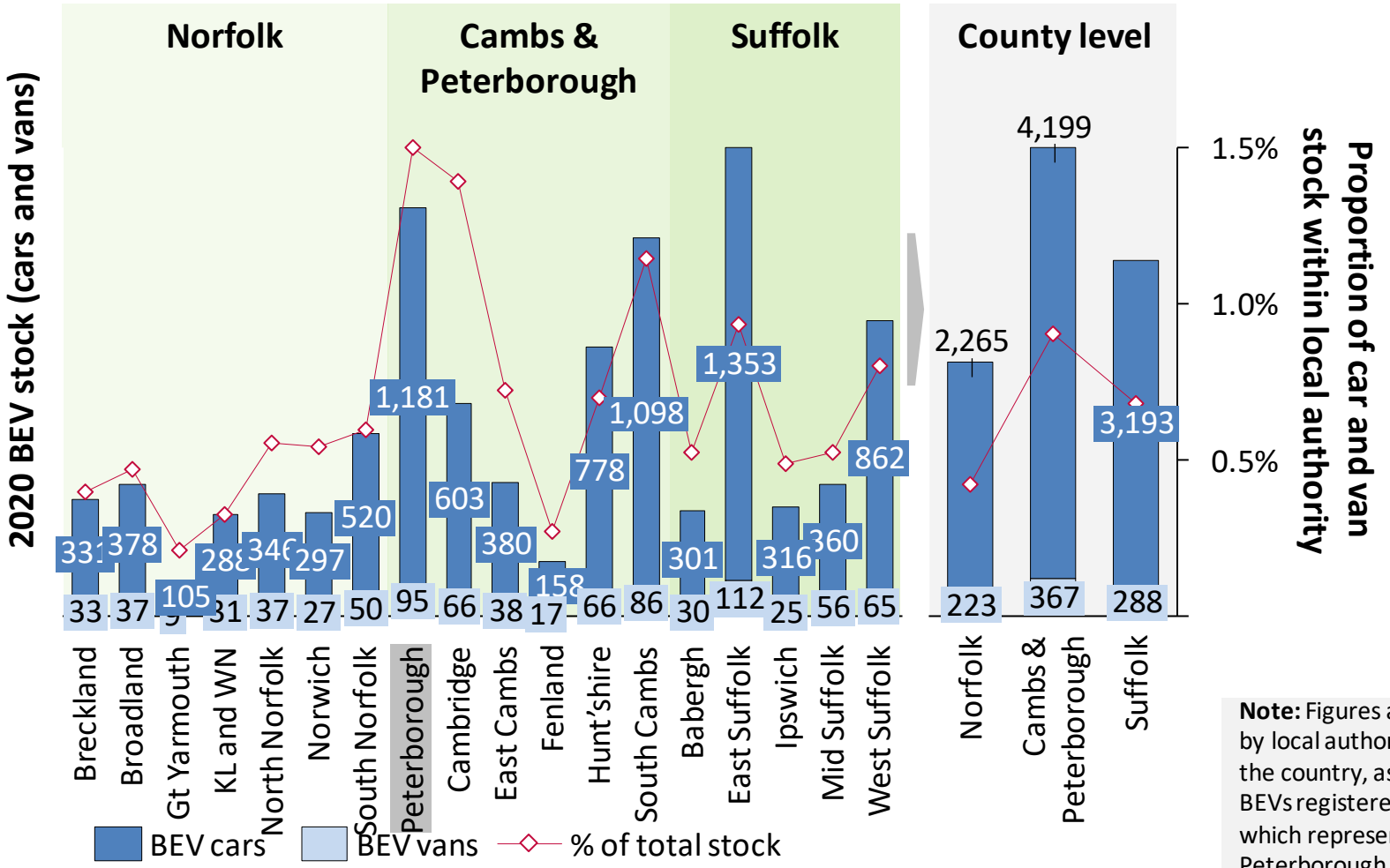


Current transport emissions density across East Anglia



Light duty vehicles: Uptake of electric cars and vans in the region is slightly above average for the UK, although varies significantly by local authority

Electric cars and vans in East Anglia split by local authority and as a proportion of total local car and van stock



Summary

i. There are an estimated 8,600 electric cars and 800 electric vans in East Anglia as of end 2020, giving an uptake rate of 0.66% across the region (national average 0.57%)

ii. However, this is skewed by a few high uptake local authorities, with 11 of the 18 below the national average

iii. Generally the higher the absolute number of EVs in the local authority, the higher the proportion of the total stock this represents

Note: Figures are based on EE cleaned version of the DfT's statistics on vehicle stock by local authority. The cleaning process involves redistributing company cars across the country, as they normally do not operate in the region of their registration. 97% of BEVs registered in Peterborough are company cars and thus have been redistributed, which represents a significant anomaly. The precise number of BEVs operating in Peterborough is thus hard to determine.

*Shown as weighted average of 0.57% across UK (BEVs as a percentage of total stock). Unweighted average is 0.63% across the 371 local authorities

Light duty vehicles: There are 4 key types of charge point categorised by charging speed: Slow, Fast, Rapid, Ultrarapid

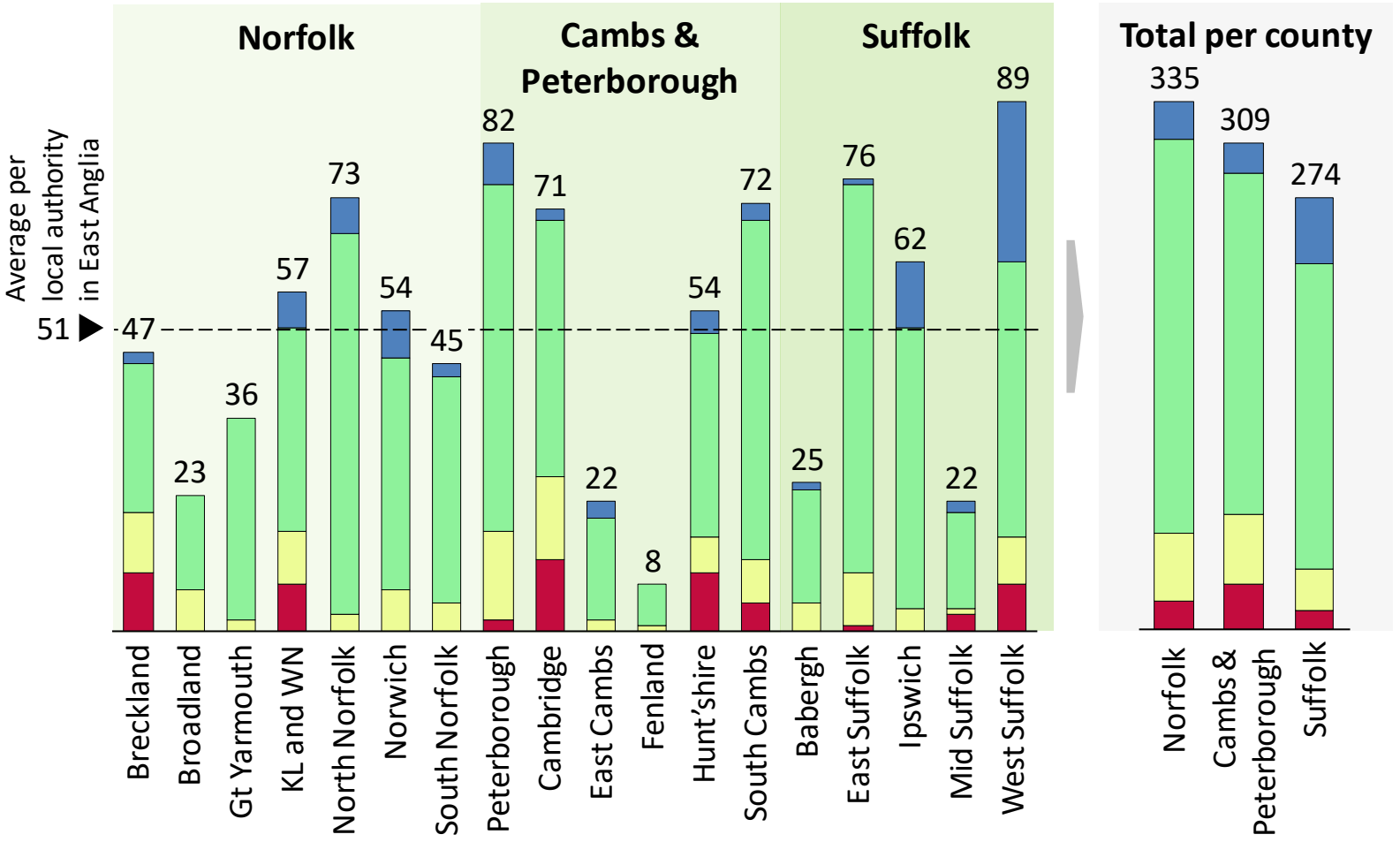
Speed	Slow	Fast	Rapid	Ultrarapid
kW range	3-5 kW AC	7-25 kW AC	50-120 kW DC	150-350 kW DC
Example				
Approx. time to fully recharge[1]	Overnight	2-4hrs	1-2hrs	< 30min (350kW chargers can add 200km range in 8 minutes)[2]
Locations	Mostly in public car parks and on-street and private residential charge points	Mostly in public car parks, on-street and highway stations	Varied locations, including motorway service stations, forecourts, car parks, city centres for taxis	Mostly at motorway services, and hubs such as Fastned and Ionity
Use case	Residential charging, work place charging or 'long stay' locations (train stations, hotels)	Residential or charging at a destination (retail, leisure, tourist attraction)	En-route charging or at a 'short stay' destination	En-route charging or 'topping-up'

There are 4 key types of charge points, categorised by charging speed. Each generally has a different use case and consumers with use a mixture of charge point types but currently the majority of charging (~75%[3]) is done at slow residential (on-street or 'at home' private) chargers.

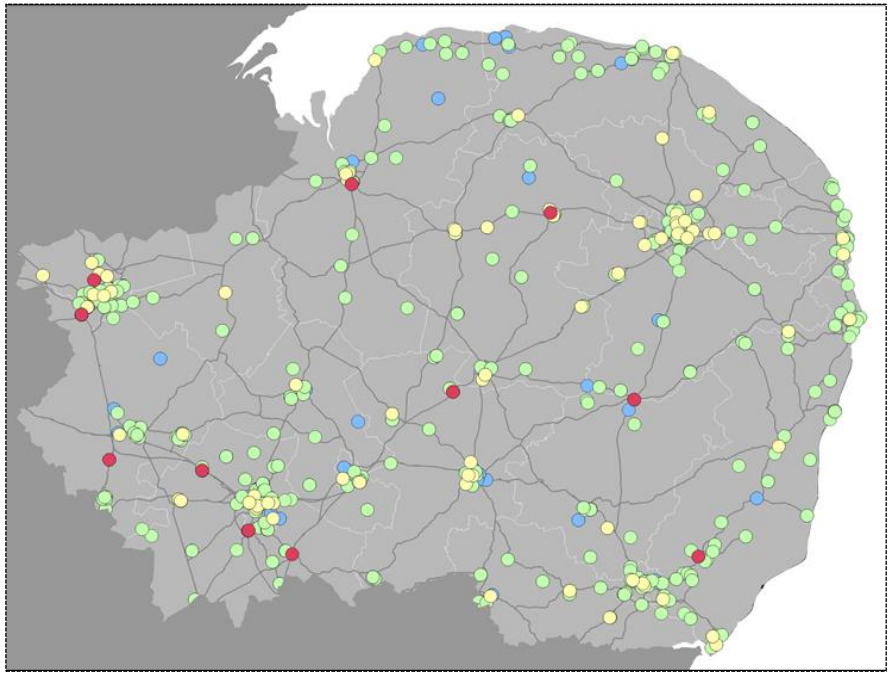
1 - Full recharge time is dependant on battery size and maximum charging speed 2 - All new vehicles can charge at 50kW max, but currently only the most expensive and/or newest vehicles have a charging speed >120kW. Currently no vehicles can charge at 350kW 3 - Element Energy for National Grid ESO (2019), Electric Vehicle Charging Behaviour Study

Light duty vehicles: There is limited EV charging infrastructure in East Anglia outside of the major towns and 80% of chargers are 25 kW or less

Electric vehicle chargers[1] in East Anglia



EV charging sites in East Anglia



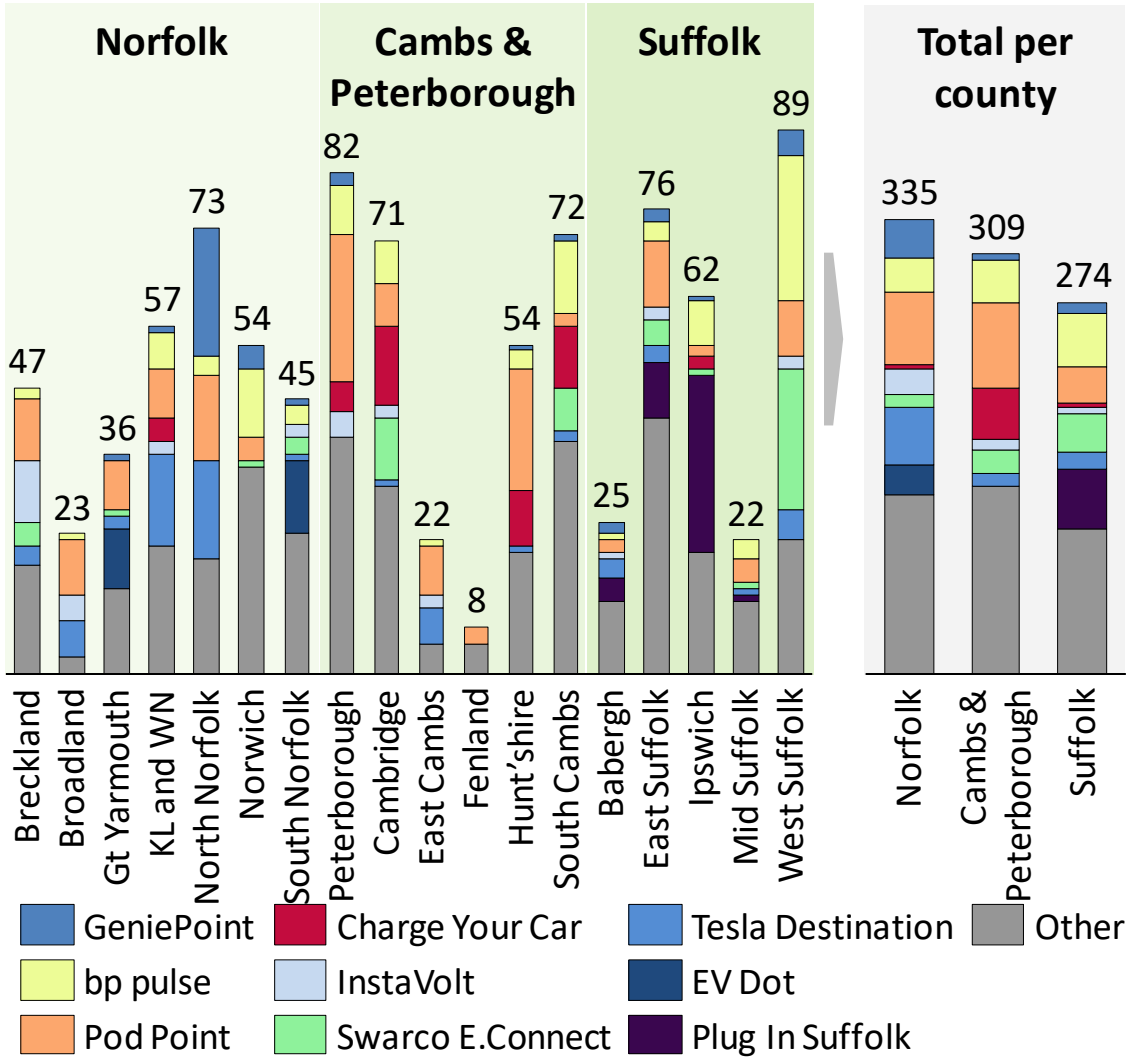
Max rate at charger[2]

3-5 kW | 7-25 kW | 50-120 kW | 150-350 kW

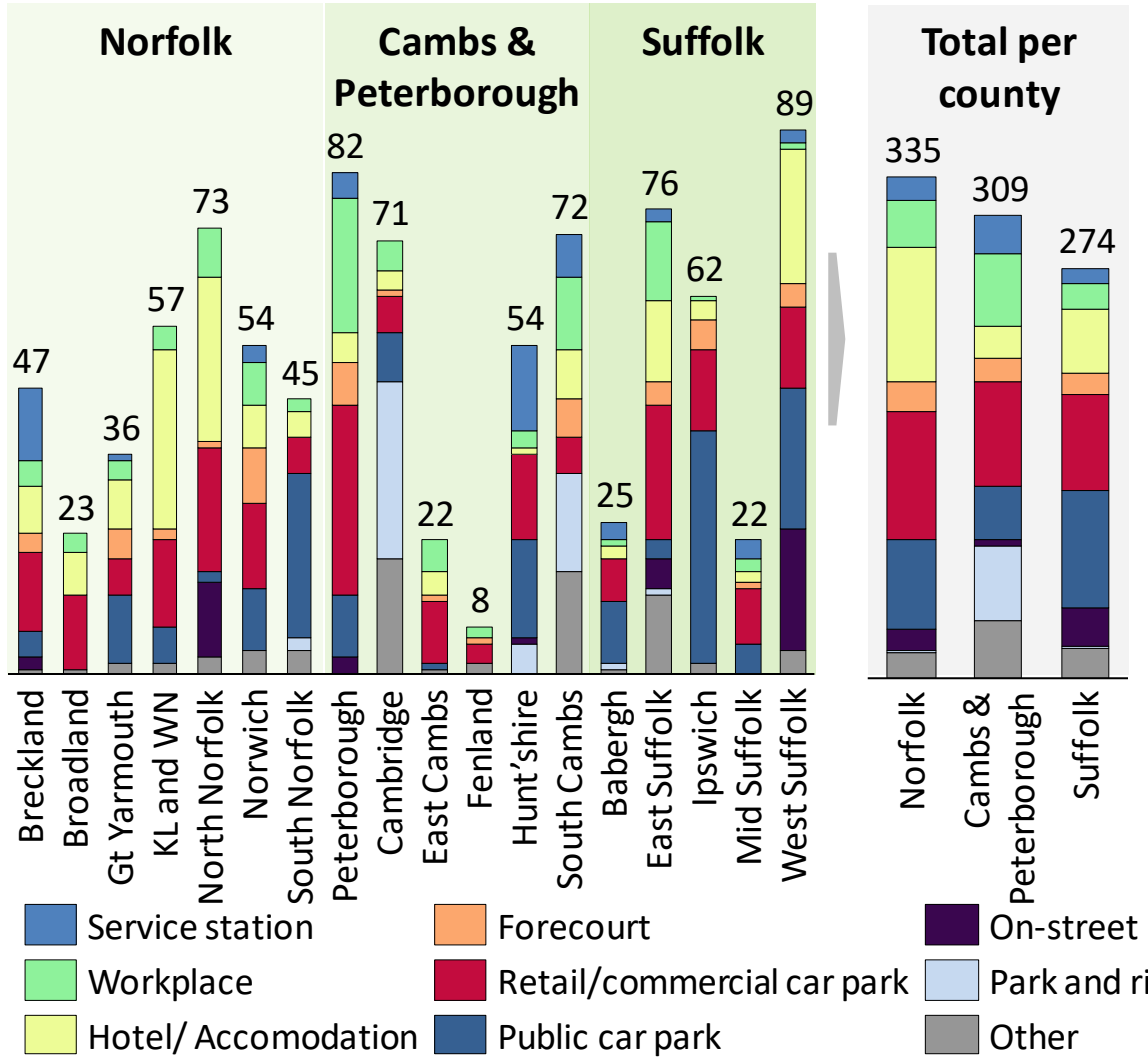
Sources: Source: EE analysis of ZapMap data & OpenChargeMap, Oct 21. Notes: 1 - An EV charger is the standalone charging device, often a tall box with multiple connectors coming out of it. For more details, see appendix. 2 - Where the charger has multiple connectors, the rate shown is that of the fastest connector

Light duty vehicles: The EV charging infrastructure in East Anglia is managed by a number of Charge Point Operators and is spread across various types of location

Number of chargers operated by each Charge Point Operators



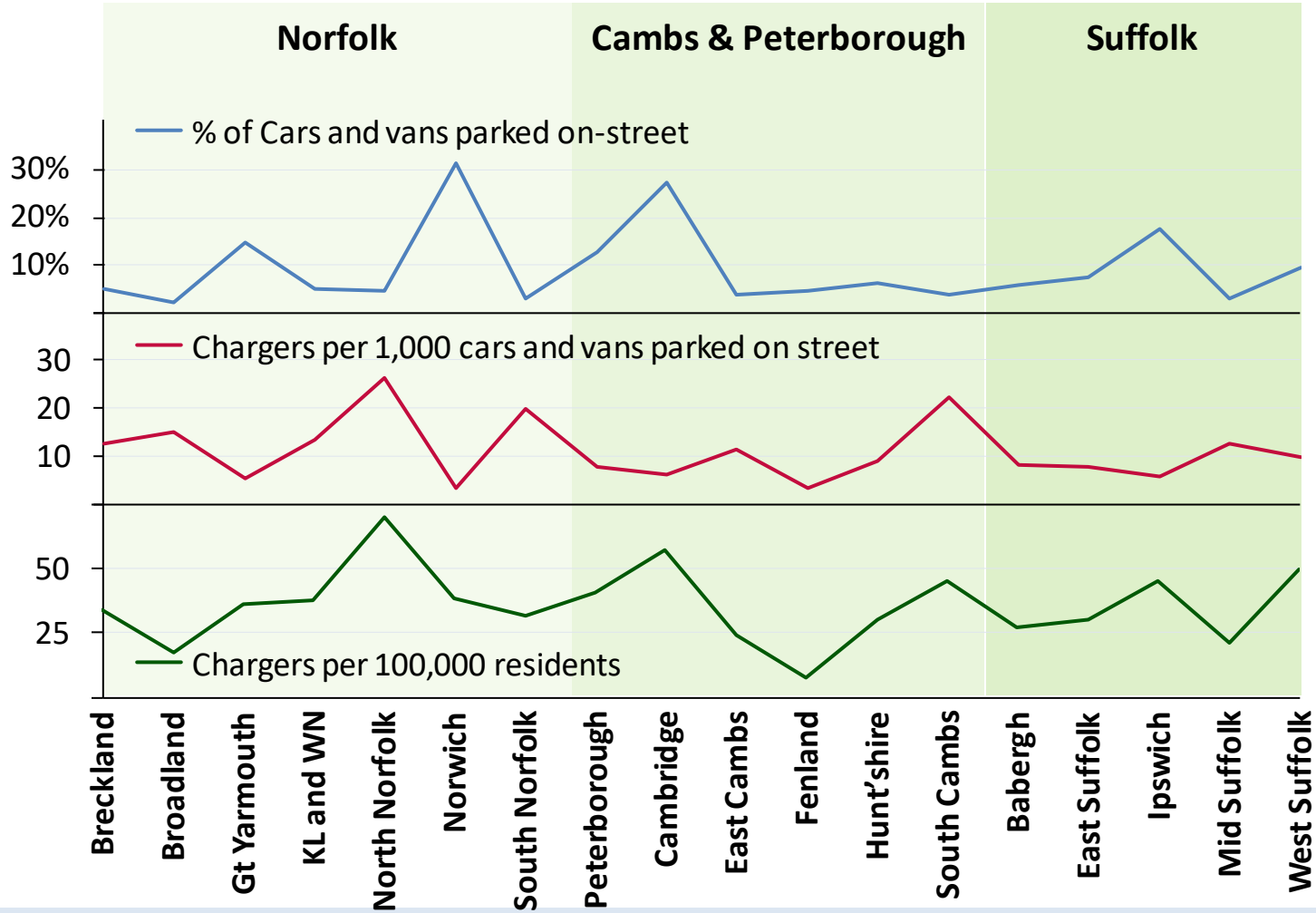
Number of chargers by location type



Source: EE analysis of ZapMap data & OpenChargeMap, Oct 21.

Light duty vehicles: The LAs across East Anglia vary significantly in the proportion of cars and vans parked on-street, and in the current charger provision for these vehicles

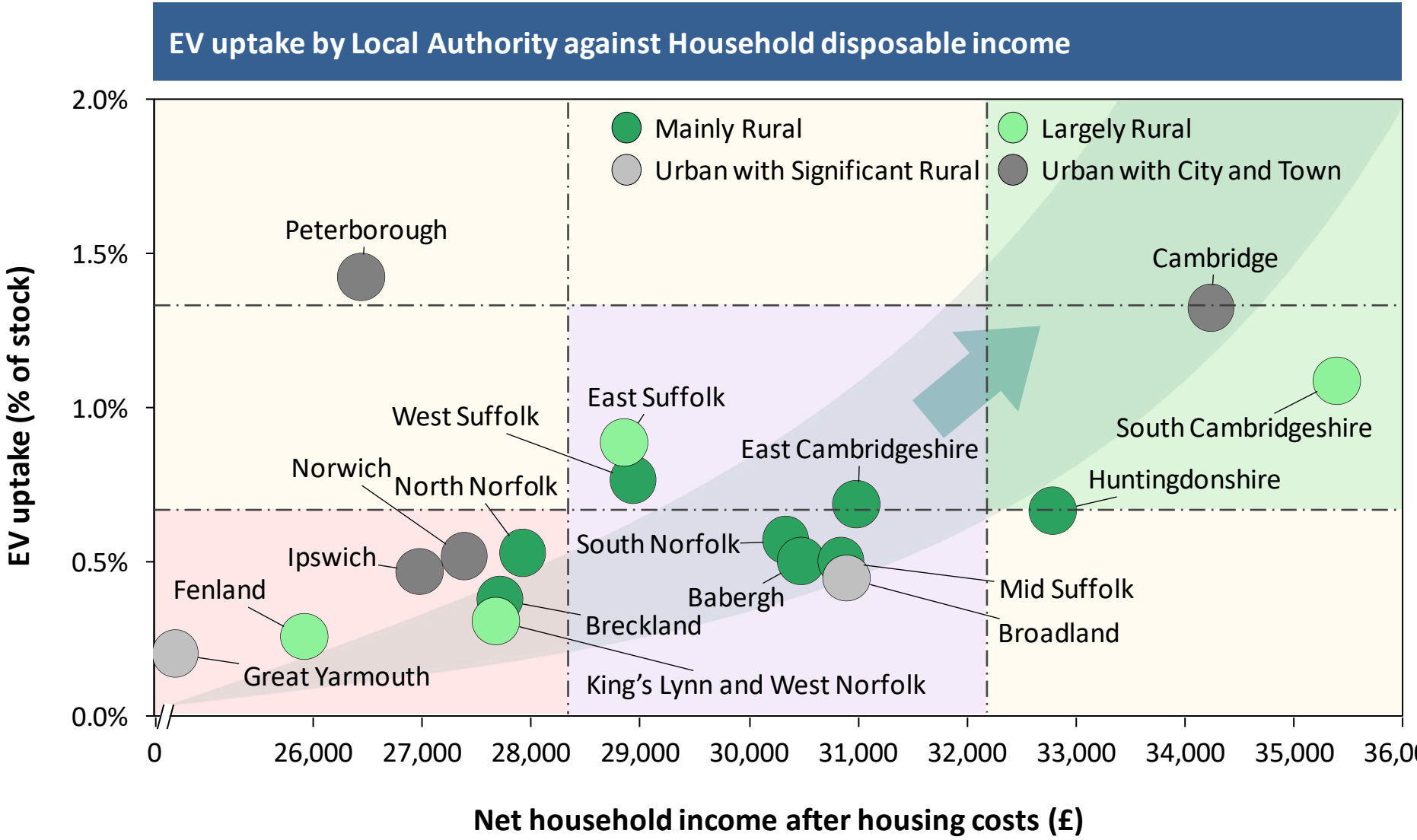
Proportion of cars and vans parked on street, chargers per 1,000 cars and vans parked on-street, and per 100,000 residents, by LA (2020)



Variations across East Anglia

- Across East Anglia, 8% of cars and vans are parked on-street, however the number varies significantly by local authority, with 31% of cars/vans in Norwich parked on-street compared to just 2% in Broadland
- Across the region, there are 8.5 chargers per thousand car/van parked on-street
- North Norfolk has the most chargers per car/van parked on-street, largely driven by the high number of chargers relative to the low proportion of cars/vans parked on-street
- Norwich, meanwhile, has the fewest chargers per car/van parked on-street, due to a more limited charging provision and high proportion of on-street parked cars/vans

Light duty vehicles: Household disposable income gives a good explanation for current variations in EV uptake by Local Authority



Summary

- Historically, there has been a strong trend between EV uptake and household disposable income
- Local authorities where household disposable income is low have therefore seen low EV uptake to date, while those LAs with higher household disposable income have seen higher uptake
- There are inevitably outliers to this trend, most noticeably Peterborough. Note however that corrected EV uptake in Peterborough has been estimated as set out here

Light duty vehicles: The factors that have historically influenced EV uptake are likely to change

Historically, BEV uptake at a local level has been centred around the purchasing decision process:

Consumers must know that BEVs exist	Consumers must then decide if a BEV is a practical solution to their transport needs	If consumers decided they would like a BEV, they must be able to afford one
1. Word of mouth: local EV uptake is self-reinforcing 2. The EV offering at local dealerships can vary 3. Consumers often have preferred car brands – now almost all OEMs offer EVs, this is no longer a barrier to uptake 4. Public charging infrastructure can act as a constant advert	1. The convenience of BEV charging can depend on off-street parking availability 2. BEVs historically had low driving ranges and thus were not suited to some users	1. BEVs are beginning to reach price parity with ICEVs on a TCO basis, however historically have been more expensive 2. Uptake has therefore been driven by high income households

Factors influencing progression through each stage of the process

Going forward, historic factors are likely to impact EV uptake less and less:

- Element Energy's total cost of ownership (TCO) analysis has shown that BEVs will soon reach price parity with ICEs, eventually becoming cheaper
- Additionally, EE's work for the European Climate Foundation has shown that purchase price is by far the most important factor in the purchase decision process, with public charging provision coming more as an afterthought
- It will therefore be a small minority of people that opt not to buy EVs in the future, once they are cheaper, and the variations in uptake by LA identified in this study will level out

Heavy duty vehicles: There is limited uptake of alternative fuel vehicles among buses and heavy goods vehicles but upcoming opportunities will improve this

Buses

- There are 5,200 buses registered in East Anglia, with 5 major companies operating over 100 vehicles each.
- The proportion of low emissions vehicles is low across the region:
  - Currently 2 BEV buses in Cambridge
  - Previously 13 biomethane buses in Norwich but no longer in fleet
- However, this will increase as two regions successfully applied to Zero Emission Bus Regional Area Scheme (ZEBRA)

ZEBRA scheme plans:

- **CPCA (fast track):** Funding will be used to fund 30 new electric double-decker buses, primarily used on short busy routes in Cambridge. Will require match funding from bus operators, the Transforming Cities Fund and Greater Cambridge Partnership's City Deal.
- **Norfolk (standard track):** Aiming to replace 15 single-decker buses with electric buses, and install supporting infrastructure. Supported by First, buses would operate on routes through Norwich City Centre.

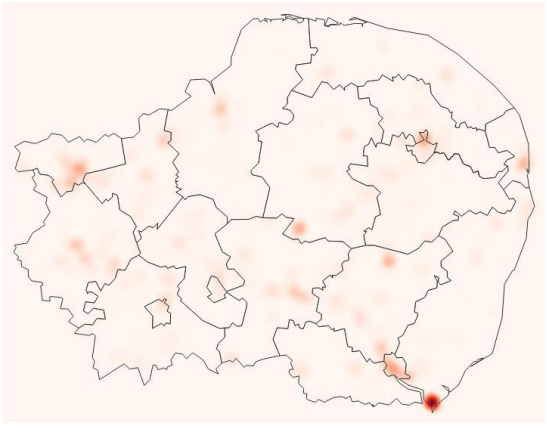
Heavy Goods Vehicles (HGVs)

- There are 24,400 HGVs registered in East Anglia, with over 400 vehicles operated by Councils and close to a quarter operated by fleets with more than 100 vehicles
- Only 45 are known to run on natural gas (liquified natural gas, see later slide)
- Close to 6% of registered vehicles are in fleets with a known interest in gas trucks, and 4% are in fleets involved in an Innovate UK-funded freight consortium focused on deployment of hydrogen vehicles

Selected fleets with local depots and interest in AFVs

Wincanton, Royal Mail, Hermes, DHL

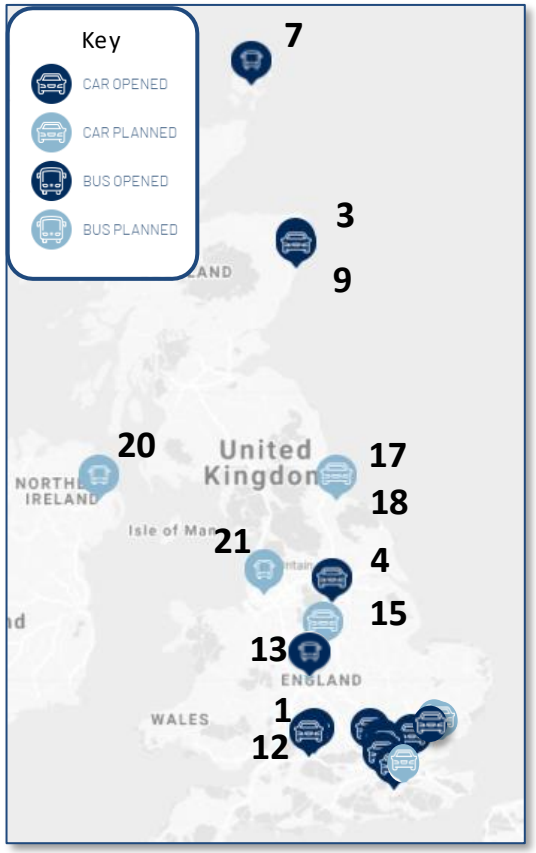
Heat map of HGVs in East Anglia



Sources: DfT Vehicle licencing statistics, Element Energy market research

Hydrogen refuelling infrastructure: As of September 2021, there were 14 hydrogen stations in the UK, most of them very small, with no existing or planned stations in East Anglia

Hydrogen refuelling stations (HRS) in the UK today



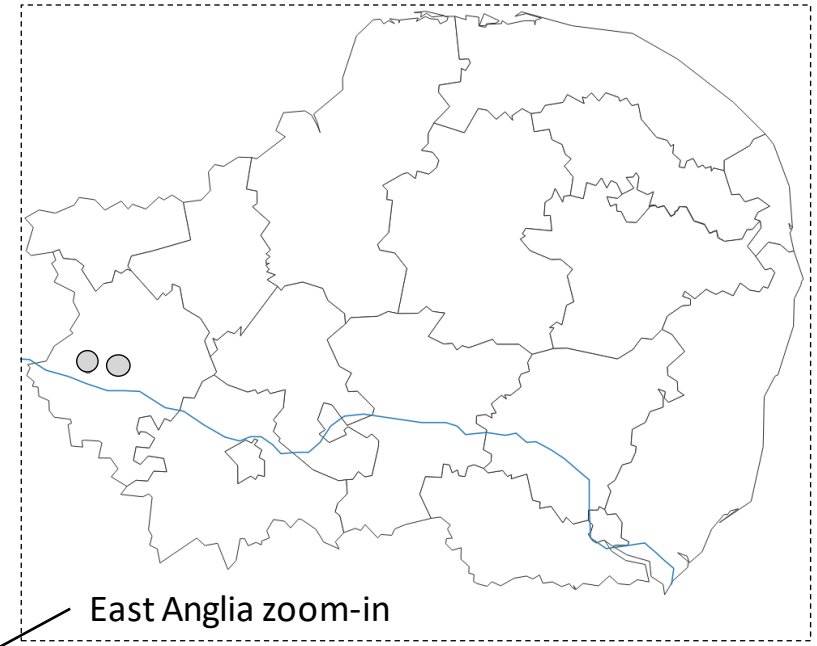
#	Location	Operator	Capacity (kg/day)	Pressure (bar)	H_2 source	Launch
1	Swindon, Honda	BOC	200	350 &700	On-site WE	2011, 2014
2	Hatton Cross, London	Air Products	80 (250)	350 & 700	Delivered SMR	2012 (2021)
3	Kittybrewster, Aberdeen	BOC	360	350 & 700	On-site WE	2015, 2018
4	AMP, Sheffield	ITM Power	80 (540)	350 & 700	On-site WE	2016 (2022)
5	NPL, Teddington	ITM Power	100	350 & 700	On-site WE	2020
6	CEME, Rainham	ITM Power	100 (270)	350 & 700	On-site WE	2016 (2021)
7	Orkney	ITM Power	80	350	On-site WE	2016
8	Shell, Cobham, London	ITM Power	80	350 & 700	On-site WE	2017
9	Tullos, Aberdeen	Aberdeen City Council	80	350 & 700	On-site WE	2017
10	Shell, Gatwick, London	ITM Power	80	350 & 700	On-site WE	2019
11	Shell, Beaconsfield	ITM Power	80 (270)	350 & 700	On-site WE	2018 (2021)
12	Swindon, J Matthey	ITM Power	80	350 & 700	On-site WE	2018
13	Tyseley Energy Park, Bham	ITM Power	1,200	350 & 700	On-site WE	2021
14	Metroline, Perivale	Nel/Ryse	1,500	350	Delivered WE	2021
15	Derby, Shell	ITM Power	270	350 & 700	On-site WE	[2022]
16	Barking	ITM Power	270	350 & 700	On-site WE	[2022]
17	Tees Valley 1	TBC	TBC	TBC	TBC	[2022]
18	Tees Valley 2	TBC	TBC	TBC	TBC	[2022]
20	Belfast	Energia	60	350 & 700	On-Site WE	[2022]
21	Liverpool	BOC	TBC	TBC	TBC	TBC

- Most hydrogen refuelling stations are small and target either light duty vehicles or buses, many supported by publicly-funded trials
- Cities including, London, Derby, Leeds and Aberdeen already have small operational HRS stations, however these have generally been shown to supply high cost hydrogen at sub optimal reliability.
- The lack of rollout of hydrogen vehicles in East Anglia means that no stations have been developed in the area
- However, as hydrogen rolls out more widely, innovation will be needed to enable a step change in the number and size of stations

Source: UK H2 Mobility

Gas vehicle refuelling infrastructure is still limited but growing with demand – very little in East Anglia despite key transport network running through the region

Heat map of HGVs and current GB gas stations



East Anglia zoom-in

- The UK gas refuelling network currently comprises close to 50 stations, of which:
  - 8 are large public-access stations (capacity for >300 trucks per day; 7 CNG and 1 LNG)
  - 2 are small public-access stations (capacity for <50 trucks per day)
  - The remainder are private or semi-private[1] facilities at depots (19 CNG, 19 LNG)
- Gas stations are currently operated by 3 major players (CNG Fuels, Air Liquide and Gasrec) and 2 smaller players (Decarbonise Fuels and Roadgas), and all major players have rapid growth plans

- **There are currently two semi-private gas stations in East Anglia**, both operated by Air Liquide and dispensing LNG:
  - Alconbury – located at Alconbury truck stop
  - Ellington – serving 45 LNG trucks in Buffaload Logistics fleet
- CNG Fuels, the largest operator of public-access (bioCNG) stations, is targeting sites within East Anglia within the next 5 years along key transport routes

Notes: 1 – These stations are private but other operators can apply for access

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Key findings on the future uptake of alternative fuels vehicles

Summary of findings:

There is a growing number of AFV models available across modes:

- BEVs are commercially available across all light duty vehicles and buses, and likely to be the main decarbonisation pathway for these modes
- The pathways for HGVs and other HDVs remains less certain, with hydrogen FCEVs ultimately expected to make up a portion of the stock and RNG HGVs present in the short to medium term

We have modelled AFV uptake in two core scenarios, relating to futures with high-electrification and high-hydrogen usage

- The absolute emissions profiles out to 2050 of the core scenarios are similar, however the relative profiles have significant differences driven by the differing decarbonisation pathways for HGVs and higher emissions factor for hydrogen than electricity
- Both scenarios see BEVs make up over 50% of the East Anglia car stock from 2033, and ultimately 98% by 2050, meaning the density of BEV cars in East Anglia will increase significantly by 2050. In both core scenarios, East Anglia would need 15,400 charge points as soon as 2030, and almost 30,000 by 2040.
- Up to five times more hydrogen refuelling stations would be needed by 2050 in the System Transformation (high-hydrogen) scenario than the Consumer Transformation (high-electrification) scenario, with required RNG refuelling stations peaking in 2035

AFV uptake was also modelled for three further scenarios with a focus on modal shift and behaviour change, with variations across rural and urban settings

- An emissions reduction of 47% by 2030 (relative to today) could be achieved in a max ambition scenario, where policy focuses on modal shift and behaviour change, compared to a reduction of only 38% if policy were to solely focus on technology uptake
- In the max ambition scenario, cars would make up 35% of transport emissions in 2030, relative to the 52% they contribute currently, and the total regional car stock would reduce by 25%, both as a result of a shift towards public and active transport, as well as no overall increase in travel demand
- Reducing private car use also reduces the required infrastructure investment with up to 20% fewer charge points needed by 2030 under the Max ambition scenario

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This analysis has considered a range of low and zero emissions technologies and supportive infrastructure

Alternative fuel options within scope include:

- **Electric vehicles (EVs)** – including plug-in hybrid electric vehicles (PHEVs) and battery electric vehicles (BEVs) – mature market for light duty vehicles, commercially available for buses, and primarily under development for heavy duty goods vehicles
- **Hydrogen fuel cell electric vehicles (FCEVs)** – mostly developed for trials /only in the small series production phase for light duty vehicles, however expected to enter commercial phase for vans in the short term. Under trial for buses, and primarily under development for heavy duty goods vehicles
- **Renewable natural gas (RNG)** – supplied in Compressed (bioCNG) or Liquified (LNG) forms – used in buses but primarily targeted for growth in the >18 tonnes Heavy Goods Vehicle (HGV) market as the only currently commercially available option for emissions reduction within this vehicle segment. Can deliver over 80% well-to-wheel emissions savings compared to diesel (may be negative in future), but is considered a 'bridging fuel' (with key window of opportunity out to 2035 to early 2040s) to deliver savings ahead of zero emissions options becoming available.

Options not in scope include:

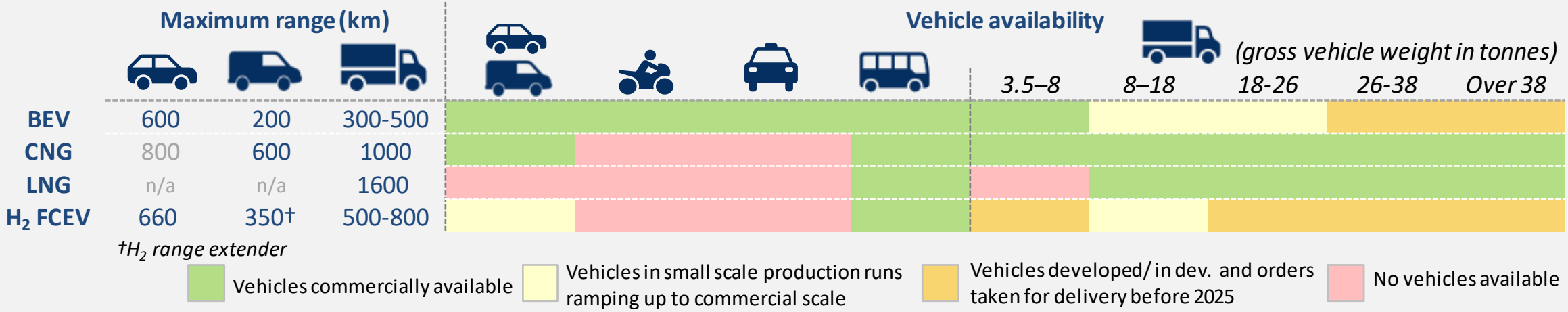
- **Liquid biofuels –** the role of biofuels in decarbonising surface transport has peaked and investment should now focus on zero emission solutions. This means that while decarbonisation from biofuels is important it is not part of the strategic investment and planning going forward and is therefore not part of this study. Some biofuels such as hydrotreated vegetable oil (HVO) are being considered by fleets as a drop in fuel which can be implemented quickly in hard to decarbonise sectors such as long-haul trucks. However, HVO is currently produced from used cooking oil sourced from countries such as Saudi Arabia, Taiwan, United States and Indonesia which, in some of these cases, has raised concerns that exporting this resource drives additional raw oil demand.[1] We therefore don't see this as a large sustainable growth area.

1. For example, where used cooking oil from these countries was already being used locally

Options to decarbonise by mode: BEVs are commercially available across all light duty vehicles and buses

More detail in Appendix from this slide

Comparison of range and availability of low carbon fuel technologies in UK/Europe



Mode	Market trends	Primary AF option
	BEV commercially available, FCEV two models technically available but in practice these cannot be purchased by the average consumer due to high price, low availability and refuelling barriers.	Predominantly BEV
	Only BEV models available, with max range ca. 200km, and average charge time 3 – 5 hours.	BEV
	No taxi specific FCEV model[1] (all hydrogen taxi trials/fleets to date are private hire) but BEV and PHEV options in production	Predominantly BEV
	Zero emission market well-developed. FCEV buses less mature than BEV and more likely to need support	Mix of BEV and FCEV
	Some short-range BEVs available, but long-haul zero emission models not expected before the late 2020s. Methane currently only proven, commercial option for long haul vehicles.	RNG currently Mix of BEV and FCEV in future

AF = alternative fuel; BEV = battery electric vehicle; PHEV = Plug in Hybrid Electric Vehicles

1 - In London this includes all Hackney Carriages but specifications for Hackney Carriages varies across LAs -unclear if FCEV car models fit Hackney Carriage requirement for all LA's in East Anglia

UK EV car and van sales have gone from 1% to 16% between 2015 and 2021 – the acceleration in EV uptake is driven by 5 key factors

Acceleration in EV uptake is related to:

1 Strong policy support

- Policy support for electric vehicles is very strong and 'set in stone'. EVs are a core part of reducing CO_2 emissions to meet the UK climate goals and aiding in improving air quality which has a significant health impact
- The UK Government confirmed a 'phase out' of new ICE cars and vans in 2030 – this target is supported by both personal and business grants for EVs and charging infrastructure

Links: 1

2 Improvement in EV product

- Driving range is increasing steadily reducing range anxiety -13 models expected to have a range of >500 km in 2022
- Ability to charge at higher kW rate (thus recharging faster) – all new models can charge at a minimum of 50kW, in 2022 there will be 36 models that can charge at >150kW cutting charging time down to <30min

1, 2

3 Increasing number of brands and models

- An increased market offering of BEVs and PHEVs gives consumers a greater choice of car type to fit their needs
- Manufacturers representing 25% of EU + EFTA sales plan to have a fully-electrified (including hybrids) line-up by 2030

1, 2

4 BEVs decreasing in price

- BEVs will soon be affordable - The upfront purchase price will decrease by 30% between 2020 and 2030. Medium BEV cars are already the cheapest powertrain over their lifetime, by 2025 they will have the lowest upfront purchase price

1

5 Improvement in public charging infrastructure

- The number of public charge points have increased by 150% since 2019 with 28,500 charge points operating in Dec 21
- Improvements in charge point technology, with over 1,200 ultra-rapid charges and many innovative EVCPs being developed

1

The zero emission HDV market is accelerating very quickly but from a low starting point and still faces some barriers to exponential growth

Acceleration in ZEV uptake is related to:

1 Strong policy support [1]

- The UK Government confirmed a 'phase out' of new ICE HGVs between 2035 and 2040
- OEM CO_2 sales targets carried across from EU law are strict enough in 2030 to require the sale of some BEV or FCEV

2 Company targets [1] [2] [3]

- OEMs are targeting high zero emission vehicle sales such as Scania who is targeting 10% ZEV sale in 2025 and 50% in 2030
- Operators are setting increasingly stringent targets such as Tesco who aim to electrify their home delivery fleet by 2028 and much of the haulage fleet in time for their 2035 net-zero target. They are now trialling the first BEV artic HGVs in UK

3 Improvement in EV product

- Improving battery technology in the car market is trickling through to the HGV market helping to improve range and decrease costs

Barriers to faster ZEV adoption:

1 Uncertainty of winning technology [1]

- Uncertainty existing in best zero emission technology for long-haul applications. This is delaying investment by operators and infrastructure suppliers as no one wants stranded assets if they select the wrong winner

2 High cost [1]

- Small scale of production leading to very high capital costs today as no economies of scale
- Cost structure (high capital cost and ongoing cost savings) of ZEVs presents a high barrier and perceived cost today

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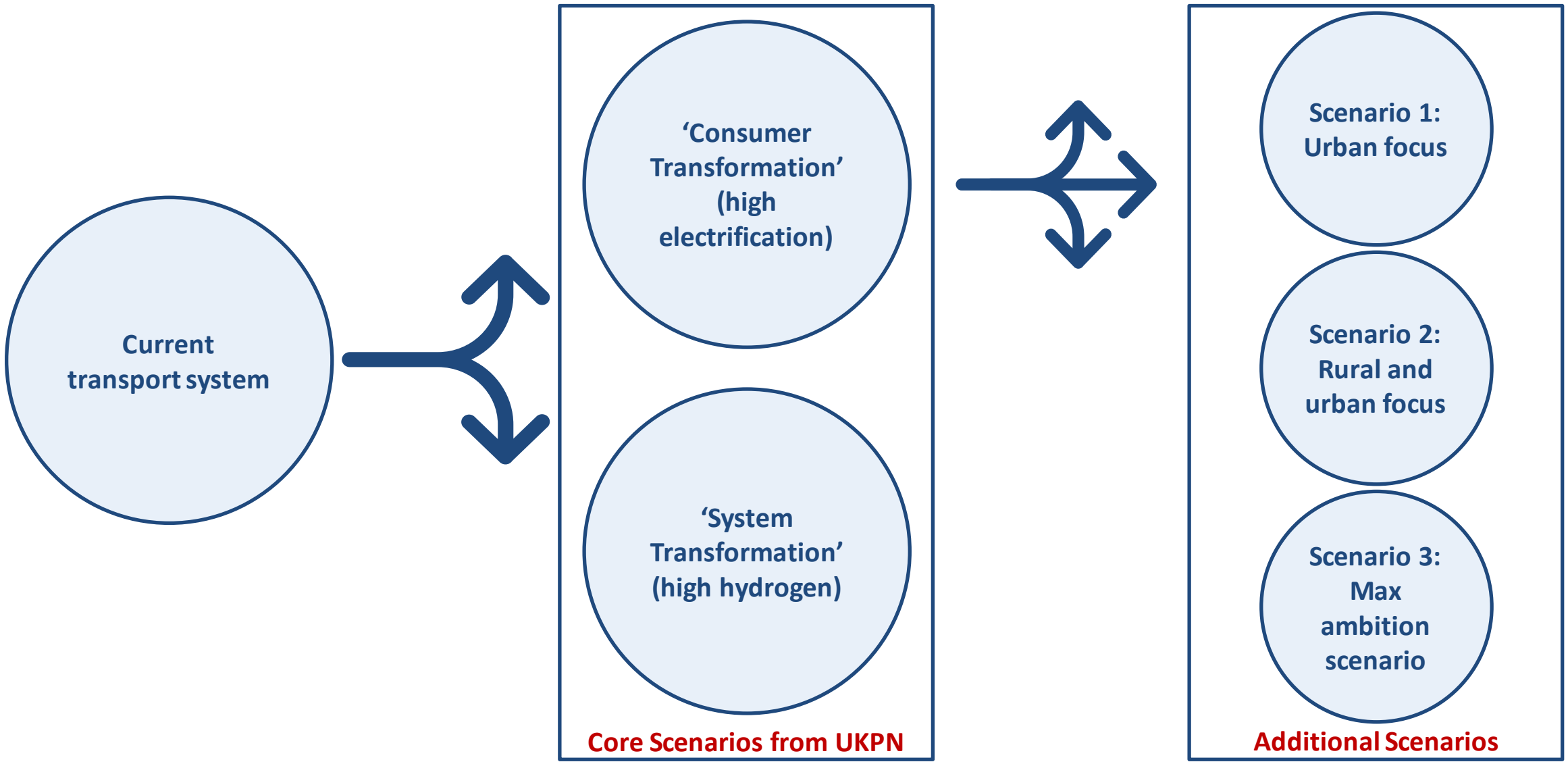
Schematic showing our approach to the modelling scenarios



Sources: Element Energy modelling for UKPN

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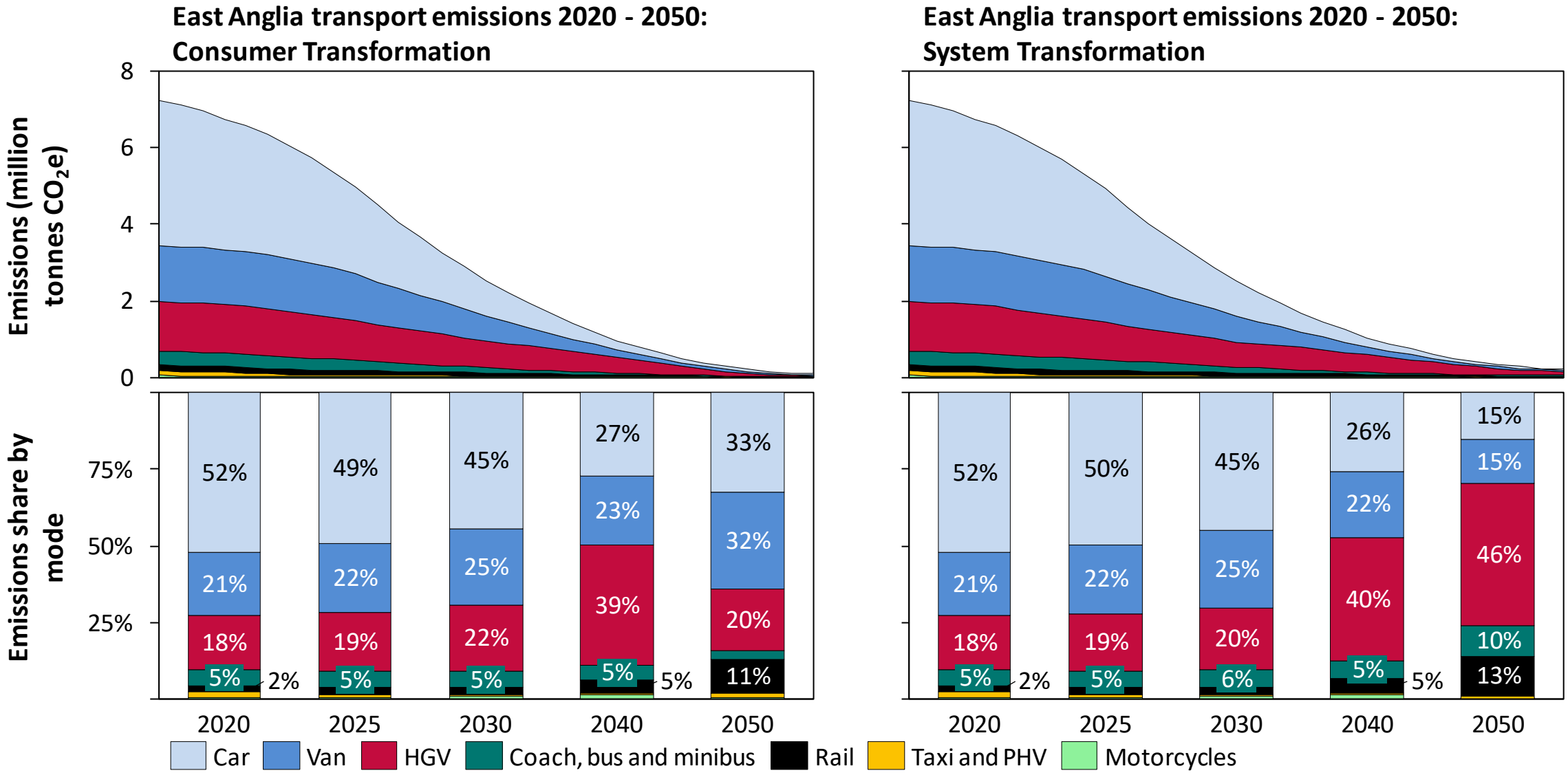
We have modelled AFV uptake in two core scenarios, relating to futures with high-electrification and high-hydrogen usage

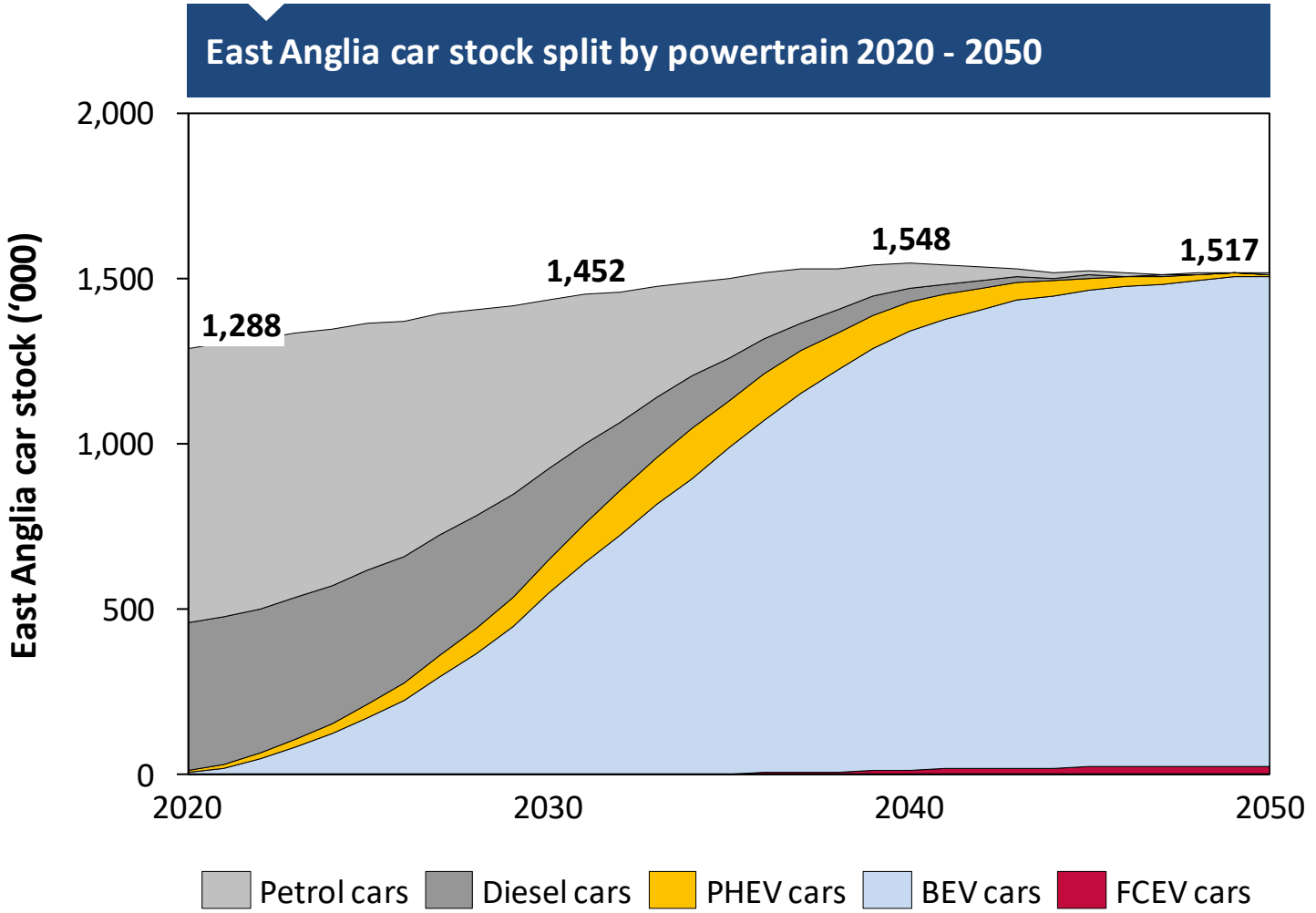
During our work for UKPN we developed two scenarios which reflect the most likely directions UK transport could develop towards

	'Consumer Transformation'	'System Transformation'
Narrative	• **Net zero achieved by 2050 due to widespread electrification of all transport applications**	• **Net zero achieved in 2050 by relying on hydrogen to decarbonise the more difficult sectors (including heavy transport)**
Key shared assumptions	• With the end of ICE and plug-in hybrid electric vehicles (PHEV) sales in 2030 and 2035 respectively, sales of EVs, especially cars and vans, continues to ramp up, resulting in widespread uptake of electric cars and vans as battery costs fall • Taxis, motorcycles private hire vehicles are decarbonised through electrification	
Key contrasting assumptions	• Energy densities improve and charging rates increase, making electric HDVs cost effective and suitable for daily operations by mid-2030's • Hydrogen only deployed for a limited number of use cases (double shifted HGVs and long distances coaches)	• Global production of hydrogen fuel cells ramps up, enabling large scale supply of zero emission buses, coaches and HGVs by mid 2030's

The absolute emissions profiles of the core scenarios are similar, however the relative profiles have significant differences driven by differing decarbonisation pathways for HGVs



Both scenarios see BEVs make up over 50% of the East Anglia car stock from 2033, and ultimately 98% by 2050

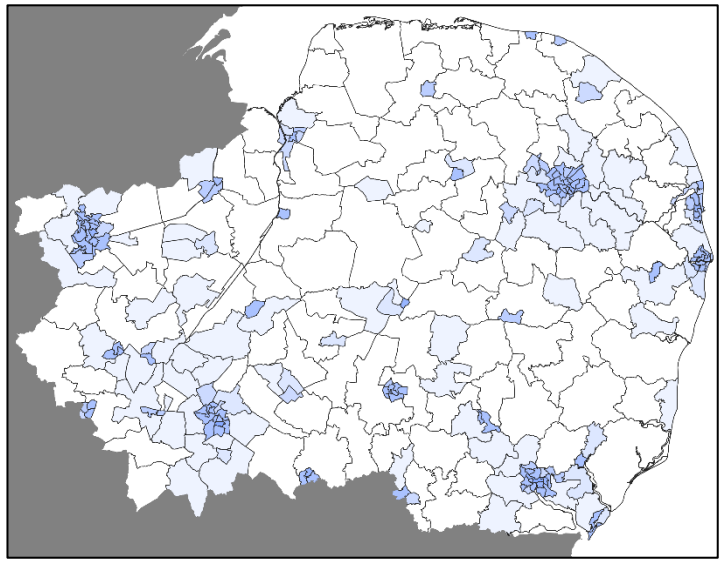


Key themes and trends

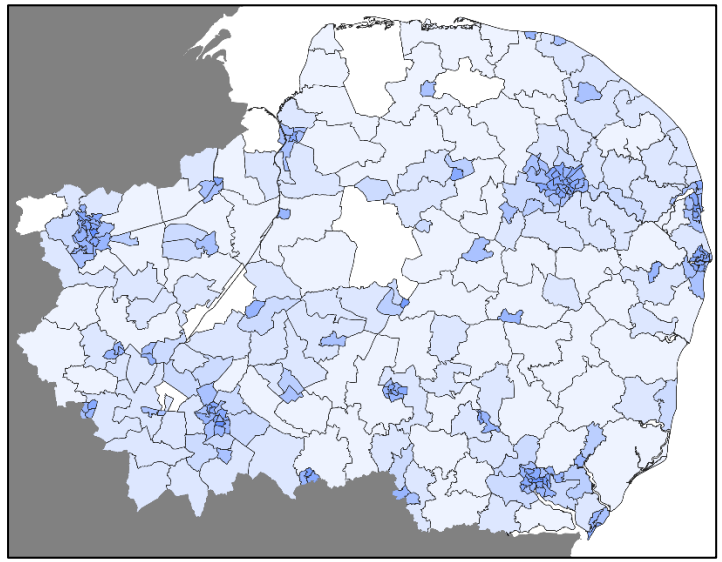
- The car stock and mix by powertrain is projected to be the same in both the Consumer and System Transformation scenarios
- These scenarios see a total car stock increase from 1.3M units to a peak of 1.6M units in 2040, before slowly decreasing to 1.5M units in 2050
- The mix by powertrain will gradually shift from petrol and diesel car dominated to BEVs, with BEVs making up over 50% of the stock from 2033 onwards, ultimately reaching 98% in 2050
- PHEVs will increase in stock share through to the mid-2030's, at which point numbers will start to decrease as new PHEV sales end from 2035
- A small number of FCEVs are expected to enter the stock, reaching a 1.7% share by 2050

The density of BEV cars in East Anglia will increase significantly by 2050

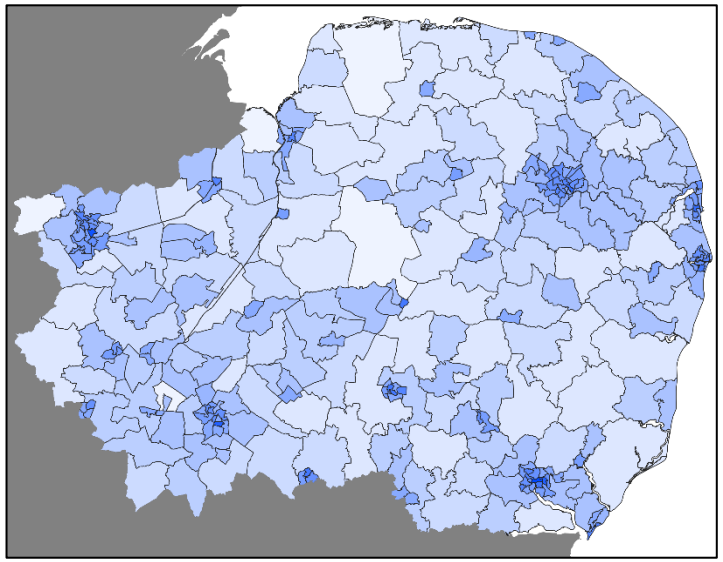
2025 BEV car density in East Anglia



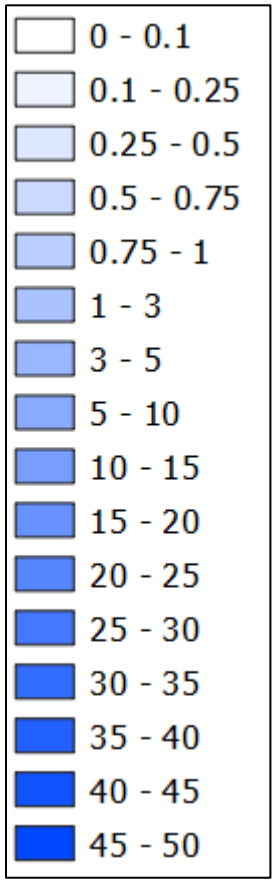
2030 BEV car density in East Anglia



2050 BEV car density in East Anglia



Key: BEVs per hectare

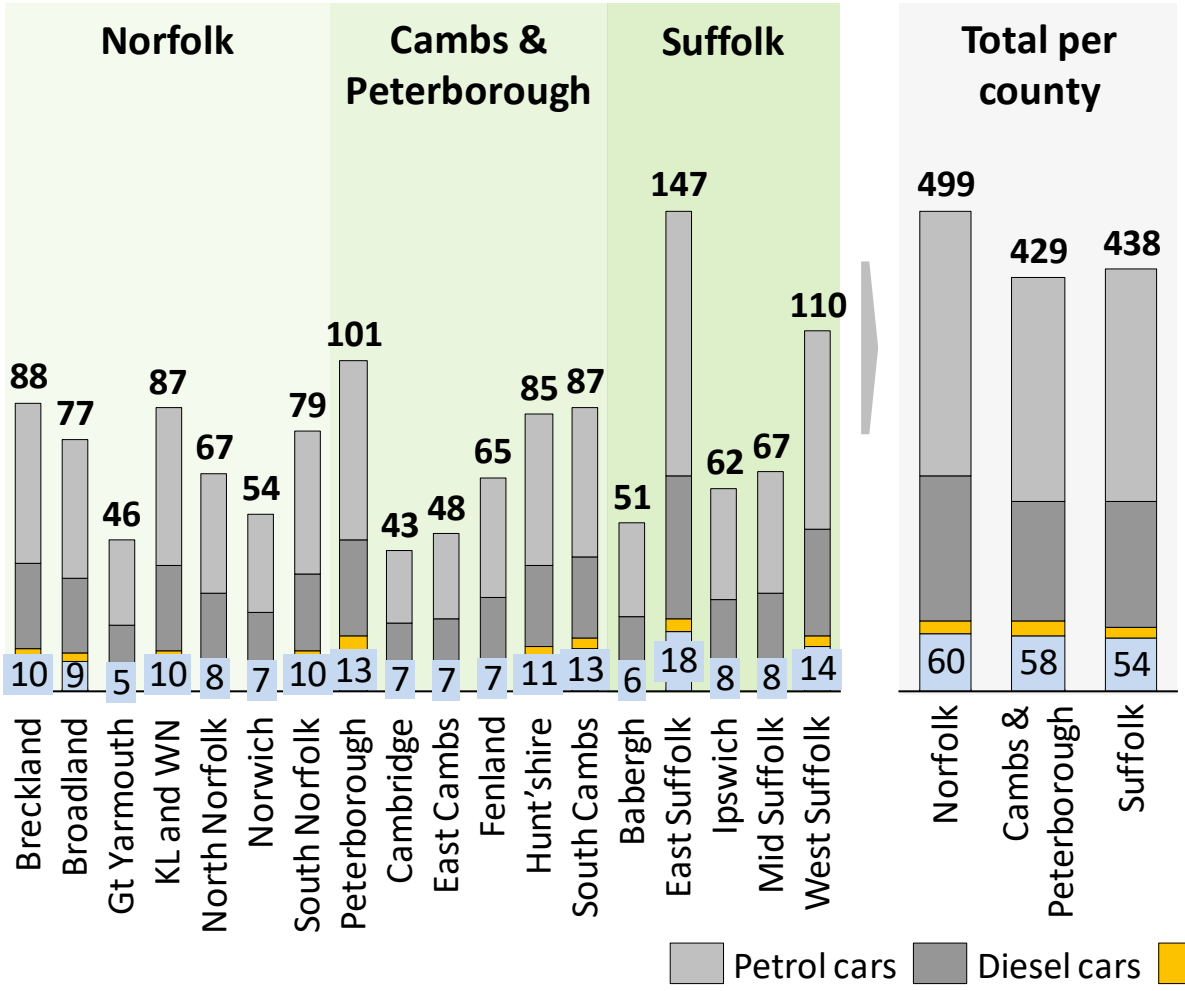


Note BEV car uptake is the same in the Consumer and System Transformation scenarios, and thus these maps reflect both

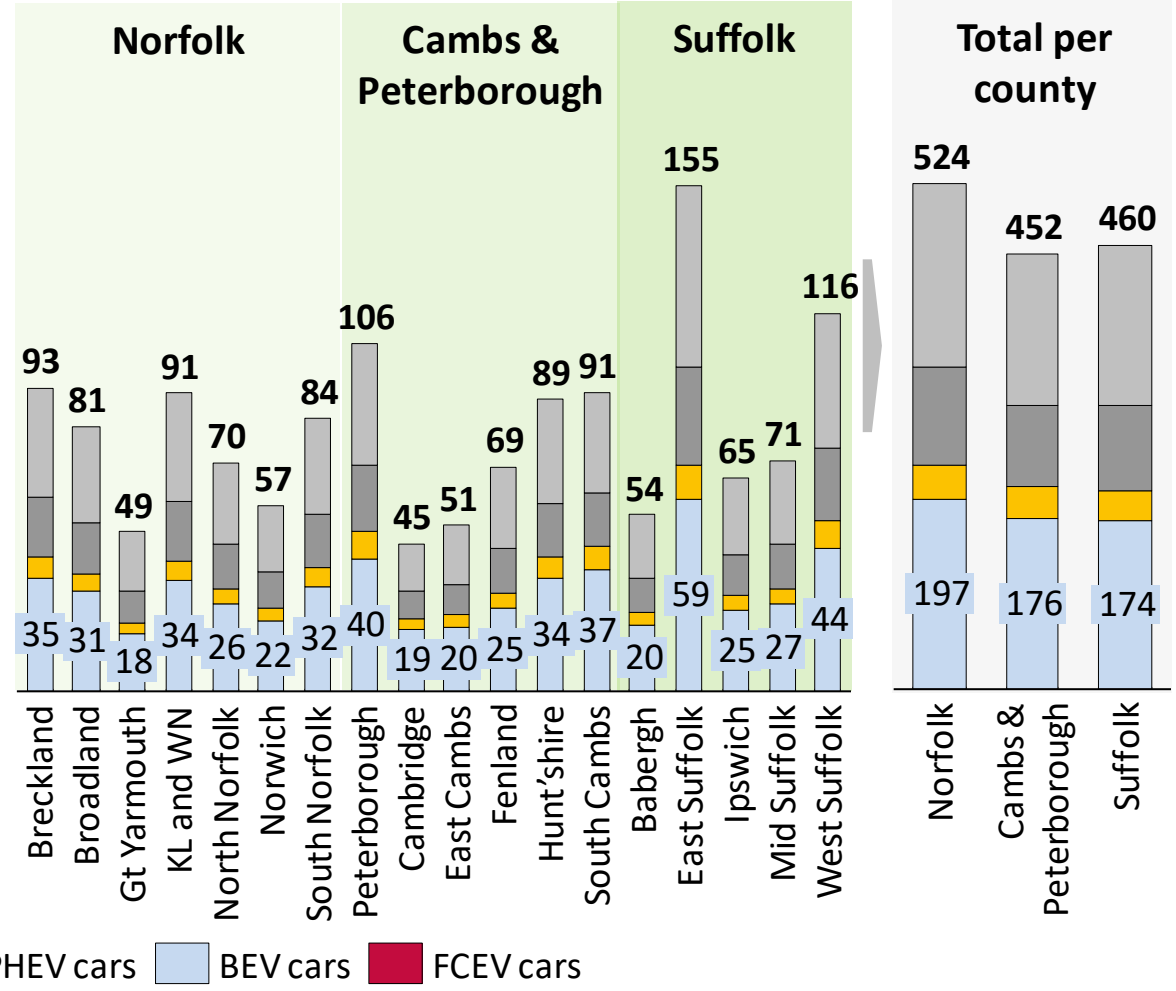
Note that a modal shift away from private cars, as highlighted in the next section, would result in a reduced total number of cars, and hence different BEV densities to those shown

Forecast BEVs per Local Authority in 2025 and 2030 in the Consumer Transformation scenario

Forecast car stock in 2025 by Local Authority ('000 vehicles)



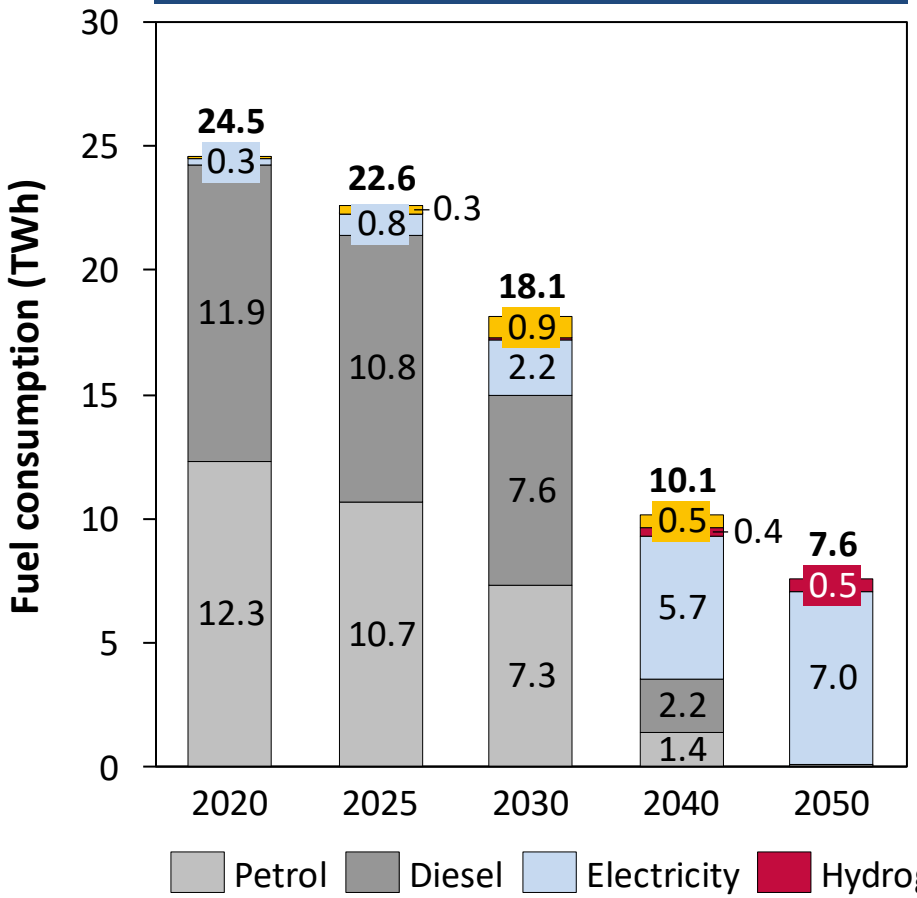
Forecast car stock in 2030 by Local Authority ('000 vehicles)



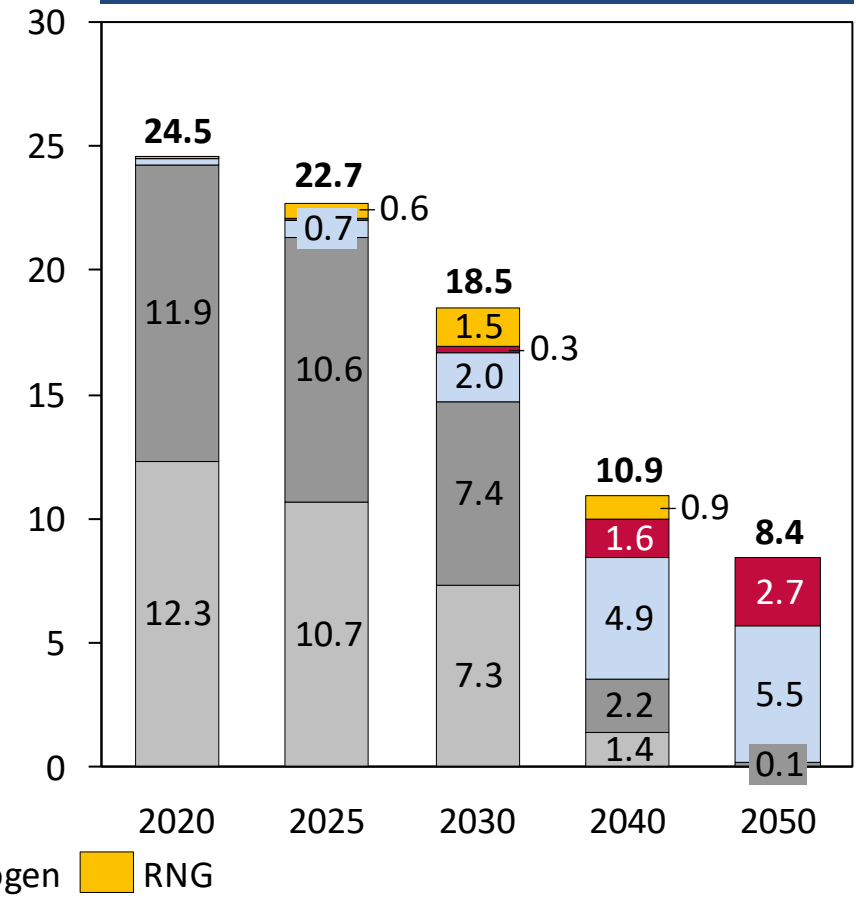
Petrol cars | Diesel cars | PHEV cars | BEV cars | FCEV cars

The core scenarios vary in their energy demand from each fuel source, resulting in a different 2050 mix

Energy demand from transport 2020 - 2050: Consumer Transformation



Energy demand from transport 2020 - 2050: System Transformation



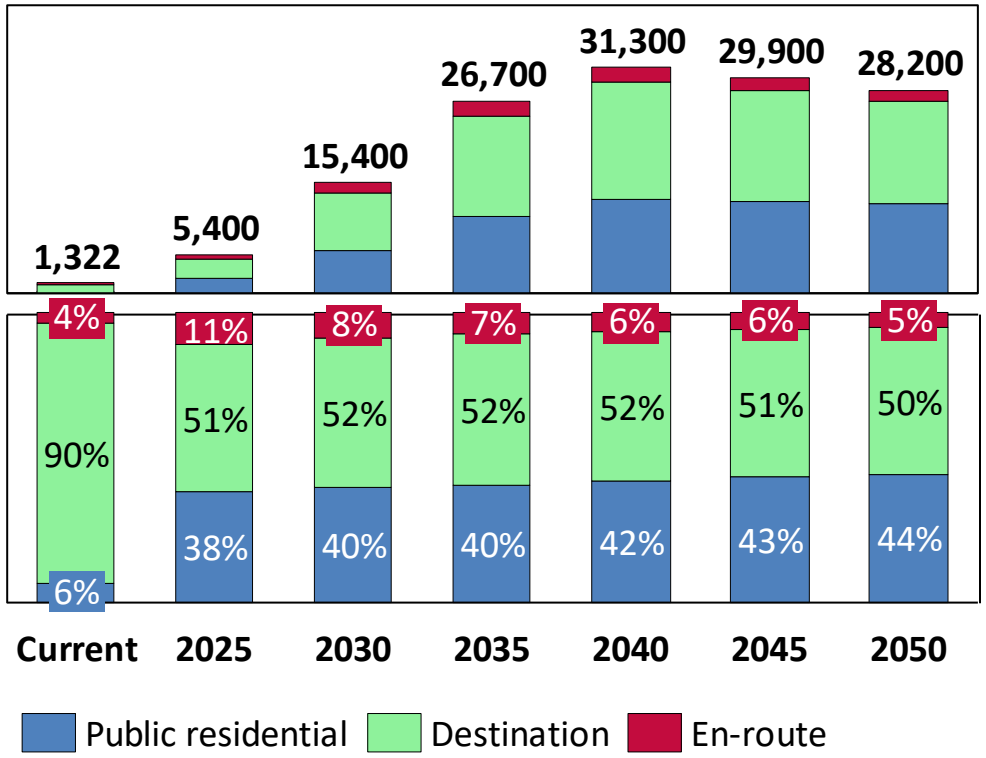
Key themes and trends

- Petrol and diesel provides for 99.5% of current transport energy demand, however this would reduce to less than 2% by 2050 under both scenarios
- Electricity and hydrogen will dominate the 2050 energy mix, with a split of 92%/7% and 66%/32% in the Consumer and System Transformation scenarios
- Both scenarios use RNG as a bridging fuel for HGV decarbonisation, with consumption peaking in 2035
- System Transformation requires around double the amount of RNG

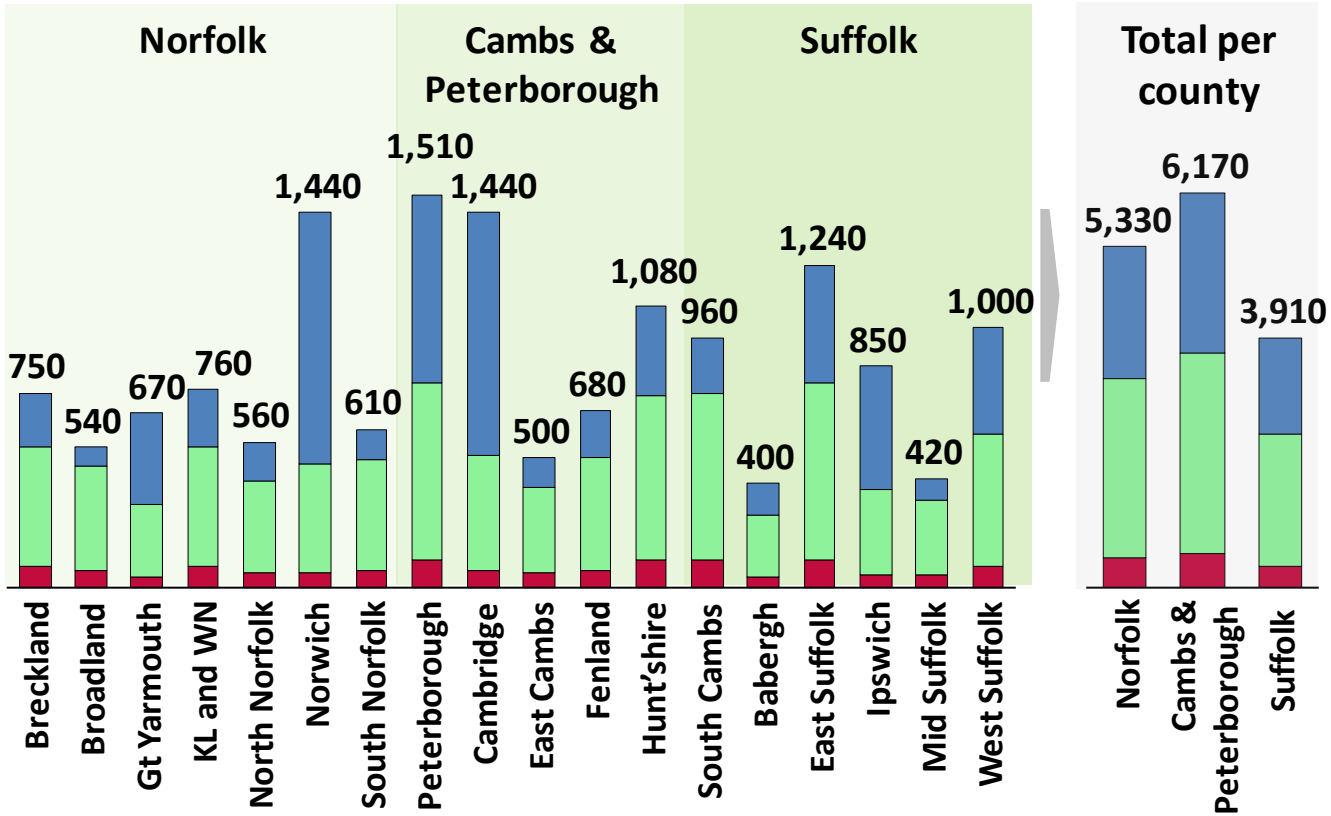
Modes included: Car, Taxi, PHV, Coach, Bus, Minibus, Motorcycle, Van, HGV, Rail

East Anglia could need 15,000 charge points as soon as 2030, and almost 30,000 by 2040 in the Consumer Transformation scenario

Forecast EV charge point demand in East Anglia out to 2050 in the Consumer Transformation scenario



Forecast EV charge point demand in 2030 by local authority and county

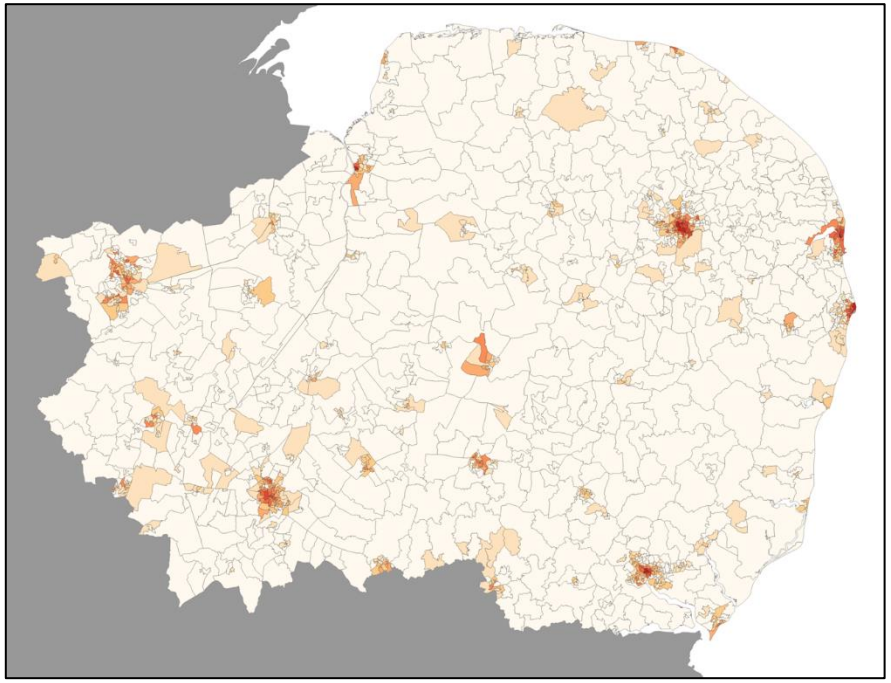


- The number of charge points required will increase significantly out to 2040 in the Consumer Transformation scenario, at which point slightly fewer will be required to 2050, as each charge point becomes increasingly powerful and thus able to serve a greater number of EVs in a given time interval
- The share of en-route chargers required would reduce to just 5% in 2050, as en-route chargers become prioritised for ultra-rapid charging and hence their average power increases relative to other charge points

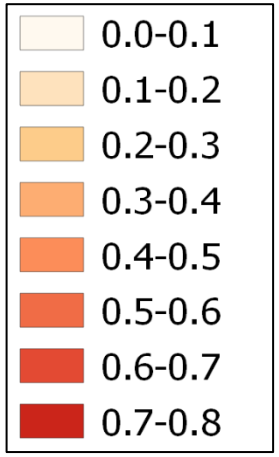
Notes: 'Current' is based on Zap Map data as of Oct 21 as shown here, and the assumption that slow/fast chargers have two charge points, while rapid and ultra rapid chargers have one charge point. Note also that workplace charging is not included here. Further detail on charge point modelling assumptions are given here

City and town centres typically have lower access to off-street parking and will therefore be a focus for residential charging solutions

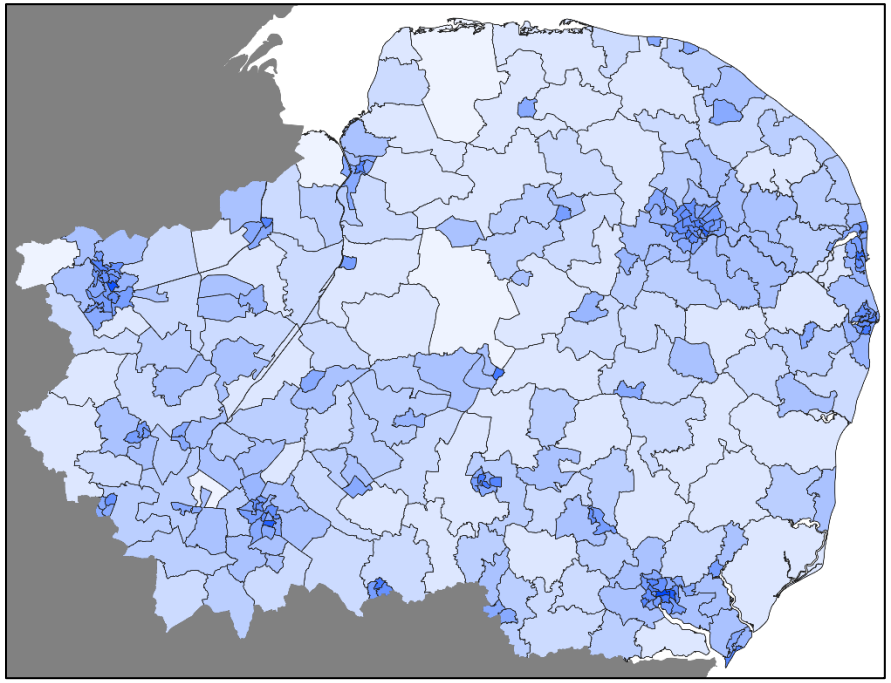
Proportion of cars and vans parked on-street across East Anglia (LSOA level)



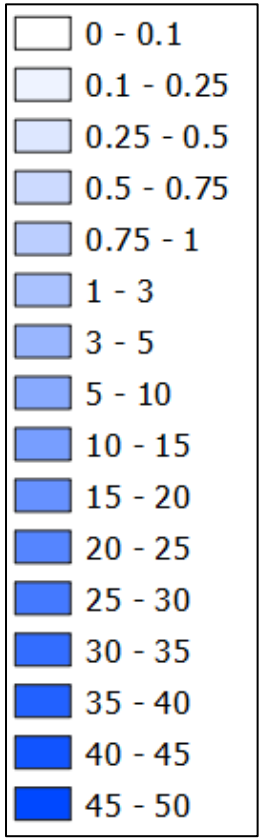
Key: Prop. cars and vans parked on-street



Projected 2050 BEV car density in East Anglia (MSOA level)

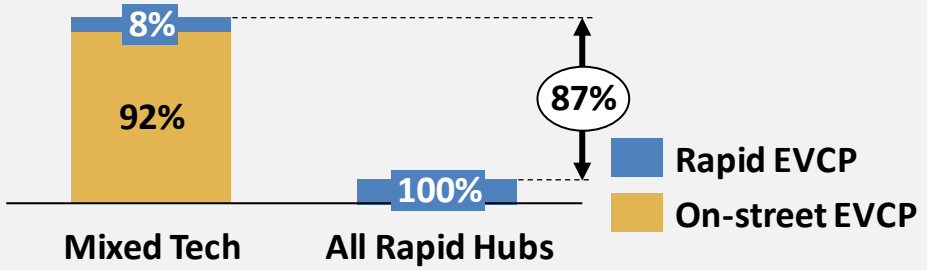


Key: BEVs per hectare



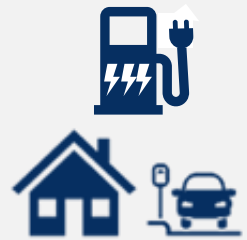
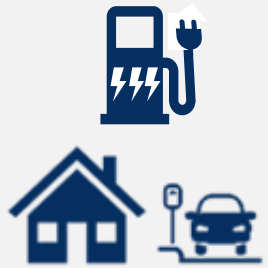
Note that a modal shift away from private cars, as highlighted in the subsequent section, would result in a reduced total number of cars, and hence different BEV densities to that shown on the right-hand side map

The precise number and distribution of charge points will depend on a range of factors that will need to be assessed in a place-based way that considers all users

Consideration	Reasoning	Potential change in EVCPs required
Charger utilisation	• The number of charge points required is **highly dependant on the utilisation**. Utilisation rate of chargers is assumed to **increase with EV uptake** as higher numbers of EVs increases charging demand[1]	A feasible range of utilisation scenarios gives a **2-fold increase in utilisation** for a single charge point[2] → This does not directly relate to a 2x increase in numbers of chargers required as utilisation is distributed across the network
Rapid vs slow on-street focus	• A significantly higher number of on-street (slow) chargers are required to meet demand compared to rapid chargers as rapid chargers can accommodate more vehicles per day • **If all EVCPs were rapid 87% fewer charge points would be needed than in a mixed technology approach** (majority on-street EVCPs) – *in practice both rapid and on-street are required to meet the needs of different user groups*	**Modelling of EVCPs required based on preferred EVCP type[3]** 
Rapid charger power	• The average **charging rate at rapid chargers is likely to significantly increase to 2050** due to improvements in the max charging speed of vehicles and increases in the number of ultrarapid chargers	Average rapid charging rates are assumed to increase **from 35 kW currently to 150 kW in 2050[2]**. If EV stock has an average charging speed lower than assumed, more rapid chargers will be required and if higher fewer will be required
Effect of tourism	• Tourist EV charging demand is expected to vary significantly with season and weekday, peaking on summer weekends.	From a study completed for tourist EV charging on the Isle of Wight, daily charging demand from tourist EVs in 2030 may **equal residents' charging demand in towns**, and exceed residents' charging demand up to **18-fold at tourist sites**.

1 - Charger power and utilisation are based on ICCT methodology. Link to ICCT report 2 – more details in assumptions slide
3. Element Energy analysis for Dublin Local Authorities

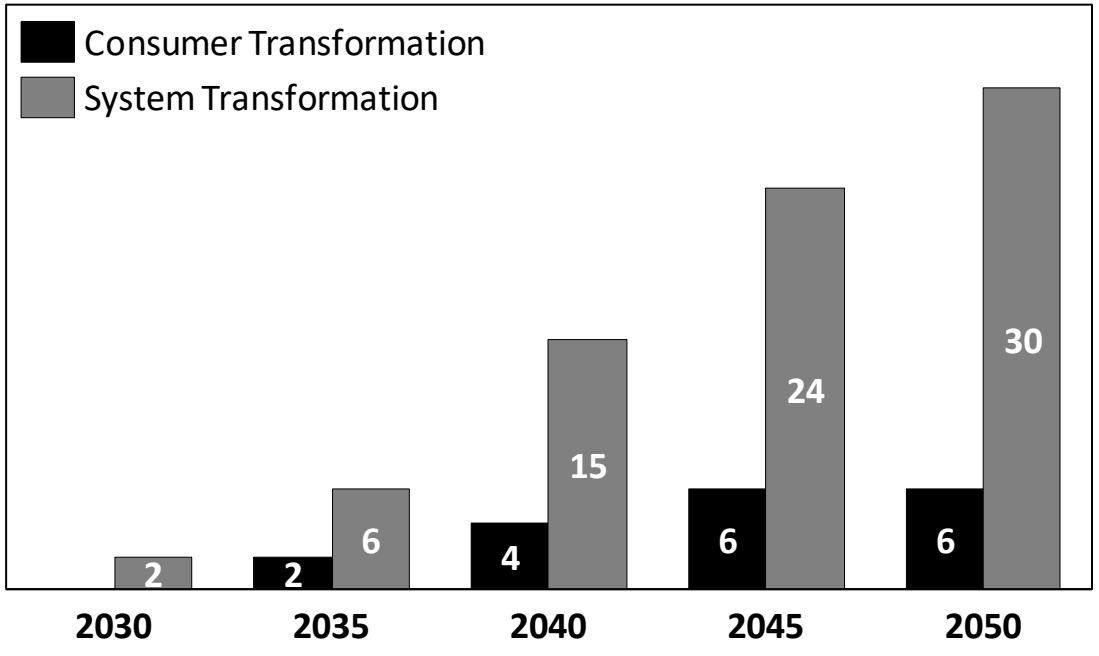
Vehicle fleets require dedicated charging infrastructure to allow them to increase their EV uptake

User Group	Reasoning	EVCP type required
Taxi and Private Hire Vehicle (PHV)	Require both **on-street and rapid** EVCPs– taxi only bays are needed at both these locations • **Rapid chargers:** Should be deployed at or near taxi ranks for topping up > drivers want to avoid taking time out of working to recharge their vehicle • **On-street chargers**: Need to be able to fully recharge their batteries overnight. Slow lamppost chargers are not suitable as Taxi batteries are large so fast (7-22kW) chargers are required so that the battery can fully recharge	
Car Clubs	Require both **on-street and rapid** EVCPs • **Rapid chargers:** Needed for 'topping-up' similar to using a petrol station • Where car clubs have dedicated bays that vehicles are returned to, on-street chargers need to be deployed at these spaces to allow recharging overnight and between users • Note that on-street car club charge points **cannot** be deployed or funded by the public sector as this can be considered '**state aid**'	
Van fleets	• Some van fleets will refuel at a depot where the vehicle is stored overnight but others are reliant on public infrastructure • For van fleets reliant on public infrastructure, en-route charging can be challenging as routes change daily and, in general, they are travelling to residential areas. In the majority of cases at home charging is not possible as even those who have off-street parking may park their vans on-street[1] • Therefore, these van fleets are reliant **on-street overnight charge points**	

1. For example, due to size constraints or if a family car requires the driveway. Source: Element Energy consultation with commercial fleets.

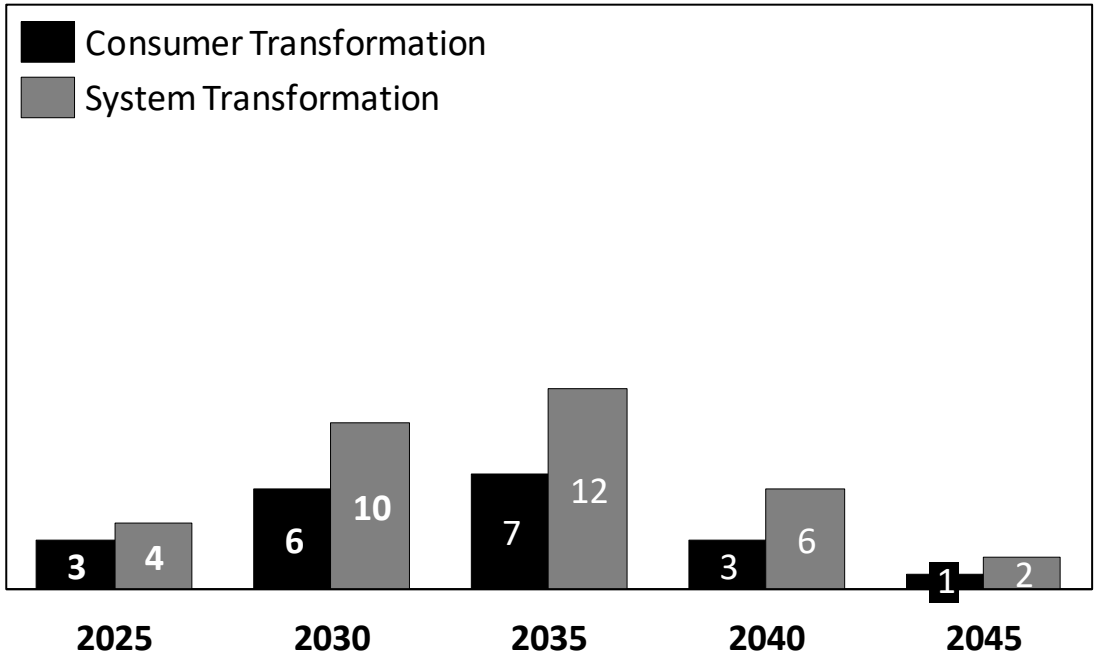
Up to five times more hydrogen refuelling stations would be needed by 2050 in the System Transformation scenario than the Consumer Transformation scenario

Number of Hydrogen refuelling stations required in East Anglia in each scenario



- From 2030 onwards, an increasing number of hydrogen refuelling stations (HRS) will be needed in either scenario, with significantly more required in the Consumer Transformation scenario, to supply the growing fleet of hydrogen HGVs and slight uptake of hydrogen fuel cell electric cars

Number of RNG refuelling stations required in East Anglia in each scenario



- Whilst RNG acts as a bridging fuel for HGVs, a small number of refuelling stations will be needed throughout East Anglia
- The System Transformation scenario would require the most stations, at a peak of 12 in 2035
- This is because RNG stations have the potential to be repurposed as (HRS), thus higher gas HGV uptake would be expected in a scenario leading to a high hydrogen HGV uptake

Assumptions: HRS – based on average number of H_2 HGVs per HRS (288 in 2030, 365 in 2050, and scaled according to total hydrogen demand for cars and HGVs. RNG – Public and private stations refuel an average of 450 and 150 trucks per day respectively, with public stations accounting for 88% of total RNG fuel demand. Source: Element Energy for Cadent, Future of Gas In Transport, 2020)

The distribution of required HGV infrastructure between private (at depot) or public refuelling/charging is uncertain but a shift towards greater public refuelling is likely for long-haul

The market today

- All medium to large fleets today bunker diesel in their depot to refuel their fleet at the end of the day
- Smaller fleets often rely on drivers refuelling the vehicle at a public refuelling forecourt at the end of the day on their way back to the depot
- Vehicles which do not return to depot often will rely on public refuelling, this will mostly be non-UK based HGVs

Urban deliveries

- Urban vehicles are likely to exclusively go electric and rely on depot recharging as range requirements are relatively small
- In some more rural areas vehicles may need some public recharging, this is likely to be on a 350kW CCS car/van chargers as these will be far more widely distributed than HGV charging stations

Regional distribution

- Regional distribution is likely to mostly go electric with some hydrogen
- Vehicles will recharge overnight in the depot and top up additional charge at destination warehouses and, where needed, at the HGV public charging network built out to support the long-haul market

Long-haul distribution

- Which technology will dominate the long-haul market is still very uncertain
- If electric, these vehicles will rely very heavily on public refuelling along the strategic road network (SRN)
- If hydrogen, some of the larger fleets may have depot refuelling but most fleets are expected to rely on public stations built around depot clusters and along the SRN

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- Current situation
- **Future uptake of Alternative Fuels Vehicles**
  - Market landscape for Alternative Fuels
  - **Scenarios for uptake of AFVs**
    - Core scenarios
    - **Impact of changing travel demand**
- Opportunities to support uptake of AFVs
- Appendix

Scenario narratives: as well as encouraging AFV uptake additional policy is focused on behavioural change and a modal shift

Scenario 1: Urban focus

1

Policy focuses on instigating a shift away from private car use and road freight in urban areas by 2030.

Improved public transport services and a greater number of walking and cycling routes through towns and cities allow passengers to depend less on cars for travel. Similarly, an increase in rail capacity for freight into urban areas reduces the proportion of freight moved by HGVs, whilst increased use of cargo bikes reduces last-mile van freight.

Overall transport demand follows the baseline growth as projected in the Consumer Transformation scenario.

Scenario 2: Rural and urban focus

2

Policy targets a modal shift in passenger and freight transport across both rural and urban areas by 2030.

Public transport and active travel options are made significantly more effective across the region as a whole, allowing a shift away from private car use. Rail capacity for freight is also increased, ensuring fewer goods are moved by HGV, whilst cargo bikes continue to reduce last-mile van freight in urban areas.

Overall transport demand follows the baseline growth as projected in the Consumer Transformation scenario.

Scenario 3: Max ambition

3

Policy targets a modal shift in passenger and freight transport by 2030, as outlined in the rural and urban focus scenario.

On top of this, policy ensures total demand for passenger and freight transport does not exceed current levels, which with population growth implies that demand per person actually reduces.

By adopting policies that support place based solutions to improve and reinstate service in communities, average trip distances to amenities and services become shorter, offsetting the increasing population.

Freight consolidation ensures increased efficiency in the movement of goods by HGVs and vans, resulting in fewer journeys.

Key features of further scenarios: passenger demand

- More detail in Appendix from this slide

Variations by travel scenarios

1

- Baseline increase in travel demand through to 2030, based on current growth projections
- A significant shift away from car use in urban areas, resulting in an increased use of active travel and public transport, which sees increasing occupancy rates

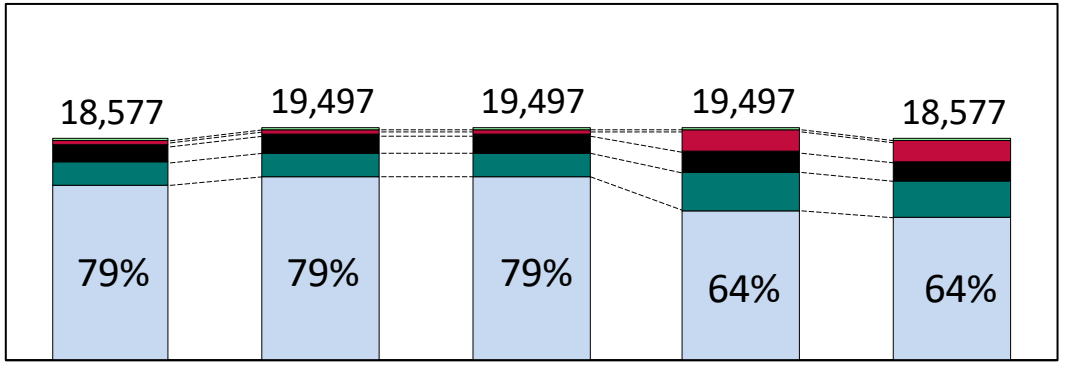
2

- Baseline increase in travel demand through to 2030, based on current growth projections
- A significant shift away from car use in rural and urban areas, resulting in an increased use of active travel and public transport which sees increasing occupancy rates

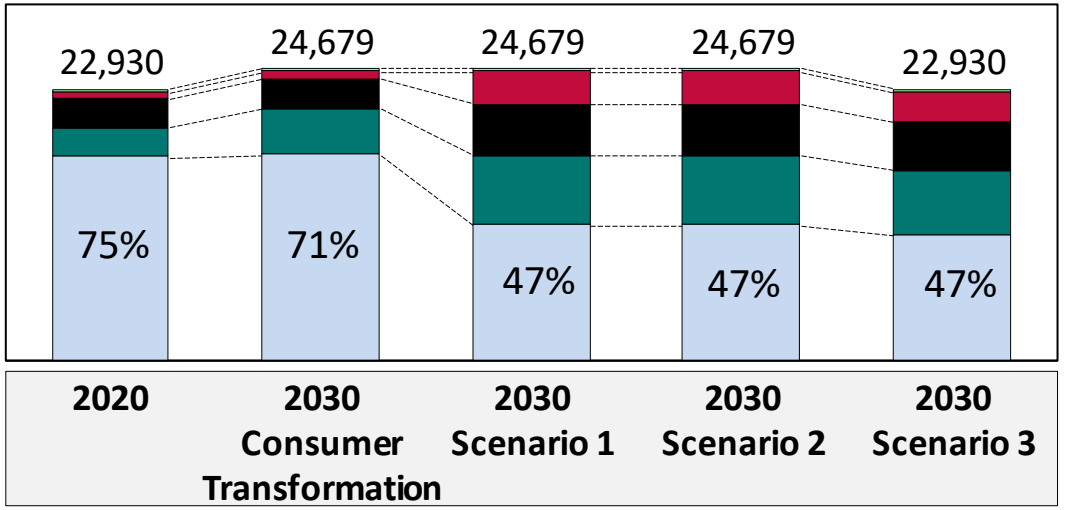
3

- Travel demand per person reduces, as amenities and services become more geographically distributed, and trips shorten
- A significant shift away from car use in rural and urban areas, resulting in an increased use of active travel and public transport, which sees increasing occupancy rates

Rural travel demand (million passenger km)



Urban travel demand (million passenger km)



Key features of further scenarios: freight demand

- More detail in Appendix from this slide

Variations by freight scenarios

1

- Baseline increase in overall freight demand through to 2030, based on current growth projections
- A moderate shift away from HGV freight towards rail freight in urban areas
- Moderate shift of van freight towards cargo bikes for last mile delivery in urban areas

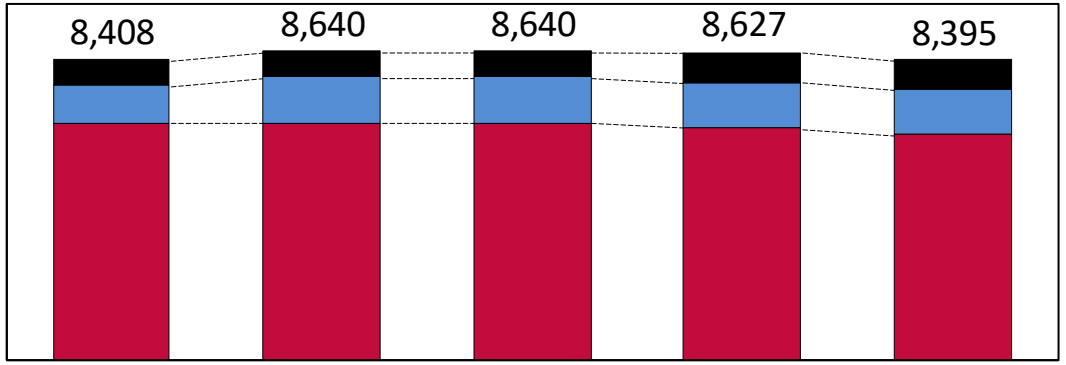
2

- Baseline increase in overall freight demand through to 2030, based on current growth projections
- A moderate shift away from HGV freight towards rail freight in urban areas
- Moderate shift of van freight towards cargo bikes for last mile delivery in urban areas and a slight shift in rural areas

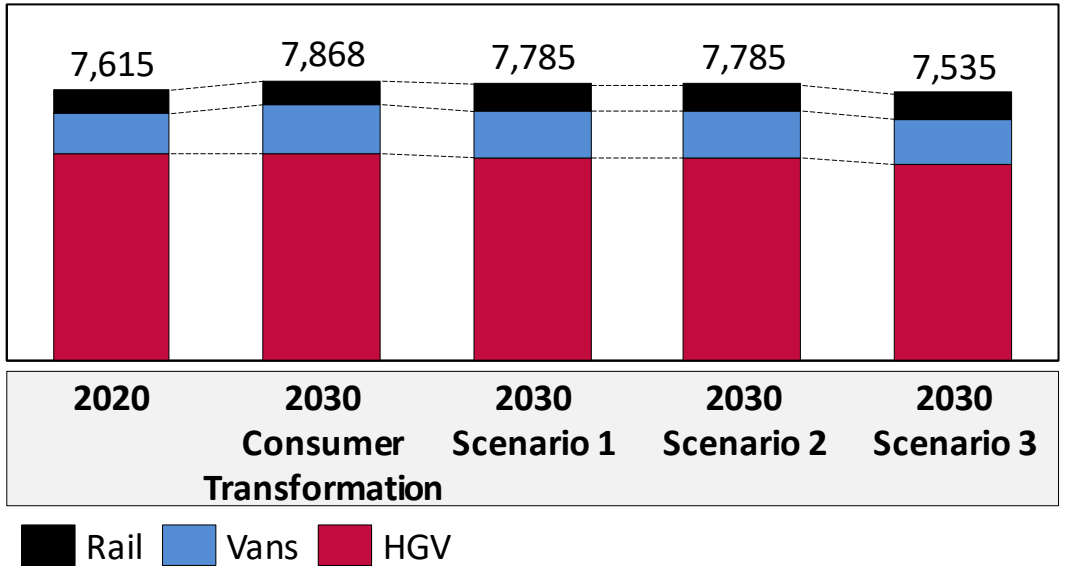
3

- Freight demand reduces per person, and freight becomes increasingly consolidated and efficient resulting in fewer HGV and van journeys (although no impact on overall tonne km)
- Redistribution of freight to rail and cargo bikes as in the rural and urban focus scenario (2)

East Anglia rural freight demand (million tonne km)

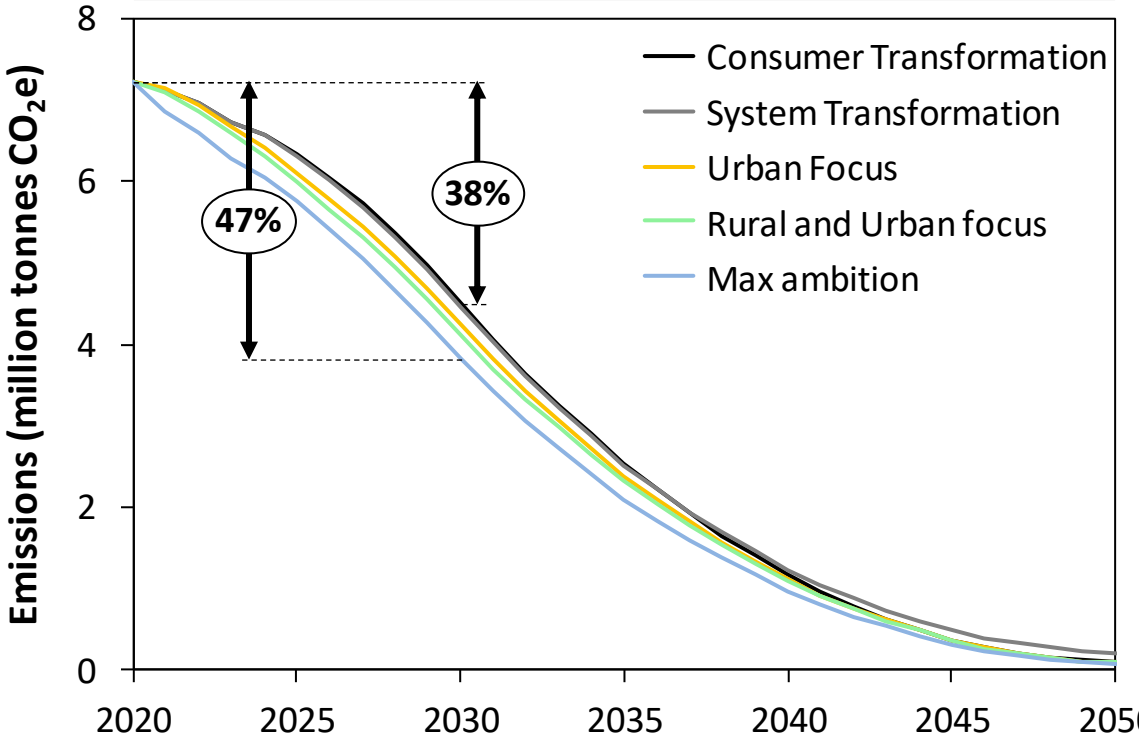


East Anglia urban freight demand (million tonne km)

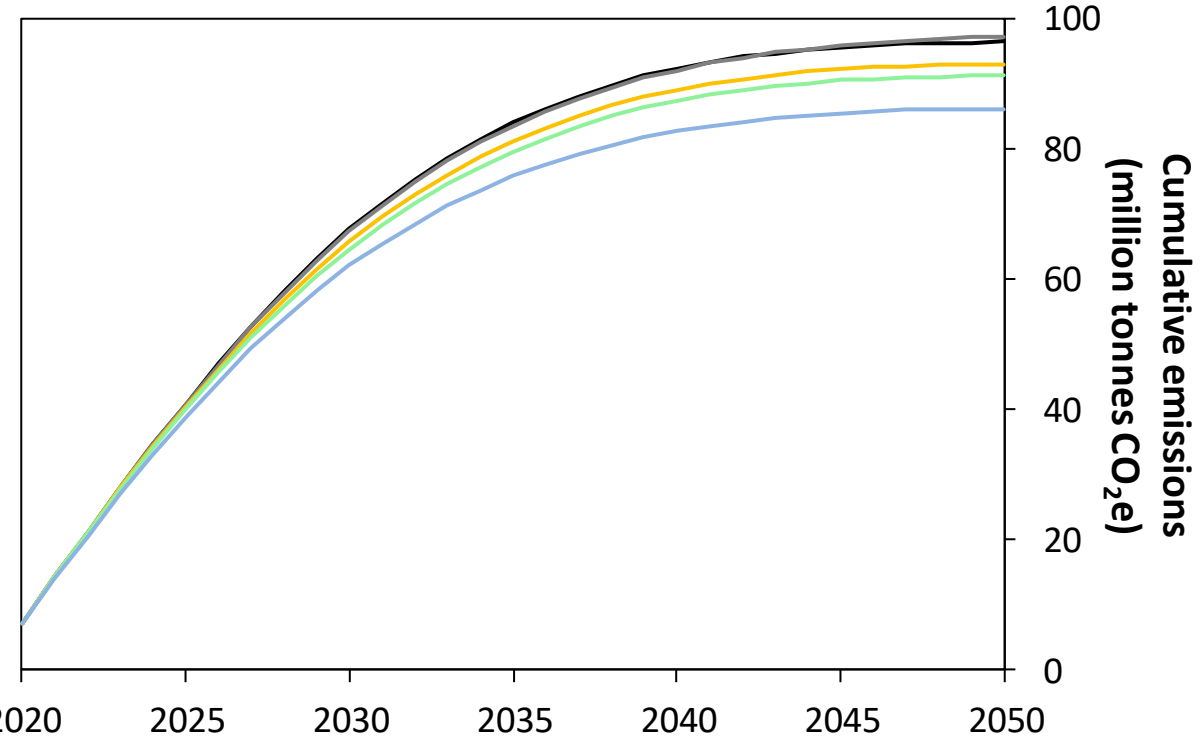


Transport emissions could reduce by 47% in a max ambition scenario by 2030, relative to today

East Anglia transport emissions 2020 – 2050 by scenario



Cumulative transport emissions in East Anglia 2020-2050 in the modelled scenarios



- Policy that instigates behavioural change would achieve emissions reductions much more quickly than policy solely focused on technology uptake and improvement
- This is seen by the extra 11% emissions reduction achieved by 2030 in the Max ambition scenario when compared to the Consumer Transformation scenario, allowed by the additional policy focus on areas such as a shift away from private cars

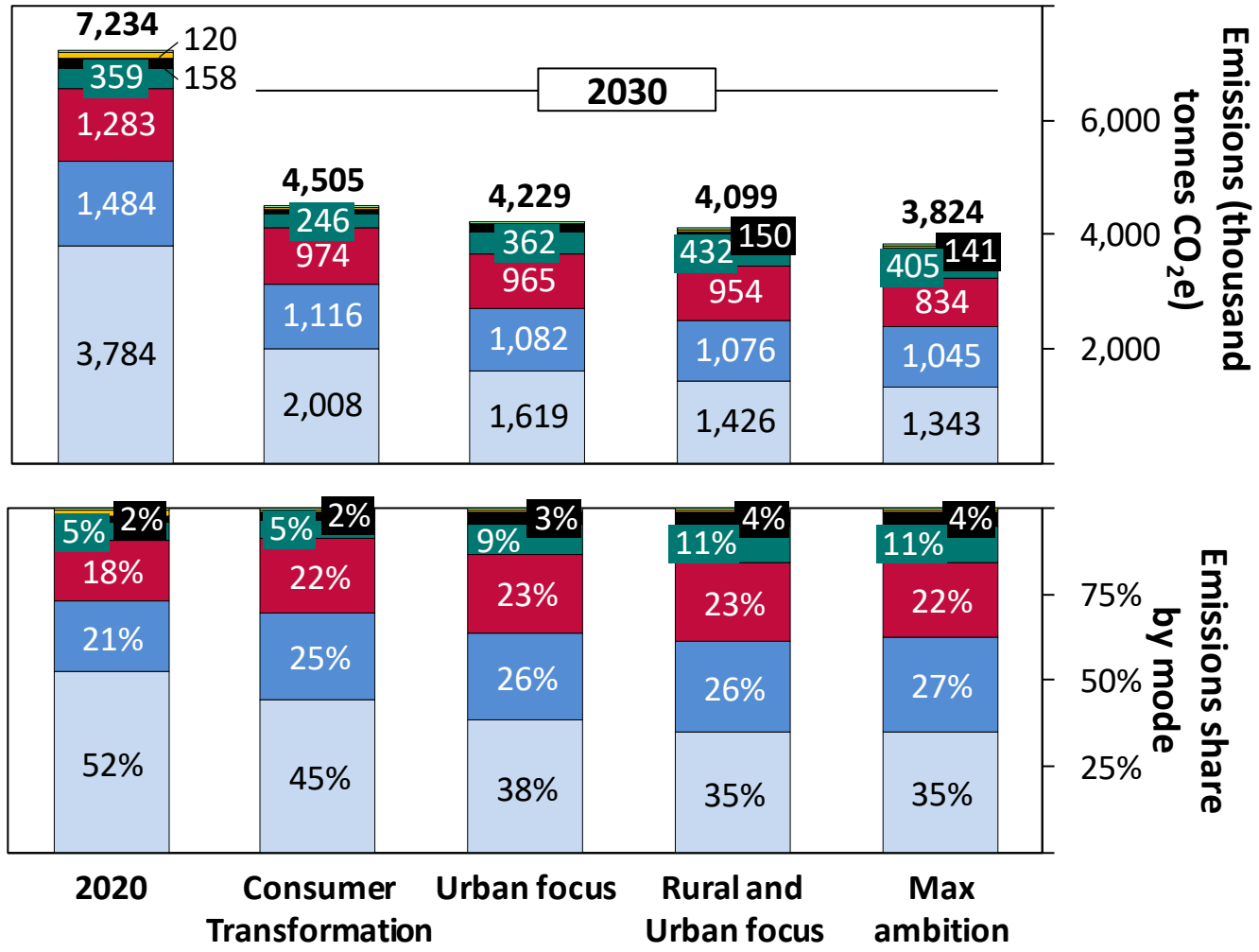
- A total of 10 million tonnes less CO_2e would be emitted between 2020 and 2050 in the Max ambition scenario (86 Mt CO2e), when compared to the Consumer Transformation scenario (96 Mt CO2e)
- As both scenarios have similar emissions in 2050, this highlights the importance and potential impact of policy that achieves significant emissions reductions by 2030

Cars could make up 35% of transport emissions in 2030 in a Max ambition scenario, relative to the 52% they contribute today

Key themes

- Cars currently make up 52% of total transport emissions[1], however this would fall to 45% by 2030 in the Consumer Transformation scenario, and 35% in the Max ambition scenario
- Emissions from cars would reduce by 64% by 2030 relative to today in the Max ambition scenario, versus a reduction of 50% in the Consumer Transformation scenario
- Due to the significant increase in bus and coach use in the Max ambitions scenario, emissions would increase slightly through to 2030, despite an increasing portion of zero emissions vehicles in the stock, and the emissions share would increase from 5% to 11% for these modes

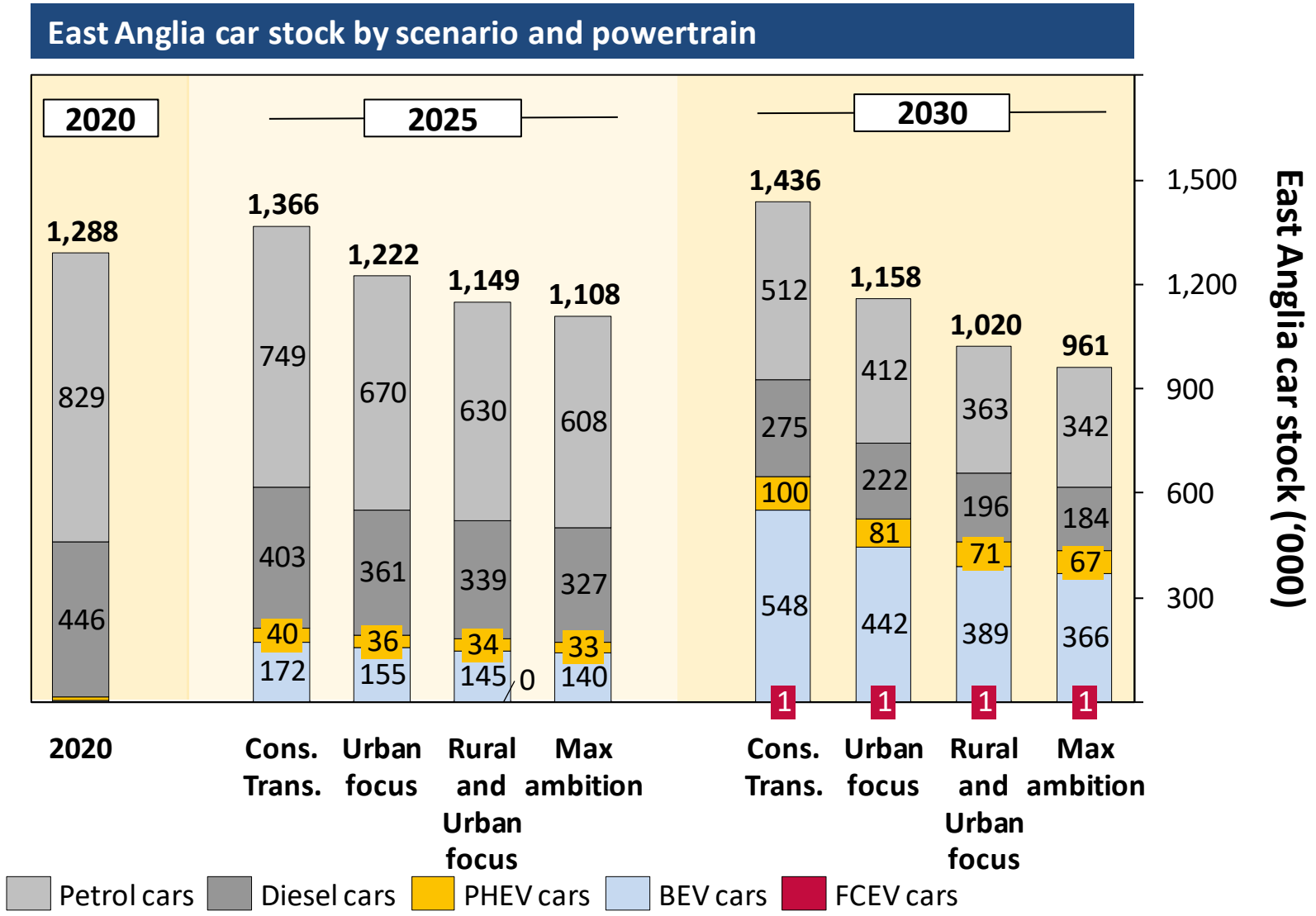
East Anglia transport emissions in 2030 by scenario relative to 2020, split by mode



Notes: 1 – As a percentage of all modelled transport modes.

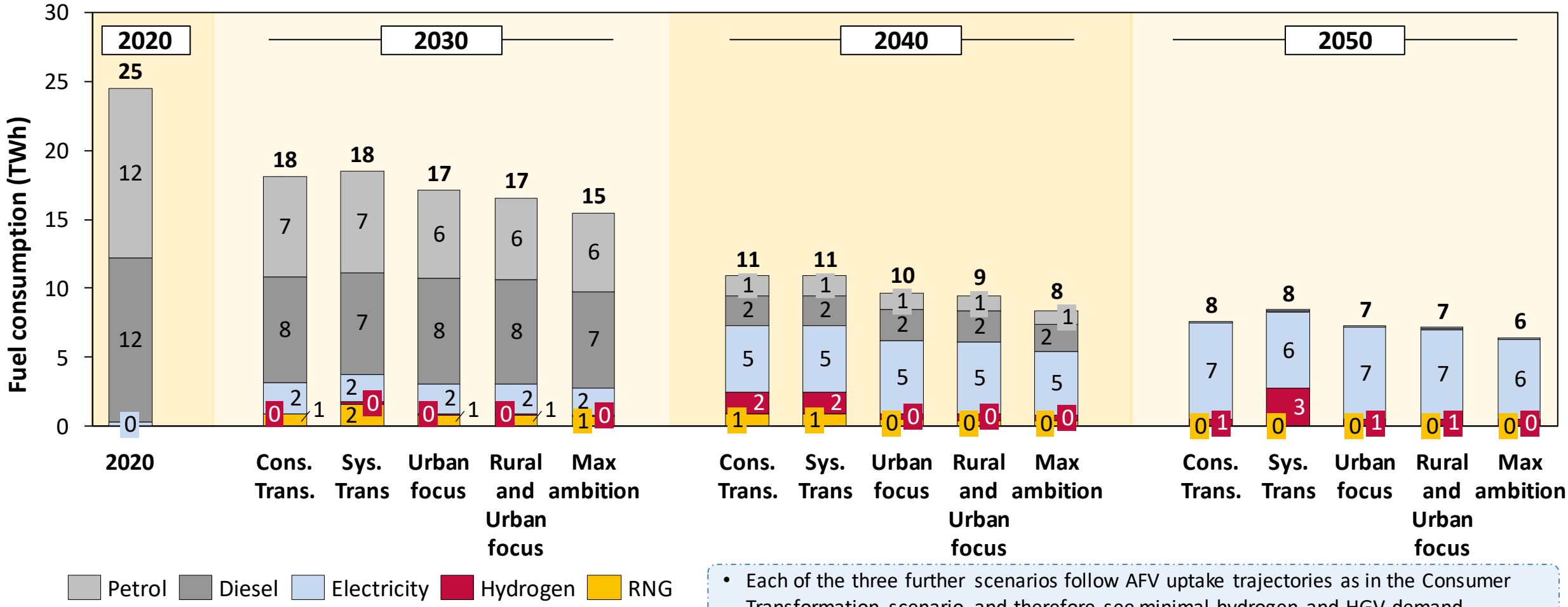
The total regional car stock would reduce by 25% by 2030 in the max ambition scenario

- The three scenarios focusing on behaviour change and a modal shift see a decrease in the total East Anglia car stock by 2030, ranging from 10% in the Urban focus scenario, to 25% in the Max Ambition scenario, relative to 2020
- The Consumer Transformation scenario meanwhile sees an increasing car stock, driven by economic and population growth



The total energy demand from transport would reduce significantly in each scenario by 2050

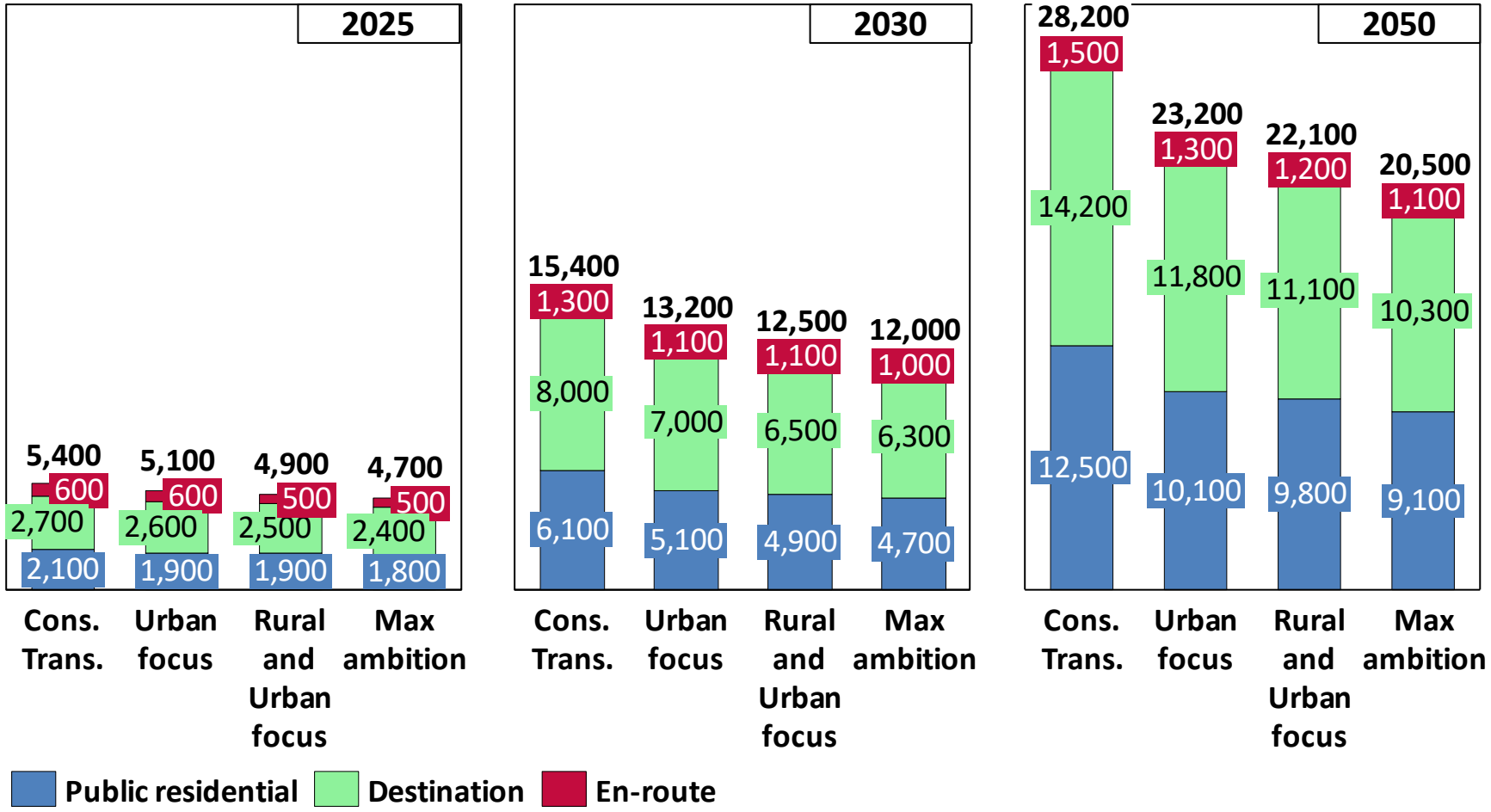
East Anglia transport fuel demand in 2025 and 2030 by scenario



- Each of the three further scenarios follow AFV uptake trajectories as in the Consumer Transformation scenario, and therefore see minimal hydrogen and HGV demand
- Infrastructure requirements in these further scenarios (resulting from the fuel demand) have hence been considered focusing on EV charging requirements

East Anglia is estimated to need 4,700 – 5,400 charge points by 2025 and 12,000 - 15,400 by 2030

Forecast EV charge point requirements in 2025, 2030 and 2050 by scenario

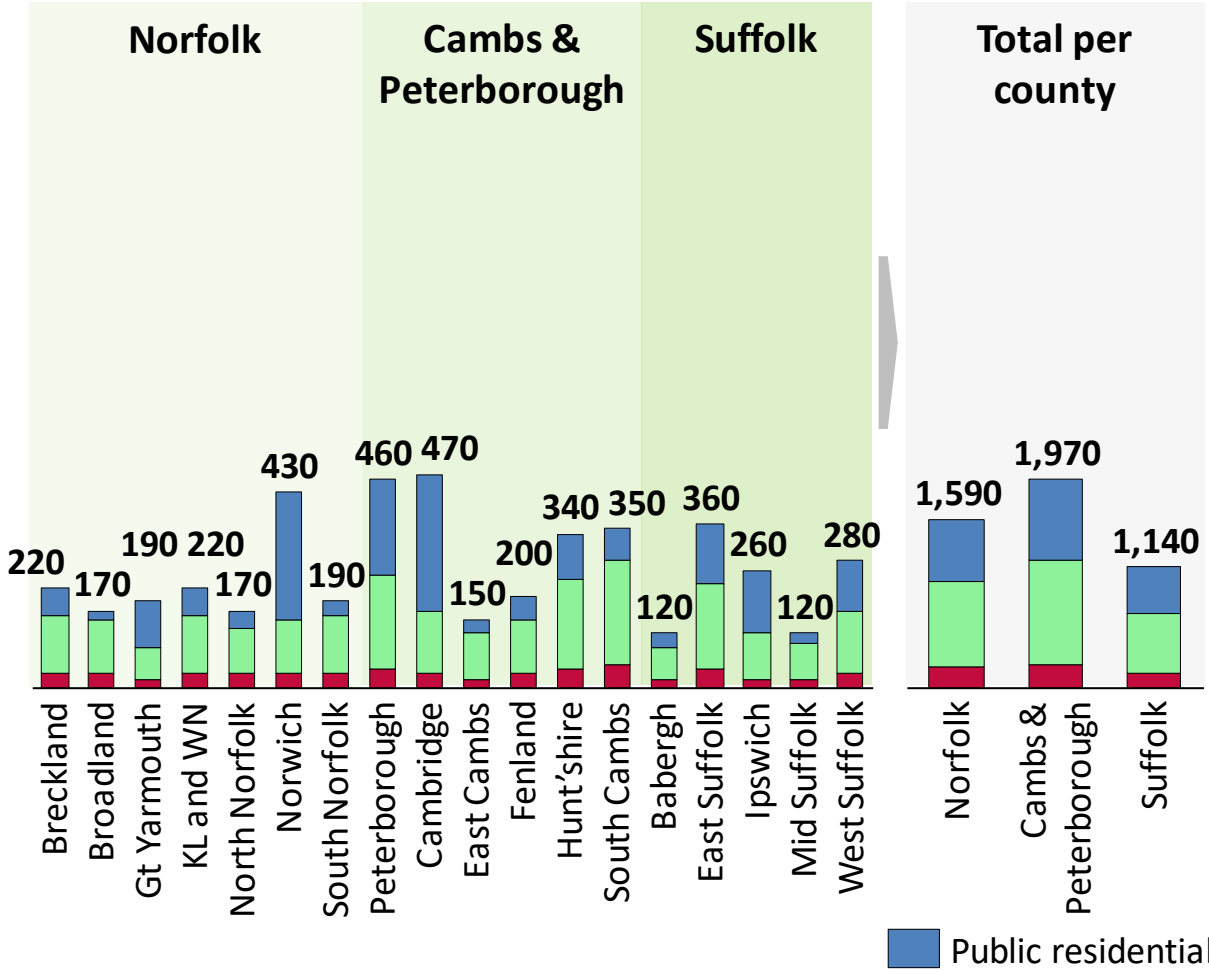


- The Max ambition scenario would require the fewest charge points of any of the scenarios in each year, requiring 27% less in 2030 when compared to the Consumer Transformation scenario
- This is driven by the decreasing stock of cars and resultant lower number of BEVs needing charging infrastructure

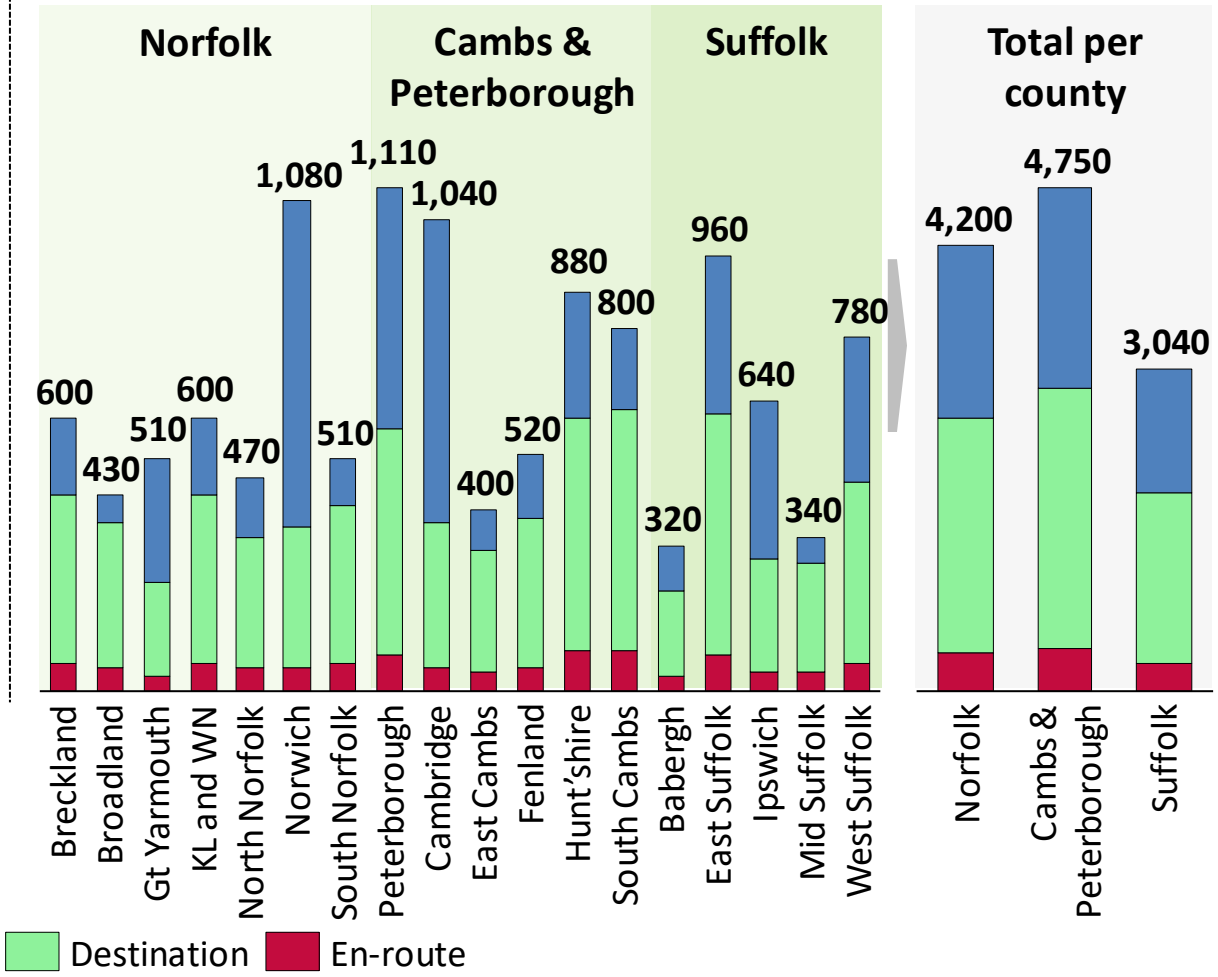
Note: the impact of changes in charging behaviour (such as through increased car sharing or home working) have not been considered. Further detail on charge point modelling assumptions are given here

The number of charge points needed in each Local authority is slightly lower in the Max Ambition scenario than in the Consumer Transformation scenario

Forecast EV charge point requirements in the Max ambition scenario in 2025 by Local Authority



Forecast EV charge point requirements in the Max ambition scenario in 2030 by Local Authority



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- Future uptake of Alternative Fuels Vehicles
- **Opportunities to support uptake of AFVs**
  - Review of best practice
  - Opportunities for innovation
  - Funding to support AFV rollout
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Overview – Action to support transport decarbonisation must target reduction in travel demand alongside a shift to alternative fuels

- Technology alone cannot deliver the scale of emissions reduction required in the next decade, and taking a demand reduction-first approach will be key in enabling the transition to a zero emission transport system
- Reducing car ownership and reliance on private cars requires consumers to be confident that they can meet all their travel needs by other, sustainable means
  - While walking, cycling and public transport should take a leading role in future transport choices, not all journeys are suited to these modes
  - Therefore, an integrated transport system is needed that comprises a range of mobility options that, together, meet the full range of personal travel needs and competitive with car travel on cost and convenience
- Measures to reduce car travel need to be carefully designed to be appropriate to each area and will need to extend beyond simply the remit of transport departments (e.g. wider local planning will be required)
  - Reducing private car use includes shortening trips as well as avoiding them; therefore, particularly in rural areas, the focus of policy should be on reviving towns so that people don't need to travel as far to access services such that the number and length of trips is reduced, even if travel to an area still includes some car use
  - Measures that focus solely on discouraging car use (e.g. parking charges, road user charging) risk disproportionately impacting low-income and rural residents and future transport must be designed to mitigate this risk
- In this section, the evidence base for action to support transport decarbonisation is reviewed across three topics:

1 Review of best practice

Examples of action taken by local and regional authorities, as well as wider stakeholders, in the UK and elsewhere to support reduced travel demand, modal shift, and alternative fuels uptake

2 Local opportunities for innovation

Opportunities for innovation to feed into the strategy are highlighted, drawing on local strengths and focusing on:

- Multi-modal hubs
- Hydrogen in transport

3 Review of funding

Details of public (UK and European) and private funding streams to support infrastructure and AFV deployment

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- Future uptake of Alternative Fuels Vehicles
- **Opportunities to support uptake of AFVs**
  - **Review of best practice**
  - Opportunities for innovation
  - Funding to support AFV rollout
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A review of best practice has been carried out across measures to reduce travel demand and shift to sustainable modes, as well as measures to accelerate alternative fuels uptake

Scope of best practice review

- A review of best practice for successfully reducing travel demand and shifting to sustainable modes, while also accelerating alternative fuels uptake has been compiled, across the following categories

Reducing travel demand and shifting to sustainable modes

- Discouraging private vehicle use and encouraging car sharing
- Improving public transport options as an alternative to private car use
- Affordability – modal shift must be affordable for all transport users
- Improving road space safety so that active travel is a more attractive option
- Deliveries – in particular solutions for 'last mile' deliveries with cargo bikes

Accelerating alternative fuels uptake

- Encouraging the take up for taxis and private hire vehicles
- Supporting charging infrastructure rollout, in particular:
  - Public rapid destination and on-street charging
  - Rural charging
- Overcoming key barriers to charging infrastructure, such as:
  - Network constraints and connections
- Adopting a unified planning approach to related infrastructure

Key examples highlighted by the case studies on the following slides include:

- Workplace charging levies
- Scrappage and mobility incentives, including those linked to public and shared transport
- Integrated public transport networks and active travel schemes
- Freight consolidation and sustainable last mile deliveries
- EV charging frameworks and charging deployment approaches

Best practice review: reducing travel demand and shifting to sustainable modes (1/4) – focus on discouraging private vehicle use and encouraging car sharing

Nottingham City Council - *reducing travel demand*

- Nottingham introduced a Workplace Parking Levy in 2012, which charges employers £415 per parking space provided to employees
- 8/10 employers currently pass this cost onto employees who use the spaces, providing another incentive to use the city's public transport links
- A similar scheme is being considered by the London Borough of Hounslow as a means of funding new Overground links between Brentford, Southall, and Syon Lane.

London Borough of Hackney - *reducing travel demand*

- Hackney's upcoming 'Local Plan 2033' stipulates that all new developments in the borough must be car free, and that all proposals for, or including, new public car parks will be refused
- Additionally, sites that are redeveloped must significantly reduce their parking provision under these proposals.

London - *encouraging car sharing*

- The TfL van scrappage scheme is open to sole traders, charities and micro businesses
- They give £3,500 for each non-ULEZ compliant van scrapped. Third parties offer promotions: for instance, Zipcar offers a match funding (if recipients use the fund towards a Zipcar account, Zipcar adds £3,500 too).
- This encourages consumers to use car sharing instead of having a private vehicle.

Berlin, Germany – *encouraging car sharing*

- The number of car sharing users in Berlin has grown from 180,000 people in 2010 to 2.46 million in early 2019. A number of private car clubs operate within the city, with VW launching their WeShare service earlier this year with a fleet of 1,500 e-Golf cars. WeShare follows the "free-floating" model of competitor car2go which allows users to park their car in any legal parking spot throughout the city.

See also City Fringe Zen for best practice around car sharing

Best practice review: reducing travel demand and shifting to sustainable modes (2/4) – focus on improving public transport services and affordability

Bus network, Vitoria-Gasteiz – *improving public transport*

- The bus network was reduced from 17 lines to 9 lines with new itineraries, timetables and improved frequencies
- New bus stops were introduced in 146 locations and more resources and information were provided at all bus stops
- Buses were given priority at traffic lights, and bus lanes and queue jumpers at busy junctions were introduced
- Users can access the whole city with a maximum of two transfers and journey times are comparable to a private car.

Bus rapid transit network, Metz - *improving public transport*

- Two METTIS rapid transfer lines operate in the city, carrying up to 2,400 passengers per hour per direction in the morning rush hour
- New 24 metre articulated buses travel in dedicated lanes and are assigned priority at traffic lights, allowing a high frequency, high volume service (every 5 min)
- Contactless ticketing and the introduction of three park and ride facilities contribute to high usage of the network.

Mobility scheme, Birmingham – *affordability*

- In the context of the Clean Air Zone (CAZ) (opened in 2021), Birmingham is setting up a mobility scheme to encourage people to use public transport instead of their car. Individuals who travel into the CAZ for work, have a non-CAZ compliant car and earn under £30,000 p.a. will be eligible to choose from:
  - £1,000 mobility credit
  - Scrapping their car and getting £2,000, either as mobility credit or against the purchase of a CAZ compliant car
- The mobility credit will be added to the Swift card, the regional transport card that includes, tram, buses and trains.

Employer-funded public transport, France – *affordability*

- In France, it is a legal requirement for the employer to pay 50% of public transport cost of the employee (or public shared vehicles such as the Barclays bike equivalent, Vélib).
- This appears on the pay slip but is not taxed.

Multi-modal mobility service, Montpellier – *affordability*

- The EMMA mobility card allows customers to use the tramway, shared bicycles, car sharing, and car and bike parks in the city with a single subscription
- The service includes an itinerary and schedule calculator across all modes.

Best practice review: reducing travel demand and shifting to sustainable modes (3/4) – focus on active travel and road space safety

Waltham Forest, London - *active travel and road space safety*

- Developed a Cycle Action Plan and 2020 Vision for Cycling to implement Mini-Holland funding (£27m from TfL) to improve conditions for cycling in the Borough
- Over 5 years, the borough has delivered 22km of segregated cycle lanes, 40 modal filters to prevent rat-running, improvement of road junctions, and installation of 300 bike hangars for residents and 7 station cycle hubs
- A fund of £20,000 is available per year to community projects (up to £2,500 per project) that encourage walking and cycling. Residents were consulted throughout scheme design.

Ghent, Belgium – *reduced car travel*

- In 2017 Ghent implemented a 'Circulation Plan', carving the city centre up into six wedge districts and banned cars from travelling between districts
- This has resulted in a 13% reduction in rush hour car traffic, and a 39% reduction in cars on the most popular streets in the inner city
- Space freed up from cars has been reallocated to widened cycle lanes and bus corridors, as well as improvements to the public realm.

City Fringe ZEN – *active travel*

- Established in 2012 as a partnership between the London Boroughs of Hackney, Islington, and Tower Hamlets, the Zero Emissions Network (ZEN) offers free advice and services to businesses and residents in the City Fringe area to help them switch to low emission energy and travel options
- The Network provides services such as free trials of electric vehicles and cargo bikes, to cycle training and repair courses, and workplace energy audits
- They also offer a range of financial support such as a £2,000 workplace grant to improve walking and cycling facilities, as well as a number of promotional offers for joining local car clubs
- So far 31 polluting vehicles have been switched for electric ones and 117 private vehicles have been given up for car club memberships
- The ZEN has garnered widespread praise and was awarded an additional £200,000 by the Department for Environment, Food and Rural Affairs' Air Quality Grant scheme earlier this year
- A similar scheme with funding support from the Mayor's Air Quality Fund is to be set up in Hammersmith.

Best practice review: reducing travel demand and shifting to sustainable modes (4/4) – focus on freight and last-mile deliveries

City of London – *freight*

- Following a review of council-owned assets, policies to encourage cycle freight are included in City of London's Draft Transport Strategy (Proposal 38), including development of three micro-distribution hubs within underutilised car parks
- The council also carried out their own loading bay survey to assess the potential for modal shift.

London Boroughs Consolidation Centre - *freight*

- The London Boroughs of Camden, Enfield, Islington and Waltham Forest established a consolidation centre for council deliveries, now used by up to 41 suppliers and resulting in a 46% reduction in the number of vehicle trips delivering to council sites.

Waltham Forest cycle freight scheme - *freight*

- Waltham Forest (WF) secured £400k funding through the Mayor's Air Quality fund for a Zero Emissions Delivery service, which was used in part to implement a cycle freight delivery service
- An initial trial in 2016 saw 20 businesses sign up, and 1,000 packages delivered, with riders covering 45km/day, which was then expanded to a lasting service (initially funded for 2 years)
- WF Council (who have 1 FTE supporting the scheme) partnered with a cycle logistics operator in 2017 to continue the scheme, which now operates commercially

Amsterdam, Netherlands – *last mile deliveries*

- DHL operate an integrated boat-to-bike system to enable deliveries in and out of the city centre by canal boat, with the first and last mile carried out by cargo bike.

Utrecht, Netherlands – *last mile deliveries*

- Catering supplies are delivered to 60 businesses along the river by electric-powered boat (the "beer boat", funded from the council's air quality budget.

Best practice review: encouraging alternative fuels vehicles uptake (1/2) – focus on supporting the charging infrastructure rollout

GO-EV project on the Isles of Scilly[1] – *rural charging*

- Project aims to install a network of 27 EV charge points across all 5 islands
- 10 charge points will be dedicated to an EV car share scheme
  - Vehicles from the car share scheme will also be V2G capable and will help to balance the grid
  - Will also be optimising solar PV generation from canopies above the charge points
- Isles of Scilly have only 10 miles of road and a population density of 139 per km.

EV charging on Orkney Islands – *rural charging*

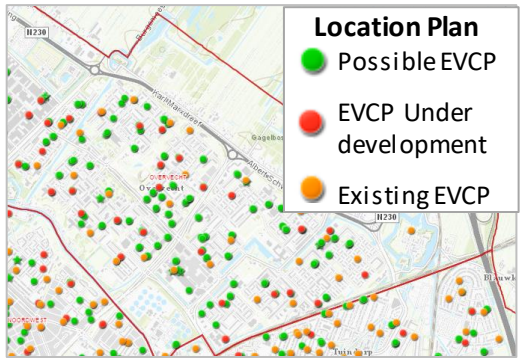
- Orkney Islands has 30 charge points (higher number than petrol stations), largely provided and operated by Orkney Islands Council[2]
- Funded by grant from Transport Scotland[2]
- Over 220 EVs in Orkney, which is highest proportion of fully electric vehicles in Scotland[3].

Birmingham City Council – *on-street and rapid charging*

- Birmingham have appointed ESB as their preferred provider of charging infrastructure with the arrangement that BCC provide council land and ESB deploy and maintain the infrastructure and provide advice – in a part private sector part public sector funded project.

Utrecht: Neighbourhood-oriented - *on-street charging*

- A neighbourhood-central decision-making process is used to determine where and when new EVCPs need to be deployed. This ensures that new charge points are deployed as soon as demand increases so that every EV has accessible charging infrastructure.



City of Westminster – *on-street charging*

- Westminster has the highest number of charge points per capita in the UK, with 1.47 per 1,000 population
- Residents are also able to request a new on-street charge point to be installed in lamp columns near their home.

Amsterdam: demand led – *on-street charging*

- A demand-led approach is used. Individual residents make a request for a charge point by completing an online form using a centralised website run by Nuon now part of Vattenfall energy company.
- Deployment is demand led but guided by requests from residents. Analysis of the current network identifies areas of rapidly increasing demand for one site identified 3 EVCPs are installed.

Source: 1 - https://www.ioscv.co.uk/carshare; 2 - https://www.oref.co.uk/charging-infrastructure/ ; 3 - https://www.orcadian.co.uk/ev-charging-fees-set-for-to-be-introduced-in-may/

Best practice review: encouraging alternative fuels vehicles uptake (2/2) – Adopting a unified planning approach to related infrastructure and overcoming key barriers

London's EVCP installation guidance – *planning*

- TFL published in 2019 a document setting out guidance for the installation of EVCPs in London, with regards to charge point location, access, speed and vehicle type, ensuring a uniform approach to their local installation
- The document includes guidance around gaining planning and consents, such as the instances in which planning permission will be required or an exemption may be granted, as well as the various consents required to deliver EVCPs.

UKPN grid management – *overcoming key barriers*

- UKPN have committed to publishing heat maps of potential future flexibility requirements in response to low voltage constraints
- UKPN will release an EV-driven LV constraint map covering the GLA area (subject to controlled access)
- The map will identify LV transformer sites and other network assets likely to be constrained by increasing EV uptake without deployment of any smart/managed charging.

London - *planning and overcoming key barriers*

- Two procurement frameworks are open to Boroughs to facilitate infrastructure delivery: Electric Vehicle Infrastructure Framework (on-street) and Rapid Charging Framework
- The London EV infrastructure delivery plan launched in 2019 includes quantified medium-term (to 2025) estimates for the number of rapid and slow to fast charge points required
- The focus, however, is on addressing barriers to scaling up existing infrastructure, such as network constraints, long lead times, and the need for suitable locations
- Recommendations and actions for overcoming such barriers are given in the plan.

Haringey Council telematics service - *key barriers*

- In 2017 Haringey Council was awarded funding from the Mayor of London and TFL, the council in part used the funding to provide free telematics services for local users of light goods vehicles via the company CleanCar (who measure real-world driving data)
- The user receives a report detailing their suitability to switch, recommended vehicles, estimated impact (cost and emissions savings) and charging infrastructure recommendations.

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Multi-modal hubs: Co-locating renewables and recharging opportunities for several transport modes has the potential to bring multiple benefits, including modal shift and reduced congestion

Benefits of multi-modal hubs

- Provides EV charging along road network to support wider infrastructure and help build confidence among fleets
- By locating outside urban centres can reduce urban traffic (air quality and congestion benefits)
- By co-locating various modes, can support active travel
- Coupling charging infrastructure with local generation can reduce impact on grid/avoid grid constraints

@multi mobility, Sophia von Berg, 2014

Local strengths and opportunities:

- Hubs are a priority area to explore for Greater South East Energy Hub and England's Economic Heartland
- Opportunities for learning through existing experience in co-location of renewables and charging through:
  - Deployment at Park and Ride sites in Cambridgeshire (Babraham and St Ives)
  - Integrated energy infrastructure through PIRI
- Initial analysis shows potential in the region across several criteria outlined as necessary or desirable for locating hubs[1] (see next slide)

Actions to support multi-modal hubs

- Work with sub-national transport bodies, Energy Hub, and Local Authorities to explore integration of hubs into EV charging plans
- Work with public and private sector to put forward land for potential sites

- **Multi-modal hubs** are locations at which key transport infrastructure and services intersect across modes by design
- This may include the co-location of bus, rail, park and ride and other public transport stations, connections into walking and cycling routes, freight consolidation centres, as well supporting infrastructure such as EV charging hubs, refuelling stations, renewable electricity generation and battery energy storage

1. Criteria as set out in Midlands Regional Transport Hubs report, Cenex for Nottingham City Council (2020)

Multi-modal hubs: Several areas of East Anglia meet a number of key parameters that have been identified as essential and desirable for locating multi-modal hubs

Traffic flow, major roads

Traffic flow – no. vehicles passing count point on an average day:

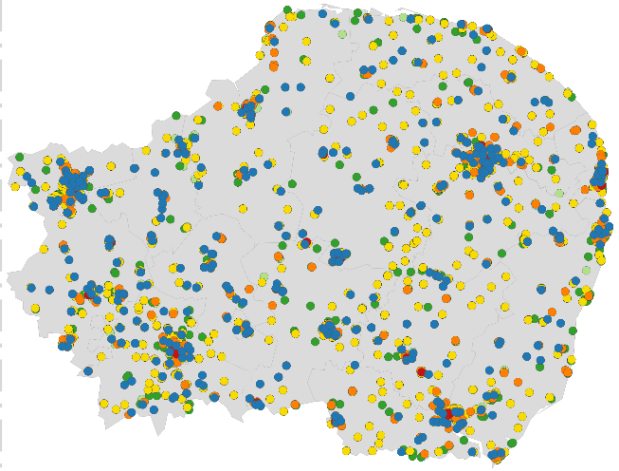
Low – 10 vehicles

High – 105,658 vehicles

- Indicate regions with high en-route demand suitable for rapid charging

Source: DfT traffic counts

Key amienities



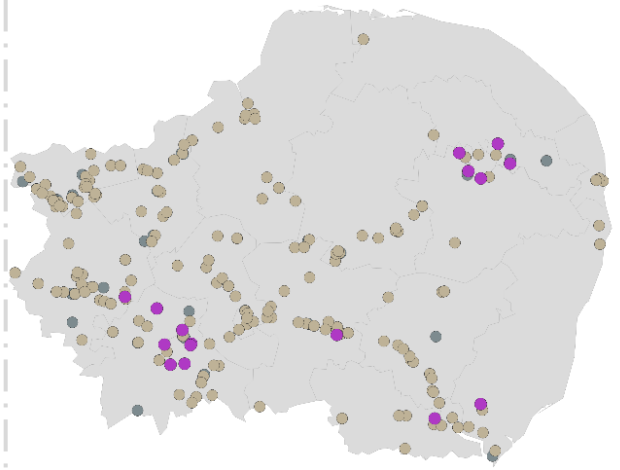
Key Amenities:

- Supermarkets
- Convenience stores
- Cafes
- Fast food restaurants
- Fuel forecourts
- Taxi ranks

- Indicates regions with high demand for destination charging

Source: OpenStreet Map

Park & Ride sites, and truck stops



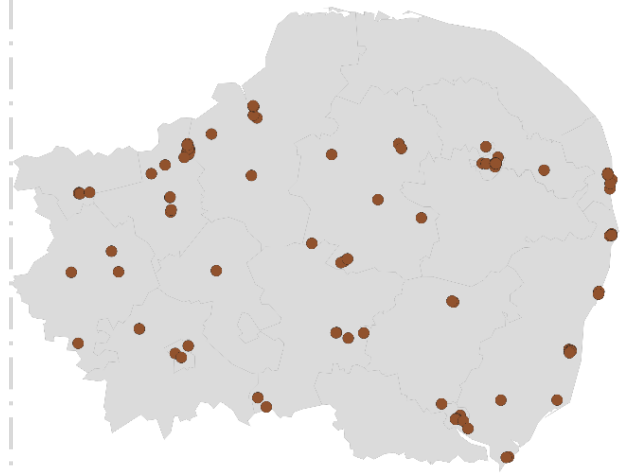
Vehicle stop locations:

- Long haul truck stops
- Regional truck stops
- Park and ride sites

- P&R sites are appropriate for long-stay public charging
- Truck stops are suitable for fleet charging*

Source: Park and ride http://www.parkandride.net/
Truck stops: EE analysis of acea data

Brownfield sites



- Brownfield sites indicate locations that may be suitable for deploying rapid charging hubs
- Other site specific factors need to be considered when determining the suitability of a site such as grid capacity, site size, accessibility and land cost/ownership

- Possible locations for hubs to be deployed – particularly where these coincide with high traffic flow or high amenity density areas

Source: OpenStreet Map

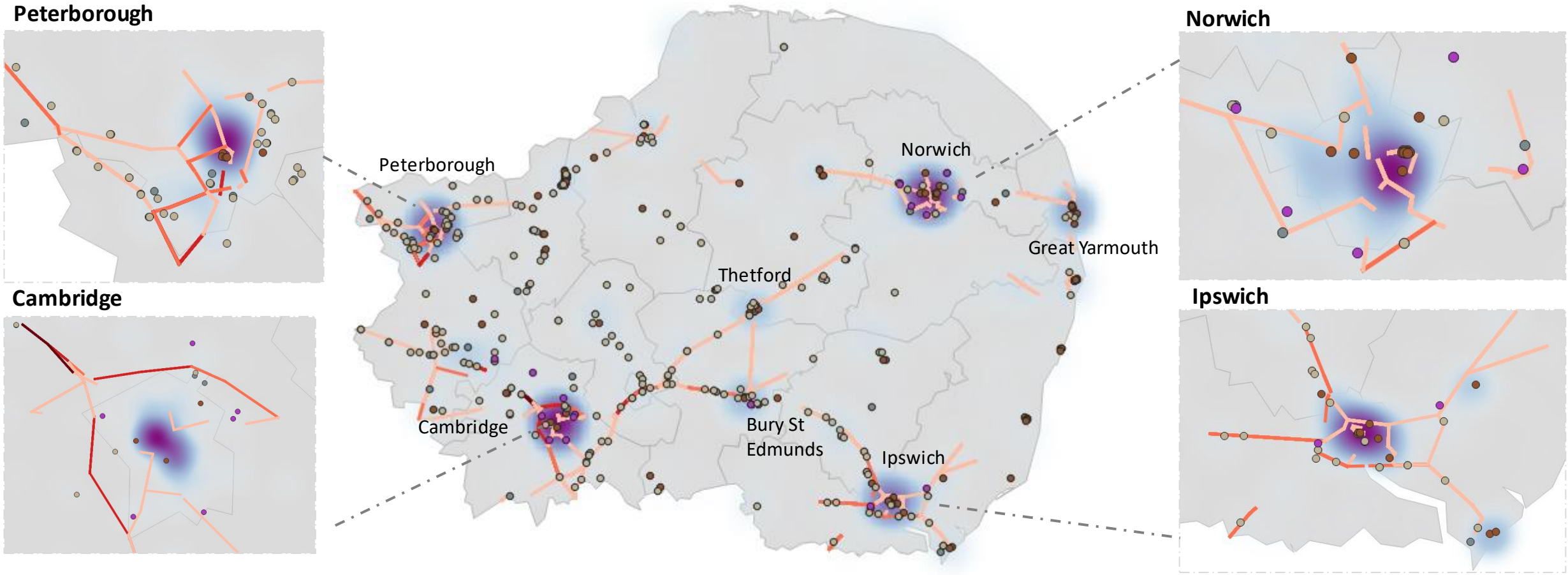
The datasets above can be used to identify regions likely to have high EV charging demand or appropriate sites of multi-modal hub deployment

Multi-modal hubs: Areas with multiple overlapping parameters should be investigated further for the deployment of hubs

Map key:
- Traffic flow: 20k vehicles – 100k vehicles
- Amenity Density: Moderate – High
- Park & Ride sites
- Long haul truck stops
- Regional truck stops
- Brownfield sites

Traffic flow, major roads* | **Key amenities** | **Park & Ride sites, and truck stops** | **Brownfield sites**

Key Locations are: in and around city centres and along major traffic routes – other parameters (such as grid connection, accessibility and site size) need to be considered to determine precise locations of appropriate sites



* Filtered to only show traffic flow above 20,000 vehicles per day; through discussions with CPOs this is the minimum traffic flow for en-route charging to be deployed

Hydrogen for transport: East Anglia has strong opportunities for local hydrogen production, and its use in transport can support retention of local value from these projects

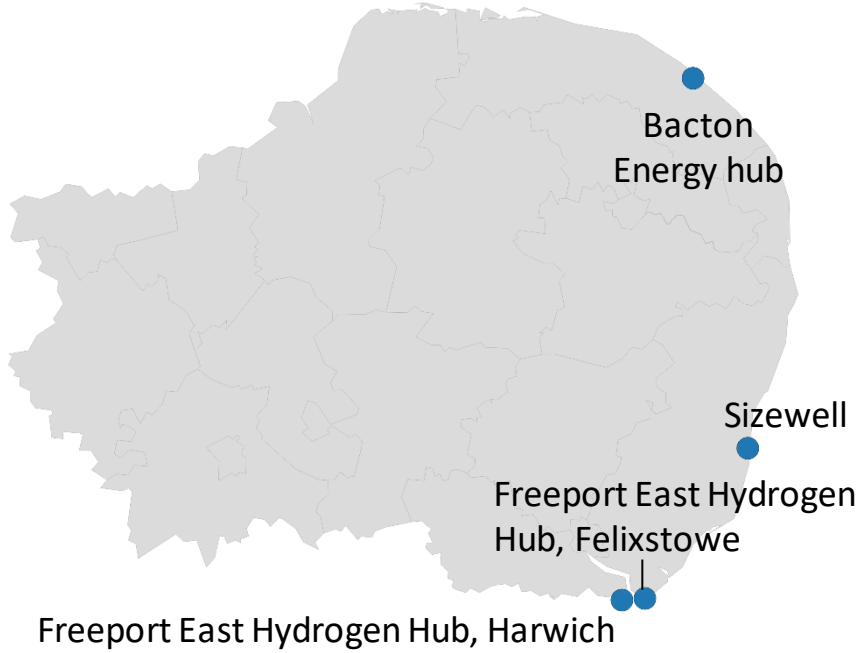
Key challenges to delivering hydrogen for transport:

- For transport, need for large fleet commitment to justify refuelling infrastructure (e.g. ~20 trucks or 100 vans) – demand aggregation important
- Damaging geopolitics of natural gas suggests transport should rely predominately on green, not blue, hydrogen. This constrains supply and means its use should be limited to the most reliant sectors such as shipping where limited alternatives exist.
- Cost of vehicles – private sector unwilling to invest without funding support
- Lack of dedicated funding streams – may change in future

Local strengths and opportunities:

- East Anglia has two potential hydrogen production sites under development:
  - **Bacton Energy hub** – mix of blue and green hydrogen
  - **Sizewell** – green hydrogen from nuclear power
- **Freeport East Hydrogen Hub** (supplied by hydrogen from offshore wind and nuclear power at Sizewell) has strong potential to leverage aggregated demand for transport through co-location of shipping, high HGV traffic, and rail
- Upcoming projects will explore hydrogen elsewhere in the region, such as the **Norfolk Sustainable Hydrogen Infrastructure for Transport** study (SHIFT)
- **Hydrogen East** are a body bringing together key stakeholders in hydrogen in the East of England, aiming to raise awareness around local hydrogen opportunities and ultimately establish East Anglia as a leading hydrogen region

Map of hydrogen projects in East Anglia



For recommended actions to encourage the transition to hydrogen for transport, see policy C5

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  - Opportunities for innovation
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    - Electric vehicle charging
    - Heavy duty vehicles
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Overview – there is a range of funding available to support deployment of EV charging infrastructure at UK and European level, but more limited options for supporting HDVs

Summary

UK, public

Funding available for Local Authorities to support rollout of local charging – primarily residential but also supporting other users

Key schemes:

- On-street Residential Charging Fund (ORCS)
- Transitioning towards ZEV Funding – Infrastructure
- Local EV Infrastructure Fund
- Project RAPID

LAs are also supported by the **Vehicle Charging Infrastructure Solutions (VCIS) Framework**

Other options **include innovation funding** – regular rounds covering freight, on-street charging, smart charging, improving accessibility etc

- There is a total of £3bn in funding to support buses including plans to deploy ~4000 ZEBs - the ZEBRA scheme also supports the deployment of ZEB infrastructure
- The plug-in-vehicles grant includes HGVs but there is no public funding for HGV infrastructure

European, public

European funding typically targets larger, pan-European projects with innovative elements

Key schemes:

- Horizon Europe Work Programme – Smart EV Charging & V2G flexibility
- EIC – Green Deal innovations for the Economic Recovery
- CEF Energy Work Programme
- Example CEF Transport Call for Proposals

Scale of projects require high ambition and collaboration but **offer opportunity for leadership**

Private

Primarily aimed at private sector – including charge point operators and electricity DNOs – to fund charge point deployment, infrastructure upgrades, and/or enable access to key sites

Examples include:

- Electric Vehicle Network (EVN)
- Charging Infrastructure Investment Fund (CIIF) [benefitted from £200m from gov.]
- Network Innovation Competition (NIC) – Call for Ideas
- SEEIT Investment
- Citi Group Green Bonds
- Macquarie Group - Green Investment Group

Private sector investment offers an additional route for those who do not want to be reliant on public funding but would require private sector involvement – see slide

- **HGV** projects would fit into the scope of private funding schemes covering all green energy opportunities

ZEB = Zero Emission Bus

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UK public charging funding is targeting both on-street and rapid charging to support rollout of residential and en-route charging

On-street Residential Charging Fund (ORCS)[1]
UK Gov – OZEV
Up to £13k per EVCP

- Funding is available to **local authorities** to help with the costs of **procurement and installation** of on-street charge points for residential use
- Funding is available for **75% of the capital costs up to £13,000 in cases where connection costs are high** – can be located **on-street or in car parks but must be on council owned land.** There is no longer a constraint on project size
- Charge points must be located in **residential areas** and have a charging speed of **3.5-22kW but not above 22kW DC or 23kW AC**
- Local authorities will need to **demonstrate home charging is not an option** for the residents where the charge points are to be located and locations must meet **current or anticipated future demand.** ORCS must sign off each location
- **Fast charging hubs are within scope** as long as they are resident-focused (as opposed to facilitating en-route charging).
- **Utilisation data must be shared** for 3 years after installation

Transitioning towards ZEV Funding – Infrastructure[2]
UK Gov – OZEV
£300k - £800k per project

- Funding available to **charge point operators with a maximum of 3 collaborators** to fund innovative infrastructure solutions that support the transition to zero emission vehicles
- Technologies **must meet at least one of 4 scope challenges**: (1) Improve public residential charging in urban areas, (2) Improve rural charging, (3) Improving fleet solutions, (4) Enhance ZEV user infrastructure experiences
- Scheme is **currently closed but will potentially run annually**; scope of next round not yet announced but will potentially fund trials

Local EV Infrastructure Fund[3]
UK Gov – OZEV
£90m total

- Upcoming fund (announced July 2021) to support the rollout of larger on-street charging schemes and rapid charging hubs across England
- Deployment will be where there is market failure or additional to what the market can deliver
- Currently being scoped by OZEV, **will be launched by Summer 2022.** Will replace ORCS.

Project RAPID[4]
UK Gov – DfT/OZEV
ca. £1.25m per site

- Fund that will finance a proportion of costs at approximately 400 sites across the Strategic Road Network (113 Motorway Service Areas and ~ 200-300 A road sites) where upgrading connections to install rapid charge points is prohibitively expensive
- Some may bid as part of a consortium, but **funds primarily for landowners**
- Grant design and business case still in development and **fund will launch in 2022**

Source: 1: ORCS 2: OZEV competition overview 3: OZEV competition overview, Discussion with OZEV 4: Project RAPID announcement, Discussion with OZEV

The Vehicle Charging Infrastructure Solutions (VCIS) Framework enables public sector to access services that support vehicle charging infrastructure

Vehicle Charging Infrastructure Solutions Framework

- The Vehicle Charging Infrastructure Solutions framework is part of the Dynamic Purchasing System Marketplace, run by Crown Commercial Services. The framework runs from **April 2020-April 2024**
- The framework offers the **Central Government and Wider Public Sector** access to products and services that **support vehicle charging infrastructure**
  - This includes: Central Government Departments, Local Authorities, NHS bodies, Charities and Universities, colleges and schools
- It is open to suppliers of:
  - Consultancy and feasibility
  - Civil design and installation
  - **Provision, installation and maintenance of hardware**
  - Software and back-office solutions
  - **Lease and purchase of products**
  - Full end-to-end service

Rapid charge point operators on the framework

As of late 2021, a total of 63 suppliers are part of the framework, 7 of which operate rapid charge points. These are:

- Chargemaster limited (bp)
- Engie services limited
- ESB innovation UK limited
- Franklin EV limited
- Osprey charging network ltd
- Swarco UK limited
- Clenergy EV ltd
- Ubitricity

Source: https://supplierregistration.cabinetoffice.gov.uk/dps, https://assets.crowncommercial.gov.uk/wp-content/uploads/RM6213-VCIS-Buyer-guidance-v1.0.pdf

European public funding streams are available to UK local authorities, typically targeting larger scale, innovative projects

Horizon Europe Work Programme – Smart EV Charging & V2G flexibility[1] European Commission **€7-10m per project**	• Horizon Europe project - HORIZON-CL5-2021-D5-01-03 System approach to achieve optimised Smart EV Charging and V2G flexibility in mass-deployment conditions. • The programme will fund Smart V2X EVCP projects at mass market scale. Smart charging solutions must be developed such as: data models, AI driven data management schemes, communication systems and integration of V2X data. • Currently closed but likely similar proposal will run again	
EIC – Green Deal innovations for the Economic Recovery[2] European Commission **€2.5m – over 7.5m depending on scale**	• The Innovation Fund focuses on highly innovative technologies and big flagship projects with European value added that can bring significant emission reductions. • The funding is for the demonstration of innovative low-carbon technologies and first-of-a-kind projects. The fund support both small and large scale projects. • Currently closed but likely similar proposal will run again	
CEF Energy Work Programme[3] European Commission **€70m average**	• The CEF Energy Work Programme will contribute to the further development and implementation of projects of common interest (PCIs) in the energy sector, namely in electricity (including smart grids), gas and cross-border carbon dioxide networks • Currently closed but likely similar proposal will run again	
Example CEF Transport Call for Proposals[4] European Commission **€160 m total**	• CEF Transport announces approx. 1 call each year. The 2020 CEF Transport MAP call addresses actions related to the funding objective "removing bottlenecks, enhancing rail interoperability, bridging missing links and, in particular, improving cross-border sections • Currently closed but likely similar proposal will run again	

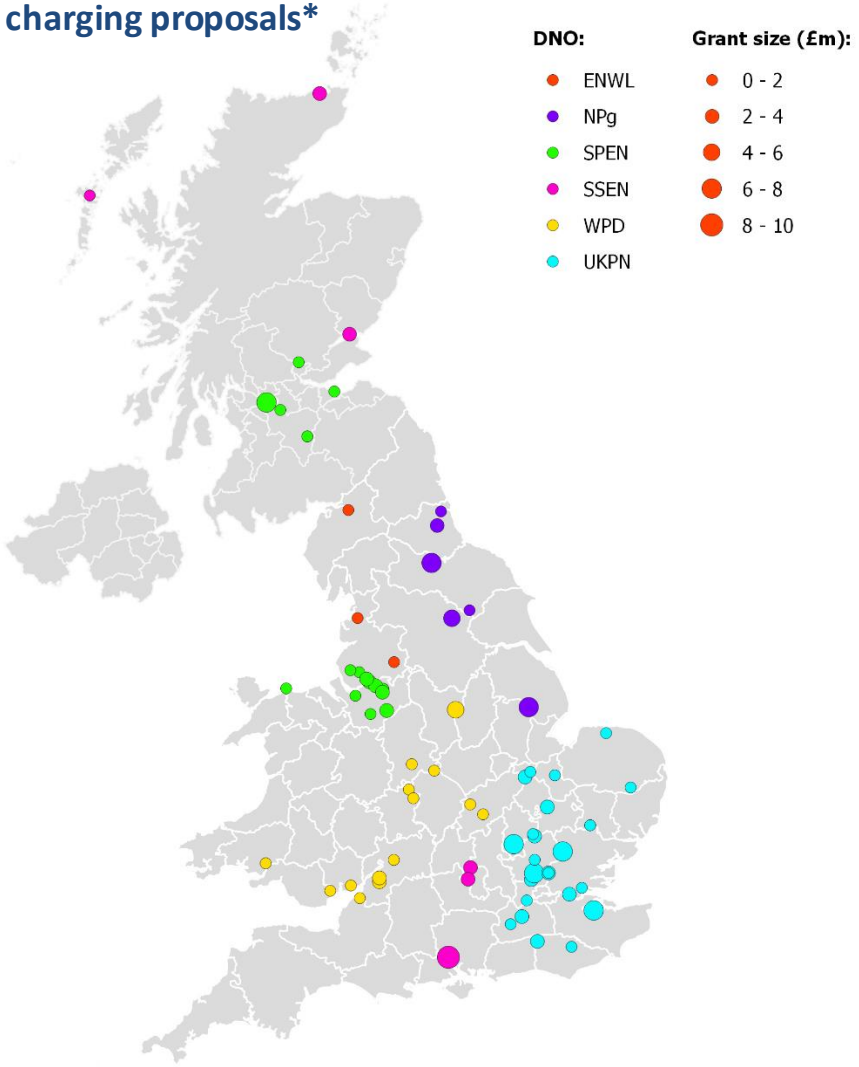
Source: 1: Horizon Europe Work programme proposals 2: European Commission Portal 3: CEF Energy calls for proposal 4: CEF Transport Call

Ofgem recently provided Green Recovery grants to DNOs, with most of the funding going towards EV charging projects and a number of projects in East Anglia

DNO	No. proposals submitted	Value of submitted proposals (£m)	No. proposals accepted	Value of proposals accepted (£m)	No. EV charging proposals* accepted	Value of EV charging proposals* accepted (£m)
ENWL	11	20.28	11	20.28	4	3.14
NPg	14	75.10	14	53.10	7	25.20
SPEN	42	89.37	40	61.70	20	29.17
SSEN	12	40.92	12	40.92	7	27.16
UKPN	90	82.40	88	66.10	Grouped, so unclear	65.90
WPD	39	58.40	39	58.40	14	27.52
Total	**210**	**£366.47m**	**204**	**£300.50m**	**>52**	**£178.09m**

- Value of DNO proposals related to EV charging infrastructure make up ca. 60% of total value of proposals accepted by Ofgem
  - Proposals often focus on increased network capacity around or connection capacity to Motorway Service Areas (MSAs) to enable rapid charging, or around strategic road network

Location and value of Ofgem grants awarded to EV charging proposals*



MSA = Motorway Service Area. *Note: some proposals included do not explicitly state that they will be used for EV charging, but involve upgrades to connections around MSA or strategic road network. Source: EE review of Ofgem report https://www.ofgem.gov.uk/system/files/docs/2021/05/dno_green_recovery_scheme_decision.pdf

Private Investment: three private investment opportunities which offer funding for EV infrastructure are outlined below – it is likely funding would need to go through a CPO

Opportunity name	Funding amount	Funding type	Contract timescale	Technology focus	Overview	Key takeaways
Zouk: Charging Infrastructure Investment Fund	Generally between £20-30m	Investment: typical private equity investment	5 years	Charging infrastructure focus but will also fund auxiliary tech e.g. batteries, solar EVCP covers, software	Typical private equity investment, focused on EVCPs but some scope to fund auxiliary tech. Some data sharing is required and the contract is short	This scheme only offers funding and no support in deployment, it would require the CPO to apply (possibly in partnership with LA) as a **proportion of the revenue share would go to Zouk**
SDCL: SEEIT Investment	No limit to amount of funding available	Investment: typically SDCL covers 100% of the assets on site but flexible	10-20 years	Funds any projects that fits the sustainable energy scope, particularly interested in multi-technology investments	Investment where SDCL will typically fund 100% of the assets. Funding for EVCPs and any associated tech inc. multi-technology projects. CPO has full control over sites and tech type and limited data sharing required	Likely that application would need to be through a CPO, **SEEIT would own 100% of the assets at the site** – this may be an issue if Council owned land is being used
The Electric Vehicle Network	Approx. £1-5m per site	Investment: EVN develops and owns the assets at the site and leases this to the CPO. Assets can be bought back at the end of the contract	20 years	EVN will fund all the CAPEX and legal work. Speed and number of EVCPs will be suggested by EVN and the CPO can negotiate dependent on their needs	Investment where EVN fully develops site/pays for the CAPEX and CPO pays an annual service fee. Less control over sites and tech as EVN generally proposes the sites and EVCP numbers. Some flexibility as site setup can be negotiated with EVN and CPO can bring their own sites.	The CPO would need to have a contract in place with EVN. If using EVN sites there is **no guarantee how many sites are within East Anglia** and another CPO can all bid for these sites. LA or CPO could bring their own sites but **EVN would own 100% of the assets**.

- Zouk generally funds between £20-30m per project. EVN will fund £1-5 million per site. SDCL gives no funding limit but generally funds 100% of the assets, suggesting a similar funding amount per site as EVN (£1-5m).
- **In the past these schemes have only funded private companies so it is likely that investment would need to go to a CPO – but LA could be involved through offering LA sites**

CPO = charge point operator

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There are several UK schemes that support buses and, to some extent, commercial fleets – CPCA has benefited from three of these schemes

Funding entity / fund name	Description	Timeline	Funds available	Eligible technologies	Eligible vehicles
OLEV – Ultra-Low Emission Bus Scheme	Funding for local authorities and bus operators to help purchase Ultra-Low Emission Buses and supporting infrastructure	2018-2021 (Awarded but similar scheme could open in future)	£48m	'Ultra-Low Emission'	
Zenobe – EV Fleets Fund	Financing for local authorities, equipment manufacturers and fleet operators for zero emission vehicles and supporting infrastructure	Launched May 2019	£120m initially, further £150m secured in 2020	Electric	 *Commercial fleets*
DfT - Bus Service Operator Grant (BSOG) Low Carbon Emission Bus (LCEB)	Incentive to ensure that operators running more fuel-efficient vehicles would be entitled to similar financial support as operators running conventional diesel vehicles.	Launched 2015	£0.06/km for LECB, LEB or ULEB running on public routes	'Ultra-Low Emission'	
DEFRA Air Quality Programme Grants	Funding for projects to reduce NO_2 or PM_{10} in areas of exceedance	Closed for 2021 but could run again in future	£9m available in 2021	Any technology reducing pollutant emissions	All
DfT – Transforming Cities Fund (part of the National Productivity Investment Fund)	Funding for new local transport to boost productivity by improving public and sustainable transport connectivity	2018-2022 (Awarded)	£840m in total. CPCA awarded £95m, Norfolk County Council awarded £32m	Not specified	N/A
ZEBRA- Zero Emission Bus Regional Areas scheme	Funding from local transport authorities to introduce zero-emission buses and the infrastructure needed to support them	2021-2022 (Awarded)	Total of £270m, initial CPCA selected as part of the fast track programme and benefit from a share of £71m	Zero Emission Buses and associated infrastructure	

LEB: Low Emission Bus *ULEB: Ultra Low Emission Bus* *LCEB: Low Carbon Emission Bus*

Several nationally-funded trials have been run to support the development of alternative fuel trucks, with an increasing focus on zero emissions vehicles

2012 → 2017 → 2021

Low Emission Truck Trial (2012-2016)

- £11m total funding to support low emissions freight solutions across 13 projects
- No applications for electric vehicles, reflecting the lack of options at the time

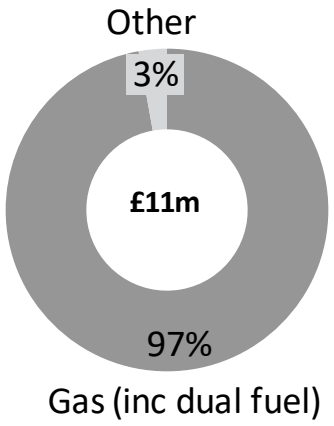
Low Emission Freight and Logistics Trial (LEFT) (2017-2018)

- £20m fund to support low emissions freight solutions across 20 projects
- Included biomethane trucks, dual-fuel hydrogen trucks, and electric vans

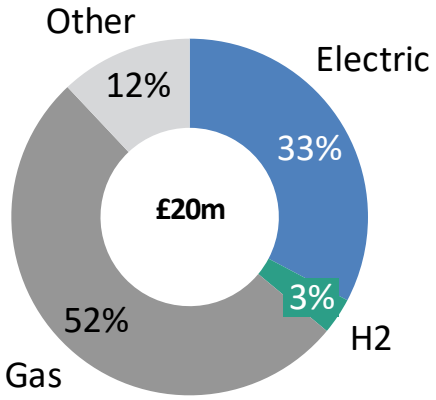
Zero Emission Road Freight Trial (ZERFT)

- £20m fund to support transition to ZE road freight
- Funding strands covering vehicle trials, electric road systems, and supply chain technology
- Further phase expected in 2022 with focus on deployment

Powertrain[1]

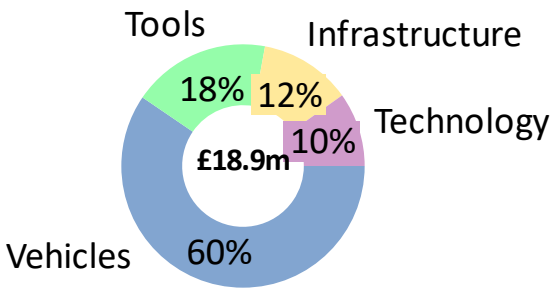


Powertrain[1]

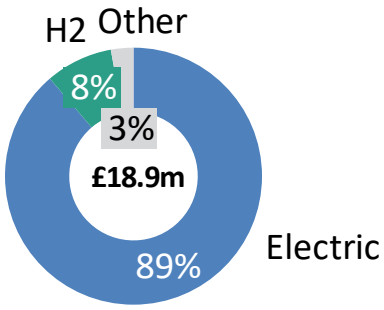


Share of ZERFT funding awarded to date

Project focus



Powertrain[1]



1. "Other" refers to powertrain-independent solutions such as trailers or refrigeration systems

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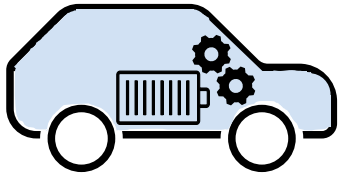
There are several types of plug-in electric vehicles: Battery EVs, Plug in Hybrid EVs and Range-extender EVs

Battery EV (BEV)

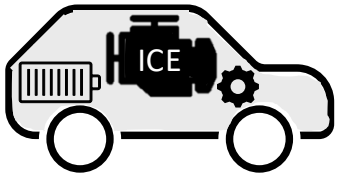


- **No engine**
- Electric motor only, fed by a battery
- Batteries across all plug-in EVs are lithium-ion batteries

- Classify as **"Zero emission"** under government scheme/taxes (as they consider only tailpipe emissions)

- BEV models exist across the range: **cars, vans, trucks and buses**
- BEVs will be the dominant future powertrain for cars, taxis, and probably vans.

Plug in Hybrid EV (PHEV)

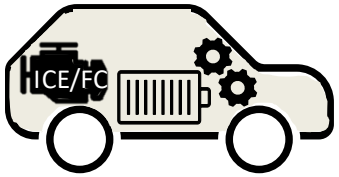


- Has **both an engine** (typically petrol) and a **motor**, and thus both a **tank and a battery**
- Battery typically smaller than on a BEV, giving a limited electric driving range
- *The battery/motor combo supports the engine*

- They are **"Zero Emission Capable" not "Zero Emission"** so benefit from less policy support

- PHEV models exist across a more limited range: **cars and vans**

Range extender EV (RE-EV)



- Has both **engine and a motor**, but the powertrain design is closer to a BEV than a PHEV: the battery is comparable to BEV battery and **the engine is used as a generator**, to refill the battery in the occasions when the driving range is not enough
- *The engine/tank combo supports the motor*

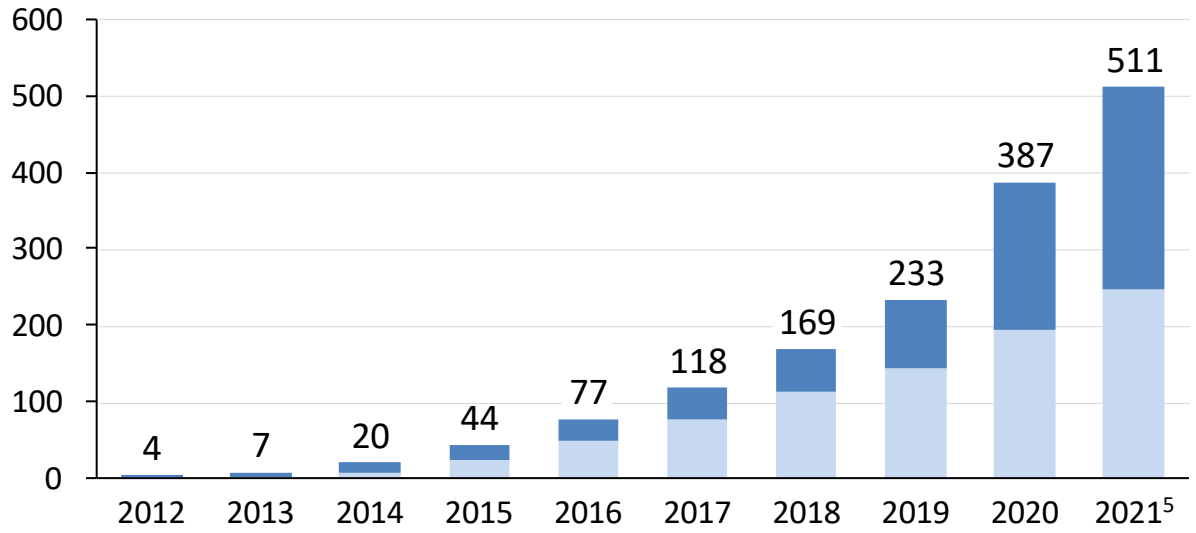
- Some models have a Fuel Cell instead of an engine, thus a hydrogen tank instead of a petrol/diesel engine – in this case the **RE-EV is Zero Emission**

- Not relevant for cars anymore but **relevant for taxis, vans and trucks**

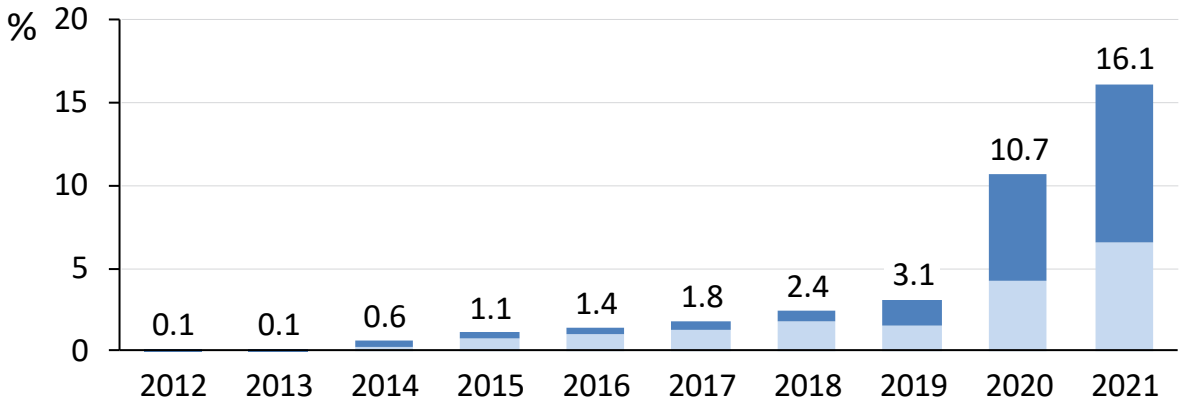
Plug-in electric vehicles have seen significant sales growth in the UK driven by an improved choice, policy support and decreasing prices

BEV
PHEV

Stock of electric cars in UK, thousands[1]



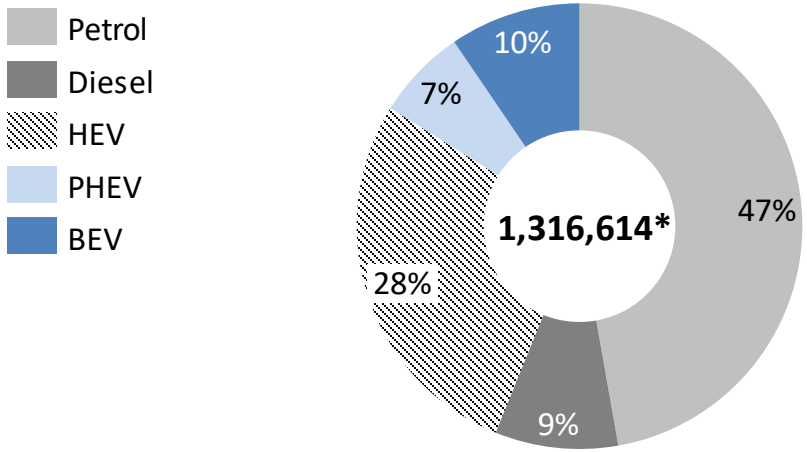
UK Market share of BEV & PHEV (% sales)[2]



Number of models:

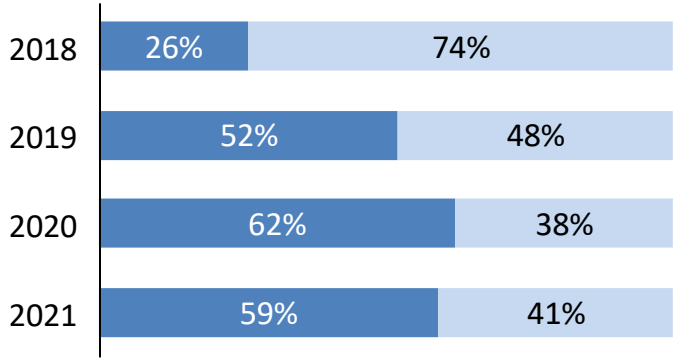
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
BEV[3]	2	5	9	10	13	18	18	17	36	56
PHEV[3]	3	9	13	14	20	22	24	25	51	77[7]

UK Share of new car registrations by fuel type 2021[6]



**Total new registered cars in the UK in Q1-3 of 2021*

Annual percentage split of BEV and PHEV in the UK 2018-21[4]



Top 3 models in 2020[6]

BEV

1. Tesla Model 3
2. Jaguar i-Pace
3. Nissan Leaf

PHEV

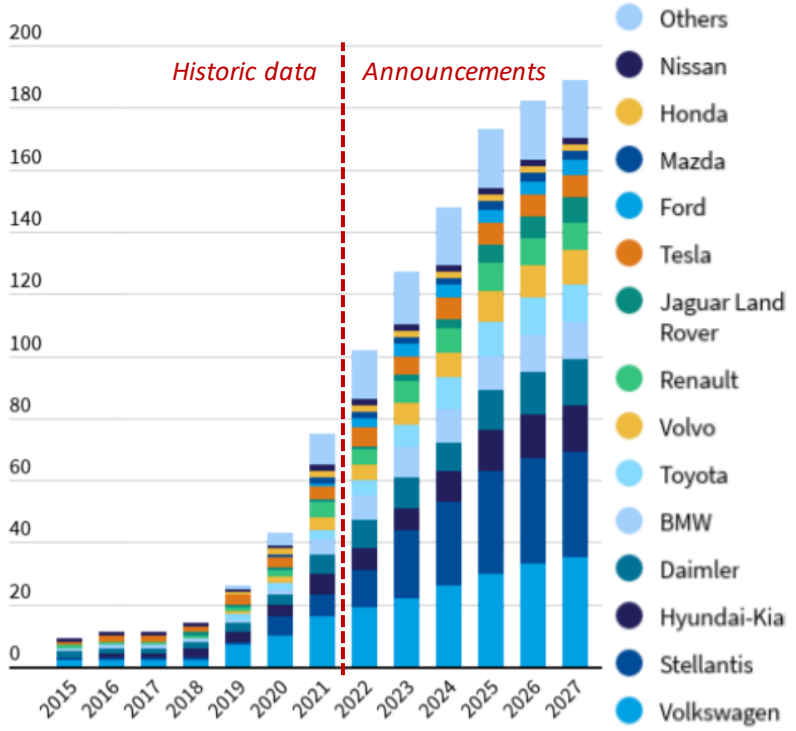
1. BMW 330e
2. Mercedes A250e
3. Volvo XC40 PHEV

Sources: 1) DfT Table Veh0133 2) ACEA (European Automobile Manufacturers Association) 3) EE analysis of EVDatabase.co.uk data; 4) EAFO (European alternative fuels observatory); 5 – Up to Q2 2021 6) Plugged-in: T&E EV Market Watch; 7) Autocar (23/09/2021) *Every PHEV on sale in UK* (accessed Dec 21), Link

There are now a significant number of plug-in models on the market in Europe, and manufacturers representing over 25% of EU sales have announced plans for a fully-electrified line-up by 2030[1]

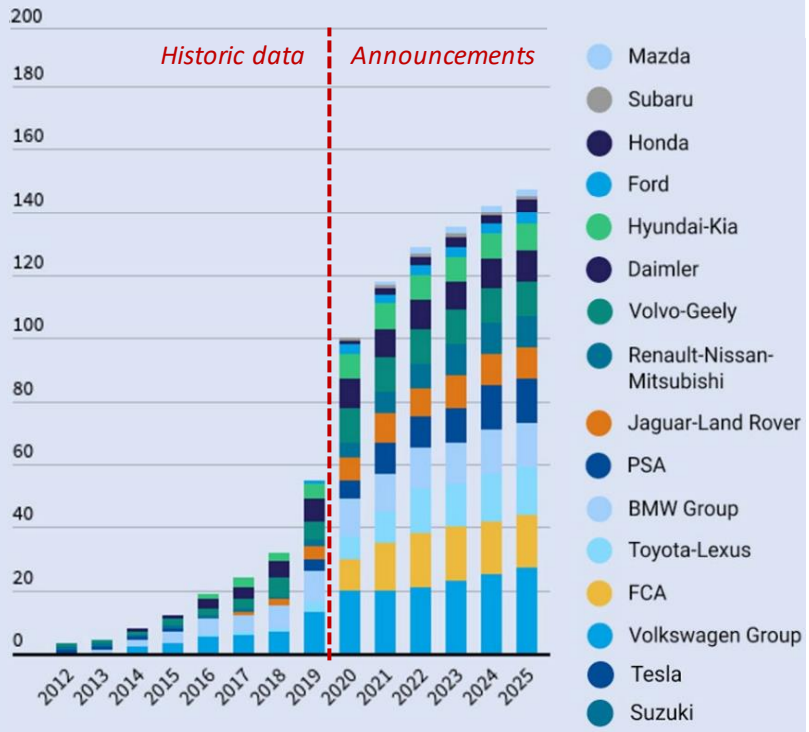
The number of available plug-in car models is expected to grow rapidly

Number of BEV models available across Europe



*Source: Transport & Environment **(2021)**. Promises, but no plans*

Number of PHEV models available across Europe



*Source: Transport & Environment **(2019)** Electric surge: Carmaker's electric car plans across Europe 2019-2025*

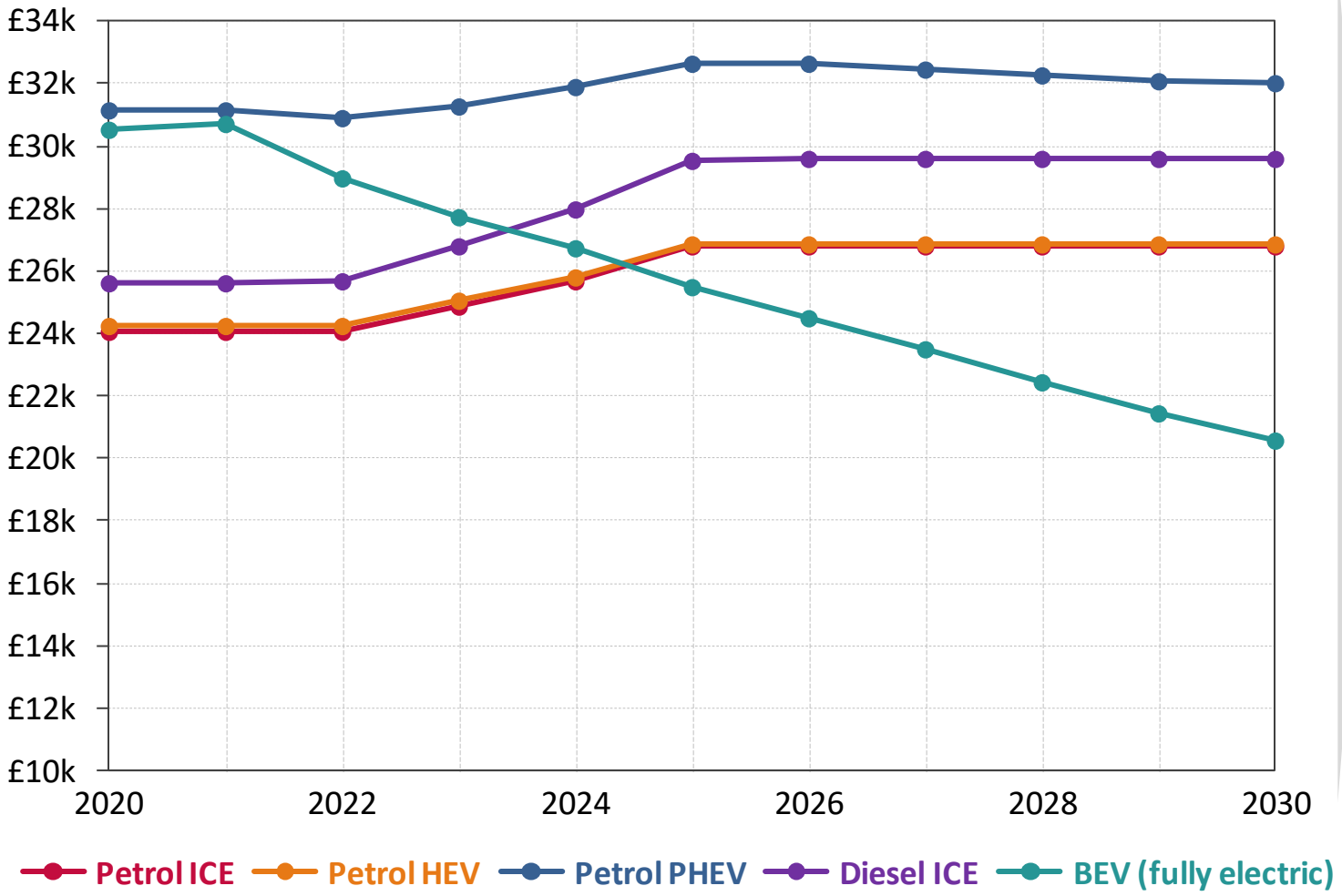
- Manufacturers representing 25% of EU + EFTA sales plan to have a fully-electrified (including hybrids) line-up by 2030[1], with 7% planning a fully electric line-up by 2030[2].
- The number of available BEV passenger car models has increased rapidly over the last two years and is due to continue increasing at pace out to 2027, by which time there is due to be ca. 190 models on the market.
- The number of available PHEV models jumped in 2020 to meet EU CO2 targets and is expected to rise gradually to 2025.
- The improving market offering is one factor driving an increase in EV sales across Europe.
- A number of car OEMs have indicated they will have a fully electrified or even a fully BEV line-up in Europe by 2030.

Number of models available in 2021 was slightly lower than shown due to delays resulting from COVID supply issues. UK market has fewer models than EU due to OEMs not releasing right-hand drive models.

1) PSA, Volvo, Land Rover; 2) Ford, Tesla, Jaguar

Affordable BEVs forecast to be just around the corner in the UK, with dedicated manufacturing platforms leading to cheaper, more mainstream vehicles

Upfront purchase price forecasting: medium cars[1] (excludes VAT, taxes & grants)

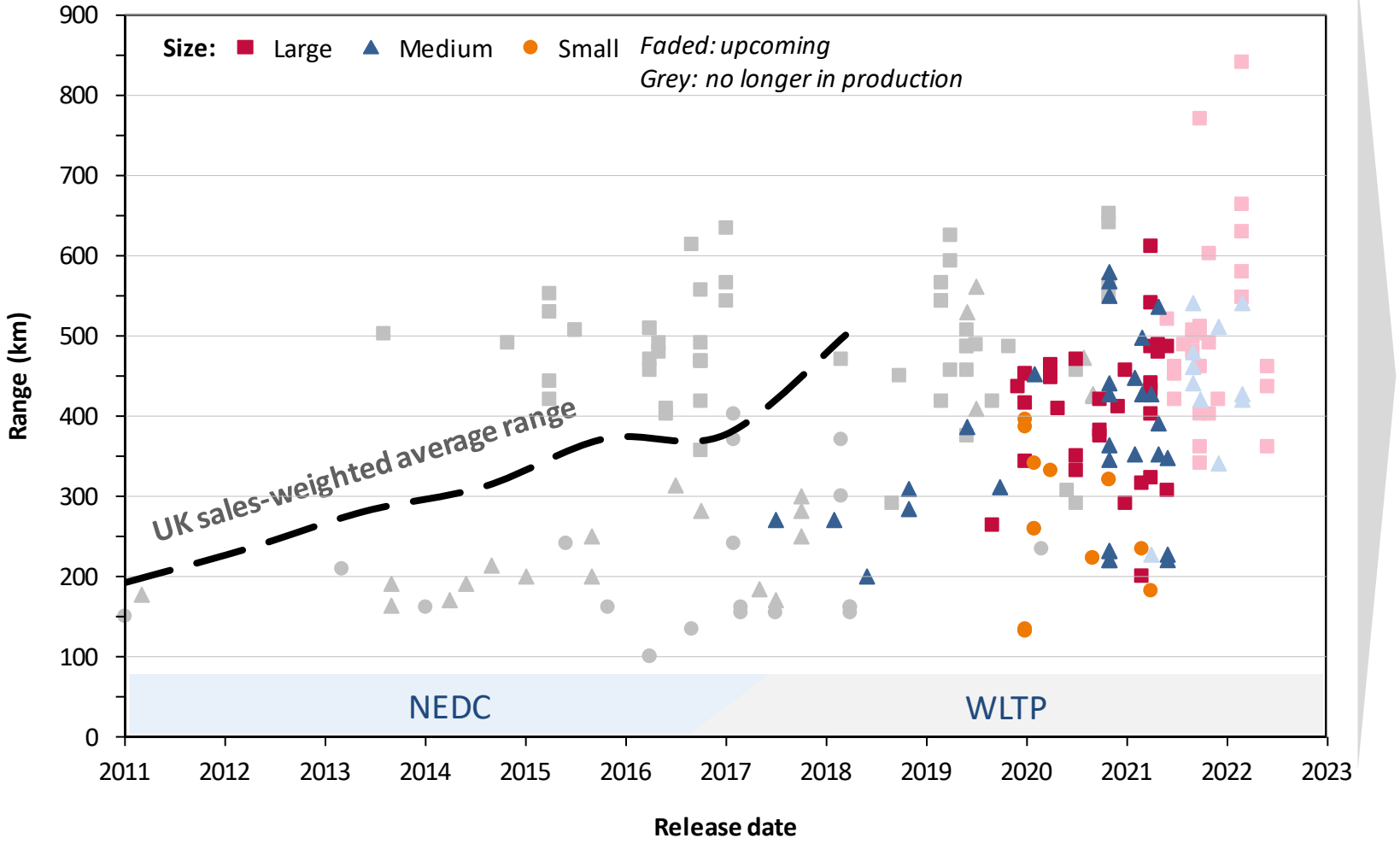


- An electric car currently costs more today but BEVs are forecast to be the **cheapest powertrain by 2025 for medium cars**, and will become **cheapest for all size segments by 2027**
- Costs for ICE vehicles are forecast to increase between 2022-25 due to meeting Euro 7 tailpipe emissions requirements
- On a **lifetime Total Cost of Ownership** (TCO) basis medium **BEVs bought new today are the cheapest powertrain**. BEVs also have lower costs than ICEs for new car buyers (4-year ownership) that have a high mileage (ca. >20,000km)
- **Emerging subscription model EV-specific financing schemes**, such as Onto and elmo, which structure pricing on a TCO basis, will help make **leasing BEVs cheaper than ICEs**
- BEVs provide substantial savings for consumers that **often go into the London congestion zone**, with **additional costs for ICEs estimated to be ca £4,500 per year** (300 days in zone)

1 – Bloomberg New Energy Finance for Transport and Environment (2021), Hitting the EV Inflection Point. Increase to BEV price in 2021 is due to models with larger batteries entering the market; ICE = Internal Combustion Engine, BEV = Battery Electric Vehicle, PHEV = Plug-in Hybrid Electric Vehicle, HEV = Hybrid Electric Vehicle (Full Hybrid), TCO = Total Cost of Ownership

Driving range capability has improved significantly since the early generation BEVs, and looks set to continue to improve as battery prices fall and vehicle efficiencies improve

Electric driving range of BEVs offered on the UK market, 2010 – 2023



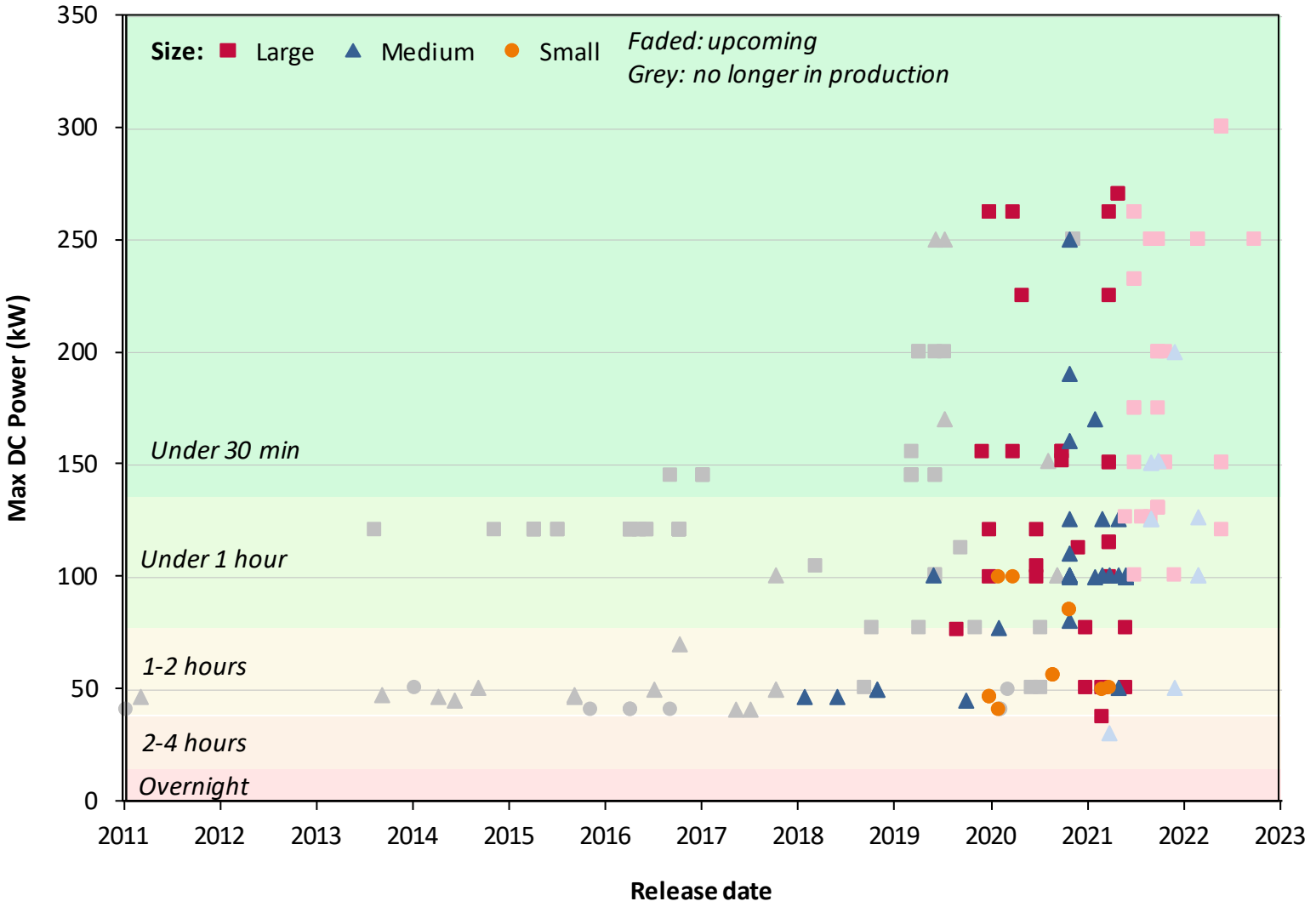
- BEV driving range continues to improve, with almost 13 models expected to have a range of 500 km or above by 2022.
- Range is still perceived as a barrier to EV adoption, so we can expect higher ranges to result in more sales.
- The average range of vehicles sold in the UK since 2010 has increased, reflecting consumer preference towards higher range vehicles.
- For EV drivers with access to home charging, a higher range means a lower reliance on public charging, so the trends shown above will directly impact the future utilisation / usage patterns of public EVCPs, as well as the number of chargers needed.
- The variance in BEV range is also increasing - some BEV have a range of over 600km while others have approximately 150km

Note: NEDC and WLTP are the official emission test procedures used in Europe (past and present)

Graph Source: EVDatabase.uk, SMMT, and EE market research NEDC: New European Driving Cycle WLTP:World harmonized Light-duty vehicles Test Procedure

The maximum power that BEVs can charge at is continuing to increase with plans for some models to reach 300kW in 2023

DC charging power of BEVs offered on the UK market, 2011 – 2023



BEVs can charge from two kinds of charge points:

- **AC** – found at home and slow public charge points. Takes several hours to charge.
- **DC** – found often at forecourts or motorway services. Newest charge points and cars can bring charging times down under 30min.

All BEVs can charge at 7kW AC, taking 3-10 hours to charge, but the max power a BEV can accept on DC varies between cars.

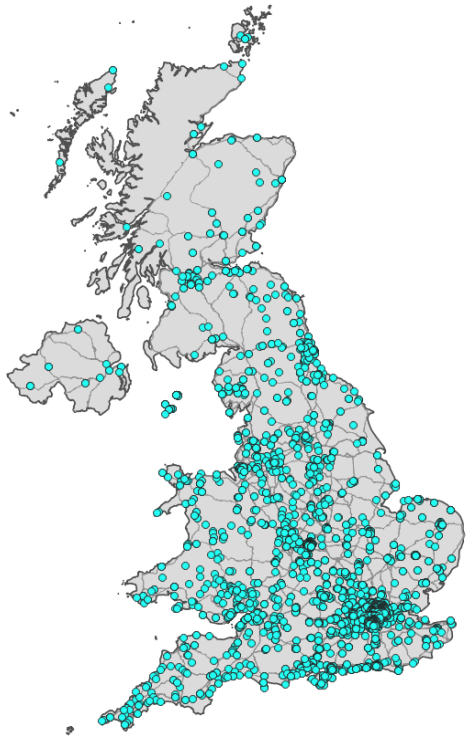
The higher the power (kW) the car can accept, the faster it can charge on a DC charge point.

50kW has historically been the fastest any non-Tesla car could charge, taking 1-2 hours to charge. However, within the past few years faster charge points have become more common, with **some cars now capable of charging over at 200kW, bringing charging times down to <30min**.

Graph Source: EVDatabase.uk, SMMT, and EE market research, June 21. Time to charge shown on graph indicative only; dependent on car's battery size, battery state-of-charge, environmental conditions etc.

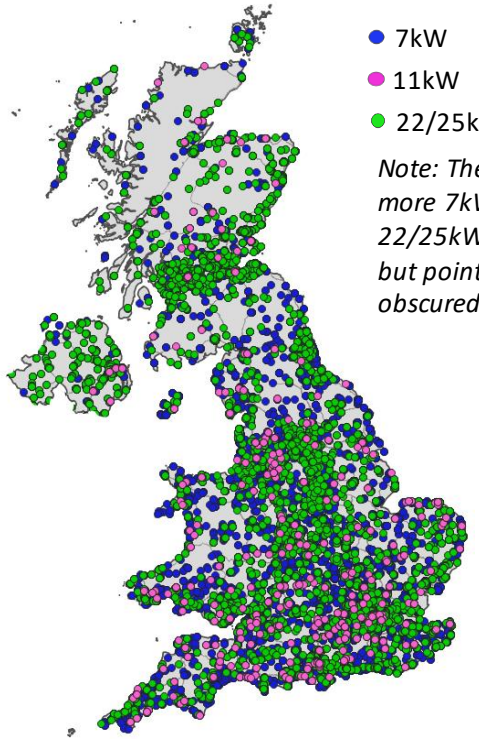
A strong public charge point infrastructure base has grown in the UK, within over 47,000 public charge points installed at over 17,000 locations

Slow charge points
3-5 kW AC



Mostly in public car parks and on-street

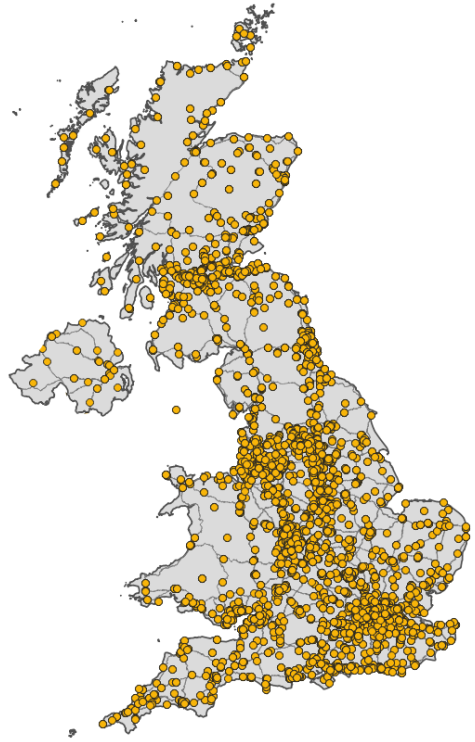
Fast charge points
7-25 kW AC



Note: There are more 7kW than 22/25kW EVCPs but points are obscured

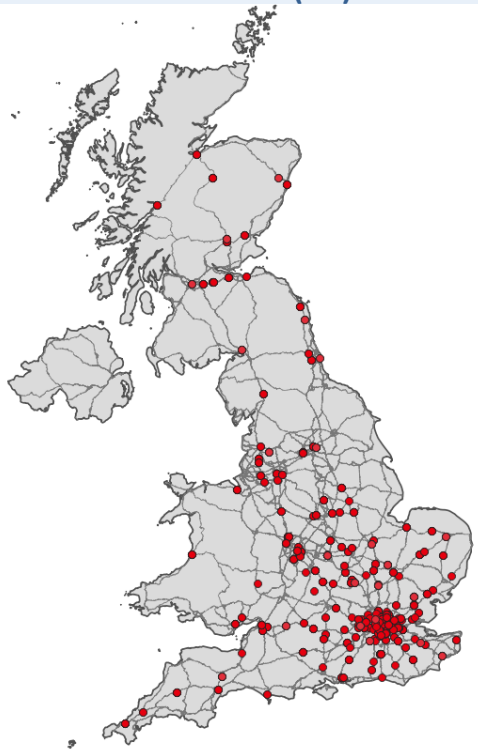
Mostly in public car parks, on-street and highway stations

Rapid charge points
50-120 kW DC



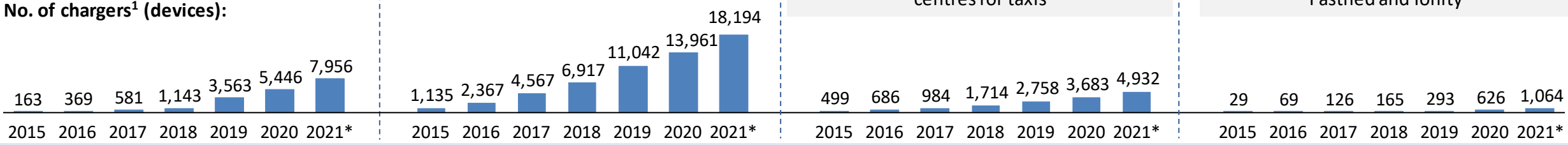
Varied locations, including motorway service stations, forecourts, car parks, city centres for taxis

Ultra rapid charge points
150-350 kW (DC)



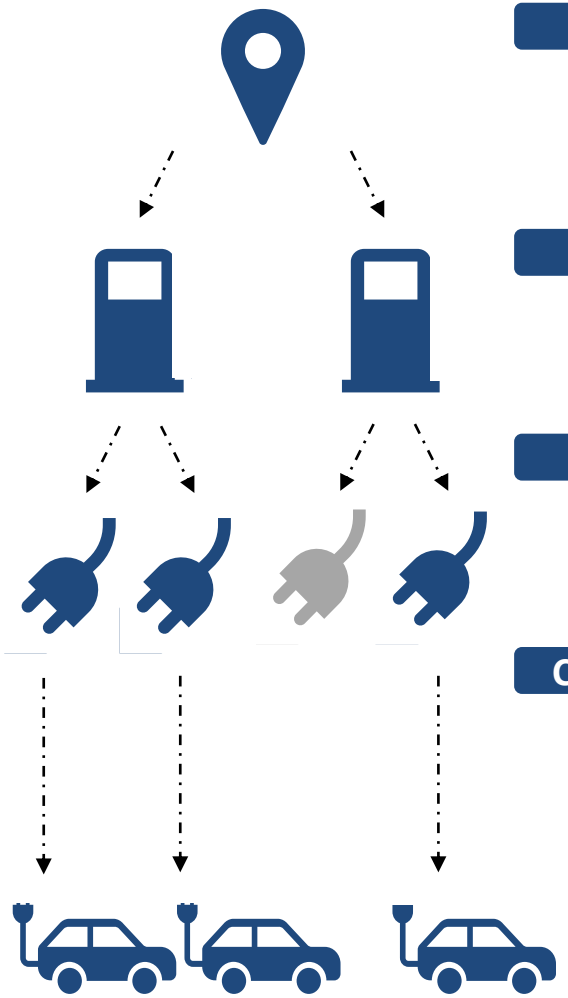
Includes Tesla Superchargers, mostly at motorway services, and hubs such as Fastned and Ionity

No. of chargers[1] (devices):



Data as of Dec 2021, based on Zapmap & OpenChargeMap. *Data up to 1st Dec 2021. 1- Note some chargers had no deployment date, so slight discrepancy between numbers on maps and data in pie charts (on following slide)

Definitions relating to electric vehicle charging – *What is the difference between a charger, connector and charge point?*



Location/ Site

- EV chargers are deployed at high demand locations to ensure the charge point has a high utilisation, sites are generally at MSA's, in car parks or on-street. One **site** may have a single **EV Charger** or multiple **EV Chargers** in a 'hub'. Some hubs have more than 20 EV Chargers (the average in East Anglia is 2 chargers per location).

Charger

- An **EV charger** is the standalone charging device (often a tall box) – each charger may have multiple connectors/ cables attached to it. The charger contains all the hardware including metering system, card reader (where applicable) and is connected to the power supply.

Connector

- An **EV connector** is a individual cable connected to an EV charger which plug into a vehicle
- One charger can have multiple connectors (up to 3), these can have different 'plug types' to allow different EVs to charge (e.g older vehicles have a different plug type) or the same plug type to allow multiple vehicles to charge simultaneously.

Charge Point (EVCP)

- **Electric vehicle charge points (EVCP) are individual charging connectors / plugs attached to an EV charger, which can charge different EVs simultaneously**
- Some chargers (commonly 7 and 22kW chargers) have two connectors of the same type, splitting the power and allowing two cars to charge from a single charger *– in this case these chargers would correspond to two EVCPs*
- In other cases (commonly 50kW chargers) one charge has multiple connectors types but only a single vehicle can charge *– in this case these chargers would correspond to one EVCP*
- There are also cases where the number of cars that can charge simultaneously is limited by the number of parking spaces at a site – *this may be a business choice or due to space constrains but reduces the number of EVCPs*
- The number of EVs that can be charged simultaneously in any given region is generally between the number of chargers and the number of connectors in that region

A range of business models can be used to deploy fast & rapid charging – we have provided a summary of the typical cost breakdowns

Uses funding examples shown in the previous section

Concession models

	CAPEX			OPEX				
Fast & rapid charging business models	Hardware	Install	Ground & Grid	Back office	Electricity	Maintenance	Revenue	Contract length
Own & Operate[1]	Council	Council	Council	Council	Council	Council	All to Council	-
External Operator	Council	Council	Council	Supplier	Council	Supplier	Majority to Council	-
Private sector match funding	Typically split Council (or Gov) 75% and supplier 25%			Supplier	Supplier	Supplier	Varies	Varies
Concession: Bham	Council	Supplier	Supplier	Supplier	Supplier	Supplier	Share to Council	ca. 5-10 years
Concession: Notts	Supplier	Council	Council	Supplier	Supplier	Supplier	Share to Council + significant min. payment	
Concession: London	Supplier	Supplier	TfL or LA	Supplier	Supplier	Supplier	Share to TfL or Council	
Lease model[2] **(rapid)**	Supplier	Supplier	Supplier	Supplier	Supplier	Supplier	Share to Council	15-25 years

- It should be noted that it is assumed **Council cost components would typically come from national funding schemes** (e.g. OZEV)
- Concession contracts appear to be increasingly common for LA rapid charging installations - these vary in terms of the share of upfront costs covered by the supplier, but are typically used where suppliers are confident of profitability and deployment scale
- The concession arrangements shown highlight the different approaches that have been negotiated by Councils

1. LA would invest in hardware and software support
2. Model can be flexible, e.g. LA retain ownership of ground and grid works and electricity (everything behind the EVCP)

Fuel cell cars in Europe: vehicles have been largely introduced by two OEMs and major FCH JU funded projects

Toyota Mirai		The second generation Mirai (shown left) was released in 2021, with an improved range (400 miles), efficiency and updated design to the first generation, with prices from £50k. A number of first generation Mirai cars were leased to customers in the UK from 2015/16, with typical lease periods were of four years.
Hyundai NEXO		Hyundai's second fuel cell car has a >400 mile range and has been available since 2019 in Europe. in September 2021 Hyundai Motor Group launched its Hydrogen Vision 2040. Part of the company's strategy is to offer fuel cell versions of all its commercial vehicle models by 2028. The precise timing of when vehicles will be available to UK customers is currently uncertain.
Honda Clarity		Honda has only deployed a small number of Clarity FCEV in Europe, instead so far focusing its fuel cell vehicle deployments on the Californian and Japanese markets.
Mercedes GLC F-Cell		Daimler has released limited volumes of the GLC F-Cell in Germany, however, has yet to announce plans for wider deployment in Germany or elsewhere in Europe.
BMW X5		BMW is planning to present hydrogen fuel cell electric BMW X5 in 2022, which will be based on BMW I HYDROGEN NEXT (shown left). BMW is developing fuel cell systems with Toyota.
AUDI h-tron		Audi is / was developing h-tron and considering offering limited volume lease trial to customers in 2021. However, in late 2020 it was reported that Audi is discontinuing its development of hydrogen-powered cars.
JLR		JLR is developing fuel cell technology for SUV range, which could be available from the mid-2020s. First prototype was due to begin testing in 2021.
INEOS Grenadier		INEOS is developing an off-road vehicle (Grenadier) initially petrol/ diesel engines, although with plans to use hydrogen fuel cell (potentially next generation).
Riversimple Rasa		The Rasa is a lightweight two-seater car (c. 600 kg), with a carbon fibre chassis, with capacity for 1.5 kg hydrogen 350 bar tank. The Rasa includes an 8.5 kW fuel cell, motor with 55 kW peak power output and range of c.300 miles.

Available in the UK

There has been very limited availability of hydrogen-fuelled vans in Europe to date, but several manufacturers have announced plans to begin selling FC light commercial vehicles

- Deployment of fuel cell vans has been very limited to date. In Europe, vehicles introduced through pre-commercial demonstration projects include the Renault Kangoo (conversions of the battery electric Kangoo by Symbio FCell) and conversions of diesel vehicles to dual fuel by UK-based ULEMCo.

- There is growing demand from customers for a fuel cell van offering, which is looking to be addressed through initiatives such as the Aggregated Hydrogen Freight Consortium (AHFC) project (more details on the following slide).

- Vehicle OEMs have been slow to address this market, partly due to the low cost (and margin) of diesel vans and unwillingness from customers to pay a premium. However, several OEMs have announced plans to enter the market in Europe, including:
    - Stellantis (a company formed by the merger of Groupe PSA (parent company of Peugeot and Citroen, which also owns Vauxhall / Opel) and Fiat Chrysler Automobiles (FCA)). Stellantis has announced plans to introduce plug-in hybrid fuel cell vans under the Citroen, Opel / Vauxhall, and Peugeot brands. Initial markets are Germany and France, with vehicles on sale in the UK from 2023.

    - Renault recently announced the HYVIA joint venture with Plug Power, which planned to offer three fuel cell Master (large) vans from late 2021.

    - New entrants such as Quantron (formed in 2019). This commercial vehicle conversion company has been developing a fuel cell drive system for vehicles >3.5 tonnes. They have so far developed the FCEV based on the Iveco Daily, with ranges from 300–500 km, depending on the H_2 tank size.

Source: public statements and bilateral discussions with vehicle developers

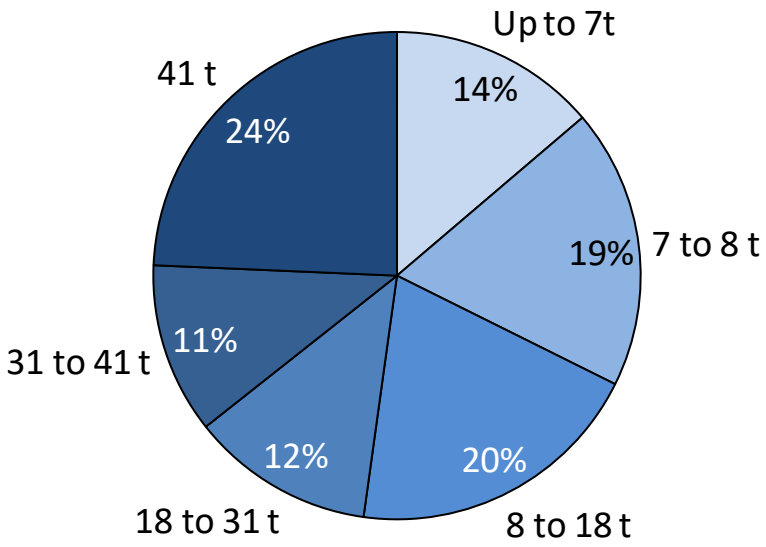
Within HGVs, the primary market for gas vehicles is in the heaviest vehicle segments with the most demanding duty cycles

Vehicle market

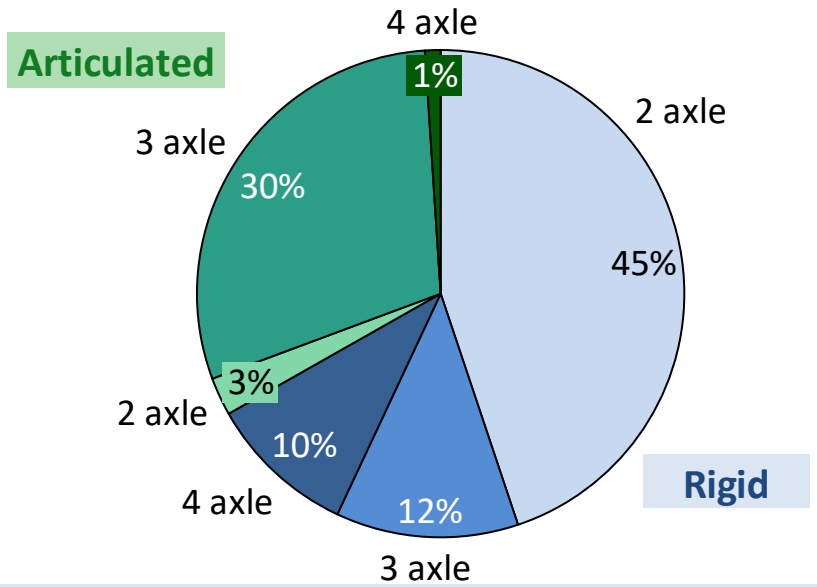
- The primary market for gas-powered HGVs is in sectors for which there are not currently suitable high range zero emission alternatives.
  - This includes **all vehicles over 18 tonnes** gross vehicle weight (GVW)
  - Specifically this covers municipal refuse collection vehicles (RCVs), construction vehicles, HGVs for regional distribution and HGVs for long-haul goods delivery[1]
  - Vehicles falling into these categories account for **48% of the current UK HGV stock**

Current UK HGV market[2]

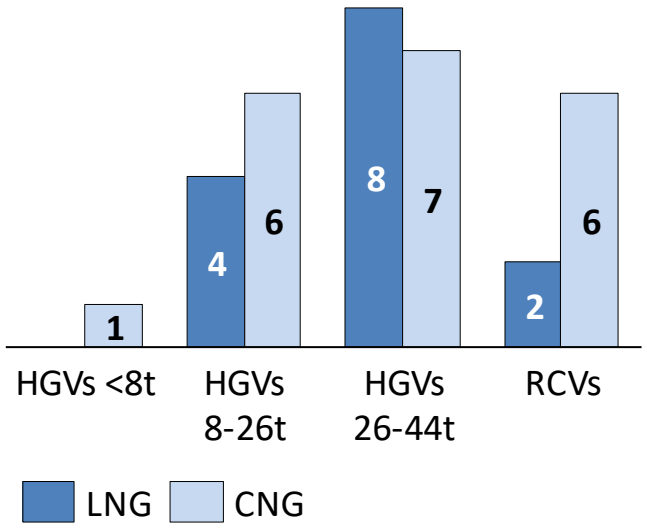
UK HGV fleet by gross vehicle weight



UK HGV fleet by axle type



Available gas HGV models by GVW



1. Estimated distribution: ca. 20% construction, 50% long haul, 20% distribution, 8% municipal 2. Source: DfT vehicle statistics, 2020

RCV: Refuse Collection Vehicle

Gas vehicle supply is focused on heavy trucks up to 44t tractors with 460 HP

		Models	Fuel	Engine Options (HP)	Typical Range (km)
Heavy Goods Vehicles		• Iveco Daily NP	CNG	136	300
		• Iveco S-Way NP Rigid • Volvo FE • Scania L-Series	CNG/LNG CNG CNG/LNG	330/460 320 280/340	400(CNG) 1,100(LNG) 400 500
		• Iveco S-Way NP Artic • Scania P/G/R-Series • Volvo FM* • Volvo FH*	CNG/LNG CNG/LNG LNG LNG	330/400/460 280/340/410 420/460 420/460	500(CNG) 1,600(LNG) 500(CNG) 1,000(LNG) 1,000 1,000
Refuse Collection Vehicles		• Scania P • Iveco S-Way NP Rigid • Volvo FE	CNG/LNG CNG CNG	280/340 330/460 320	450 400 400

*Compression ignition engine - requires a small amount of diesel

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- Opportunities to support uptake of AFVs
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  - Technical assumptions

Review of Local Plans in Norfolk

We have reviewed all available transport plans published by county councils and local authorities in Norfolk

Council	Active travel	Public transport	Freight	Net Zero date	EV charging
Norfolk County Council	Dedicated cycling lanes in urban areas; prioritising funding for cycle and walking route upkeep	Dedicated bus lanes; improvements of specific rail links e.g. Kings Lynn to Cambridge		Net zero 2030	Have proposed a county wide EV strategy which includes specific EVCP deployment targets
Breckland	Increase proportion of journeys made by foot and cycle	Improve connectivity of bus network		Net zero 2035	
Broadland, Norwich and South Norfolk	Significant improvements to walking & cycling options	'Bus Rapid Transit' on key routes, improved rail to London& Cambridge	More use of rail for freight	Norwich 2045, Broadland 2050, South Norfolk TBC	
Great Yarmouth	Encourage walking and cycling for shorter trips	Improve bus and rail offering; improvements to bus stations	Increased leverage of port for freight as an intermodal interchange		
King's Lynn and West Norfolk	Encourage walking and cycling instead of private car	Improve bus services in targeted areas	Increase use of rail and port for freight movement	Net zero 2050	
North Norfolk	Facilitate increased walking and cycling	Improved access to key services by PT	More use of rail and water for freight	Net zero 2030	

= specific targets backed with actions = unspecific targets/no supporting actions = no targets or actions

Review of Local Plans in Cambridgeshire and Peterborough

We have reviewed all available transport plans published by county councils and local authorities

Council	Active travel	Public transport	Freight	Net Zero date	EV charging
Cambridgeshire County Council	Targeted increase in walking and cycling routes (specified routes)	Improving links between rural towns and large urban centres	Shift towards rail freight; re-routing of road freight to minimise traffic	2050	Supporting EVCP role out but with unquantified targets
Peterborough City Council	Use of AT to alleviate City Centre and linkage with villages	Improve PT; new developments must prioritise bus access		2030	Encourage incorporation of charge points at car parks
Cambridge City Council	Targeted walking and cycling improvements	Targeted bus and rail infrastructure improvements		2050	EVCP action set out in CCC's EV and infrastructure strategy
East Cambridgeshire District Council	Segregated routes for walking and cycling	Improvement of specific services	Use of Ely rail lines for freight	2040	Targeting public and private car parks
Fenland District Council	Integrated walking and cycling routes	Improving bus and rail services	Shift freight to rail and waterways	*Not declared*	
Huntingdonshire District Council	Segregated routes for walking and cycling	Promote public transport		2040 (TBC)	Recognise need for 1 EVCP per 20 parking spaces
South Cambridgeshire District Council	New developments must be integrable with active travel	New developments must be integrable with active travel	Promote the use of rail for freight movement	2050	Encourage incorporation of CPs at car parks

= specific targets backed with actions = unspecific targets/no supporting actions = no targets or actions

Review of Local Plans in Suffolk

We have reviewed all available transport plans published by county councils and local authorities in Suffolk

Council	Active travel	Public transport	Freight	Net Zero date	EV charging
Suffolk County Council	Targeted improvements in walking and cycling infrastructure	Targeted improvements in bus and rail infrastructure	Expansion of rail freight capacity	Net zero 2030	Plug in Suffolk project to create charging network throughout Suffolk
Babergh	Creation of specific new cycling routes	Expansion of P&R facilities and station car parks		Net zero 2030	
East Suffolk	Improved walking and cycling routes	Improve bus and rail capacity; new bus quality partnership	Increase rail freight capacity	Net zero 2030	Support EV uptake and necessary infrastructure
Ipswich	Improved cycling and waling routes	Enhanced PT system, including increased rail capacity	Increased rail capacity for freight	Net zero 2030	
Mid Suffolk				Net zero 2030	
West Suffolk	Improved cycling and waling routes	Improve PT	Improve rail routes for freight usage	Net zero 2030	

= specific targets backed with actions

= unspecific targets/no supporting actions

= no targets or actions

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Intro on emissions from electricity/H2 production

Hydrocarbon fuels

- For **petrol** and **diesel**, the BEIS conversion factors used for emissions reporting, including well-to-tank emissions, have been used
- An adjustment for the adoption of E10 petrol has been made
- **RNG** emissions factors are based on Element Energy Well-to-Wheel emissions modelling for private client (2018), assuming production shifts from 100% anaerobic digestion in 2018 to 25% gasification in 2032, and 77% of CNG is dispensed from stations connected to the LTS in 2032

Electricity

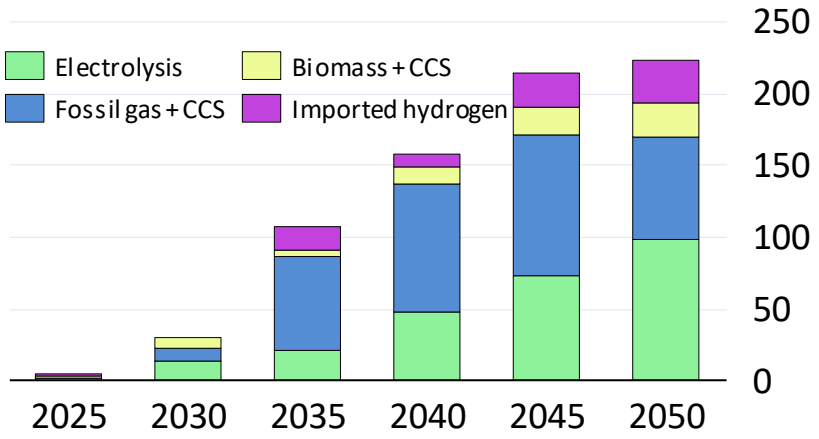
- Emissions factors for electricity are taken from the latest BEIS projections
- Represents the CO2e emissions per unit of final energy demand, including losses during generation and transmission

Hydrogen

- Emissions factor calculated based on an assumed mix of green and blue hydrogen
- **Short term** - All sources used in 2030 when securing supply is still a major challenge
- **Medium term** - The role of blue hydrogen grows as it is able to scale up to meet increased demand. Green hydrogen production grows as well but renewables rollout cannot keep up with demand
- **Long term** – Role of blue hydrogen wanes as the residual emissions are too high for the net zero target

Fuel	Units	Emissions factor			
		2025	2030	2040	2050
Petrol	$kgCO_2e$/litre	2.7	2.7	2.7	2.7
Diesel	$kgCO_2e$/litre	3.2	3.2	3.2	3.2
RNG	$kgCO_2e$/kg	0.5	0.6	0.6	0.6
Electricity	$kgCO_2e$/kWh	0.12	0.05	0.02	0.01
Hydrogen	$kgCO_2e$/kg	5.0	2.5	1.7	1.6

Mix of different hydrogen production pathways assumed (forecast UK hydrogen supply, TWh)[1]



Notes: 1 – CCC analysis. This only includes H_2 produced in the UK, or imports of H_2.

Key assumptions in additional scenarios

Passenger

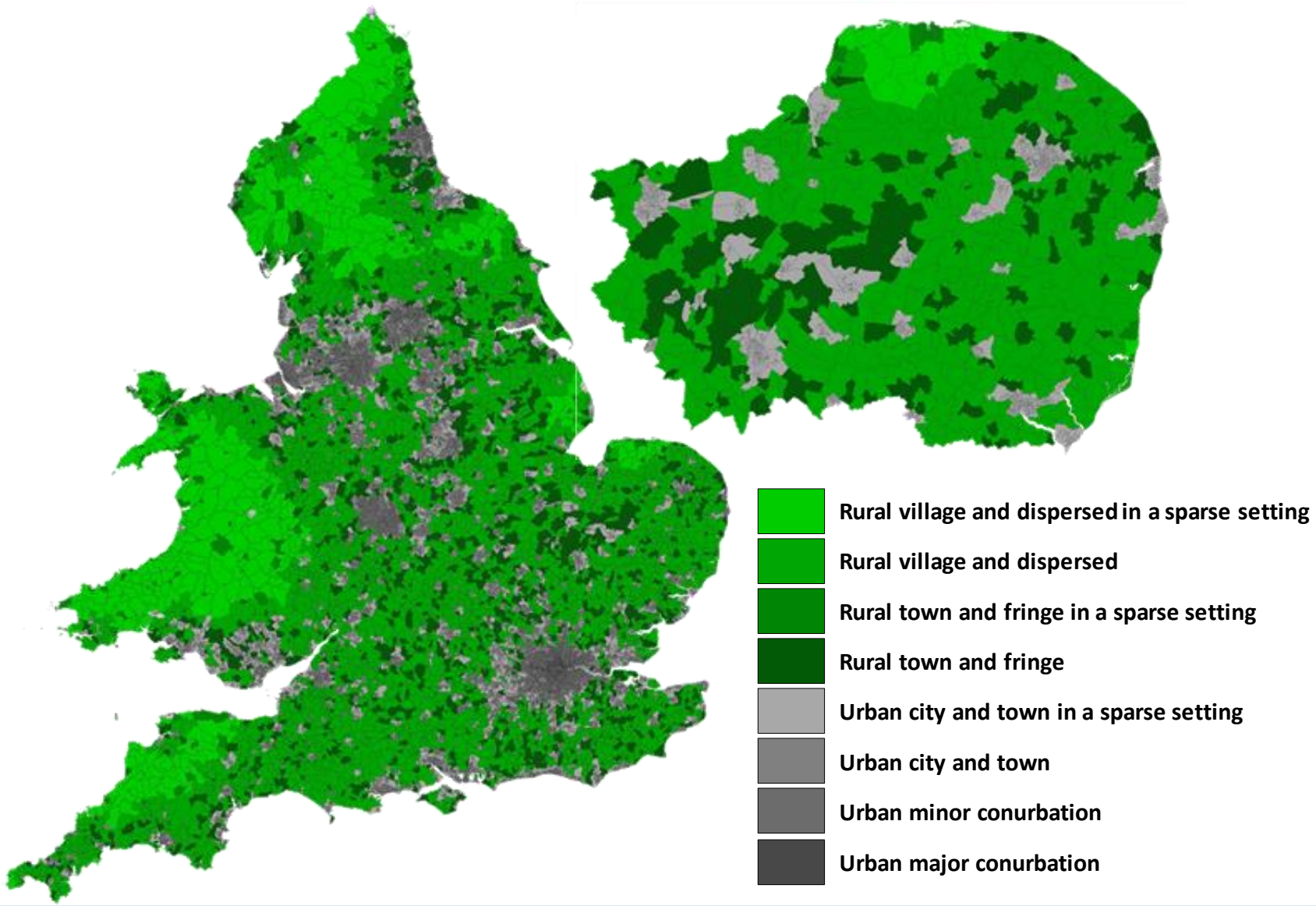
Assumption	Scenarios		
	Urban focus	Rural urban focus	Max ambition
A 20% reduction in car kilometres by 2030 is achieved, with a contribution from urban and rural areas of 15% and 5% respectively. The demand is re-distributed across active travel and public transport.	15% urban contribution only	✓	✓
Increases in average car occupancy by 1% in rural areas and 2% in urban areas, as a result of increased car sharing for commuting journeys driven by a workplace parking levy.	Urban increase only	✓	✓
Increases in average bus occupancy by 100% in rural areas and 50% in urban areas, as a result of increases in public transport demand.	Urban increase only	✓	✓
Total travel demand remains at current levels - average trip distances to amenities and services become shorter, offsetting the increasing population.	×	×	✓

Freight

Assumption	Scenarios		
	Urban focus	Rural urban focus	Max ambition
10% reduction in HGV kilometres and 5% reduction in van kilometres due to increased freight consolidation and efficiency, meaning more goods can be moved in fewer journeys.	×	×	✓
30% of HGV trips over 300km are shifted onto rail (which would have an impact of 2% of all HGV journeys in East Anglia being shifted to rail).	Urban areas only	✓	✓
Reduction in last mile van freight due to a shift towards cargo bikes. A shift of 6% in urban areas and 1% in rural areas.	Urban shift only	✓	✓

Note: the ticks and crosses indicate whether that assumption applies in the given scenario

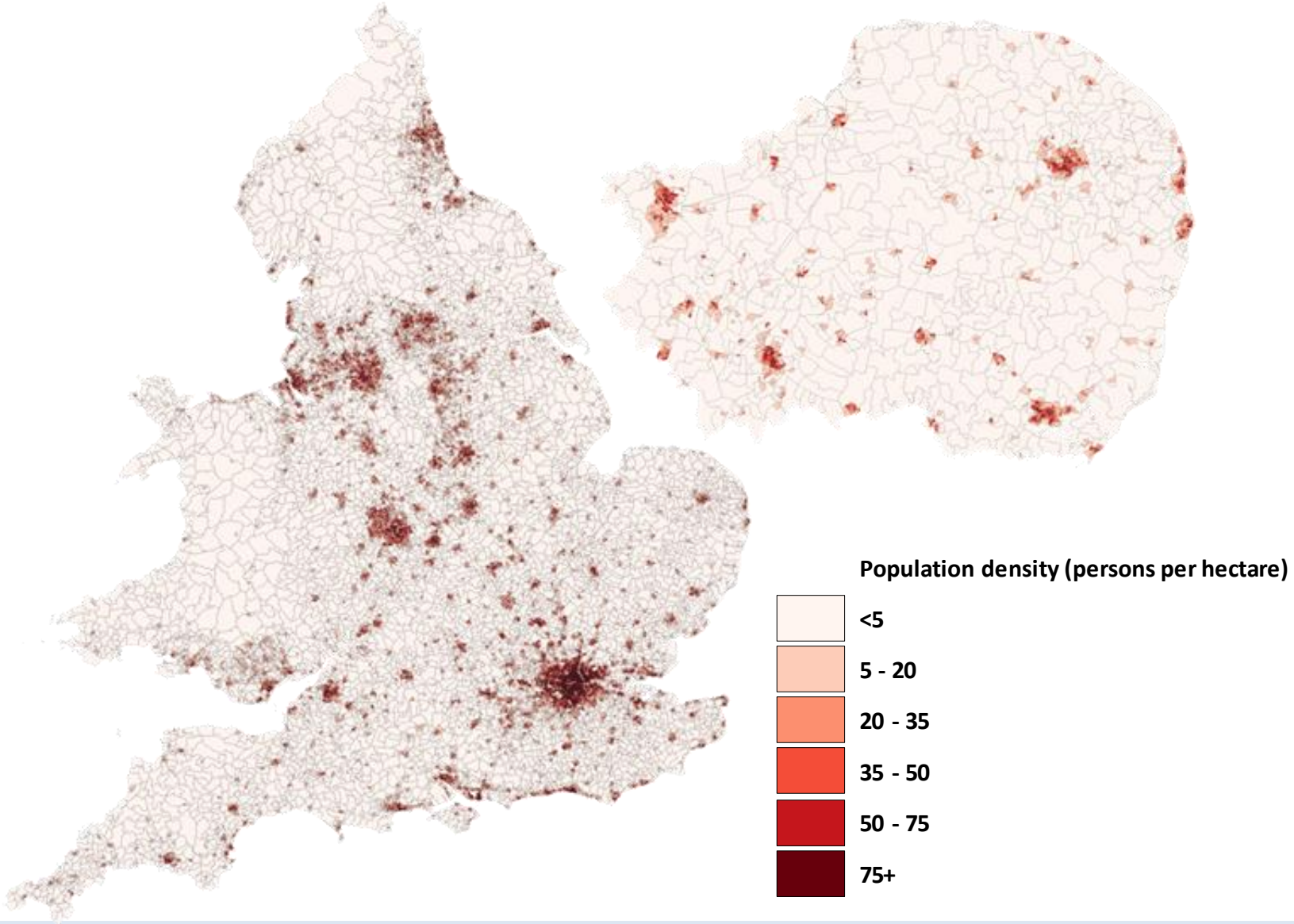
The ONS 2-fold rural urban classification was used to distinguish between rural and urban areas



- The assumptions used in the additional scenarios for behavioural change are different for rural and urban areas
- The ONS 2-fold classification was used to distinguish between rural and urban areas
- The map to the left gives the ONS 10-fold LSOA classification (note only 8 categories shown) – the 2-fold rural urban classification is the first word (i.e. 'rural' or 'urban') in each of these categories

Sources: 1 – Rural urban classification, Office for National Statistics.

ONS population data was used in relation to population statistics



Where relevant, the analysis in the technical evidence report has used:

- Population values per the ONS LSOA mid-2020 population estimate
- Area measurement values per the ONS Standard Area Measurements for 2011 Census

Utilisation and Charging Power Assumptions: Based on equations developed by ICCT, utilisation rate of chargers is assumed to increase with EV uptake:

Charger type	Utilisation Assumptions based on equations developed by the ICCT[1]:
Non-rapid (public residential and destination) charger utilisation	• Increases from 4.3 – 4.7 hr/day in 2025 • to 5.9 – 6.4 hr/ day in 2050
Rapid charger utilisation	• Increases from 2.9 – 3.3 hr/ day in 2025 • to 4.4 – 4.7 hrs/ day in 2050
Workplace charger utilisation	• Assumed to be constant at 4.8 hours / day (averaged over weekdays and weekends)

- Considering a feasible range of utilisation scenarios in previous work gave a 2-fold increase in charger utilisation from the highest to the lowest utilisation scenario in 2030, from 3.6 – 7.2 hours / day. These figures represent the expected range of utilisation rates for a single charge point, but the overall utilisation for the entire charging network is likely to be between these two values.

Charger type	Charging Power assumptions
Non-rapid (public residential and destination) charger	• Assumed to provide 8 kW to BEVs and 3.5 kW to PHEVs for all years
Rapid charger	• Average rapid charging rates are assumed to increase from 35 kW currently to 150 kW in 2050

1 - Charger power and utilisation are based on ICCT methodology. Link to ICCT report