National Grid ESO

The role of EV flexibility in a net zero electricity system

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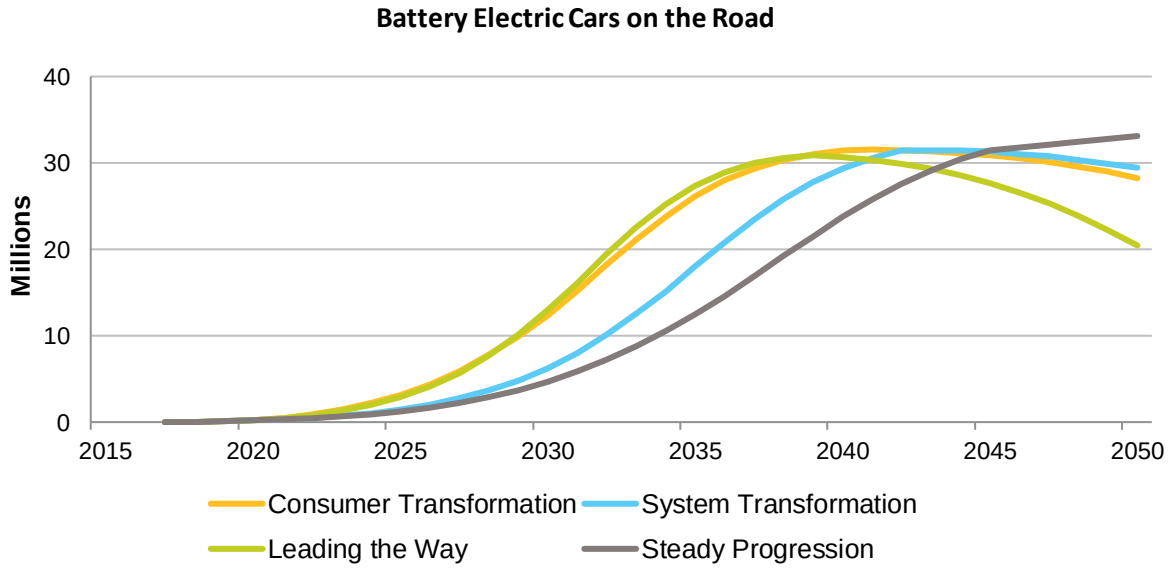
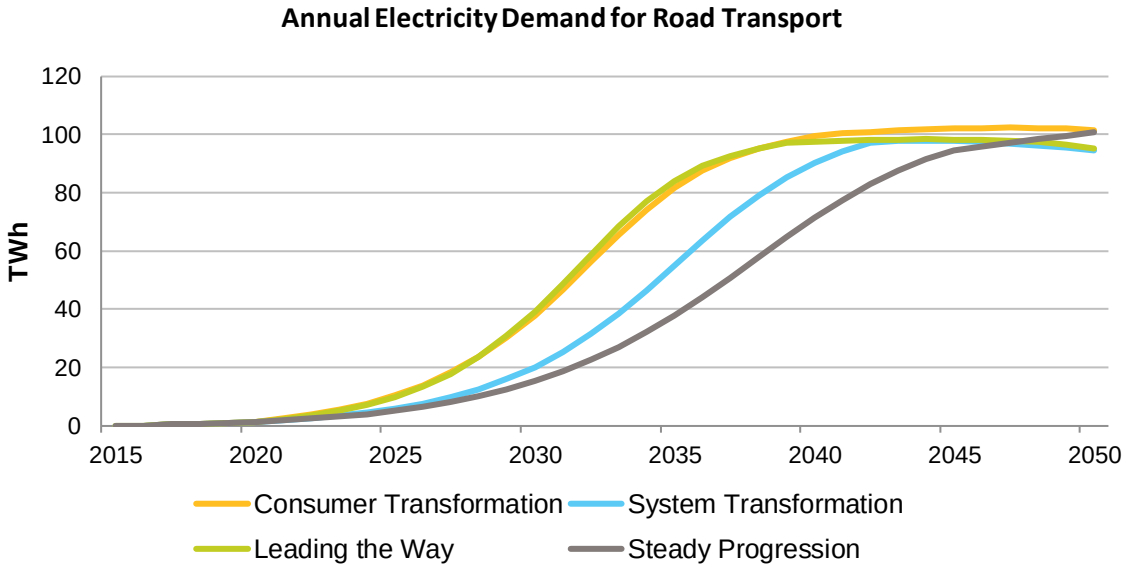
Future of EVs

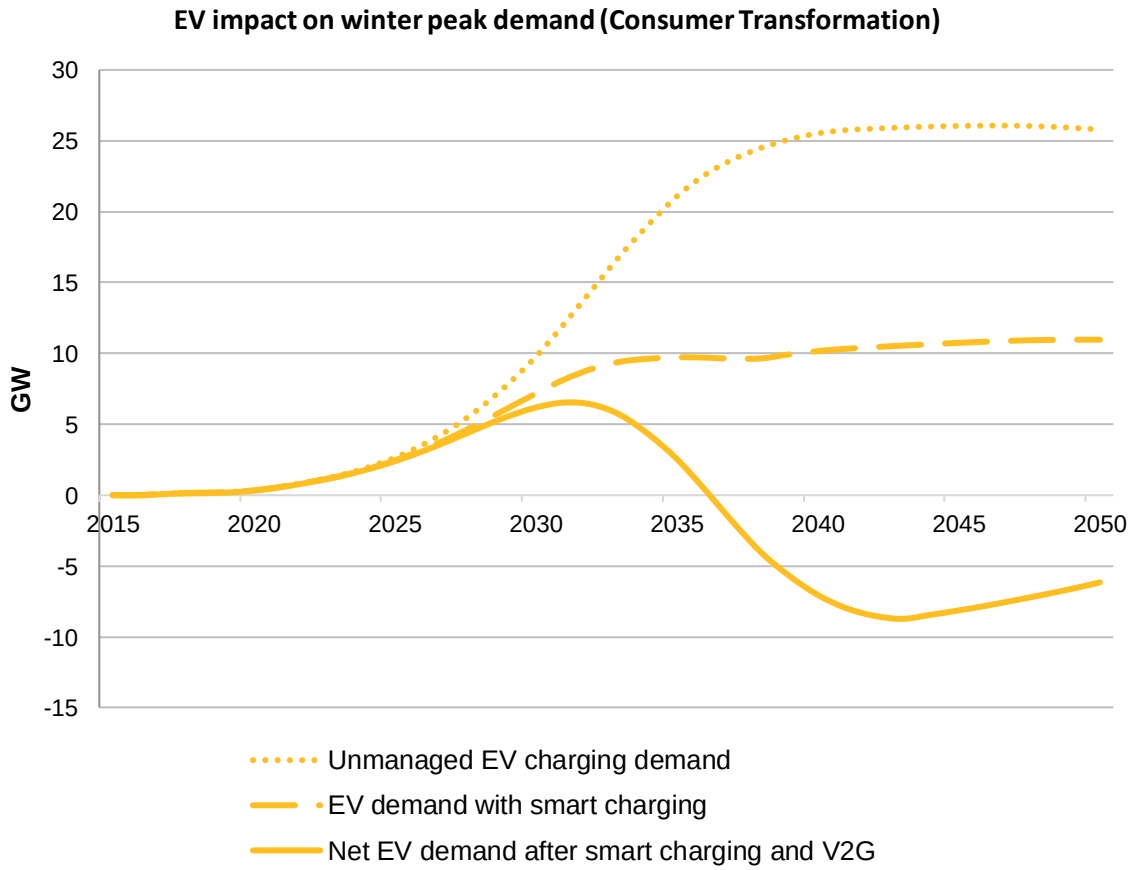




- EVs will become the dominant passenger vehicle in the 2030
  - The ramp up in the 2030s will be as big a change to system operation as renewables have been
  - By 2035, in two of our net zero scenarios, we have over 25m
- EV charging will become a large part of annual system demand
  - By 2035, in the same 2 scenarios, it reaches over 80 TWh
  - For comparison residential electricity demand is about 100 TWh now and electric heat demand will grow by about 25 TWh in the same period

Ref: ESO - Future Energy Scenarios - Jul 2021

System benefits from EV flexibility - within day “shiftability”



- An efficient EV, doing average daily mileage, needs less than 1 hour per day on a typical home charger
- But it might spend 10-20 times that long plugged in, giving lots of flexibility to move the demand around
- Smart demand plus vehicle-to-grid could take 20 GW off the winter peak in 2035
- EV flexibility could also help with many other system needs e.g. low demand on a summer afternoon or a windy night, fast ramping renewables, responding to an unplanned outage

Ref: ESO - Future Energy Scenarios - Jul 2021

System benefits from EV flexibility - system needs in 2035

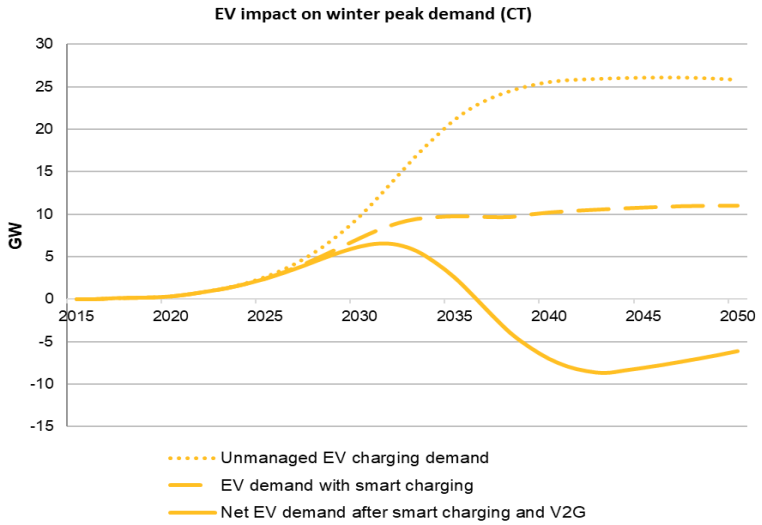
'Shiftability'	Moving energy through time, mainly within day, to flatten peaks and follow renewable generation
'Adequacy'	Ensuring firm generation capacity is always sufficient to satisfy inflexible demand and efficiently managing any oversupply
Frequency	Adjusting generation and supply to keep the frequency stable. Some services are very quick (<1 second), some are slower.
Stability	Properties like inertia that improve how the system responds to disturbances, automatically slowing and correcting deviations
Voltage	Managing reactive power flows throughout the transmission system to control voltages
Thermal	Ensuring power flows do not take temperatures of network assets beyond safe operating limits
Restoration	Ensuring the system could be recovered in the event of a large transmission system failure

EVs will do a lot of within-day energy shifting

In time EVs could contribute to other system needs:

- Via an aggregator or a large charging site
- As part of a portfolio combined with other assets
- Indirectly, by reducing operability problems caused by low demand

Challenges for EV flexibility
How will EV drivers actually behave?



First queues begin at UK petrol stations as motorists urged not to panic buy

The Russian invasion of Ukraine has sparked fears there may be fuel shortages and price spikes, as the nation is the world's second-biggest oil producer, and mainly sells to other European countries

By Lucy Williamson, Reporter
21:01, 24 Feb 2022 | UPDATED 23:53, 24 Feb 2022

175 COMMENTS

Snow, ice and gale-force winds to batter Britain as Beast from the East II roars in

Eastern England faces blizzard conditions, caused by cold air from Russia and Scandinavia meeting Storm Darcy

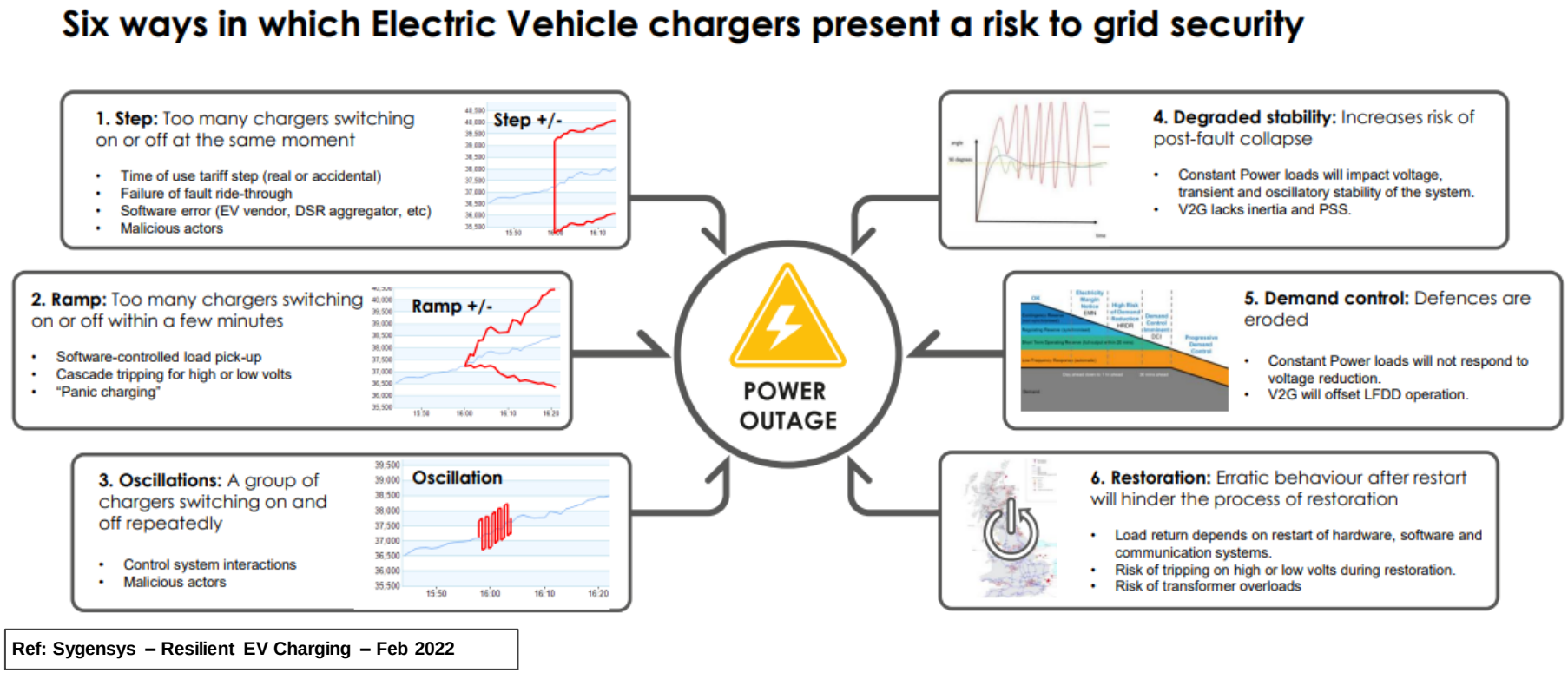
UK weather: Rare 'thundersnow' phenomenon could cause travel disruption and power cuts - as Met Office issues snow and ice warnings

The big chill has arrived for many areas, as yellow warnings for snow and ice have been issued by the Met Office for parts of northern England and Scotland for today and tomorrow.

Thursday 6 January 2022 17:16, UK

- We are confident that, by 2050, EV charging will provide a lot of flexibility
- We are much less confident about:
  - How much EV flexibility we will have by 2035
  - Whether the flexibility will be there on the extreme days when the system really needs it
  - Whether we can rely on the flexibility enough to buy less generation and transmission capacity

Challenges for EV flexibility – system risks



Ref: Sygensys – Resilient EV Charging – Feb 2022

- Uncontrolled flexibility from EVs could cause system security problems
- E.g. a communication outage affecting 1% of charging EVs
- How should we manage the risks without slowing deployment and innovation?

Facebook outage: what went wrong and why did it take so long to fix after social platform went down?

Billions of users were unable to access Facebook, Instagram and WhatsApp for hours while the social media giant scrambled to restore services

Massive internet outage hits websites including Amazon, gov.uk and Guardian

Technical problem traced to network run by Fastly brings some sites down entirely

What caused the internet outage that brought down Amazon, Reddit and Gov.uk?

Challenges for EV flexibility - Coordination

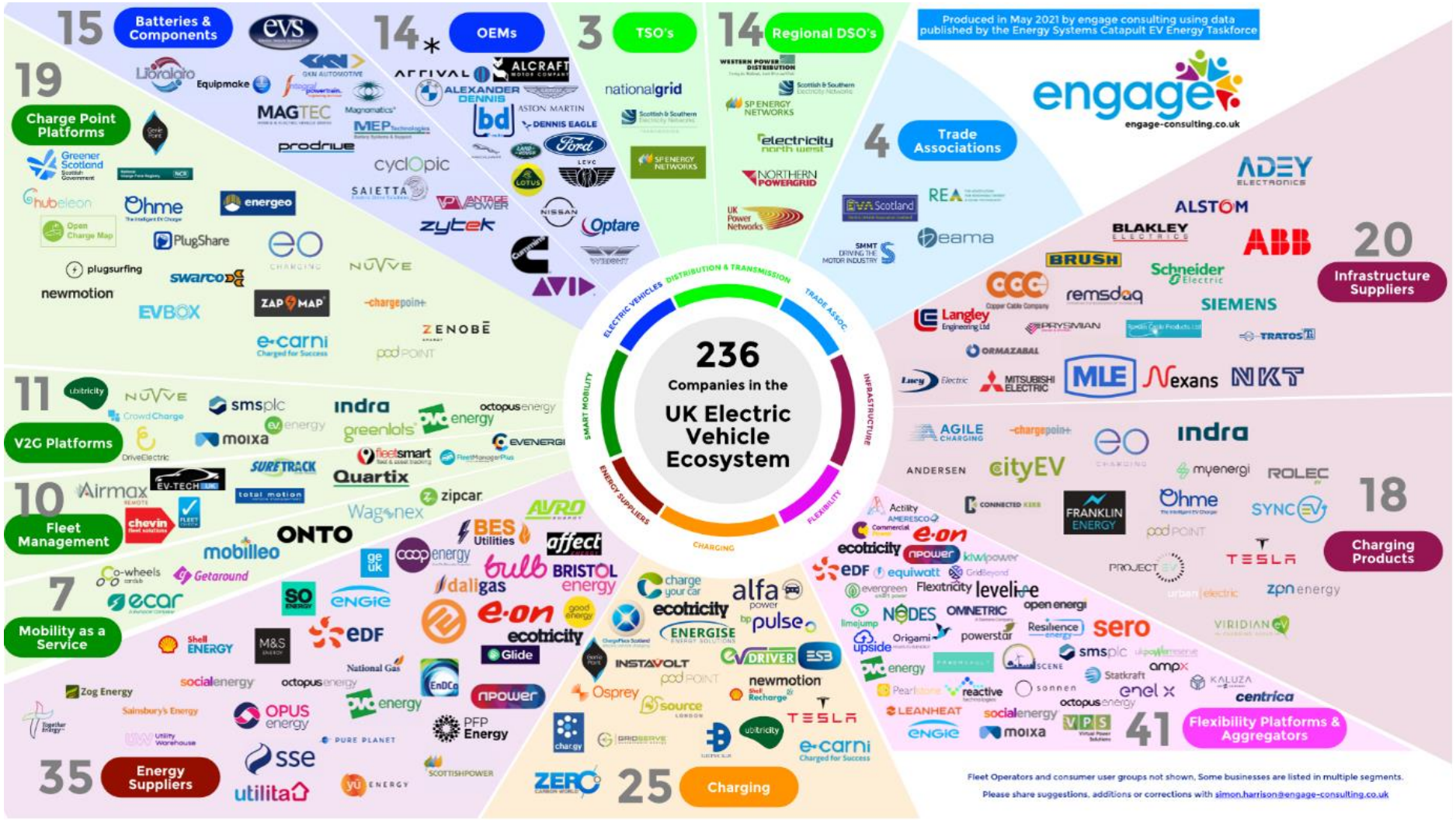
Flexibility from tens of millions of EVs

+

Planning and operating a zero carbon electricity system

=

Lots of coordination!



Ref: Engage Consulting – Welcome to the UK EV Ecosystem – Jun 2021