Electric Vehicles: the silver bullet to decarbonise transport?

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CENTRE FOR ENERGY POLICY
SCHOOL OF GOVERNMENT AND PUBLIC POLICY

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Electrifying transport: Why it is important?

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Why it is important?

The need to tackle climate change and other sustainability issues

Several cities and countries have set net-zero emission targets

- But timing is important!

To limit global warming to 1.5C, we need:

- ***Major reductions by 2030 (75%)***
- ***Net zero by 2050 (100%)***

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If we don't…

1m sea level rise
(https://coastal.climatecentral.org/map/)

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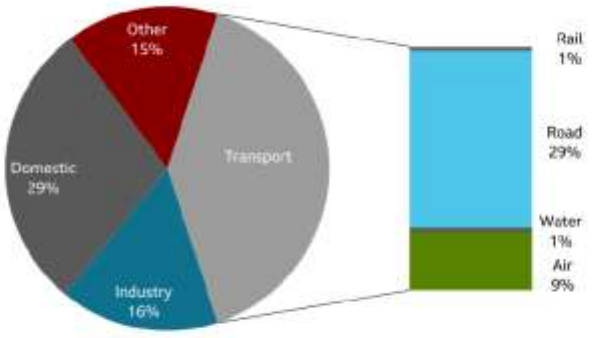
Why transport?

Percentage of total energy consumption (1637.68 Billion kWh) by sector 2017



BEIS | July 2019 | DUKES

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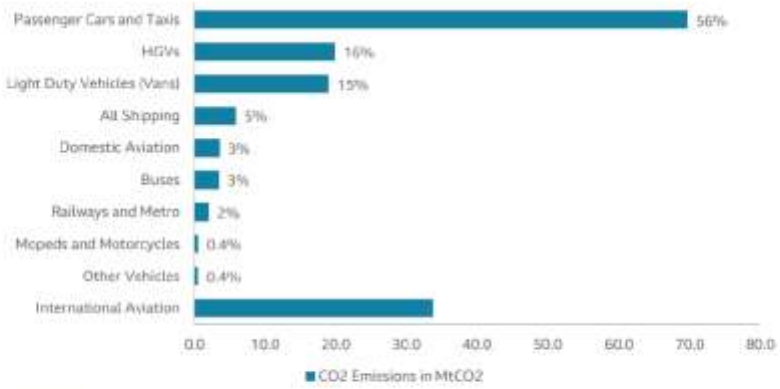
Sources of Emissions – Transport

UK CO_2 emissions in $MtCO_2$ by transport means in 2016



BEIS (March 2018) UK Greenhouse Gas Emissions
DfT (December 2018) Passenger transport by mode from 1952

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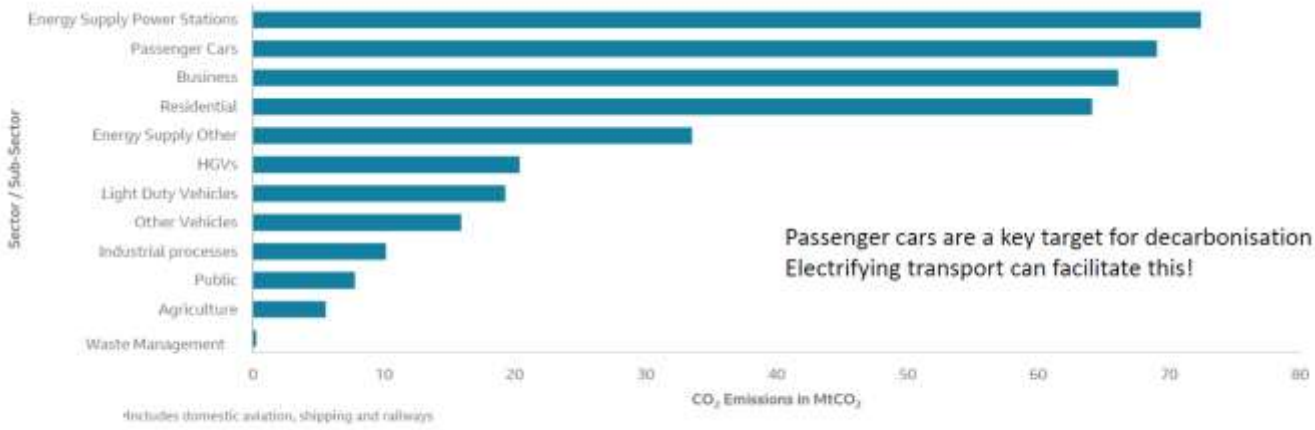
Sources of Emissions – Overall

CO_2 emissions by sector and sub-sector in 2016



Passenger cars are a key target for decarbonisation
Electrifying transport can facilitate this!

*Includes domestic aviation, shipping and railways

BEIS (March 2018) Final UK Greenhouse Gas Emissions

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What can we electrify?

CONSIDERING THAT MOST TRANSPORT MODES CAN'T BE PLUGGED WHILE MOVING

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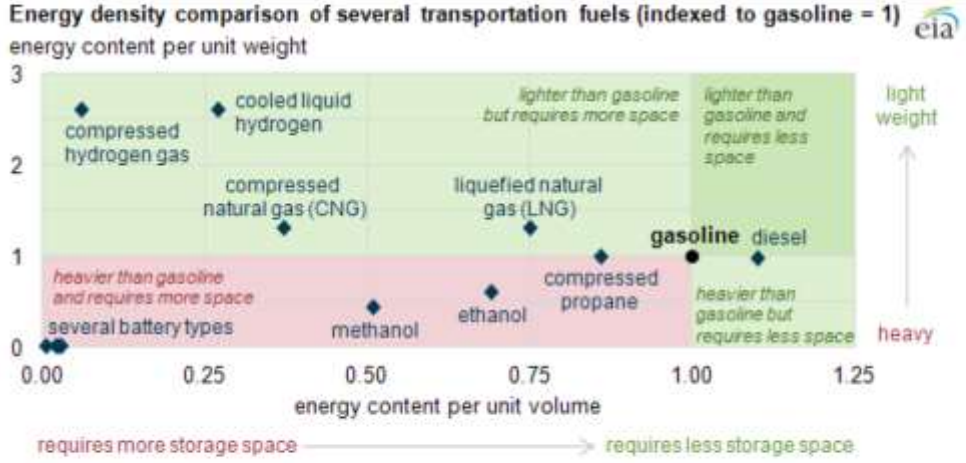
Energy storage and transport



How can electricity compete with other more energy-dense fuels?

https://www.eia.gov/todayinenergy/detail.php?id=9991

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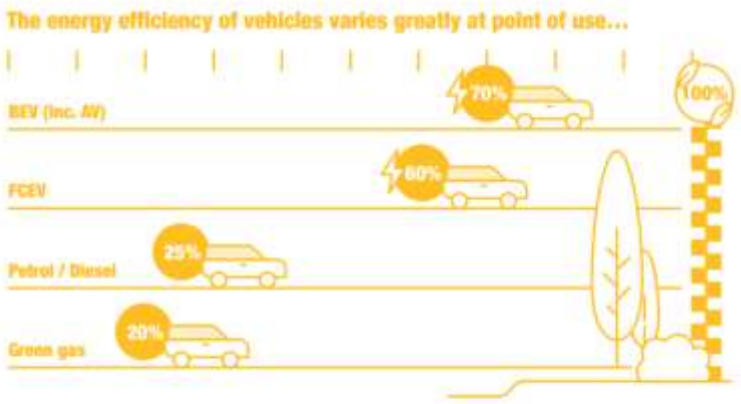
Electricity vs other energy carriers



https://www.nationalgrideso.com/future-energy/future-energy-scenarios/fes-2020-documents

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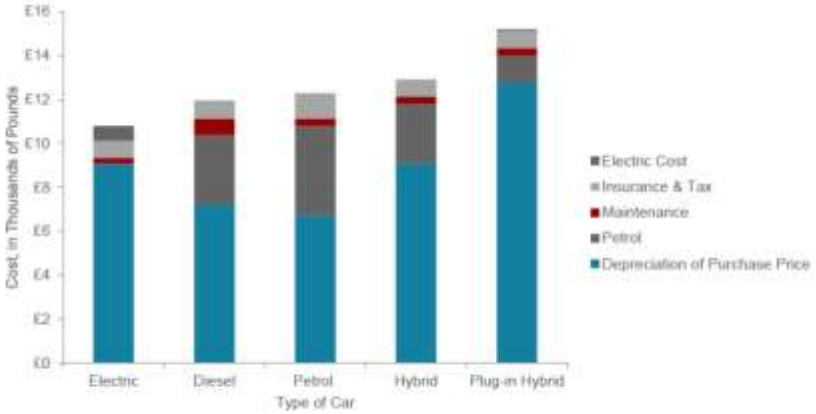
EV or the good old petrol car?

Cost over four years in the UK by car type



Kate Palmer, et al., Total cost of ownership and market share for hybrid and electric vehicles in the UK, US and Japan, Applied Energy, Volume 209, 2018.

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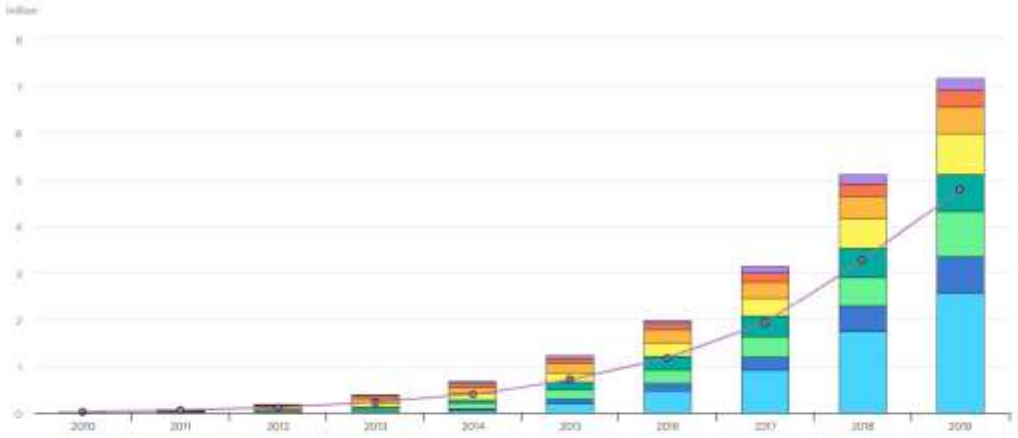
Global electric car stock, 2010-2019



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So what can we electrify?

Easier

harder

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EVs - What are the benefits/challenges?

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Direct benefits of EVs

Cheaper to run overall

No direct GHG emissions

Less air and noise pollution in cities

- Important health benefits!

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EV challenges (real or perceived)

Up-front cost

Lack of a second hand market

Range anxiety

Charging points and charging time

Lack of off-street parking (no charging at home)

Increasing electricity demand and pressure on the network

Loss of fuel duty tax

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EV costs are going down

2016: 155-mile range

2020: 235 miles range

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Range anxiety and charging point anxiety

Let me tell you a little story…

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Having second thoughts?

To be honest, we were unlucky…

- We had no control on the state of charge of the car beforehand
- Unexperienced with driving EVs and what to expect on real range
- Unlucky with the charging points

But if it was my car, I would have prepared my trip differently, potentially avoiding all these issues

Also, range keeps going up!

- How often do you drive more than 200 miles in one go?

Charging at home still is the best option for most

- But we need more charging points for people in flats!

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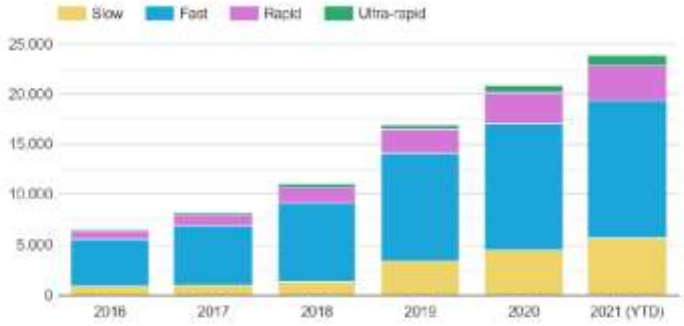
Charging points in the UK

Number of public charging points by speed (2016-to date)



Total devices: 23846, Updated: 20 May 2021

ZAP MAP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Britain's electric car charging network boosted by £300m funding
Ofgem to build infrastructure for 3,550 new ultra-rapid charging points on motorways and in towns


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Money
Got an electric car charger at home? Share it and earn cash
Co Charger app matches hosts and 'chargees' who can 'enjoy living in a cleaner, greener neighbourhood'
Why some young people are putting off learning to drive

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But challenges still remain

Many and sometimes incompatible charging networks (e.g. Tesla)
- Also, more expensive than charging at home!

Geographical distribution (very London centric at the moment)
- Ofgem announcement is very welcomed (but we need more!)

Charging for those without off-street parking
- Park and ride?
- Destination charging?
- Charging point sharing?

Lack of a significant second-hand market

As EV demand increase, most of these issues will be addressed
- Those who can afford it and can charge at home should get an EV!

Chicken or Egg?

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Impacts on the power system

The large-scale penetration of EVs will require more electricity generation and to expand the network capacity

And remember, the electrification of transport won't happen in isolation!
- Electrification of heat
- Electrification of industrial processes
- Carbon Capture and Storage (CCS) (it will need energy to operate)
- Hydrogen production? (Electrolysis)

Electrification of all domestic heating and vehicles may require a threefold increase in electricity

Energy use	Energy consumption in billions of kWh	Efficiency of substitute electrical device	Potential equivalent electricity use in billions of kWh	Multiple of current household electricity demand
Household lighting	108	-	108	1.0x
Household heating	292	Electric heat pumps around three times more efficient than gas boilers	97	0.9x
Car and light vehicle transport	363	Electric cars around four times more efficient than petrol engines	90	0.8x
Total	**762**	**-**	**295**	**2.7x**

Electricity increase needed

- If electric heat pumps were used in all domestic heating, demand for electricity would almost double
- This would need to be coupled with upgrades to improve energy efficiency
- It would almost double again, if all private cars were electric too
- With full electrification, the total combined domestic and private vehicle demand for electricity would be almost three times (2.7x) its current level

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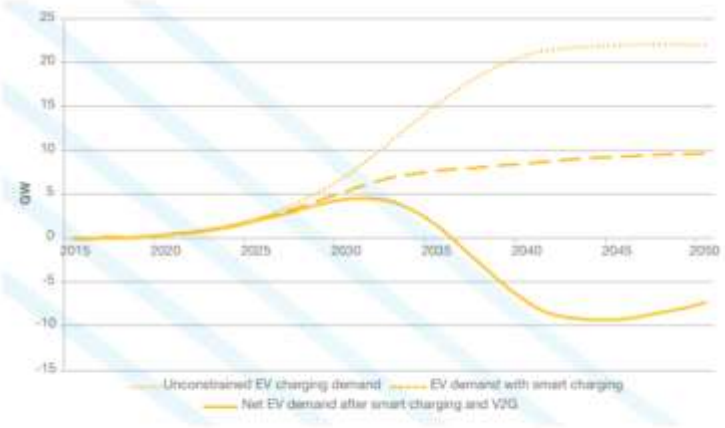
How can we reduce the impacts on the network?

Smart charging
- Avoid peak-time charging
- Charge only when is good for the network

Vehicle-to-grid (V2G)
- Use your EV as a battery
- Provide balancing services to the grid



https://www.nationalgrideso.com/future-energy/future-energy-scenarios/fes-2020-documents

How can we reduce the impacts on the network?

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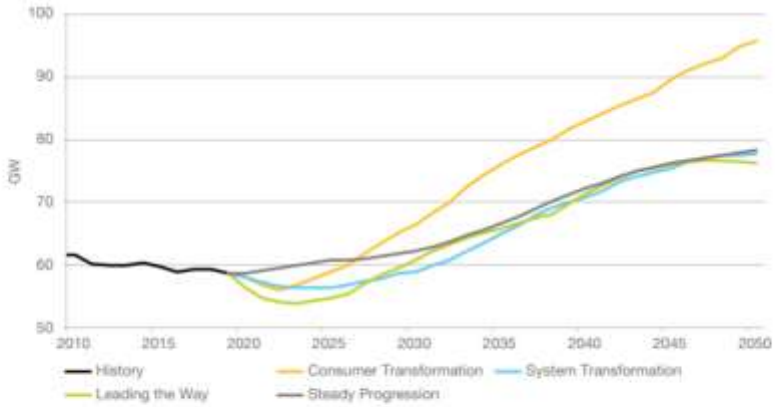
Figure SV.4: Electricity peak demand (including losses)



Even if we can reduce the impact on the network, very large investments will still be required!

But is not all that bad!

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Policy Briefing

Can the electrification of private transport lead to economic prosperity?

Oluwafisayo Alabi, Karen Turner, Christian Calvillo, Antonios Katris, Jamie Stewart and Constantin Brod

Introduction

The UK has set binding targets to meet net zero emissions by 2050 and transport is one of the key sectors where emissions will have to significantly reduce. While a range of options exist to decarbonise transport, electrification is currently seen as a leading option for private transport in particular. To facilitate the rollout of electric vehicles (EVs), significant electricity network reinforcement is likely to be needed. However, not least because any investment in the electricity network will have to be paid for by consumers through electricity bills, a key question remains as to how this will impact economic prosperity in the long term. This policy briefing builds on a foundation of CEP research,[1,2] to report on the impacts on wider economy and economic well-being indicators of investing in the electricity network to facilitate the rollout and of the subsequent impact of shifting from conventional vehicles to the extent of 99% EV penetration by 2050.

https://strathprints.strath.ac.uk/73568/

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Strathclyde Uni research shows green car investment could create 30,000 jobs

Some 30,000 jobs could be created if major investment is undertaken in the UK's energy network to enable the transition to electric vehicles.

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What about the fuel duty tax?

How can the government increase its revenue?

- Increasing taxes ✗
- Increasing the size of the economy ✓

Positive net expansionary activity across the economy will allow Government to begin to accumulate gains in revenue and the public budget balance. This is important in a UK policy context, where identification and tracking of such outcomes is crucial in enabling public budget decision makers to consider what the most beneficial way of using any additional budget savings in the wider context of the transition to net zero, including how to address losses in fuel duties.

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Are EVs the solution?

SUSTAINABLE MOBILITY

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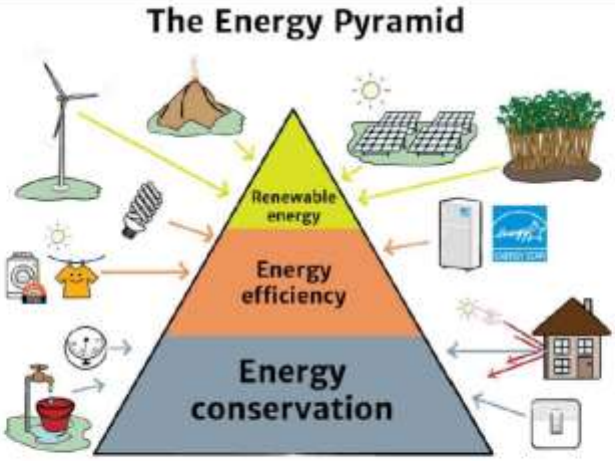
More than just renewables sources



Source: https://www.solarschools.net/knowledge-bank/sustainability/reduce-reuse-recycle/reduce/energy-consumption

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Reducing Energy Waste in mobility

Example: how can we reduce energy use in transport?

- Reduce unnecessary travel
- Smart urban planning
- Remote working
- Etc.

But if you must travel...

Reducing Energy Waste in mobility

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But if you must travel...

- Don't get and SUV!

'Their larger engines and bulk mean on average SUVs have CO2 emissions 14% (16g/km) higher than an equivalent hatchback model. A 2018 Committee on Climate Change report noted that "the popularity of SUVs is cancelling out emissions savings from improvements in technology".'

Source: https://www.theguardian.com/cities/2019/oct/07/a-deadly-problem-should-we-ban-suvs-from-our-cities

Point of discussion:
Behavioural issue? Technology/industry issue?
Policy issue?

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Improving efficiency in mobility

Can we do better than choosing smaller cars?

- EVs are 3 to 4 times more efficient than petrol or diesel cars
- EVs don't have emissions or pollute directly*

So, are EVs the solution?

- *They 'solve' the car CO2 emissions problem*
  - *(they still create emissions in their life cycle)*
- *But not the land-use problem*
- *Or improve access to sustainable and fair mobility*

One more lane?

Also a recommendation:

- Video 'How highways make traffic worse' https://youtu.be/2z7o3sRxA5g

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Sustainability is more than energy use

Land use

- More green spaces?

Accessibility

Social justice

Wellbeing

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But COVID!!!

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The best form of mobility?

Public transport is definitely up there.

But (in my humble opinion) the winner is:

- Active travel!
- How long is your commute? (UK average car trip is less than 9 miles)

If it is cheaper, cleaner and healthier, why don't we cycle more?

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Conclusions

Electrification of transport is a necessity
- Cars and vans are the straightforward candidates for this

EVs can produce important economic benefits
- Both at individual level and to the economy as a whole

But EVs are not a silver bullet!
- A 1-to-1 replacement of cars with EVs is not compatible with Net zero
- It will drive electricity costs up, not accessible for everyone, may even increase the land use problem

This system wide change give us an extraordinary opportunity to rethink mobility
- Reducing waste (energy, materials, land) and improving wellbeing

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Thank you!

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