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Can spending to upgrade electricity networks to support electric vehicles (EVs) rollout unlock value in the wider economy?

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EPSRC National Centre for Energy Systems Integration flexible fund project

CESI National Centre for Energy Systems Integration

Context/background

- Transition to electric vehicles (EVs) in private transport is already playing a crucial role in the UK's commitments to mid-century 'net zero' targets for territorial CO2 emissions aligned with UNFCCC 1.5 degrees Celsius ambitions


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Can spending to upgrade electricity networks to support electric vehicles (EVs) roll-outs unlock value in the wider economy?

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- *These will come at some cost to households, industries and the economy- but there maybe opportunity to capture benefits and/or unlock value in the wider economy*
- *Fuelling of electric vehicles can exploit strong UK domestic supply chain capacity*
- *A shift to EVs can unlock and increase value in different parts of the UK economy*

- Following the UK Parliament's legislation of a 2050 net zero target (BEIS, 2019), a previous 2040 target to end the sales of new conventional cars and vans was brought forward to 2030 (UK Government, 2020) and supported by a Transport Decarbonisation Plan (TDP)
- *If such a pathway is to be sustainable in a political economy setting, it is necessary to understand the potential wider economy and distributional consequences of extensively electrifying a previously fossil fuel powered activity*
- A central and crucial question is on how and to what extent the level and timing of investment to support the projected EV rollout not only enables targeted emission reduction, but also affects the pathways and nature of economic expansion and economic wellbeing

Net Zero Principles Framework

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CEP has developed a *Net Zero Principles Framework* which can be used as a tool for policy makers. It describes:

- **Enabling stage:** before emissions reductions can begin, need to invest in, install and facilitate operation of new equipment, infrastructure and/or systems capability to **enable** emissions reduction
- **Realising stage:** with this capacity and capability in place, we can actually **realise** emissions reductions by working with this new capacity in how we live and work.

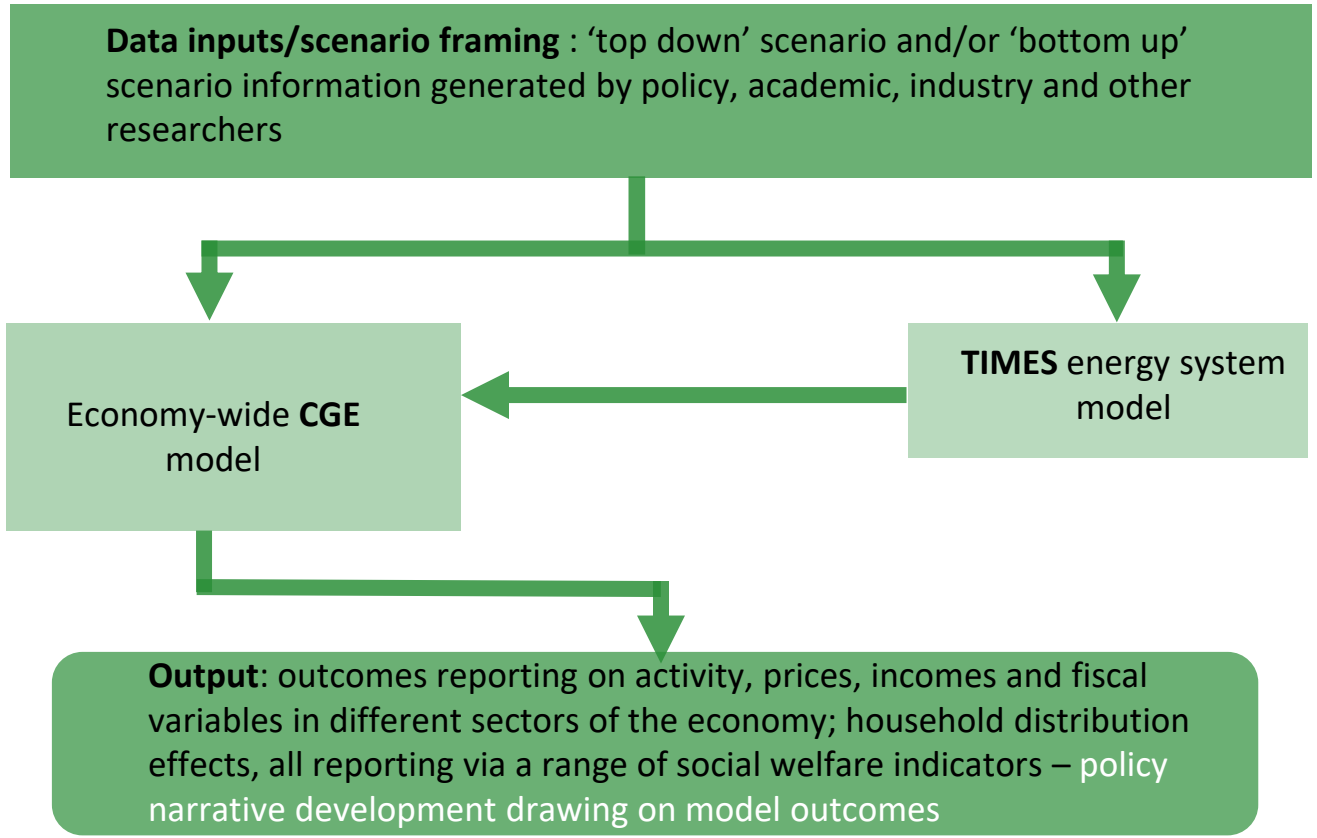
EVs : Enabling stage	EVs: Realising stage
• Range of activities, including putting wires and cables in the ground - mainly construction spending within UK • Full cost of this must be 100% recovered through UK consumer bills • Cost recovery pushes up electricity prices; additional investment activity in economy pushes up prices more generally (labour, capital costs) - can cause 'crowding out'	• Progressive shift from conventional vehicles to electric vehicles • Change of fuel source from petrol and diesel to electricity • Efficiency gains in private transport – less energy needed per mile driven • Coincides with ongoing recovery of enabling costs through consumer bills

Turner, K., Katris, A., & Race, J. (2020). The need for a net zero principles framework to support public policy at local, regional and national levels. Local Economy, 35(7), 627-634. https://doi.org/10.1177/0269094220984742

Method and approach

Our core method involves two models:

- First, an **energy system model (UK TIMES)** is used to simulate scenarios involving different assumptions around extent of 'smart' charging capability and consumer response for projected EV rollout
- Secondly, the outcomes of the UK TIMES on the required investment costs, and efficiency gains realised through using EVs for private transport, is used to inform our core multi-sector **economy-wide UK ENVI Computable General Equilibrium (CGE) model**



Research focus

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Research questions :

1. How will a **more rapid rollout of EVs** in different timeframes impact the economy-wide picture of who ultimately pays and gains?

2. How will the picture in (1) change if **the manufacture of EVs (at UK and global levels) cannot meet the demand implied by the projected rollout**, in different interim timeframes and overall?

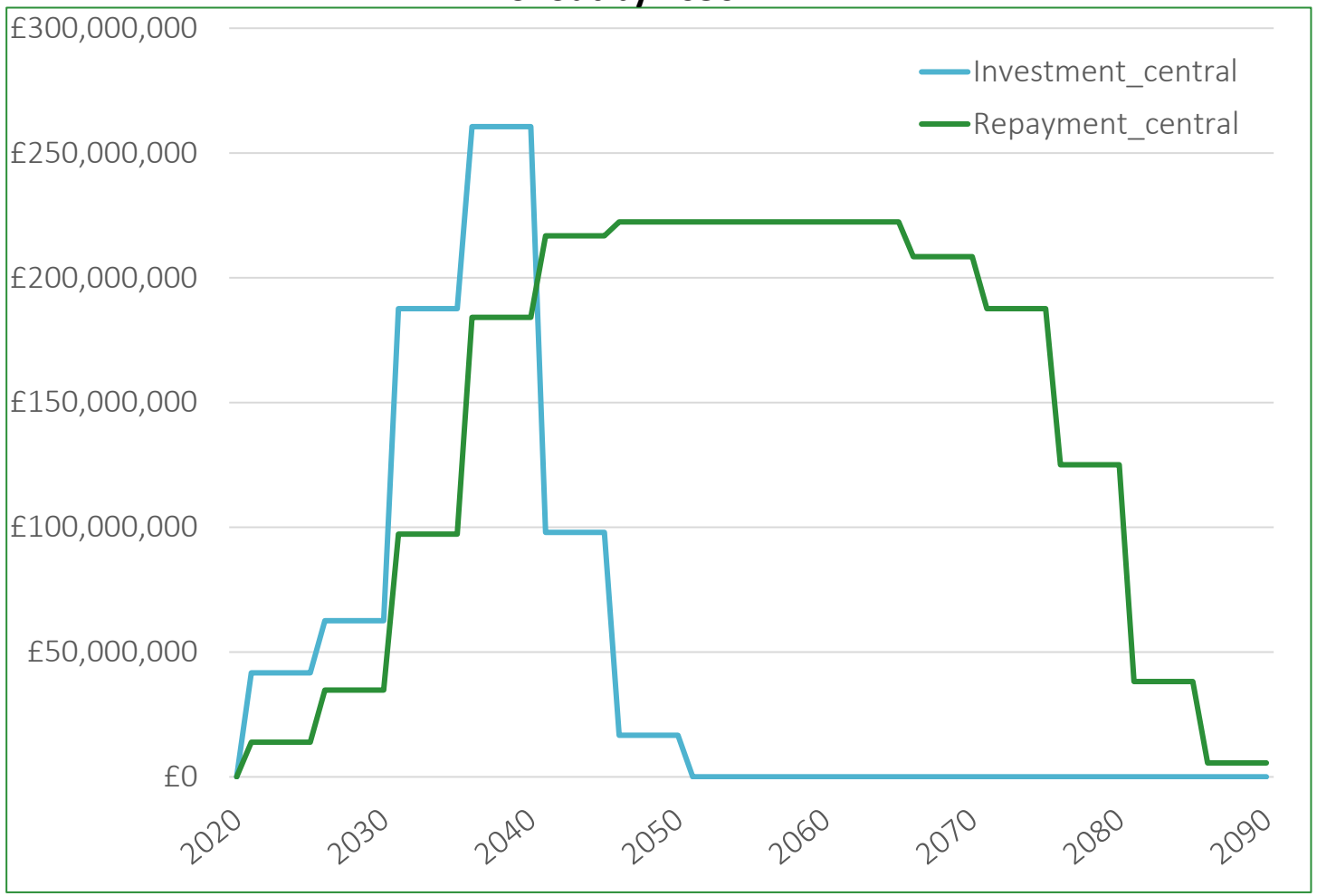
We focus on electricity network investment only required for projected EV rollout up to 2050 and develop three energy system scenarios :

- Slow EV uptake (£11billion)
- **Central EV uptake (£10billion)**
- Fast EV Uptake (£8billion)

- **100% EV rollout** – progressive build up from 2% in 2020, 31% by 2030, 95% by 2040 and 100% by 2050
- 1/3 of investment spend in the UK construction sector
- Full cost of the investment spend passed to all consumers via higher bills until the full investment cost is repaid
- ***What if***: only 50% EV rollout – progressive build up from 2% in 2020, 16% by 2030, 48% by 2040 and 50% by 2050

Simulation strategy

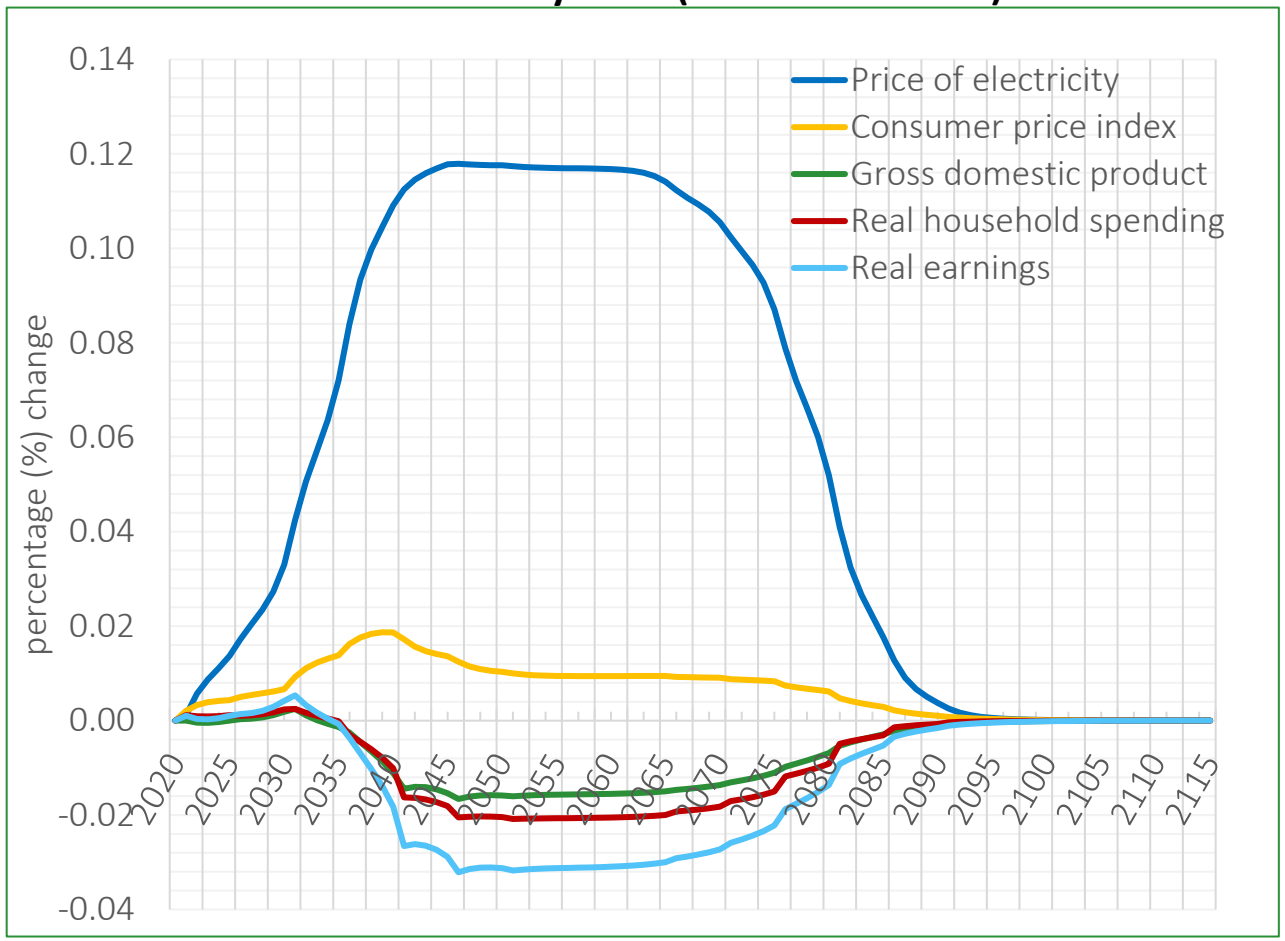
Figure 1. Evolution of total electricity network upgrade spend and repayment for 'central' scenario to enable the 100% EV rollout by 2050



- Investment spread over 6 blocks (planning period) of 5 years and payback per planning period to 45 years-asset lifetime
- 1/3 of total investment spending in UK construction sector
- Full cost of repayment paid through increase in electricity bills of all UK consumers

Results : Enabling stage

Figure 2. Evolution of gross impacts of £10 billion electricity network upgrade spending on the wider economy to enable 100% EV rollout by 2050 ('central' scenario)



- Net positive impacts of the enabling stage activity are minimal until 2035 (year 15), and mostly driven by the construction industry and its supply chain
- Time-limited net contraction in the economy emerges and persists through the remainder of the enabling stage to 2090
- Spending power of UK households' contracts throughout extended period of adjustment as CPI rises and real earnings and spending fall
- Impact of rising labour costs during most of the upgrade period, exacerbated by the electricity price burden of recovering the network investment costs which acts to reduce the competitiveness of the UK economy

Results : Enabling and realising stages

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Figure 3. Evolution of net impacts on the wider economy of £10 billion electricity network upgrade spending and 100% EV rollout by 2050 ('central' scenario)

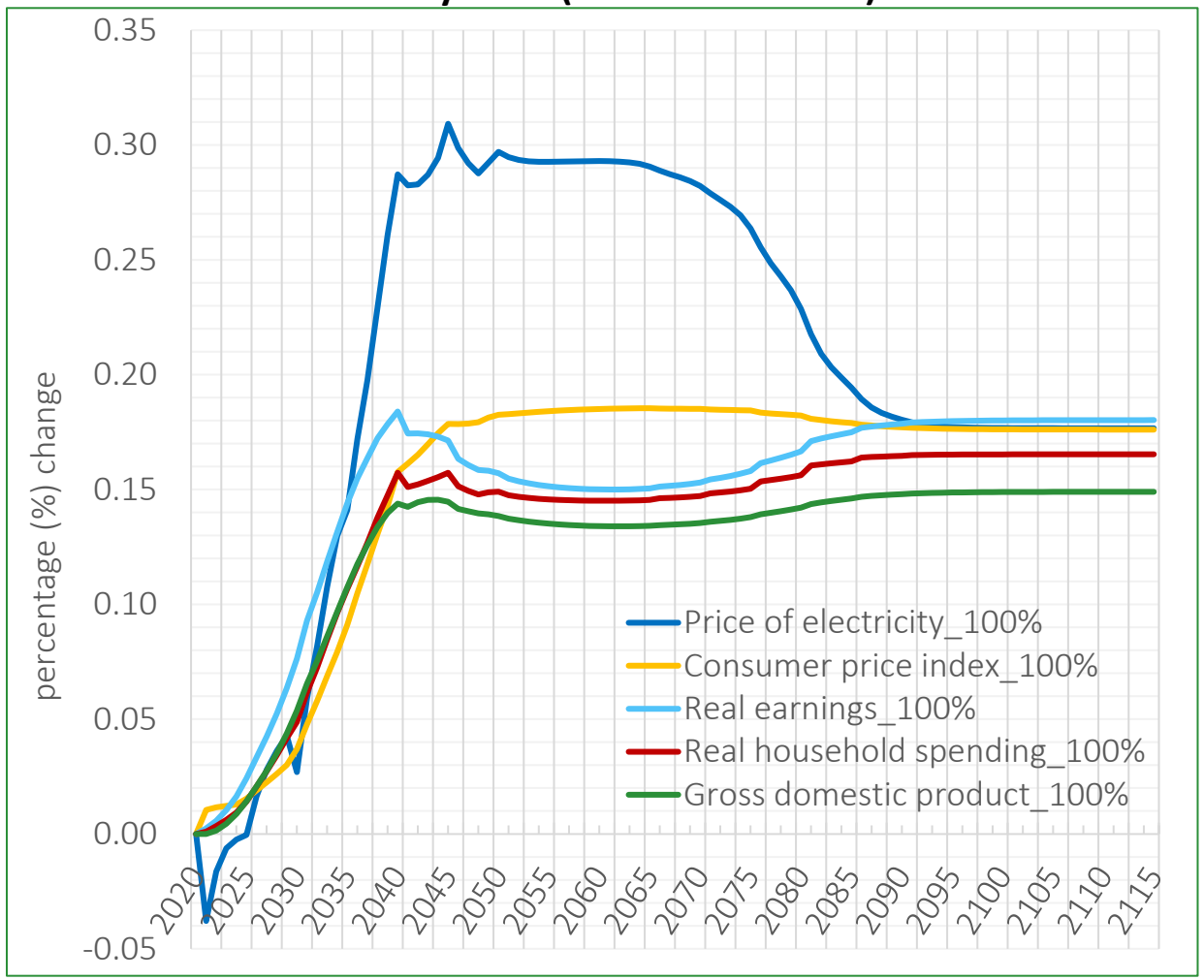
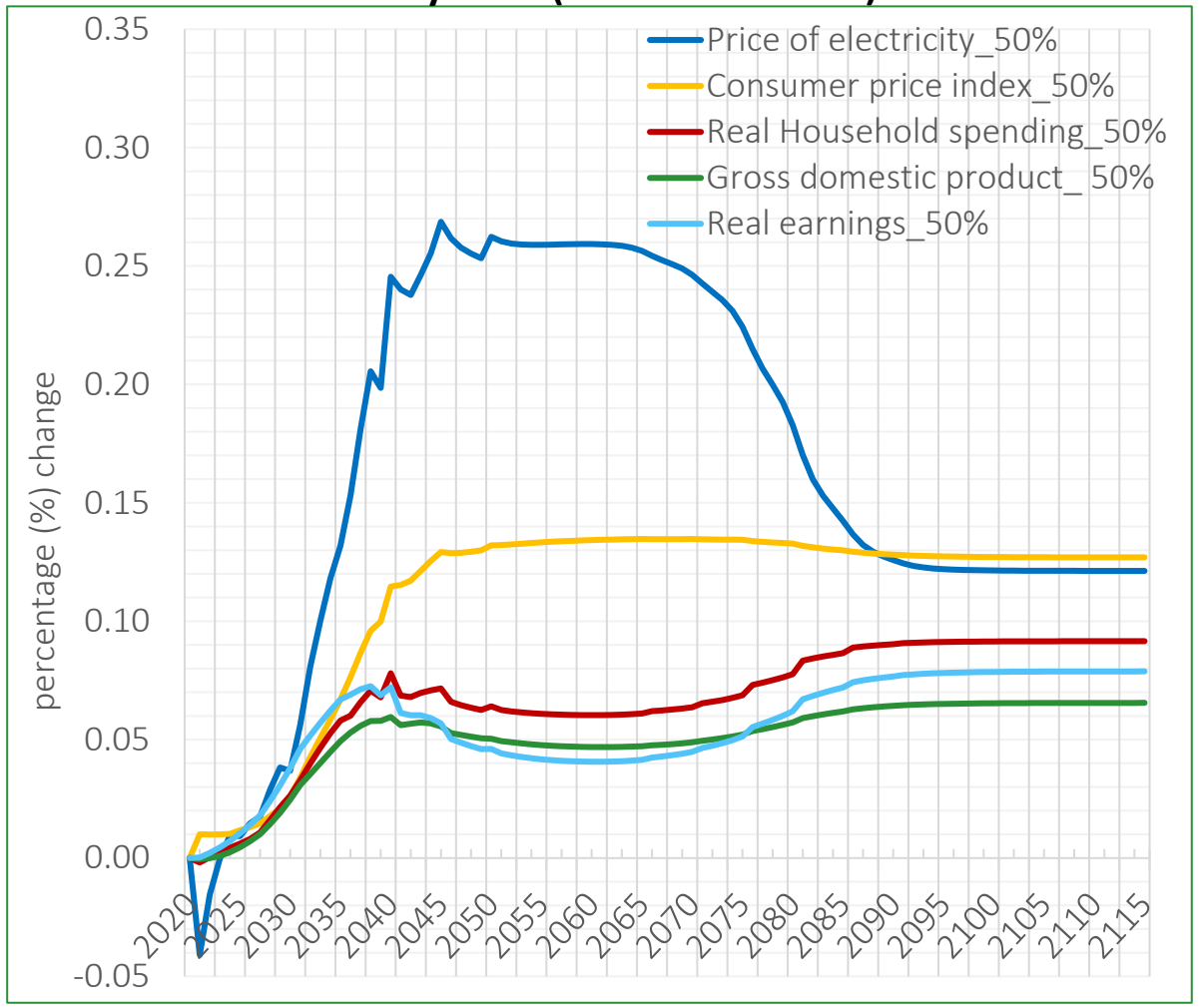


Figure 4. Evolution of net impacts on the wider economy of £10 billion electricity network upgrade spending and 50% EV rollout by 2050 ('central' scenario)



Results : Enabling and realising stages

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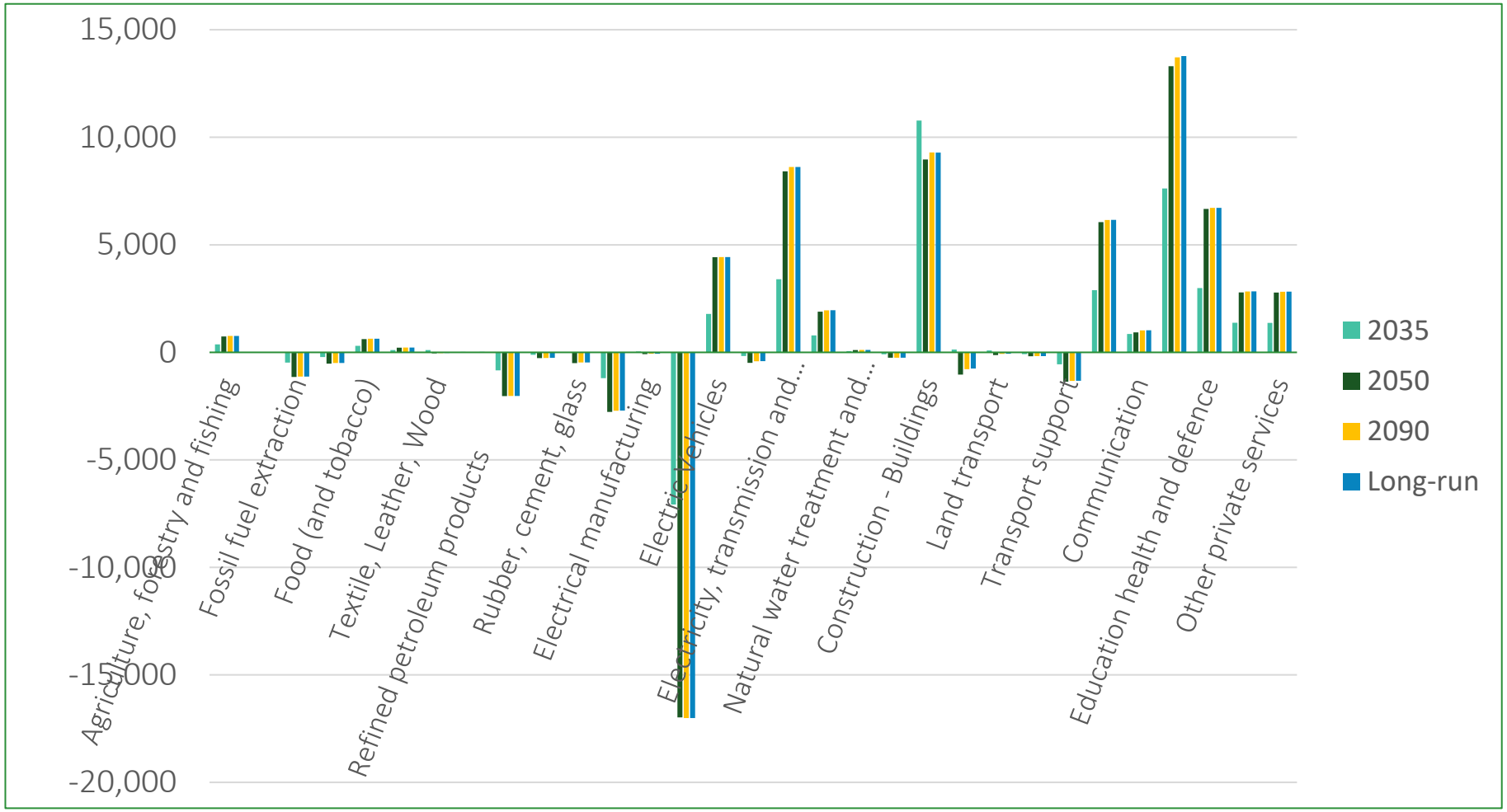
Figure 4. Net impact of sectoral employment (FTE change relative to base year values) from 100% EV rollout by 2050, enabled by £10 billion ('central' scenario) electricity network upgrade spending



- Export intensive industries such as 'Chemicals and Pharmaceuticals', 'Electrical Manufacturing' suffer loss in competitiveness due to sustained increase in labour cost
- Shift and gains in sectoral employment in favour of higher wage and value added-intensive industries associated with increased domestic electricity demand and wider increase in household consumption

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Conclusions

Key messages emerging

- The enabling stage activity in insolation delivers time-limited wider economic gains
- Sustained cost and benefits to the UK economy will be dependent on the extent of expansion in the domestic electricity industry and its supply chain and the balance against the price and income effects across different parts of the economy
- Policy challenges and trade-offs emerge through two distinct pressures on electricity and other prices: cost recovery and the extent of EV rollout enabled, coupled with increased domestic demand and production in the presence of labour supply constraints

Next steps/future work

- Electrification of transportation part of wide national priorities of several services that households use (e.g., heating) – thus there is a need to consider the EV rollout in a context where the energy system is expanded by investing in new capital, rather than upgrading the existing one
- Explore how realising the projected EV rollout feeds back to impact different consumer groups, to better understand the balance of benefits against the costs that may fall on different types of consumers

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Questions?

Notes

- The first key observation is that we have net positive and sustained outcomes across all the headline macroeconomic indicators, regardless of the upgrade level and rollout path ('central' and 'fast' scenarios), to the end of the cost recovery period (2090) and beyond
- Positive high-level macroeconomic outcome is largely driven by the realising stage involving a shift to more reliance on a domestic industry and supply chain activity in fuelling UK private transport fleet using electricity
- Household real incomes receive a further boost via increased efficiency in terms of the spending requirement per mile travelled, but also as more employment opportunities and greater wages manifest
- Impact of the enabling stage and the labour supply constraints remain the same regardless of the level of the EV rollout
- Thus comparing 50% to the 100% EV rollout case the outcomes are qualitatively the same for most of the macroeconomic indicators and across most timeframes, but quantitively different
- Headline difference observed is one of both excess capacity, reflected in the total spending rather than any unused capital, and reduced expansionary power of the realising stage
- With the reduced demand on electricity and EV manufacturing output, the expansion across the economy shifts further in favour of household consumption and sectors that service household demand

Simulation strategy

Table 1. Breakdown of network upgrade spending and repayment (2020 – 2050)

	a	b	c	d	e
		(a/45 years)	(a/3)	(c/30 years)	(c/5 years)
Scenarios	Total investment	Repayment (per year)	Total spending in the UK	UK spend (per year)	UK spend (per 5-year block)
'Slow' EV Uptake	£11,000m	£244m	£3,657m	£122m	£731m
'Central' EV Uptake	£10,000m	£222m	£3,335m	£111m	£667m
'Fast' EV Uptake	£8,100m	£180m	£2,698m	£90m	£540m