Energy technology phase-out policy:
a review of international policy analogues to inform heat decarbonisation policy

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The Buildings Heating Policy Challenge

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- Heat sector transformation within a generation
  - Extensive phase-out of an embedded technology, infrastructure, and social practice: UK buildings heating has changed only incrementally for c.50 years
- No easy technological solution: all low carbon heat technologies have challenges in the UK context
- No sector-wide consensus on the transition path
- Huge disparity between current and required rates of change
- Need to secure public support and stakeholder engagement

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Analogous reasoning in buildings heating

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What are we doing to deliver?

HM Government

UK Hydrogen Strategy

The transition to any new low carbon technology brings both opportunities and challenges for different stakeholders. We will draw on lessons learnt from raising awareness of other new and low carbon technologies, such as smart meters and electric vehicles, to ensure businesses and consumers can access and drive forward the low carbon hydrogen economy.

for heating and cooking. A hydrogen conversion would follow a similar process to the original town gas to natural gas conversion undertaken so successfully and within living memory. The process will involve minimal disruption for the customer (domestic or commercial) and require no large scale modifications to their property.

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Policy analogues

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- **Analogues to inform:** Facing seemingly unprecedented policy challenges, analogues can offer insight on the opportunities, risks and trade-offs involved
- **Analogues to engage:** Analogues can also provide familiar narratives to engagement among policymakers, stakeholders and the wider public
- In practice, analogous reasoning in policy is common, but often done informally or selectively, especially by advocates of particular solutions …

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Our approach

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Policy-driven technology phase-out

- Considering the policy mix and context: regulatory and market based policy, and socio-technical issues affecting phase-out

Phase-out, while also considering replacement technology phase-in

Case selection: Work with project sponsors/advisors to define scope and focus areas

- Energy-wide scope (buildings, transport, electricity, striking a balance between variety and similarity)
- Historic and ongoing examples
- Searching international research databases, but many cases with some contextual similarity to UK & Scotland

Systematic review method to reduce selective use of evidence

Over 100 research papers reviewed

- 3 energy sectors, 7 technology phase outs, 20 national contexts

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Our cases: buildings sector

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Phase-out analogue	Relevance (similarities and differences)	National cases included in the evidence review	Key issues raised in the evidence review
Gas grids: transition from locally manufactured 'town' or 'city' gases for buildings heating to natural gas.	- Regularly referenced national heat system conversions. - Different institutional context.	UK (1960s-70s) Netherlands (1960s)	• Governance arrangements and public-private relations • Market growth and energy service delivery
Domestic boilers: transition from non-condensing to condensing boilers.	- Regularly referenced domestic technology replacement. - More incremental change.	Netherlands (1970s - 2000) UK (1990s – 2007)	• Voluntary or mandatory phase-out policy
Domestic energy metering: transition from analogue to smart home meters	- Intervention in contemporary domestic settings. - Less disruptive intervention.	Italy (2001- present) UK (2008 – present) Netherlands (2008 – present) Australia (2008 – present) Finland (2008 – present) Sweden (2003 – present) Denmark (2013 – present) Germany (2013 – present)	• Voluntary or mandatory phase-out policy • Public engagement and acceptability

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Results: buildings sector insights

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Governance arrangements and public-private relations.

- Gas grid transitions were 'state-led' in UK and 'state-induced' in the Netherlands (with higher levels of public-private collaboration).
- Central role or compensation for incumbents.

Energy service delivery and market growth

- Gas grid transitions were predicated on improved energy service delivery and market growth – boiler and metering transitions involved only modest benefits, but were less disruptive.

Voluntary or mandated phase out

- Domestic Boilers: in the Netherlands policy incentives induced a voluntary technological transition. In the UK, a mandatory approach was needed.
- Metering: a mix of mandatory and voluntary approaches.

Public engagement and acceptability

- Smart meter programmes have faced public acceptability concerns in some cases, linked to data privacy concerns, lack of trust, and lack of perceived direct benefit to homeowners

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Relevance to heat decarbonisation

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Governance Issues

- Heat sector now involves numerous privately-owned companies with shorter planning horizons (Arapostathis et al. 2019)
- Incumbent interests: continuing roles for supply side interests (or compensation)?

Energy service delivery

- By itself, heat decarbonisation is unlikely to bring about significant overall market expansion or improved energy service delivery

Public Acceptability

- Gradual and voluntary technology phase-out may be unable to deliver required pace of change, but public acceptance issues can arise for rapid / mandated phase-out efforts

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Our cases: transport sector

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Phase-out analogue	Relevance	National cases included in the evidence review	Key issues raised in the evidence review
Personal vehicles (cars): phasing-out internal combustion vehicles (ICVs) and their replacement by low emission vehicles (LEVs).	- Range of technology options (electric, liquid fuels, etc.) - Society-wide reach across the majority of the population; envisaged pace of change; - Possibly disruptive infrastructure implications.	Norway (early 1990s – present) China (2009 – present) California (USA) (1990 – present) UK (2017 – present) France (2017 – present) Germany (2016 – present) Netherlands (2017 – present) Japan (2010 – present)	• The mix of supply side and demand side policy tools • The role of hybrid technologies
Transport Fuels: phasing-out of fossil fuels and replacement by biofuels.	- Introduction of alternative gas or liquid fuels (analogous to heating biofuels and hydrogen).	UK (2005 – present) Sweden (early 2000s – present) Brazil (1970s – present) Indonesia (2018 – present)	• Multiple benefits policy rationales

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Results: transport sector insights

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Technological consensus

- State and industry approval on the move to electric vehicles

Supply side policy (alongside demand side policy) and industrial competition

- Purchase subsidies, tax benefits, non-financial incentives, public procurement, and phase-out dates
- Manufacturer quotas, R&D support, direct aid to key manufacturers and infrastructure upgrades … and phase-out dates

Multiple benefits

- Local pollution alongside reduced GHG emissions. Low Emission Zones are increasingly common in cities around the world; there are now over 250 in the EU

Hybrid options

- Hybrid options could offer less disruption but have proved incompatible with carbon emission targets

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Relevance to heat decarbonisation

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Technological consensus

- Heat decarbonisation characterised by uncertainty and much greater variety of technologies / pathways

Supply side policy

- Some similarities with heating in demand side policy
- Supply side policies to promote low carbon technological innovation less common than in transport

Multiple benefits

- Likely lower air quality benefits, and the national economic case is less apparent. Heating decarbonisation motivated by international climate change efforts.

Hybrid technologies.

- Hybrid heating may avoid the need for electricity grid reinforcement, but they will also require maintaining both gas and electricity infrastructures, and two technological units.

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Our cases: electricity supply sector

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Phase-out analogue	Relevance	National cases included in the evidence review	Key issues raised in the evidence review
Coal-fired generation: phasing-out of coal power and its replacement by lower carbon generation.	- Earlier phase out timeframes allowing lesson drawing - Range of infrastructure issues.	UK (early 2000s – present) Ontario, Canada (2007 – present) Alberta, Canada (2015 – present) Finland (2016 – present) Germany (2019 – present)	• Policy reversal and delay • Stranded asset risks • Role of incumbent interests • Availability of replacement technologies
Nuclear power: phasing-out of nuclear power and its replacement by lower carbon generation.		Germany (2002 – present) Japan (2011 – present) South Korea (2017 – present) Belgium (2003 – present) Switzerland (2011 – present)	

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Results: electricity supply sector insights

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Delay and reversal

- Several cases of delayed or abandoned technology phase-out commitments

Phase-out at the end of economic life

- In the cases considered here phase-out only took place after the point of amortisation, avoiding stranded asset risks.

Replacement technologies

- Replacement for the phase-out technology is often attractive in ways other than carbon emission reductions.

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Relevance to heat decarbonisation

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Policy delay and the replacement technology

- All low carbon heat options present challenges suggests possible **policy reversal or delay** to buildings heating phase-out.
- What are the implications id challenging 2030 targets are missed?

Lifetimes and stranded asset

- In the heat sector, this risk extends downstream to end user technologies.
- Policymakers will want to avoid targets and measures which imply retiring homeowner assets in advance of natural replacement cycles.

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Cross-sectoral insights

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Supply side policy

- Industry – government alignment leading to industrial competition / supply-side policies
- Supply side engagement and product development

Point of change

- Determined by economics: change is economically incentivised or comes at end of economic lifetime
- Heat decarbonisation: potentially little economic incentive, thus effective heat phase out dates may need to be structured differently.

Rationale for change

- Many transitions underpinned by a compelling socio-economic rationale
- Less co-benefits associated with heat decarbonisation: heat decarbonisation is fundamentally different

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Thanks for listening,

any questions?

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