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Transitioning to a low carbon energy system: network transition challenges

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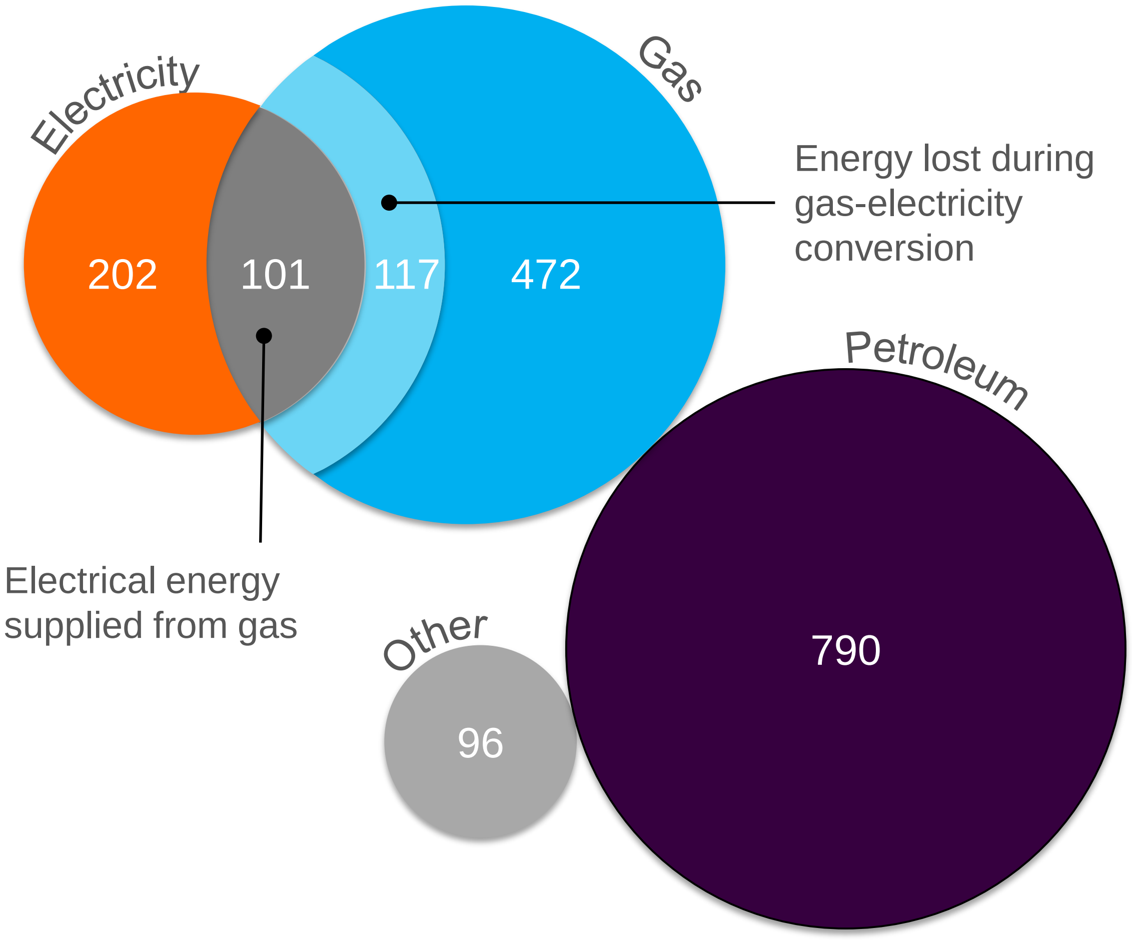
Energy networks as a part of the energy system

- Energy networks are a core part of a functioning energy system – enabling the right amount and type of energy to be delivered to where and when it is needed

- Long term changes are expected for:
  - energy generation type and geographic location
  - demand patterns and energy use requirements

- The UK's energy network infrastructure will need to evolve to manage these fundamental long term changes



Energy carried by networks in the UK (TWh/yr)

Estimated from data published by DECC (2014)

Energy system scenarios

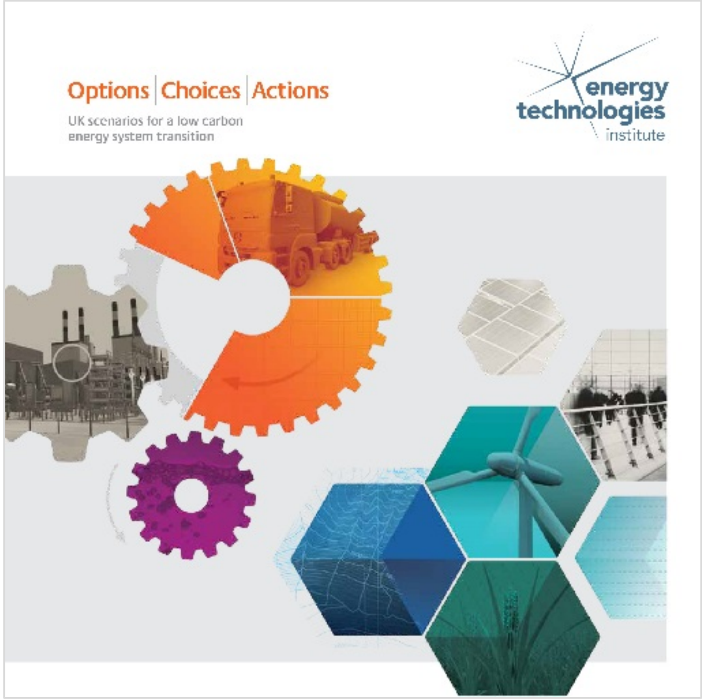
energy technologies institute

***Clockwork** – national level, coordinated planning for the energy system*

- Large scale investments in centralised thermal power generation (nuclear and CCS) alongside deployment of renewable generation
- Increased electrification of heat and transport
- Deployment of large scale heat networks
- A phased shut-down of the local gas distribution network
- Hydrogen used as a fuel for generating electricity at peak times
- Gas used for industrial process heating in conjunction with CCS

***Patchwork** – locally led development and implementation of energy strategies with strong societal engagement*

- A prominent role for renewable generation (large scale and distributed) with a continued role for large thermal power generation
- Increased electrification of heat and transport.
- In different areas, the gas distribution network is either:
  - decommissioned
  - retained as backup to heat pumps
  - utilises significantly decarbonised gas supply
- Small and medium scale heat networks are deployed in some towns and cities
- Hydrogen is used for industry, in the transport sector and to support peaking generation



Available at:
http://www.eti.co.uk/insights/options-choices-actions-uk-scenarios-for-a-low-carbon-energy-system/

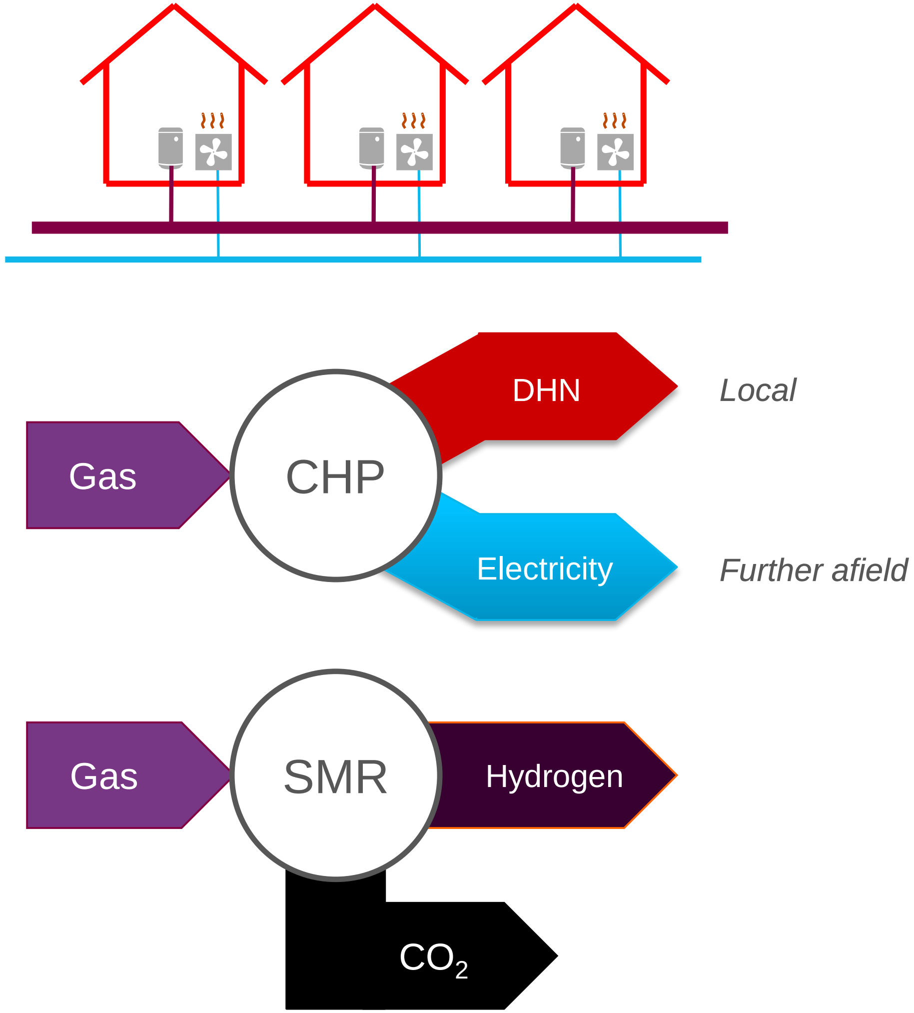
Or search for: ***ETI scenarios***

Network transition challenges

Adapting and enhancing existing networks	Electricity	Handling increased capacity
		Delivering new connections
		Balancing supply and demand
Creating efficient and effective new networks	Gas	Decommissioning (especially within the distribution network)
		Operating at much lower utilisation
		Integrating low carbon fuels at significant levels
Integrating networks to optimise performance across energy vectors	Heat	Cost reduction and technology advancement
		Supply-chain scale-up
		Adoption
	Hydrogen	Meeting the needs of different sectors
		Scale-up

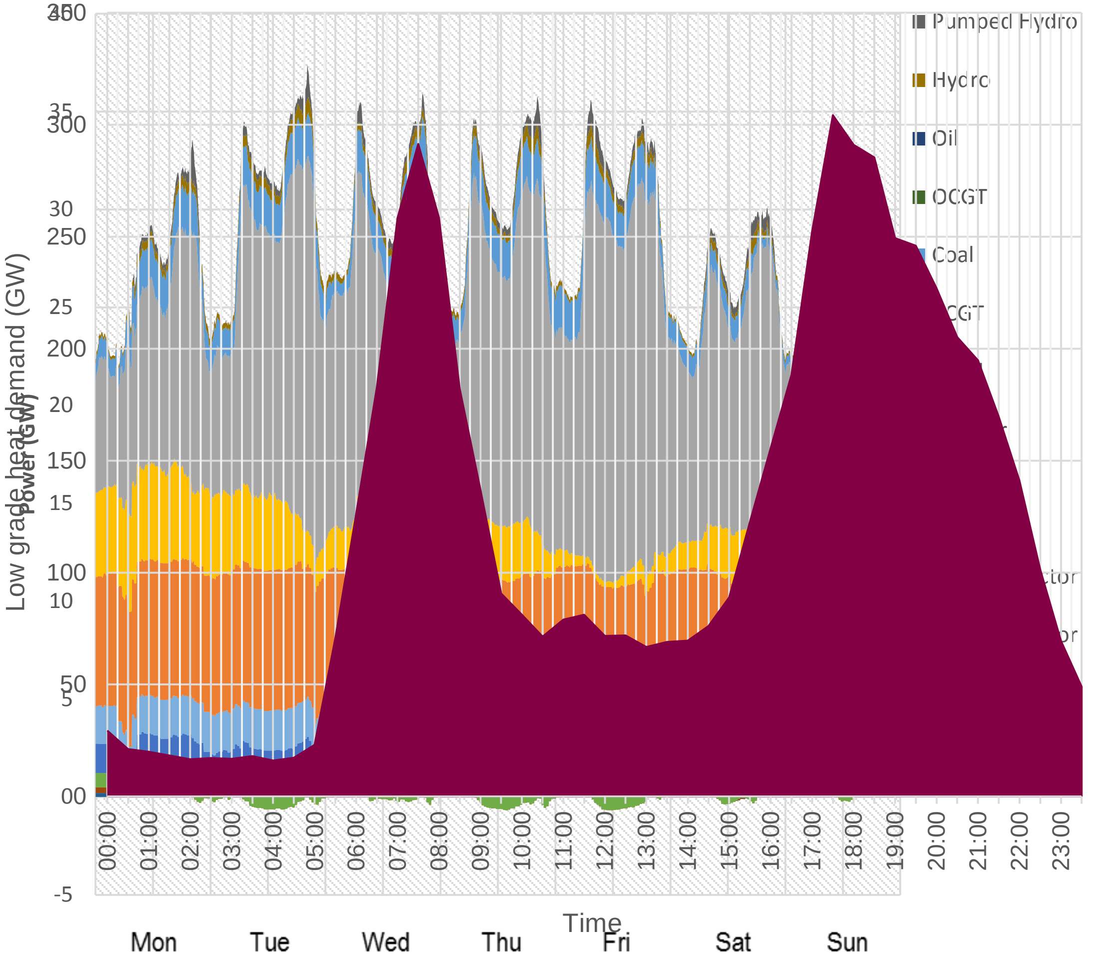
Integrating networks to optimise across energy vectors

- There are multiple instances where, in future, increased integration between networks could yield benefits
- Interdependencies could arise in terms of:
  - How networks develop
  - How networks are operated
- Understanding the value of these approaches will come from:
  - Quantifying the scale of the benefits they can offer
  - Understanding the wider technical and operational implications for each network
  - Identifying the barriers to integration and, if need be, where potential innovative solutions might be necessary



Balancing supply and demand

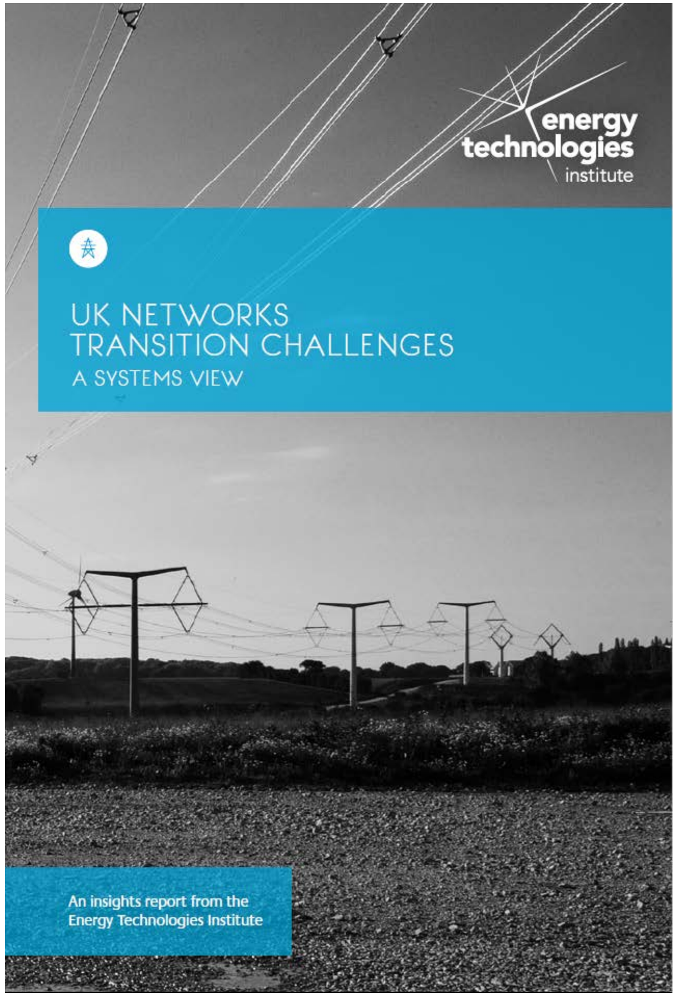
- Flexibility (keeping supply and demand in balance) is a key feature of a functional system.
- Energy storage is one means of providing system flexibility
- The ability to provide storage varies amongst the network types:
  - Gas, hydrogen and heat networks all have a level of inherent storage (e.g. line-packing in gaseous pipeline networks); whilst dedicated storage is relatively low cost
  - Electricity supply needs to be in real-time balance; and electricity storage is generally expensive
- Future flexibility options extend beyond just grid-connected electricity storage, for example:
  - Gas and hydrogen fuelling peaking plant to help balance electricity supply
  - Heat storage in homes allowing the load on electricity networks to be reduced at peak times
  - Gas as peak support for heat pumps
  - Managed charging of plug-in vehicles
- How applicable and successful these are also affects the extent to which storage is needed

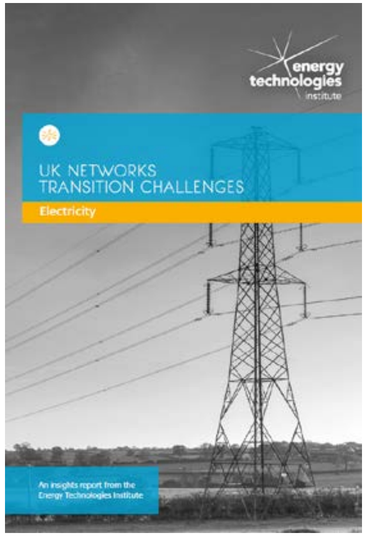


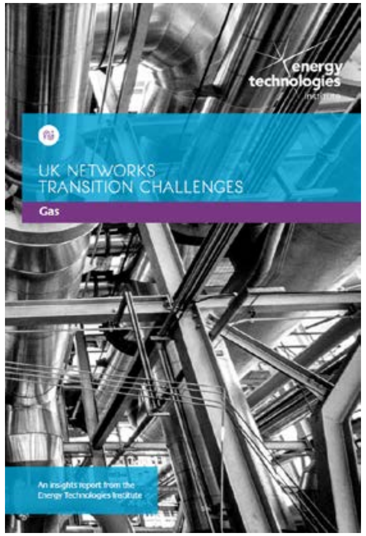
Final thoughts

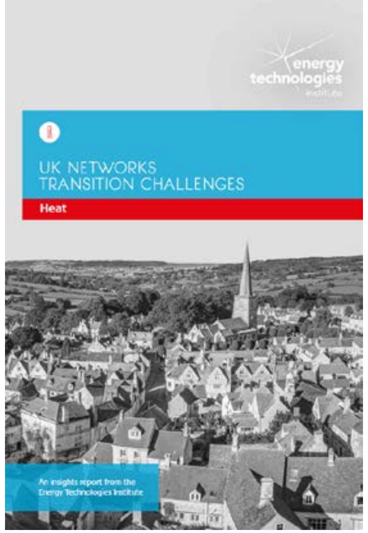
- Energy networks are a vital part of the energy system
- Over the next decade, decisions will be needed about:
  - which existing networks to enhance or adapt,
  - which new networks to create and
  - how new and existing networks can be integrated to optimise across the whole energy system.
- Factors that will need to be considered, include:
  - Changes in how energy can and will be generated and consumed
  - The ability for different networks to meet needs individually and in unison
  - Transition pathways for generation, demand and the networks that link them
  - Network lifecycle and investment opportunities
- Making robust choices is important as networks can take years or even decades to build; and once they're built cannot easily be moved or changed
- **Systems thinking is critical** which means across vectors and up and down the energy supply chain.
- Current governance and regulatory frameworks are simply not designed to enable and incentivise the radical transformation needed
- Decisions should also be based on well evidenced data and analysis.
- The next decade is critical to develop the evidence, through ongoing research and demonstrations at increasing scale

Available on the ETI's website



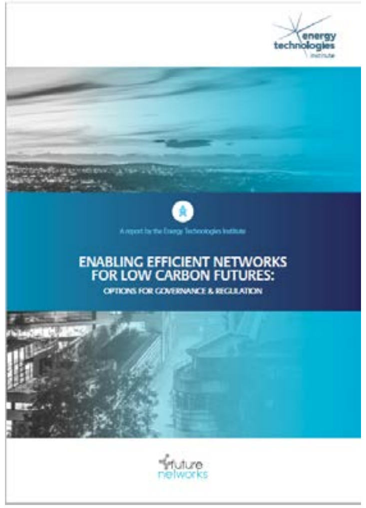






Available at: http://www.eti.co.uk/insights/uk-network-transition-challenges-a-system-view

Or search for: ***ETI network transitions*** or ***network transition challenges***



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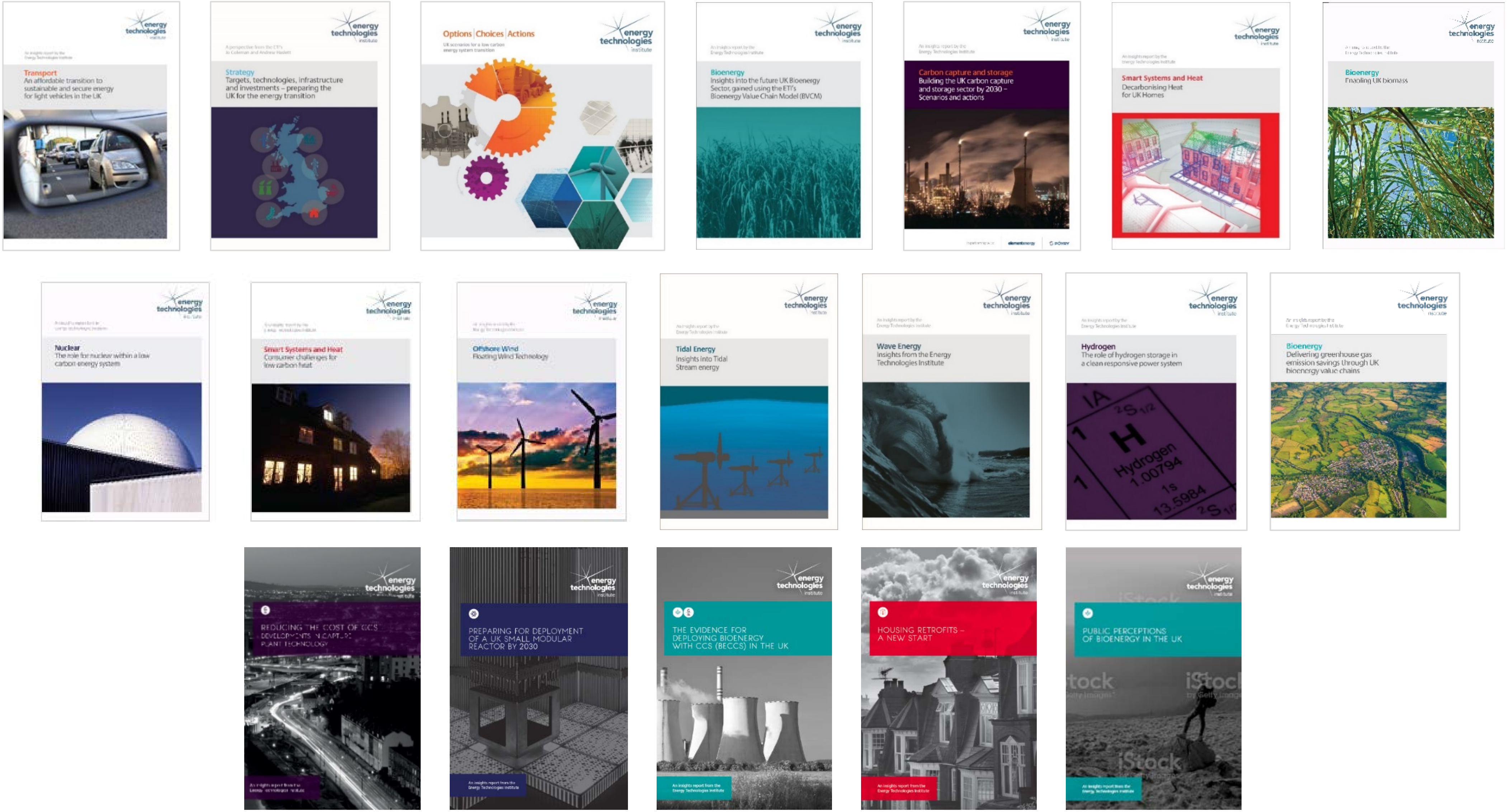

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