

We're going to burn what? H_2 for heating in the UK

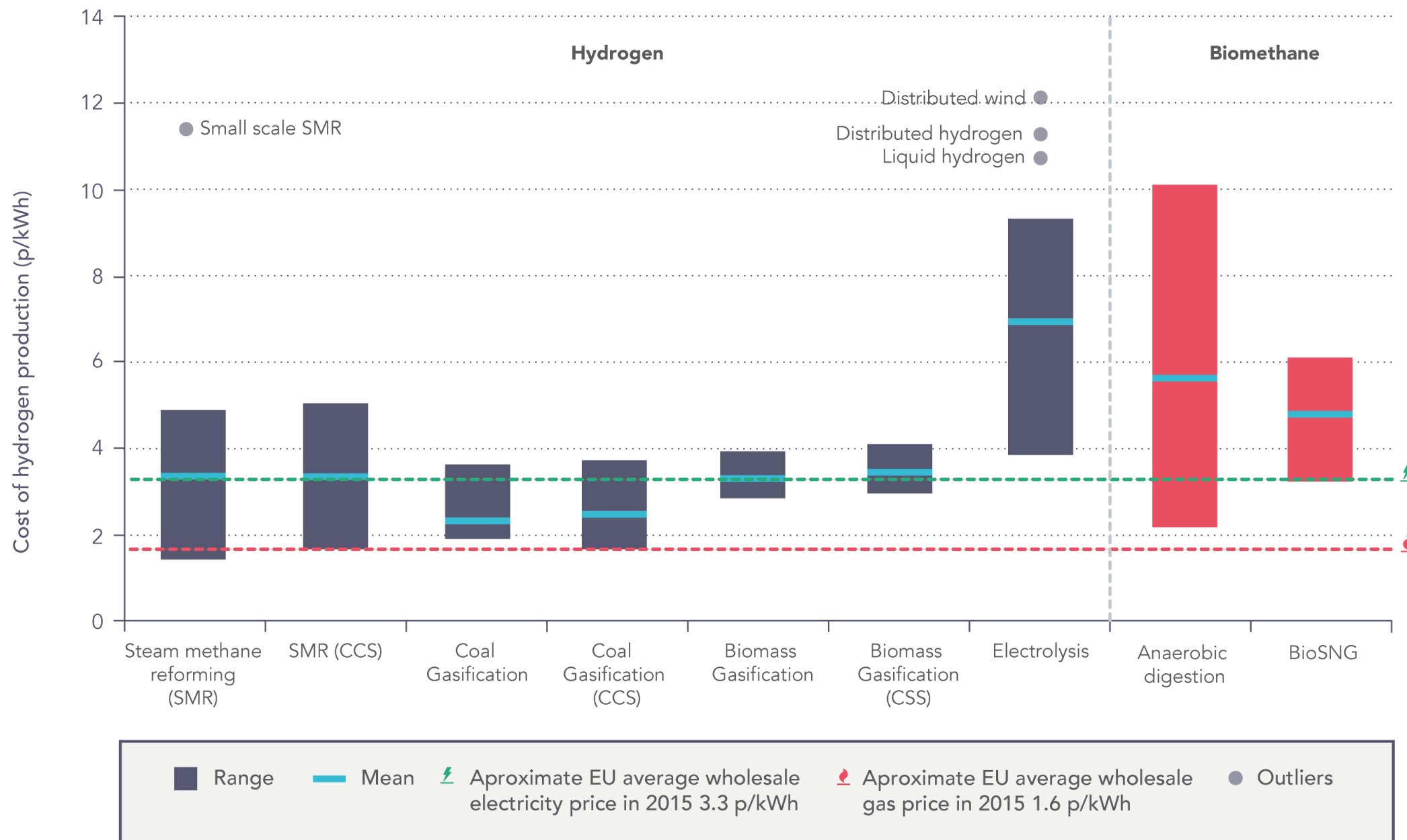
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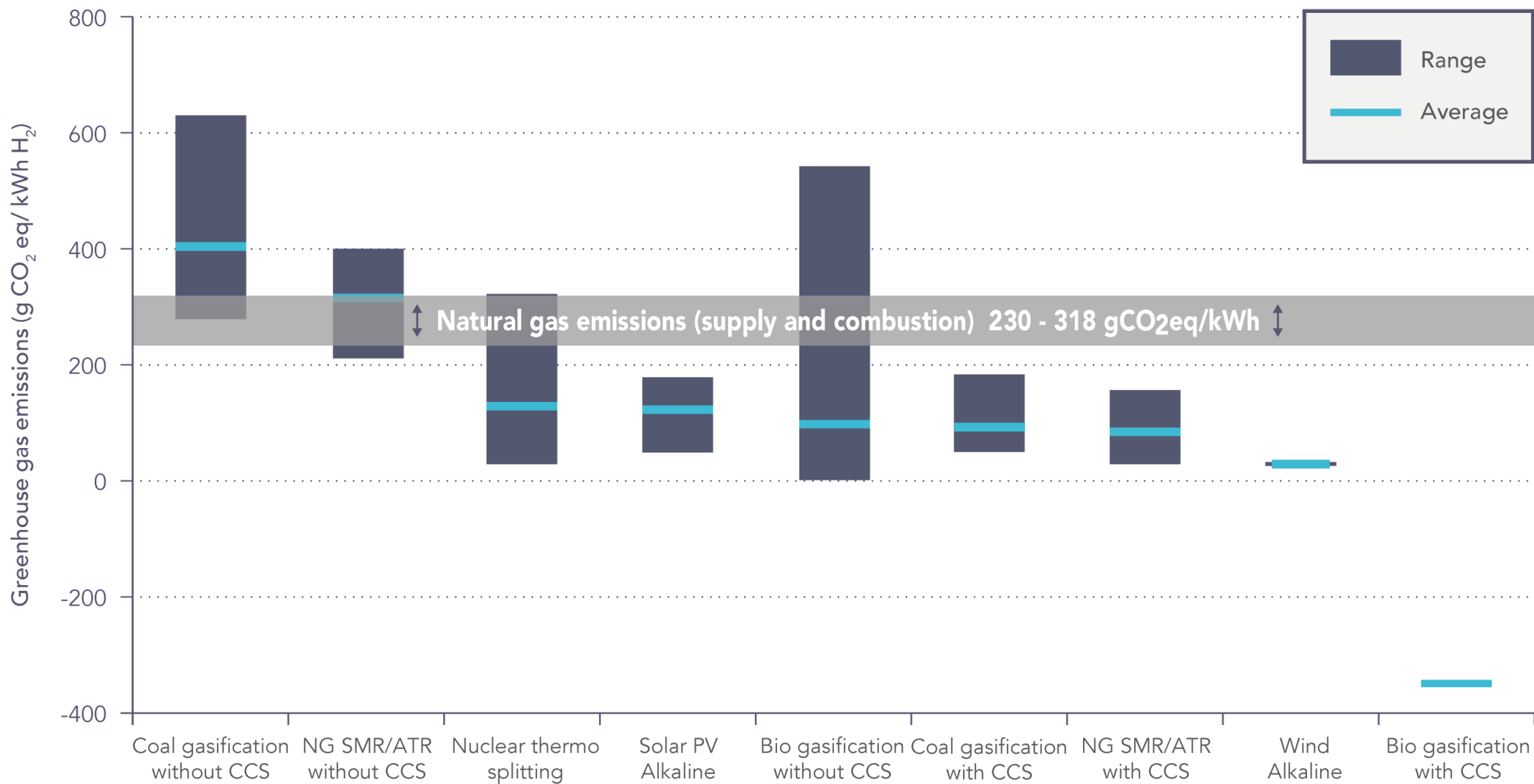


- Hydrogen for heat – economic/environmental comparisons
- Hydrogen infrastructure
- Hybrid solutions
- H₂ for heat **and CCS?**

Economic Performance

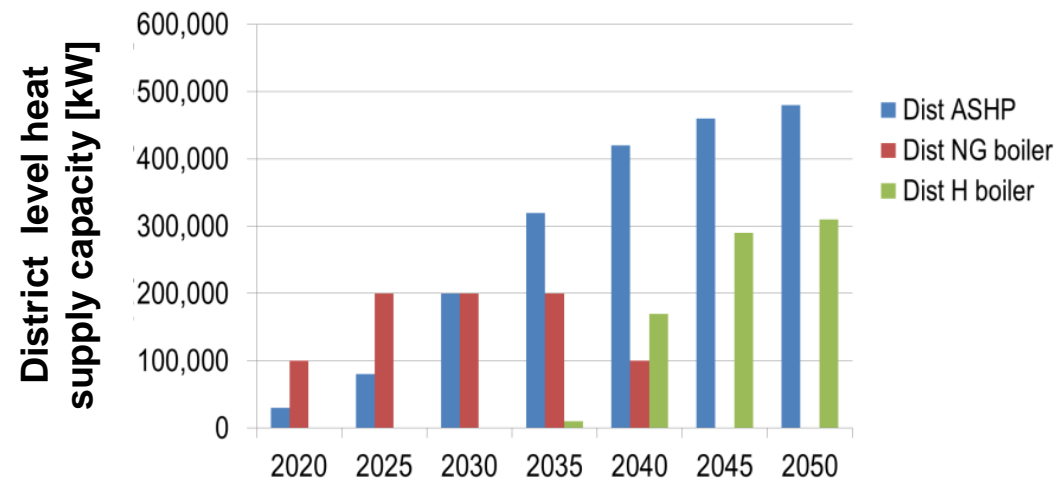
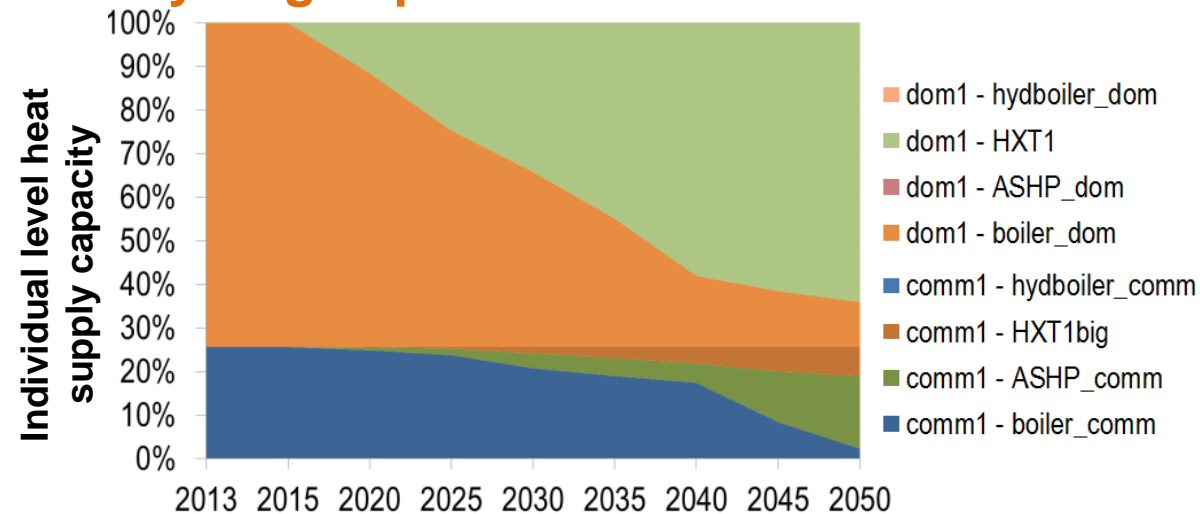


Environmental Performance

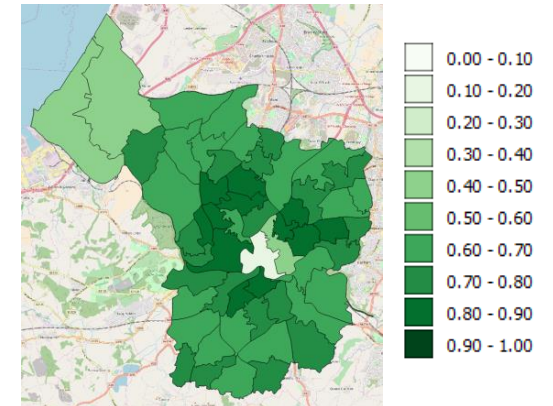


Independent H network + gas network decommissioning

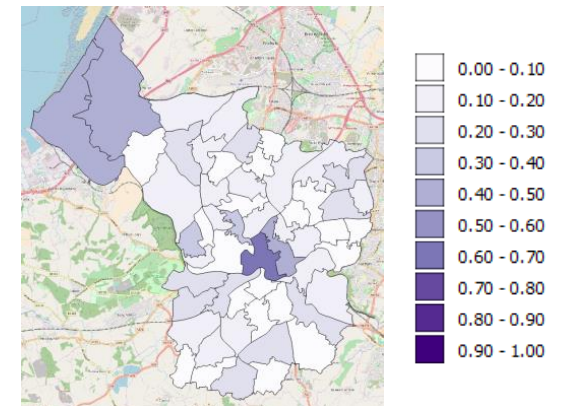
Low hydrogen price



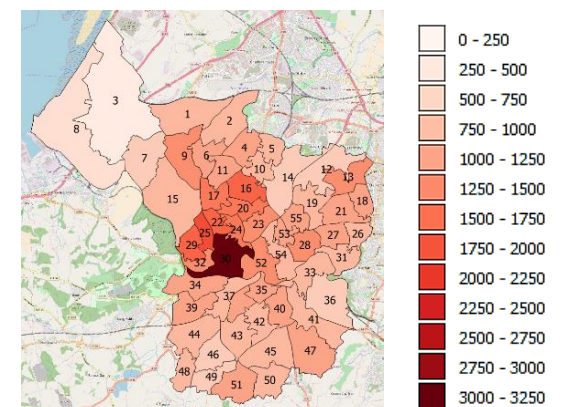
Heat
network
penetration
by 2050



Air-source
heat pump
penetration
by 2050

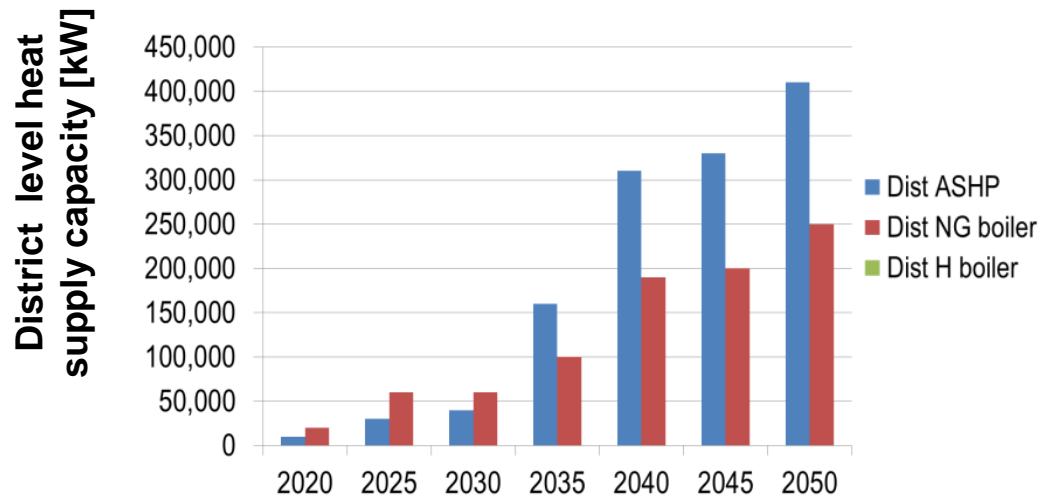
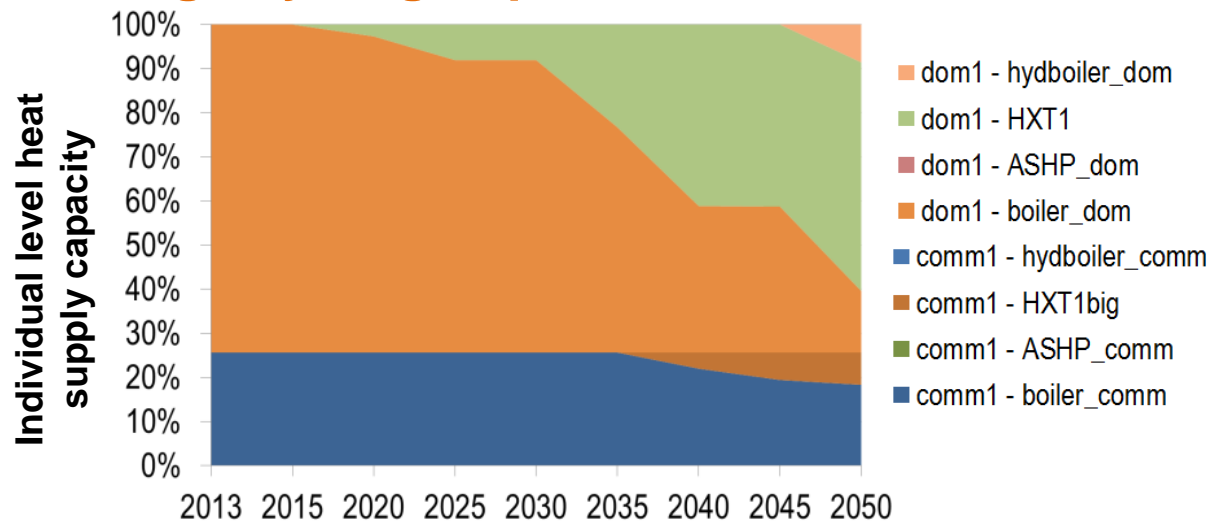


Linear
heat
density
[kWh/m]

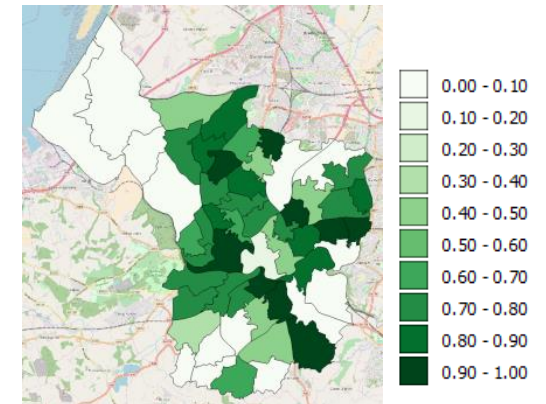


Retrofitting gas network + gas network sunken cost

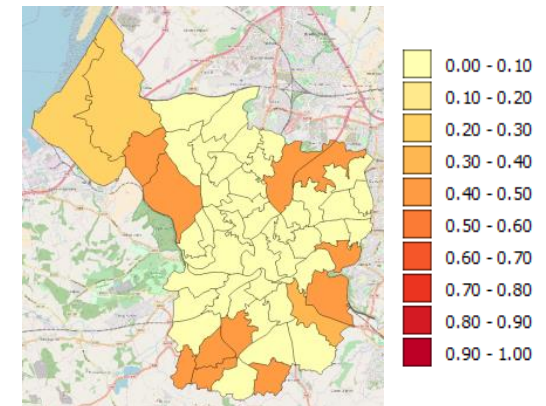
Average hydrogen price



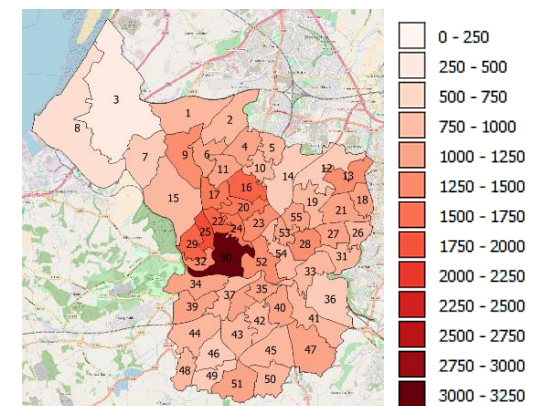
Heat
network
penetration
by 2050



Hydrogen
boiler
penetration
by 2050

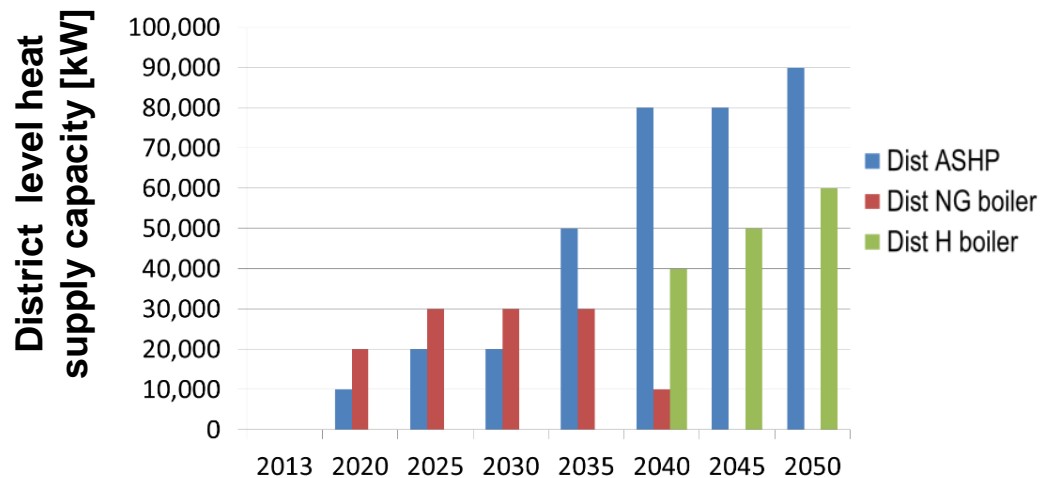
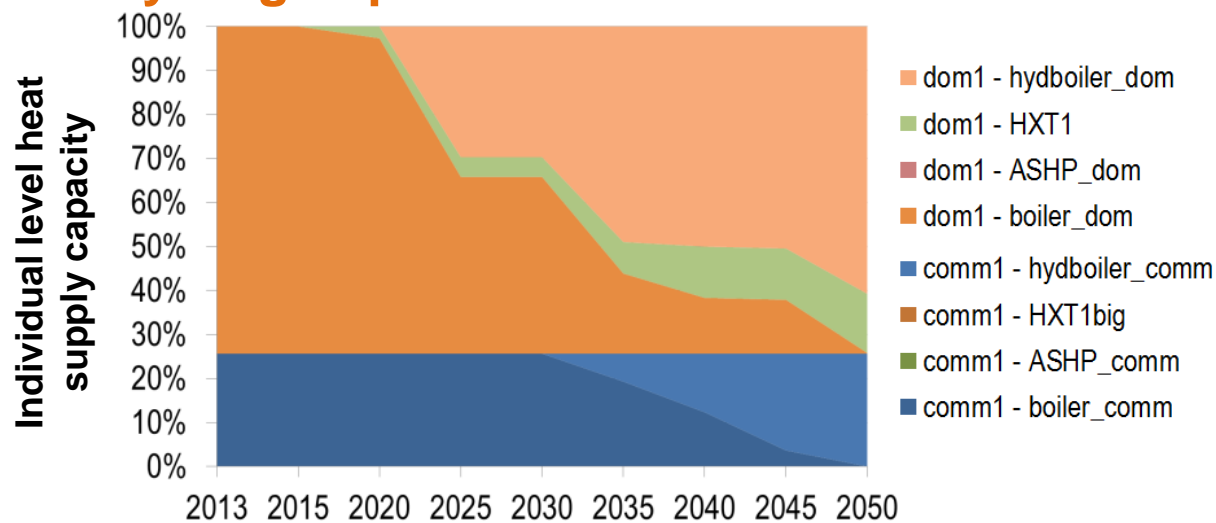


Linear
heat
density
[kWh/m]

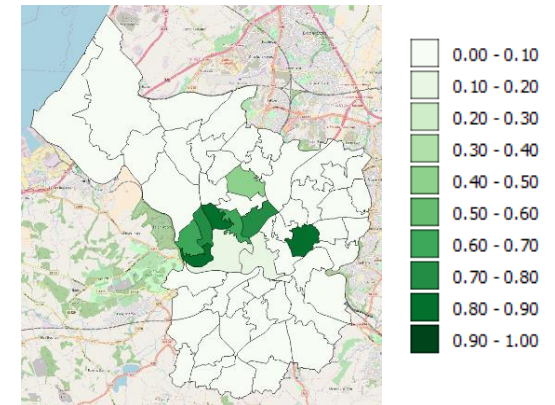


Retrofitting gas network + gas network sunken cost

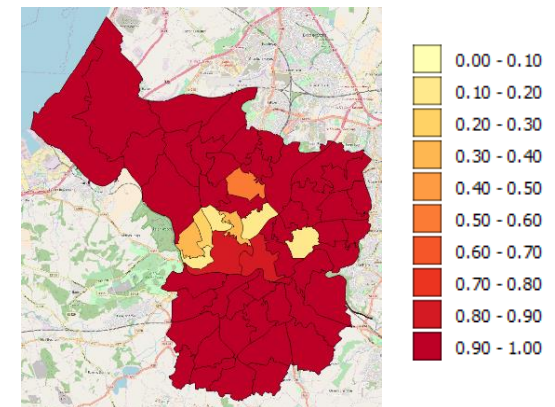
Low hydrogen price



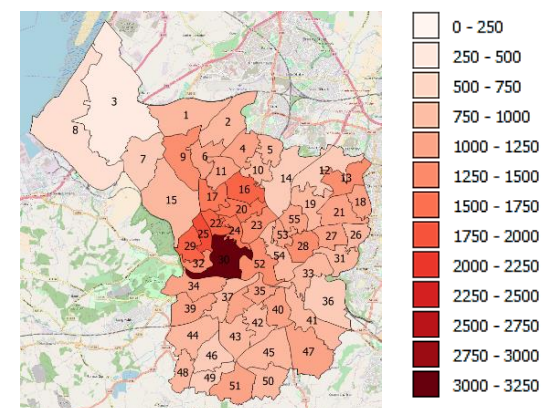
Heat
network
penetration
by 2050



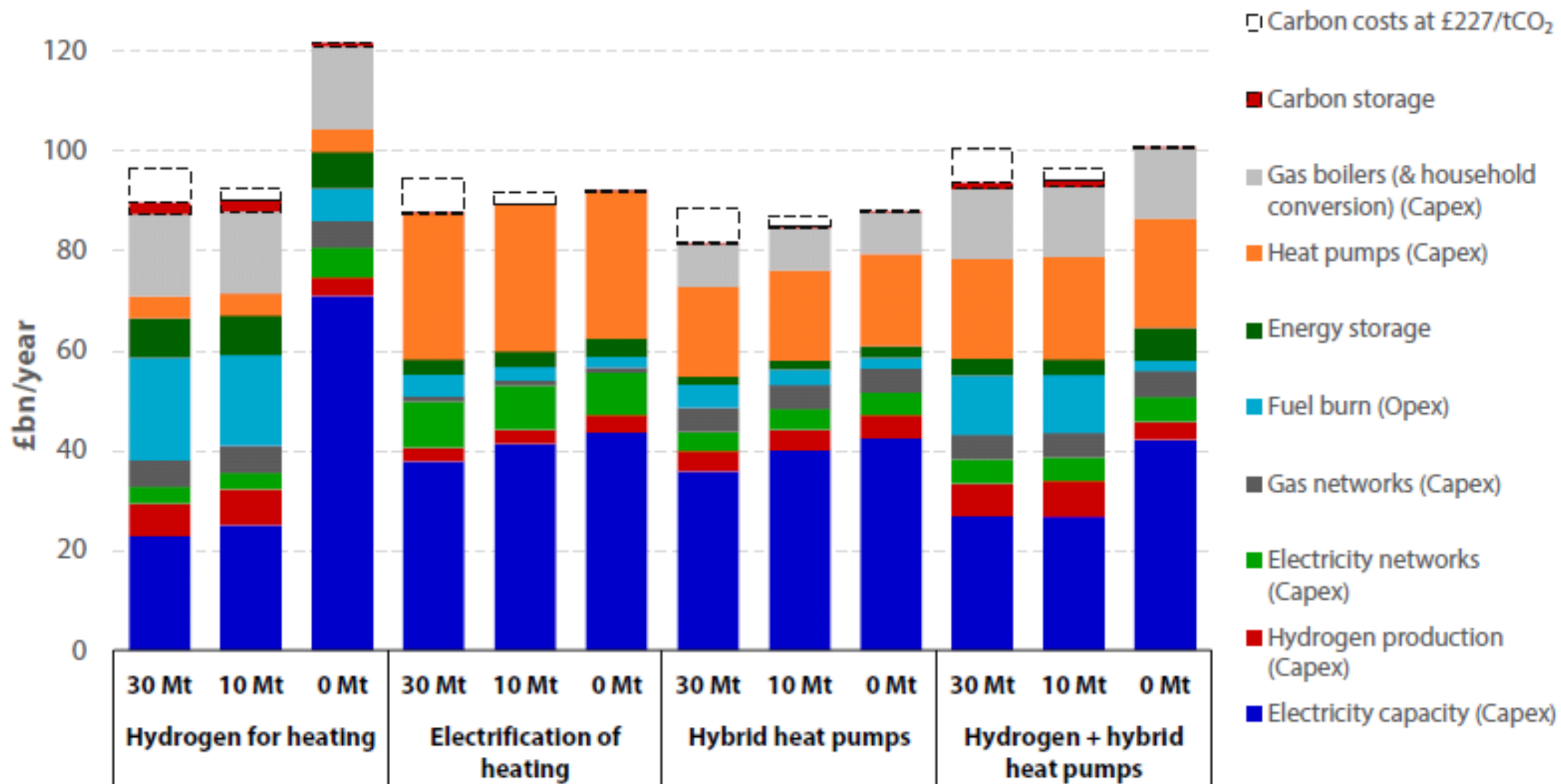
Hydrogen
boiler
penetration
by 2050



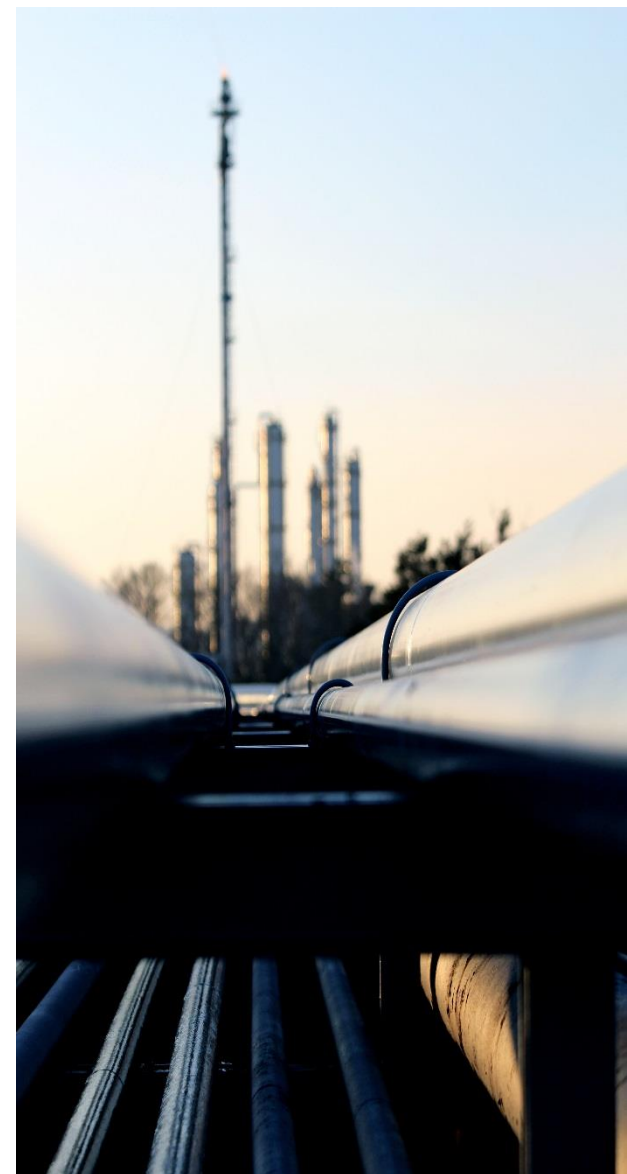
Linear
heat
density
[kWh/m]

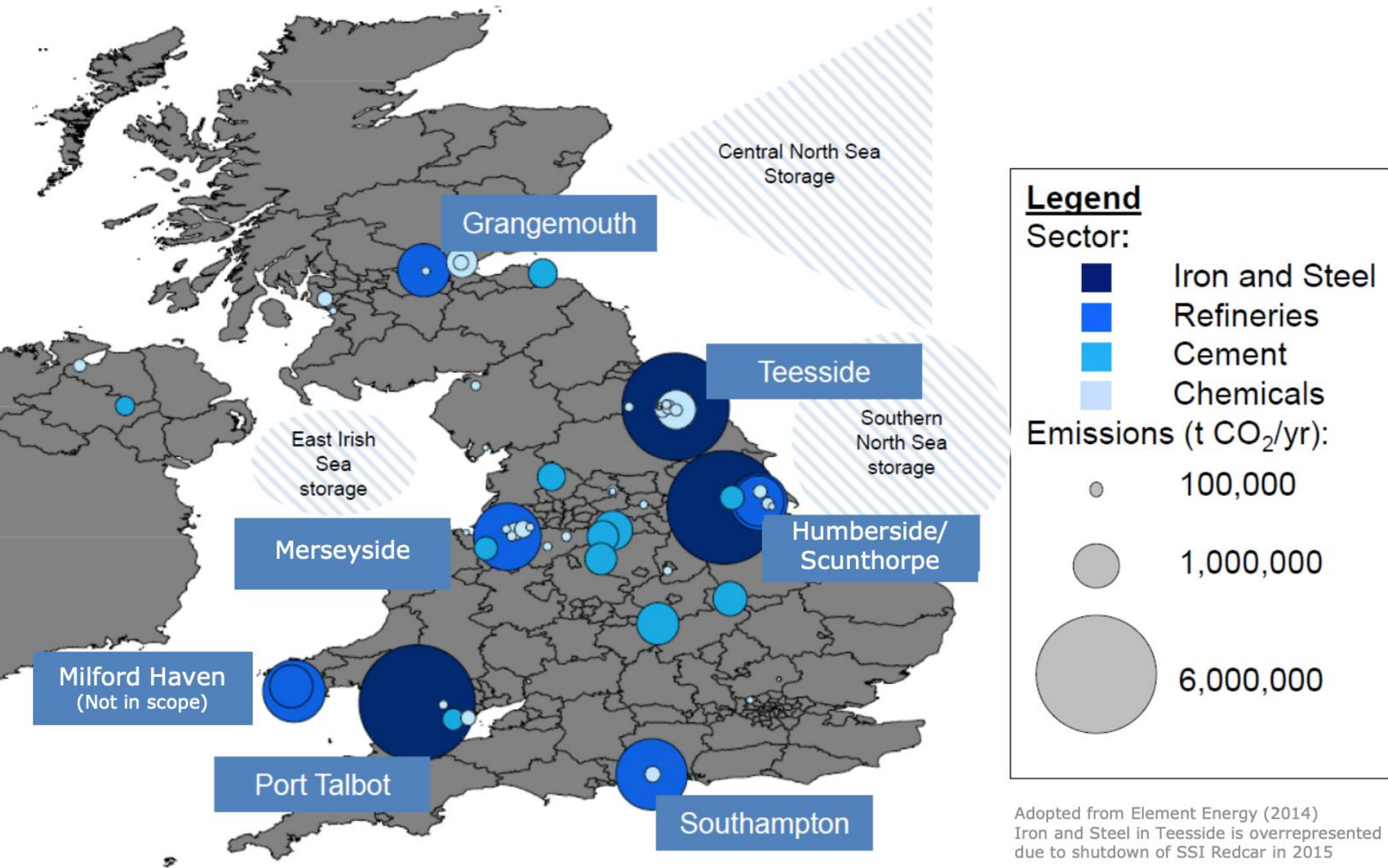


Hybrid solutions?



- Wave 1: UK's first CCS demonstration project - £1bn available - expected operation 2014. Four bidders pre-qualified:
 - BP, E.ON, Peel Power / RWE, ScottishPower
- Wave 2: 2012 £1bn still available, CfD operational support.
 - SSE/Shell Peterhead
 - Capture Power White Rose





Adopted from Element Energy (2014)
Iron and Steel in Teesside is overrepresented
due to shutdown of SSI Redcar in 2015

- **Acorn CCS**
- Caledonia Clean Energy – CCGT with post combustion capture, Grangemouth location, existing onshore/offshore pipelines, Captain sandstone formation (North Sea) injection – existing assets
- **HyNet North West**
- H21 North of England – 12.15GW H₂ production facility (with CCS), Teesside location, 22 billion pounds.
- Teesside Collective – existing CO₂ sources (I&S, chemicals, etc) – Captain aquifer, Bunter aquifer.
- BECCS pilot plant at Drax Power Station – BECCS pilot already operating, aiming to scale up.

- Without CCS, the costs of Net Zero target rise from 1% to 2% of GDP. Strong social case for support.
- One of the most favorable environments globally for CCUS, but the technology has suffered from years of turbulent policy support.
- 3rd wave new approach – many projects – step by step approach – collaboration not cooperation? Added risk of H₂?
- Technical barriers are low, challenges are commercial. But also a concern about attracting investment – political risk ranks highly!
- World-leading well-understood storage resource.
- Advice to government almost unanimous – CCS is needed

- Strategic vision with credibility: What timescale and pathway for CCUS deployment?
- Government clarity: What level of cost reductions is necessary?
- Business models: separate capture, transport, storage businesses? Regulated Asset Base for transport/storage?
- How to balance risks/liability to (a) avoid rent seeking, (b) ensure quality delivery? Government takes on uninsurable risk until they are better understood?
- 3rd wave of CCS in the UK is at risk until these points are resolved.

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