Innovating to Net Zero

Energy Systems Catapult

This report from the Energy Systems Catapult aims to inform thinking on the UK's Net Zero trajectory, specifically on the need for innovation and scale-up across three areas – Low Carbon Technology, Land Use and Lifestyle.

Crucially, the report finds that Net Zero can be reached by 2050, but that 'unprecedented innovation' in new technologies, business models, consumer offerings and market design will be required.

In order to provide a wider picture of potential action, the report looks at two broad pathways, clockwork and patchwork:

- **Clockwork:** Broadly, this is a centralised pathway, where Government will drive long term investment in the nation's strategic energy infrastructure. The modelling predicts that owing to national policy decisions, industry will be the main innovators, with individual consumers needing to make more modest actions.
    - This scenario would most benefit biomass with carbon capture and storage (CCS), wind and nuclear, owing to a more supportive national policy environment.

- **Patchwork:** Conversely, this is a more decentralised pathway, with regional low carbon strategies playing a greater role. They envisage that national policy would not extend significantly beyond nuclear power stations, leading to a greater popularity of renewables (offshore wind, distributed solar PV etc).
    - This scenario places a lesser role on biomass owing to the lack of national certainty, meaning it is unable to grow.
    - Under this pathway, and its decentralised nature, the population is more engaged, meaning they predict greater lifestyle changes and cuts to meat consumption.

Sector specific analysis

Bioenergy

Bioenergy and CCS are both essential to delivering Net Zero

- With a Net Zero target, failure to deploy either option means foregoing the negative emissions essential to offsetting continued demand for aviation and livestock products.
    - This is different from an 80% trajectory for Greenhouse Gas (GHG) reduction, which could be reached without these options, albeit at a higher system cost.

Land use must be optimised to balance carbon sequestration with other priorities

- Both pathways of the report assume an expansion of forestry from 13% today, to 18% of UK land by 2050, or 4.8 million hectares.

- New forestry will act as a carbon sink during its growth. Allowing for this, and assuming steady tree planting over the 30-year period, this expansion would provide carbon removals of -22 MtC02 annually in 2050.

Dedicated biomass crops are an important part of a cost-effective system

- Biomass crops have a dual benefit, owing to the fact they sequester carbon whilst growing, as well as an energy benefit whilst harvested – this leads to a near carbon neutral resource.
  - Also, due to the crops being harvested, they will not have the same levelling out of sequestration as is seen in forestry.
- They also predict an increase in UK sourced biomass, from what they call a negligible level today. They say this could cover 1.4 million hectares by 2050, with a sequestration impact of -34 MtCO2 by 2050.
- They do also place a role in biomass impacts, but limit this to 34TWh of generation by 2050, "reflecting international competition for this scarce resource". This provides a further -9 MtCO2 in 2050, totally -65 MtCO2 annually in 2050 for biomass.
- They suggest this resource can be used for simple combustion for power or heat, or through conversion to liquid bio-fuels, bio-methane or later down the line, hydrogen (although say CCS will be more important for these).

Bioenergy to only play an early role in decarbonisation of heat

- The report predicts that retrofitting of homes, electric heat pumps, hydrogen boilers and district heating will play the strongest role in the decarbonisation of heat.
- They predict a role for bioenergy, but only in the use of Combined Heat and Power (CHP) plants to provide heat load in the short term.
- Following this, they predict a changeover to hydrogen boilers (with hybrid in some areas) and electric heat pumps and district heating where applicable.

Advise to Government and Policymakers

- Deepen the evidence base around optimal land use and land management to improve yields, maintain soil quality and biodiversity.
- Improve biomass feedstock improvement techniques to remove impurities prior to energy conversion.
- RD&D of biomass conversion technologies, especially gasification for hydrogen production.

Storage

Energy storage will be necessary for system balancing

- Because of greatest intermittent renewable penetration, Net Zero pathways will have a greater requirement for system balancing. This can be achieved through supply side flexibility, demand side flexibility and energy storage in various forms.

- By 2050, the report findings that there needs to be between 29 and 35 GWh of non-fossil energy storage, depending on pathways.

Industry

Government should prioritise industrial decarbonisation

- This would include developing rewards for delivering verified negative emissions. The report says this will substantially improve investor certainty for CCS, domestic biomass supply chains and hydrogen production.
- This should be facilitated through direct support for innovation and early deployment of CCS and hydrogen production in industrial clusters.

Hydrogen

The deployment of hydrogen is more important under a Net Zero target

- Under an 80% reduction in GHG emissions by 2050 target, around 100TWh would need to be produced, but under a Net Zero target, this would mean a range of 200 – 300 TWh. This is because of the additional need to decarbonise heavy transport and shipping.
- The report looks at the uncertainties around hydrogen production, saying that biomass gasification is currently not scalable, and speculative innovation measures sure as steam methane are not economically viable.
    - It concludes that electrolysis is preferred, but due to its higher costs it will be a less appealing option overall.