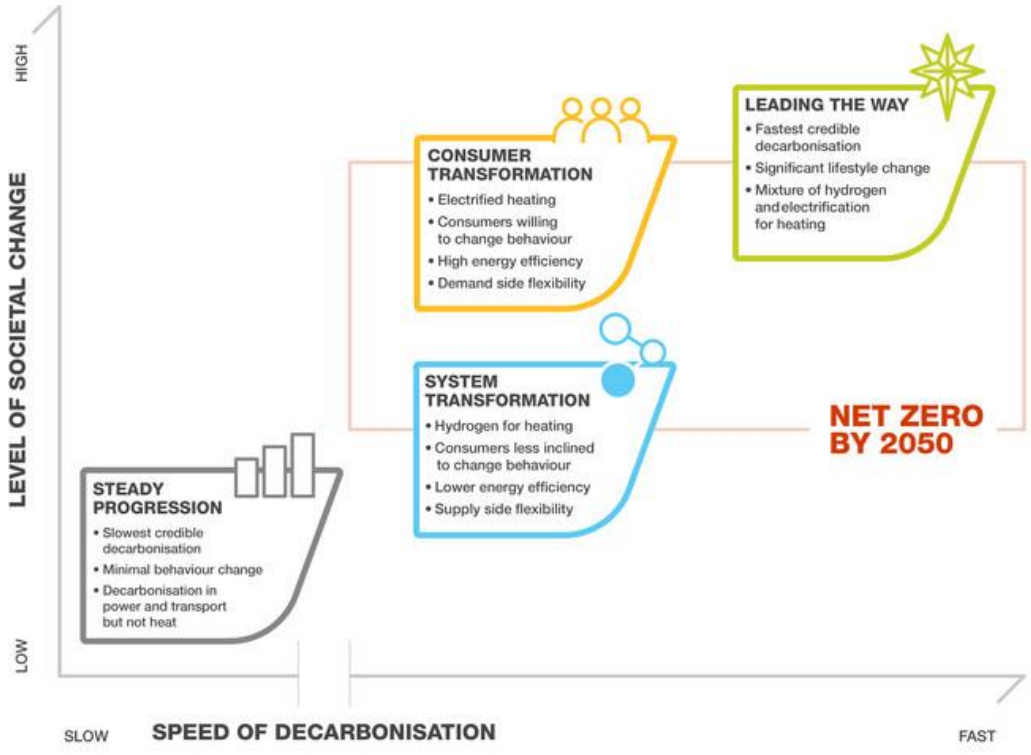
REA Members Briefing
National Grid ESO – Future Energy Scenario 2021

The National Grids Future Energy Scenarios 2021 (FES 21) is an annual release which models how UK energy systems are likely to change up to 2050.

The report focuses on four main scenarios, three of which mange to decarbonise the energy system inline with the UK's net zero ambitions.

The FES Scenarios:



Below we highlight the key takeaway messages for the decarbonisation of heat, power, and transport.

Power - Key Takeaways

The report states that power sector carbon emissions are expected to fall rapidly in the early 2020s in all scenarios.

- The power sector gets to net negative emissions by 2032 in Leading the Way and Consumer Transformation and by 2034 in all other scenarios.

- The UK power sector emitted 66 MtCO2e in 2018.
- In the best-case scenario BECCS for the power sector are responsible for the majority of negative emissions, providing -34 MtCO2e.
- All report scenarios see the power sector, led by wind and solar, reaching zero emissions in the early 2030's.

The report argues achieving the 40 GW target for offshore wind by 2030 will be difficult.

- Offshore generation requires infrastructure to bring the power onshore and to move it to demand centres.
- Best case scenario 40GW is met by 2030, worst case 2035, nevertheless this is faster than FES20.
- Offshore wind could reach as much as 113GW by 2050.

Maximum uptake for solar generation has increased substantially since FES20 report.

- Producing hydrogen can mitigate the impact of low daytime power prices when there may be too much renewable generation.
- Uptake of solar panels is expected to increase through the late 2020s.

The report believes Bioresources, paired with Carbon Capture and Storage, have an important role to play in decarbonising power

- Power generation accounts for more than half of bioresource demand in all scenarios
- The maximum amount of bioresources used in 2050 is 246 TWh, in the System Transformation scenario.
- Here, over 85% of the bioresources are used for either power generation
- The UK's largest biomass power station produces 15 TWh of electricity each year
- Plant biomass makes up the majority of bioresources, however at present 82% of biomass is imported.

The report argues natural gas must be phased out to decarbonise power

- Power makes up 22% of natural gas demand
- In the most ambitious scenario, natural gas is completely eliminated by 2035
- Power stations burning natural gas can respond quickly to changes in demand
- Gas power sector emission projects have decreased since FES20

The report argues electricity storage will become increasingly important as levels of renewable generation increase

- Falling costs of batteries and changing system needs mean we expect greater use of batteries that can deliver maximum power output for two to four hours.
- CAES and LAES all typically see much more energy stored compared to power output

Heat Pillar - Key Takeaways

The report shows heat pumps, district heating and hydrogen boilers are all needed; however biomass heat is disappointingly left out. Their distribution is driven by factors such as infrastructure availability and consumer choice.

- Using hydrogen to generate electricity for heat pumps is the most efficient process.

The report argues the commercial sector is more straightforward to decarbonise than the industrial sector.

- Most emissions come from heating and lighting, which can be reduced by investing in efficient lighting and low carbon heating.
- In contrast, industry is difficult to decarbonise, because of their reliance on heat for processes.

The report notes Current peak heat demands in winter are several times higher than peak electricity demands.

- As more heat demand is met by the electricity system, electricity demands will become more sensitive to the weather.

The report has the following findings in regard to heat pumps:

- Even Steady Progression, the slowest model, shows 1.9 m heat pumps connected by 2030.
- In the best-case scenario, 600,000 heat pumps are installed per year with 2.6 million by 2025.
- Thermal storage devices alongside heat pumps can release energy at peak times to reduce electricity demand from heating by up to 35%.
- Retrofitting homes with heat pumps will dramatically reduce demand for natural gas.

The report has the following findings regarding hydrogen:

- Storage is as important as production to get the greatest benefit from hydrogen.
- Government intervention is needed to help deliver production facilities and encourage demand.
- Hydrogen boilers are likely to be around 3 times less efficient than a heat pump.
- The retail price of the hydrogen used as a fuel is expected to be only about two thirds cheaper than retail electricity prices on average.
- Heat pumps are influenced by the availability of alternative technologies.
- In most scenarios the gas network is retrofitted to carry hydrogen, however grid connection varies by location, disadvantaging rural and off-grid homes.
- Biomass gasification to produce hydrogen, combined with CCUS for the CO2 emitted, makes up almost 10% of hydrogen supply in System Transformation.

The report disappointingly lacks biomass heat:

- Biomass heat is identified as having a small role in all scenarios, including both residential and Industrial & Commercial applications. The Leading the Way scenario sees the largest damned for bioenergy in heat use, although demand still well below biomass demand for aviation, hydrogen production or power generation.

Transport Pillar - Key Conclusions

The report expects road transport reach zero or almost zero emissions by 2050 across all scenarios.

- In 2018 surface transport emitted 115 MtCO2e.2
- Even in the slowest decarbonising scenario, it suggests no new cars with internal combustion engines will be sold after 2040.
- This means all cars on the road will be ultra-low emission by 2050 at the latest, resulting in at least a 60% reduction in energy demand for road transport.
- Total demand for road transport in 2050 is 133 TWh.

The report expects modes of transport, such as aviation and shipping, to use hydrogen and bioresources to some extent in all net zero scenarios.

- Lorries emit around 17% of emissions from the transport sector in 2019.
- All scenarios expect lorries fully decarbonised by 2050.
- By 2050, trains mostly use electricity as the energy source in all but the worst case scenario.
- Synthetic fuels replace traditional jet fuel in aviation. In all scenarios, 10 TWh of synthetic fuel is used. A further 41 TWh of biofuel is used to create bio-jet fuel with BECCS.

Hydrogen plays strong but limited role in transport decarbonisation in the report.

- Hydrogen mostly used for HGVs which rely on regional refuelling.
- Hydrogen converted to ammonia beginning in 2030 for shipping and used in place of heavy fuel oil.

The report expects BEVs, smart charging and V2G uptake will increase helping to manage higher renewable supplies on the electricity system.

- This combined flexibility could lead to up to 32 GW of peak shaving in Consumer Transformation by 2050.
- Smart charging will be an effective tool to support electricity networks.
- Best case scenario has over 80% of consumers engaged in smart charging by 2050.
- Bi-directional charge costs expected to fall in all scenarios.
- Providing flexibility from smart charging and vehicle to grid can keep costs low.
- Smart charging to keep additional peak electricity demand from electric vehicles to between 7 and 16 GW lower.

- Smart charting of BEVs expected by mid 2040s.
- Wider use of Time of Use Tariffs (TOUTs) is triggered by having an EV. TOUTs incentivise EV charging at times when flexibility is needed.

The report believes Consumer behaviour will play a large role in transport decarbonisation.

- Smart meters, time of use tariffs and automation will make the experience simple for the consumer
- Amount of time consumers keep their cars before replacement will impact decarbonisation.

July 2021