
Reviewing Low Carbon Technologies in the UK

About Me

LinkedIn Page: <https://www.linkedin.com/in/sam-godden-922317325/>

Sam Godden:

Passionate individual studying an environment sustainability and climate change HND at the University of Wales Trinity St. David, with a particular interest in sustainability and conservation. I am also fervent lover of the outdoors with eight months experience in international voluntary work (Indonesia), supporting waste management, reforestation, and education tasks.

Through my course (including a visit to Hinkley Point C), I have become fascinated with how the UK manages its growing demand for clean energy, given the unique environmental and economic climate. Within this undertaking, is an array of different professions, all working to devise practical solutions for the energy industry, with the ultimate aim to preserve the environment and economy for the next generations to come.

This blog post aims to broadly summarise the current technologies concerning this issue (with particular attention given to sustainability), as well as some of the practical challenges with implementing them. Finally, it provides an overview of the current and future outlook in relation to the 2050 net zero target.

Traditional Energy Sources

The UK is well known for its industrial heritage and widespread use of fossil fuels (Watton, 2025). Up until the late 1960s, coal was used almost exclusively before gas took over, supplying over 90% of households towards the end of the century (Watton, 2025). During the 1990s, ownership of the Central Electricity Generating Board (CEGB), was sold to the National Grid Company plc (National Grid, 2025). Following privatisation, the national grid reached a milestone in 2019, generating more energy from carbon neutral sources than fossil fuels (National Grid, 2025).

Waste incineration, has also been (and is currently) a popular method of energy production, given the added role of waste disposal (Foster, 2025; Levidow, 2023). However, traditional techniques produce vast quantities of greenhouse gases and therefore cannot work in harmony with the net zero goal (Foster, 2025; Levidow, 2023). Despite this, Foster (2025), argues that modern air filtration technology has paved the way for waste incineration with vastly reduced emissions. This provides some scope for sustainable waste incineration, although it cannot entirely be considered a green energy source.

Importance of Decarbonisation and Overall Energy Demand Reduction

Barrett et al (2021), highlights in their executive summary, the need for energy demand reduction alongside decarbonisation. The key findings list the incentives, particularly economic and capacity related, driven in part by population increase (Barrett et al, 2021). Behind this approach is the wider concept of the circular economy (displacing the traditional idea of boundless consumption).

Broadly speaking, the current government recognises the economic need for decarbonisation in their energy white paper, stating:

"The global markets for low-carbon technologies, electric vehicles and clean energy are fast growing: zero emission vehicles could support 40,000 jobs by 2030, with exports of new technologies such as CCUS having the potential to add £3.6 billion GVA by 2030." (GOV.UK, 2020)

From an environmental perspective, decarbonisation is the vital step against anthropogenic climate change and, particularly as a member of the Paris Agreement, the UK has a responsibility to this (Dixon, Bell and Brush; UNFCCC, 2025). Given the UK's industrial history, it now in the best interest of all parties to redress the balance going forward and promote a sustainable future.

Limitations of Infrastructure (National Grid)

Inflexibility is at the core of many issues concerning the national grid (Conway, 2025; National Grid, 2025). This has put pressure on engineers to upgrade the existing system and develop modular systems which bring greater efficiency and reliability, as part of a sustainable overall solution to energy demand (Conway, 2025).

One of the recent failings of the national grid, is its limited ability to incorporate intermittent renewable energy sources, such as wind and solar (Conway, 2025). This, coupled with poor energy storage, results in huge inefficiencies across the system (Conway, 2025).

Other issues include transmission losses (up to 40%), and voltage fluctuations, both of which (to a large extent) are not experienced by modern modular systems (Conway, 2025).

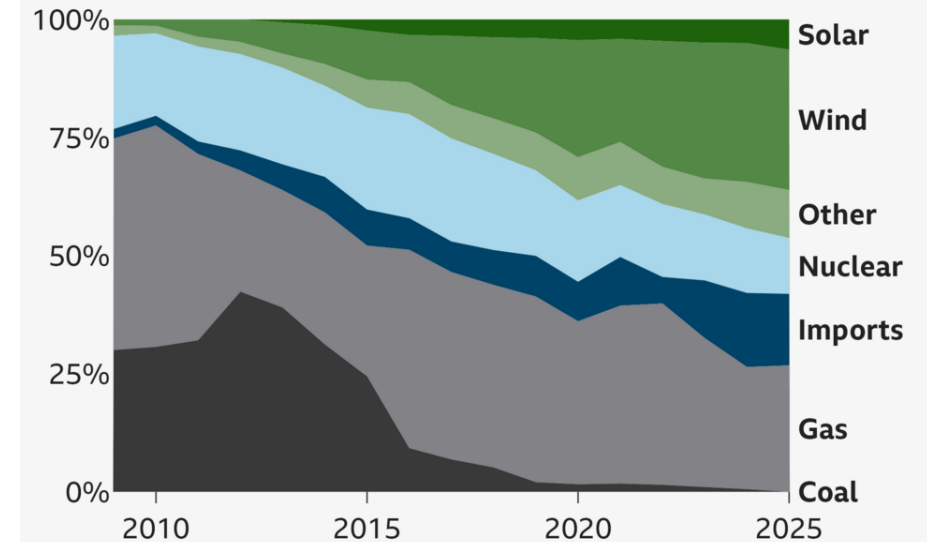
Wind

Wind has been the single largest source of renewable energy in the UK for some time, although in 2025, it accounted for almost 30% of the UK's overall electrical supply (figure 1) (Poynting, Yale and Carr, 2026).

In a Wind Europe article, Isabel (2024), writes that the government is aiming to double onshore, and quadruple offshore wind by 2030 (from 2024). This shift in energy production means wind will account for nearly half of the UK's electricity production and, critically, will require an overhaul of relevant grid infrastructure (IGEM, 2024; Isabel, 2024). Securing the funding required to meet these goals, is estimated to cost in excess of £66 billion, presenting a significant challenge to the economy (IGEM, 2024).

Growth in renewables has been pushing out fossil fuels

Annual share of Britain's electricity by source, 2009-2025



Note: Fossil fuel, biomass and hydro are from major power producers only and exclude distributed generation. Other sources include hydro, biomass and pumped storage. Biomass only appears in the data from 2017-18; solar from 2013

Source: National Energy System Operator, data to 31 December 2025



Figure 1: Renewable energy sources across the last decade (Poynting, Yale and Carr, 2026)

Solar

Like wind, the economic stability of the solar market (as opposed to the fossil fuel market), is attractive, and has received a large amount of attention in the UK (DESNZ, 2025). Therefore, it has been identified as a key area of development, constituting a major proportion of the UK Government's Clean Power Action Plan (DESNZ, 2025). Unlike wind, solar has a far greater potential for modularity, and can be installed across most buildings as direct energy sources (Spellman and Bird, 2024).

Over the course of 2025, solar experienced the biggest growth proportionally, rising by nearly a third (figure 2) (Poynting, Yale and Carr, 2026; Spellman and Bird, 2024).

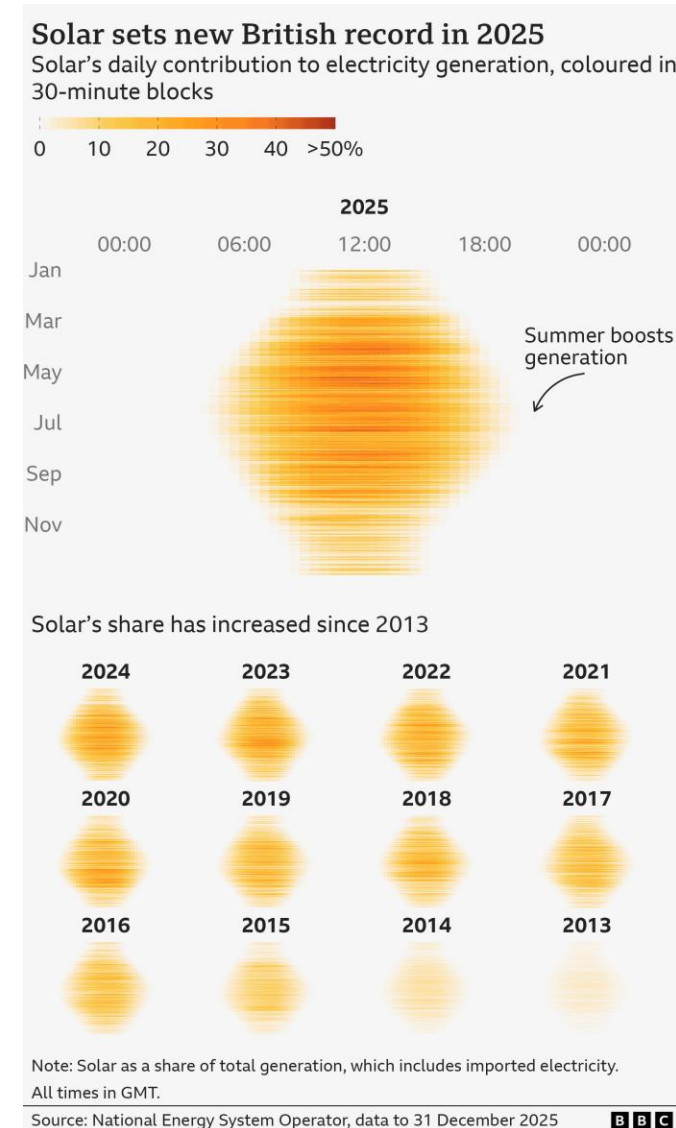


Figure 2: Solar contribution to electricity generation (Poynting, Yale and Carr, 2026)

Tide

Due to its geographic location, the UK has unique access to broad tidal ranges, with the potential (given the infrastructure) to provide a significant energy input (Kempton, 2024). Table 1 shows the current tidal range projects across the UK, with their respective target power capacity (as of 2024) (Kempton, 2024).

Ridal energy is not a new idea, much progress has been made on increasing the efficiency of tidal power, although some challenges remain (Shetty and Priyam, 2022). For example, ensuring that these technologies don't impact marine wildlife and function with manageable cost and maintenance (Shetty and Priyam, 2022).

UK Tidal Range Projects	Target Power Capacity
Swansea Bay Lagoon	0.32
Wyre Barrage	0.1
Mostyn Docks	0.13
Severn Barrage	8.6
West Somerset Lagoon	2.5
Mersey Barrage or Lagoon	0.7
North Wales Lagoon	2.3
Morecambe Bay and Duddon Estuary	4

Table 1: Tidal range projects across the UK (Kempton, 2024)

Heat Pumps

Heat pumps, along with electric vehicles, represent the largest adaptations for consumers in the UK's changing energy mix. Without these technologies, the ability for green energy to integrate into the overall mix is greatly diminished. The efficacy of heat pumps is still a topic of debate, although the rate at which technology has developed is undeniable, with future improvement likely (Ashton, 2024; Lamb and Elmes, 2024).

There are several points concerning heat pumps which are critical to their success. Firstly, pricing for heat pumps (upfront and running costs) must be competitive with traditional boiler setups and offer a comparable level of functionality (Williams and Thomson, 2023). Secondly, the importance of correct operation (including sufficient insulation) must be readily apparent to the consumer (Williams and Thomson, 2023).

Nuclear

Nuclear power remains a controversial topic in the UK, particularly in regard to nuclear waste disposal. Matthew and Walker (2022), make several strong criticisms of nuclear energy in the UK, stating that over-emphasis of nuclear energy could divert attention away from other renewable sources and that, historically, nuclear development has experienced consistent underestimation of total cost. Price, Keppo and Dodds (2023), concur with this in their conclusion:

"Since a lower-cost, secure electricity system compatible with net zero could be built without new nuclear, the current favourable policy towards nuclear from the UK Government is becoming increasingly difficult to justify." (Price Keppo and Dodds, 2023)

Current sources indicate that the UK produces roughly 15% of its electricity (6.5GW) from nuclear power (World Nuclear Association, 2025). By 2050, the government aims to significantly expand nuclear energy production (to 25% - 24GW) (World Nuclear Association, 2025).

Hydrogen

Figure 3 provides an outline of the technology behind hydrogen, including its relation to the sustainable development goals (SDGs) (Maka, Mehmood and Chaudhary, 2025). Hydrogen and fuel cell technology is still relatively new to the UK energy market, and there is insufficient knowledge to predict precisely what impact it may have (Al-Mufachi and Shah, 2022). Switching to hydrogen has diverse benefits for the economy and environment, including reduced reliance on fossil fuels, increased air quality and reliability, due to its abundance (albeit not as a primary fuel source) (Al-Mufachi and Shah, 2022). Like all alternative fuel sources affordability is a concern; Al-Mufachi and Shah (2022), suggest that this could be accounted for with a CO₂ tax.

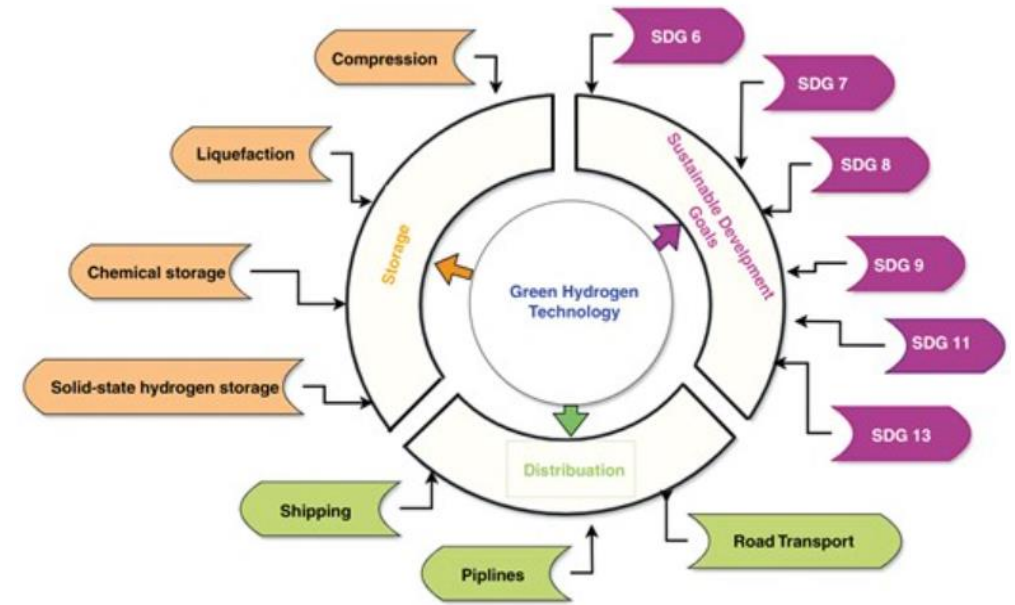


Figure 3: Green hydrogen technology (Maka, Mehmood and Chaudhary, 2025)

Biomass

The government recognises the application of sustainable biomass production in its biomass strategy, where it is argued that because its energy is sourced from photosynthesis, it absorbs the CO₂ it emits (DESNZ, 2023).

According to REA (2025), biomass accounts for 12% of current energy use in the UK. Over two thirds (66%) of this is sourced from domestic feedstocks, a relatively stable resource (DESNZ, 2023; REA, 2025). Its sustainability (emissions) depends largely on its source, with potential to be carbon negative (REA, 2025).

Unlike many renewables, biomass has the potential to be harnessed as a direct fuel source in transportation and heating, although this perpetrates similar issues of fossil fuels relating to air quality and pollution (DESNZ, 2023).

Development in Off-Grid and Modular Technology

Along with changing energy sources, the importance of storage and transmission must be considered. Existing infrastructure suffers from poor storage capacity and heavy transmission losses (Conway, 2025). This must be rectified before new sources become mainstream and expansion is necessary (National Grid, 2025).

A popular alternative traditional infrastructure is creation of off-grid systems which operate locally and therefore suffer less, particularly from transmission losses (Irena, 2024; National Grid, 2025). Solar and wind have huge potential, given that they have high modularity (Irena, 2024). One such example is Nantycaws Carmarthen Recycling Centre, a facility partially powered by a 500kW wind turbine (Taylor-Peter, 2025).

Overall Current Progress and Future Outlook

Following Brexit, the UK has entered an uncertain phase in energy production, where some EU legislation has been carried over, some has been created (or restructured), and some has been omitted (DEFRA and BEIS, 2020; DESNZ, 2024; Kempton, 2024). Whilst this has muddled future outlook, current goals aim for the UK to be carbon zero by 2050 (Burnett and Stewart, 2024).

Kempton (2024), suggests that due to the incompleteness of the 'British Energy Security Strategy', the UK requires a 'National Energy Master Plan Model' to increase its scope for higher efficiency and yield of clean energy production, which must include details of an overhaul of the national grid (DESNZ, 2025; National Grid, 2025). Ogwumike et al (2024), propose a similar idea with their 'industrial decarbonisation framework' shown in figure 4.



Figure 4: Industrial decarbonisation framework (Ogwumike et al, 2024)

Overall Current Progress and Future Outlook

According to a recent BBC News article, the UK generated over 127TWh from wind, solar, hydro and biomass in 2025, up 18TWh from 2024 (figure 5) (Poynting, Yale and Carr, 2026). This figure illustrates the unprecedented speed at which green energy has grown in the UK.

One source estimates that by 2050, the UK's energy demand will increase by 51-160% in order to facilitate large-scale changes in transport and heating (Dixon, Bell and Brush, 2022). It also mentions that hydrogen may be one of the most important energy vectors going forward, depending on its development for use in transport and heating (Dixon, Bell and Brush, 2022).

Overall, it would be fair to summarise that there is a large degree of uncertainty going forward, with much of the progress in achieving the net zero target hinging on politics (Barrett et al, 2021; Burnett and Stewart, 2025). However, whilst the time-frame is a subject of debate, it is hard to argue that the UK's approach to sustainability has changed radically over the past century, and the rate at which this is change is accelerating, is strongly related to the development of new technology (Barrett et al, 2021; Burnett and Stewart, 2025).

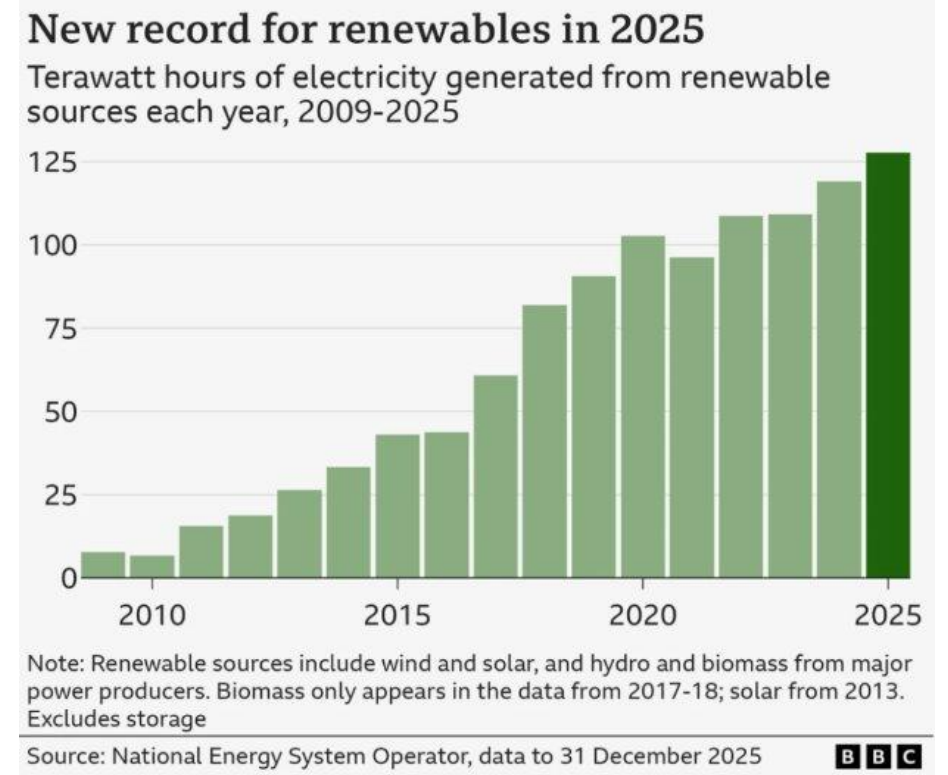


Figure 5: Renewable electricity generation from 2009-2025 (Poynting, Yale and Carr, 2026)

Reference List

- Al-Mufachi, N.A. and Shah, N., 2022. The role of hydrogen and fuel cell technology in providing security for the UK energy system. *Energy Policy*, 171, p.113286.
- Ashton, D. (2024). Are heat pumps just hot air? University of the Built Environment. Available at: <https://www.ube.ac.uk/what-s-happening/articles/heat-pumps/>. [Accessed 28.12.25].
- Association for Renewable Energy and Clean Technology (REA). (2025). The role of biomass and BECCS in the UK energy system. Baringa Final Report. Available at: <https://www.r-e-a.net/resources/report-biomass-uk-energy-2025/> [Accessed 29.12.25].
- Barrett, J., Pye, S., Betts-Davies, S., Eyre, N., Broad, O., Price, J., Norman, J., Anable, J., Bennett, G., Brand, C. and Carr-Whitworth, R., 2021. The role of energy demand reduction in achieving net-zero in the UK. *Centre for Research into Energy Demand Solutions: Oxford, UK*.
- Burnett, N. and Stewart, I. (2024). The UK's Plans and Progress to Reach Net Zero by 2050. House of Commons Library. Available at: <https://commonslibrary.parliament.uk/research-briefings/cbp-9888/>. [Accessed 28.12.25].
- Conway, M. (2025). How is the UK's grid hindering the move to renewable energy? NDT Group. Available at: <https://www.ndtgroup.co.uk/latest-news/uks-grid-hindering-renewable-energy/>. [Accessed 29.12.25].
- DEFRA and BEIS (2020). The UK's Adaptation Communication to the United Nations Framework Convention on Climate Change (UNFCCC) 2020. GOV.UK. Available at: <https://www.gov.uk/government/publications/the-uks-adaptation-communication-to-the-united-nations-framework-convention-on-climate-change-unfccc-2020>. [Accessed 16.12.25].
- DESNZ (2025). Solar roadmap: United Kingdom powered by solar. GOV.UK. Available at: <https://www.gov.uk/government/publications/solar-roadmap/solar-roadmap-united-kingdom-powered-by-solar-accessible-webpage#part-3-implementing-the-roadmap-and-assessing-our-achievements-> [Accessed 28.12.25].
- DESNZ (2024). UK energy in brief 2024. GOV.UK. Available at: <https://www.gov.uk/government/statistics/uk-energy-in-brief-2024>. [Accessed 26.12.25].

Reference List

- DESNZ (2023). Biomass strategy 2023. Available at: <https://www.gov.uk/government/publications/biomass-strategy/biomass-strategy-2023-accessible-webpage>. [Accessed 29.12.25].
- Dixon, J., Bell, K. and Brush, S., 2022. Which way to net zero? a comparative analysis of seven UK 2050 decarbonisation pathways. *Renewable and Sustainable Energy Transition*, 2, p.100016.
- Foster, J., 2025. The Rise Of Incinerators In The UK: A Sustainable Solution For Waste Management. Available at: <https://gridcomputingcenter.org/the-rise-of-incinerators-in-the-uk-a-sustainable-solution-for-waste-management/> [Accessed 29.12.25].
- GOV.UK (2020). Energy white paper: Powering our net zero future. GOV.UK. Available at: <https://www.gov.uk/government/publications/energy-white-paper-powering-our-net-zero-future>. [Accessed 26.12.25].
- IGEN (2024). Britain's renewable energy shortfall: Wind and solar projections lag behind 2030 goals. Igem.org.uk. Available at: <https://www.igem.org.uk/resource/britain-s-renewable-energy-shortfall-wind-and-solar-projections-lag-behind-2030-goals.html>. [Accessed 29.12.25].
- Irena (2024). Off-grid Renewable Energy Statistics 2024. Available at: <https://www.irena.org/Publications/2024/Dec/Off-grid-Renewable-Energy-Statistics-2024>. [Accessed 29.12.25].
- Isabel, M. (2024). New UK Government plans big push on wind. Wind Europe. Available at: <https://windeurope.org/news/new-uk-government-plans-big-push-on-wind/>. [Accessed 28.12.25].
- Kempton, R., 2024. Approach Towards a Total UK Environmental Energy Master Plan for Clean Renewable Energy, Reviewing the Incompleteness of the British Energy Security Strategy after Brexit, and Embracing Tidal Waters and other Innovative Sources. *Reviewing the Incompleteness of the British Energy Security Strategy after Brexit and Embracing Tidal Waters and other Innovative Sources (May 17, 2024)*.
- Lamb, N. and Elmes, D., 2024. Increasing heat pump adoption: analysing multiple perspectives on preparing homes for heat pumps in the UK. *Carbon Neutrality*, 3(1), p.10.

Reference List

- Levidow, L., 2023. UK Waste Incineration Fix: Perpetuating and Displacing Waste Burdens. In Beyond climate fixes (pp. 82-106). Bristol University Press.
- Maka, A.O., Mehmood, M. and Chaudhary, T.N., 2025. Green hydrogen revolution and its pathway towards sustainable development. *Clean Energy*, 9(2), pp.124-131.
- Matthew, C. and Walker, A., 2022. Nuclear energy in the UK. UK Parliament POSTnote, 687.
- National Grid (2025). Our history | National Grid Group. www.nationalgrid.com. Available at: <https://www.nationalgrid.com/about-us/what-we-do/our-history>. [Accessed 26.12.25].
- Ogwumike, C., Akponeware, A., Oyewole, A., Dawood, H., Pinedo-Cuenca, R., Ling-Chin, J., Roskilly, A.P. and Dawood, N., 2024. Transitioning or tinkering at a net-zero economy? Introducing an assessment framework for industrial cluster decarbonisation in the United Kingdom. *Energy Research & Social Science*, 110, p.103459.
- Poynting, M., Dale, B. and Carr, J. (2026). Record year for wind and solar electricity in Great Britain in 2025. BBC News. Available at: <https://www.bbc.co.uk/news/articles/cz947djd3d3o>. [Accessed 02.01.26].
- Price, J., Keppo, I. and Dodds, P.E., 2023. The role of new nuclear power in the UK's net-zero emissions energy system. *Energy*, 262, p.125450.
- Spellman, G. and Bird, D., 2024. Sunshine and solar power in the UK. *Theoretical and Applied Climatology*, 155(3), pp.1989-2003.
- Taylor-Peter, A. (2025). About CWM Environmental Waste Management | CWM Environmental. CWM Environmental. Available at: <https://www.cwmenvironmental.co.uk/about-us/> [Accessed 29.12.26].
- UNFCCC (2025). The Paris agreement. United Nations Climate Change. Available at: <https://unfccc.int/process-and-meetings/the-paris-agreement>. [Accessed 26.12.25].
- Watton, C. (2025). Researching Energy History - Churchill Archives Centre. Churchill Archives Centre. Available at: <https://archives.chu.cam.ac.uk/news/researching-energy-history/>. [Accessed 26.12.25].
- Williams, A. and Thomson, M., 2023. Significance of insulation and heat pumps in decarbonising the UK. *Journal of Energy and Power Technology*, 5(1), pp.1-12.
- World Nuclear Association (2024). Nuclear Power in the United Kingdom - World Nuclear Association. world-nuclear.org. Available at: <https://world-nuclear.org/information-library/country-profiles/countries-t-z/united-kingdom>. [Accessed 26.12.25].