Environmental Audit Committee (EAC), UK Parliament

Technological innovations and climate change: onshore solar energy

Consultation response from the Institution of Chemical Engineers (IChemE)

1. What role can developments in solar panel technology play in the UK's transition to net zero?

There has been a significant uptake in the solar panel technology in the UK with data suggesting an increase of 3.5% in the total installed solar capacity across the UK to 14.2 GW [1]. Solar photovoltaic (PV) technology can be deployed in a variety of locations including domestic/ industrial buildings and solar farms, allowing consumers to generate their own power. Moreover, renewable power is required to decarbonise hard to abate industry sectors including chemicals, refining, steel, and glass. Therefore, improvements in solar technologies when used in conjunction with energy storage can have a significant impact on the UK's transition to net zero. Research and developments within solar technology in the UK has focussed on developments such as thin films, flexible PV, and utilisation of new materials such as perovskites and organic PV which can result in higher power conversion efficiencies, better stability, and lower costs in future [2]. There are several challenges in the successful commercialisation of this new technology including short shelf life of perovskite solar cells (PSCs) and their lower structural stability and therefore further developments in this technology are required [3]. Solar technology can work in synergy with other renewable technologies such as wind and hydrogen and energy storage could provide a balance between the power supply and consumption in renewable power plant. The energy produced by solar technology can be used to produce hydrogen using electrochemical water splitting process providing flexibility for long term energy storage and transport [4]. This energy integration can result in the increase in energy efficiencies, improvements in energy system reliability, reduction in cost and the level of greenhouse gas (GHG) emissions [5]. The seven different net zero pathways for the UK energy system from 1997 to 2019, published by Energy Systems Catapult (ESC), National Grid, Centre for Alternative Technology (CAT) and Climate Change Committee (CCC), show the progress made in the contribution of Wind, Solar and Hydroelectricity from 5TWh to 84TWh [6]. It further highlights the scale of the net zero challenge and the key changes in energy demand, technology, consumer behaviour, and policy measures required to meet UK's next zero targets. Chemical engineers are working across different industry sectors to play a significant role in the development of renewable technologies including solar and contribute to addressing these challenges.

2. What are the current barriers (regulatory, technological or otherwise) to expanding the number of small and large-scale solar installations in the UK?

The major barriers to expanding the small- and large-scale solar installations in the UK [7,8,9,10,11,12, 13] can be summarised as below:

1. Lack of significant regulatory/policy reforms from the government to utilise the full potential of solar technology adoption including substantial and stable technology adoption incentives to tackle the resistance to technology diffusion, reducing the high costs of investment and relaxing financial constraints.
2. Lack of utility scale solar reforms including reforms to the Contracts for Difference (CfD) scheme, planning, nationally significant infrastructure project (NSIP) 50MW threshold, network charging and business rates.
3. Lack of reforms to the policies such as Renewable Obligations Certificate (ROC), which replaced initial policies from the 1990's such as Non-Fossil Fuel Obligation (NFFO), aimed at encouraging firms and suppliers to invest in systems larger than 50KW.
4. Availability of the grid and its inability to keep with the pace of the solar deployment in the UK
5. Dominant role of the Wind Power technology in comparison with the Solar PV hinders the diffusion of solar technology
6. Technical barriers including, balancing and flexibility challenges since high volatility in weather leads to solar intermittency and forecast errors, stability, voltage and power quality issues.
7. Availability of critical minerals/metals to support solar panels/cells and batteries manufacture. It would require the need for improved and sustainable production capabilities, supported by robust supply chains.
8. Grid reliability risks in areas where solar farms might be located
9. Global supply chain constraints hindering solar technology's success to enable secure transition to net zero
10. Social barriers including lack of consumer education and technology awareness, social stigma such as technology not aesthetically pleasing and disinterest to change.
11. The demand for clean energy technologies due to ever increasing gas and electricity prices recently has meant that UK needs a larger workforce to meet this demand. A 2020 survey by the Electrical Contractors Association in partnership with Solar Energy UK shows that 48% of traders in solar and energy storage sectors currently lack access to skilled employees.
12. From a system's perspective, decarbonisation of the heavy industry using dispatchable low carbon power and development of technology such as carbon capture and utilisation (CCUS) would need to be part of the UK's net zero response.

3. **To what extent is the contribution of solar technologies to the UK's renewable energy mix limited by storage and distribution capacity?**

   The intermittent nature of the solar power due to different seasons means that significant proportion of solar energy produced in the UK needs to be stored for use during peak demand periods. This is also important since the industry requires reliable and constant power to decarbonise. There are technical challenges in storing energy into a useful and storable energy carrier like hydrogen since it requires large PV installations due to the conversion losses during production and use of hydrogen [20]. UK would need to build its energy storage capacities and distribution networks to support the energy production using solar technology since the existing energy storage and distribution capacity is limited [14]. As per the committee for climate change, the UK has the potential to deploy 130-540TWh (145-615GW) of solar power [15]. National Grid outlines four technologies for the future energy scenarios, pumped hydro, compressed air/liquid, batteries and hydrogen [16]. These technologies have strong storage potential, storing solar power when it is abundant and cannot be used especially during summer months. For smaller scale distributed energy storage batteries are the solution. Battery storage can be used to provide overnight demand and balance the PV production during the day. Co-locating solar and battery storage in the same site can reduce system installation costs and support the local energy system [9]. Similarly, thermal storage can be used for decarbonisation of heat and coupled with other renewable technologies such as solar to support UK's long term emission reduction goals [17]. Chemical engineers are making significant contributions in the development of energy storage technologies which could support the faster uptake of renewable energy technologies including solar [21].

The Institution of Chemical Engineers (IChemE)

The Institution of Chemical Engineers (IChemE) is a professional association with 30,000 members. IChemE is a not-for-profit, member-led qualifying body and learned society that advances chemical engineering's contribution worldwide for the benefit of society. We support the development of chemical, biochemical and process engineering professionals and provide connections to a powerful network of members in more than 100 countries. The Institution of Chemical Engineers has its head office in the UK with regional offices in Australia, New Zealand, Malaysia, and Singapore.

This response has been produced by IChemE members in the UK and draws on the Institution's expertise within the clean energy sector. IChemE's position on climate change was published in November 2020 and reflects the institution's commitment to work collaboratively with all stakeholders to contribute to a net zero future [18]. Between 2020-22, IChemE also produced sectoral plans to support climate change action in multiple industries and jurisdictions, including energy transition, clean energy, water, food, and pharmaceuticals.

IChemE supports its members in applying their expertise and experience to make an influential contribution to solving major global challenges, including achieving the UN Sustainable Development goals. The institution celebrated its 100 years centenary in 2022 with significant member contributions such as written technical articles, blogs, interviews, and webinar across nine different chemical engineering themes including sustainability and environmental, energy, materials, built environment and transport [19].

IChemE would welcome the opportunity to provide more detailed information and response to the Environmental Audit Committee (EAC) on the points discussed in this consultation if required. It can successfully leverage its experience within chemical engineering on topics related to climate change and clean energy including solar technologies to participate in debate on net zero.

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