The implications of landscape visual impact on future highly renewable power systems: a case study for Great Britain

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The decarbonisation of power production is key to achieving the Paris Agreement goal of limiting global mean surface temperature rise to well below 2°C, particularly so given the drive to electricity transport and heat. At the same time, variable renewable energy (VRE) sources such as solar photovoltaics (PV) and wind have seen rapid cost reductions in recent decades bringing them into cost parity with base load fossil generation. Therefore, recent long term planning studies, which utilise cost-optimising models, have demonstrated the important role of VREs in decarbonising power systems across the world. However, while technoeconomically detailed, such studies tend to neglect key social factors that often shape the real world evolution of the energy system.

Of particular relevance to VRE deployment is their visual impact on the landscape which can act to undermine their public acceptability. Here, we use crowd-sourced scenicness data to derive spatially explicit, empirically grounded wind energy capacity potentials for three scenarios of public sensitivity to this visual impact. We augment these with a detailed analysis of Great Britain's (GB) solar PV capacity potential. We then use these scenarios in a cost-optimising model of GB's power system to assess their impact on the cost and design of the electricity system in 2050. Our results show that the levelised cost of the system can increase by up to 15% when public sensitivity to visual impact is high compared to low. In part this is driven by our finding that some of the most picturesque parts of GB also happen to be the most cost-effective for onshore wind, leading to large reductions in installed capacity as we move through our sensitivity scenarios. Indeed, deployment is heavily limited in Scotland and the South-West which in turn acts to limit the spatial diversity of onshore wind. We conclude that it is essential for policy makers to consider these cost implications and to find mechanisms to ameliorate the visual impact of onshore wind in local communities.