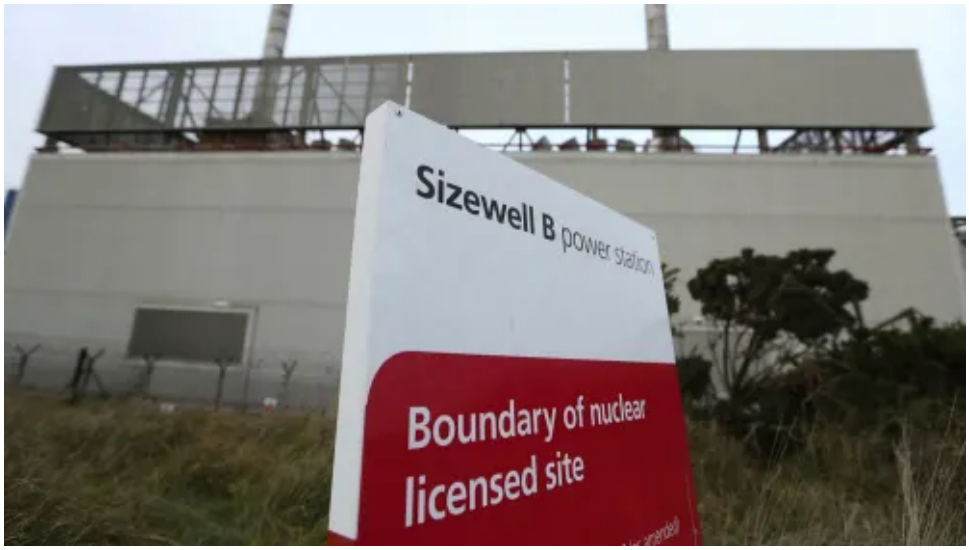
UK energy

Green power needs to be dense power

Decarbonisation requires whole-system outcomes with technologies that are scalable



For a solar field to match the output from Sizewell's two giant reactors would require 300 square kilometres of land © Bloomberg

August 17, 2020 3:00 am by **Jonathan Ford**

Here are two green power projects. The first, a solar farm in Kent, Britain's largest, received planning consent from the business and energy secretary, Alok Sharma, in May. The second is a planned nuclear project at Sizewell in Suffolk. Its developer, EDF Energy of France, recently applied for approval, which has yet to be received.

Both would make substantial contributions to Britain's green electricity supply. Cleve Hill would have sufficient solar panels to generate 350 megawatts - enough, its developers claim, to power 91,000 homes. Sizewell, meanwhile, would be an order of magnitude greater. Its two giant reactors would have the capacity to generate 3,200MW of electricity, roughly 7 per cent of Britain's current power needs.

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The issue was once illustrated by the former chief scientific officer to the UK energy department, the late David MacKay. He compared his own territorial estimate of UK energy consumption, roughly 1.25W/square metre, with the energy yield of a wind turbine, which he put at roughly 2.5W for each square metre they occupied. On that basis he estimated that you would need to cover half the UK's landmass to generate the necessary energy.

The political impossibility of anything remotely like this ever happening should be evident. A study of the US state of Iowa by the consultancy Lucid Catalyst showed that political resistance to wind projects escalated between 2008 and 2019 as more schemes were put forward.

About 60 per cent of counties in the state progressively imposed restrictions or moratoriums on wind development. And that was despite renewables operators deploying only 11 gigawatts (GW) of capacity over the period, a fraction of the 517 GW theoretical maximum estimated by the National Renewables Energy Laboratory, a body funded by the US energy department.

In a crowded country such as Britain, the pressures on land use are sharper, given the competing priorities to grow food, plant more forests and protect existing wildlife habitats. Put simply, greater land use for energy generation has an escalating opportunity cost.

Greenpeace, no enemy of renewables, expressed concerns about the Cleve Hill development, arguing that "vast continuous fields

of panels on agricultural land" were not "the best way to go solar".

This should prompt reflection in light of the UK's political commitment to achieve net zero carbon emissions by 2050. It is hard enough decarbonising electricity, as Germany has discovered with its costly and struggling "Energiewende". But electricity is about a quarter of final energy demand and the rest is largely powered by fossil fuels.

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Estimates from consultancy LucidCatalyst suggest that replacing the UK's oil demand with hydrogen produced using solar could absorb a startling 23,000 sq km (equivalent to 14 counties the size of Surrey).

Renewables experts argue not all oil use would need replacing with hydrogen, reducing the need for renewable capacity. They also say much could be done with offshore wind turbines, reducing the land requirement. But as wind is less dense than solar, you would still end up gobbling large chunks of the North Sea.

Historic energy transitions have moved from less power dense to more dense energy technologies; so coal succeeded wood, and was in its turn succeeded by oil and natural gas.

Renewables such as Cleve Hill have their place in decarbonisation. It is worth noting too that the only other zero carbon technology to hand, nuclear, faces its own political challenges. But in planning how to decarbonise, policymakers should think about whole-system outcomes. They need power technologies in the mix that are scalable and dense.

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The really stark difference comes when you consider their respective physical footprints. While Cleve Hill would need

around 950 acres of land for the roughly 800,000 panels required to generate its output, Sizewell would require a mere 80 acres to house its plant.

Nor does that paint the whole picture. The gap actually widens further when you consider their respective output. Cleve Hill's panels will not be generating constantly: thanks to Britain's rainy climate, solar produces power only 11 per cent of the time. Meanwhile, nuclear's so-called capacity factor is roughly 90 per cent.

What all this means is that simply to match annual output churned out by Sizewell's 3,200MW reactors, you wouldn't just need nine 350MW Cleve Hills, but more like 77. Turn that into acres and it comes to almost 74,000. That's equivalent to some 300 square kilometres of land, versus the 0.3 sq km the nuclear plant consumed.

It all goes to illustrate one of the awkward truths about renewables, and one that is often buried beneath impressive statistics showing the declining cost of solar panels and wind turbines. Their relatively low "power density" makes them more consumptive of resources.