AtkinsRéalis

Countdown to 2035: can we meet net zero energy system targets?

January 2024

Engineering Net Zero™

Background

In 2019, AtkinsRéalis published its first build rate analysis, which forecasted that 10.5GW of new generation capacity would need to be constructed annually to meet the requirements of a 2050 energy system (Ref 1).

In June 2022, we published an updated build rate to reflect the UK's more ambitious net zero power system targets, projecting how much new generating capacity would need to be brought online each year to meet the UK's net zero targets and maintain security of supply by 2035. We forecasted that 12-16GW would be needed per year (Ref 2).

The build rate analysis acts as a benchmark to measure progress towards 2035: a view of how steep the curve to climb will be over the next decade as we build a low carbon energy system that will power the net zero transition.

Muted progress

Over the past twelve months, there have been many expert reviews of the UK's progress towards a net zero power system in 2035, all with the recurrent theme that we urgently need to accelerate delivery of almost all elements of the future energy system.

While positive progress has been made, such as the connection of the world's largest offshore windfarm Hornsea 2 contributing 1.3GW to the 4.5GW connected to the UK network in 2022, it still falls short. 4.5GW/year is still significantly lower than the annual rate required to ramp up new generation and ensure the UK can balance forecast demand levels with a supply of low carbon energy.

This publication's new analysis provides an update on the build rate based on updated forecasts and the latest data on future 2035 power system capacities. It addresses two key questions: are we building fast enough? What are the consequences if we don't?

4.5GW

2022 actual build rate

15.5GW

annual build rate required to meet 2035 system goals

Build rate update

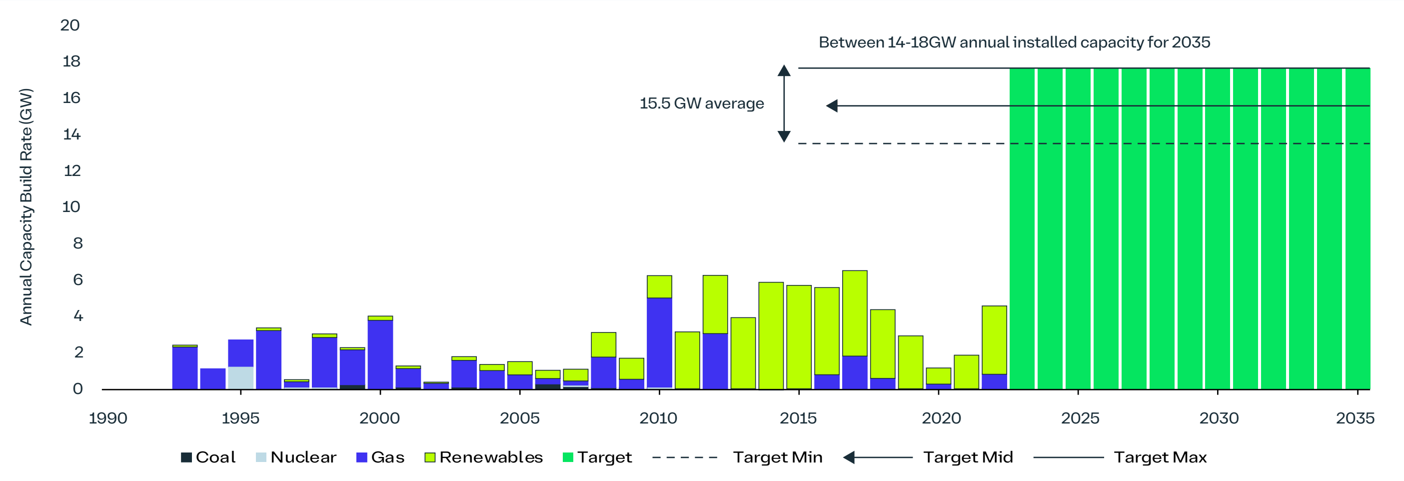

Figure 1: 2023 analysis estimating annual build rate required to meet 2035 target

Our new 2023 analysis is based on a need to deliver 187GW of new generating capacity by 2035, for a total energy system of 260GW. This is to balance supply and demand of an increasingly electrified economy, as laid out in the Government's most recent net zero scenarios.

The build rate required between 2023 and 2035 has now increased to 15.5GW/year, as indicated in Figure 1.

To help visualise this change in build rate from our past analysis, Figure 2 shows the historical build rate of UK generating capacity compared with the required future build rate estimated at each of our reviews. In simple terms: in 2019 we estimated the build rate had to jump to 10.5GW/year, by 2022 this had increased to 14GW/year and by 2023 the target increased to 15.5GW/year. This new build rate constitutes an increase of 11% in GW/year compared to the 2022 build rate and is 344% higher than the 2022 actual build rate of 4.5GW.

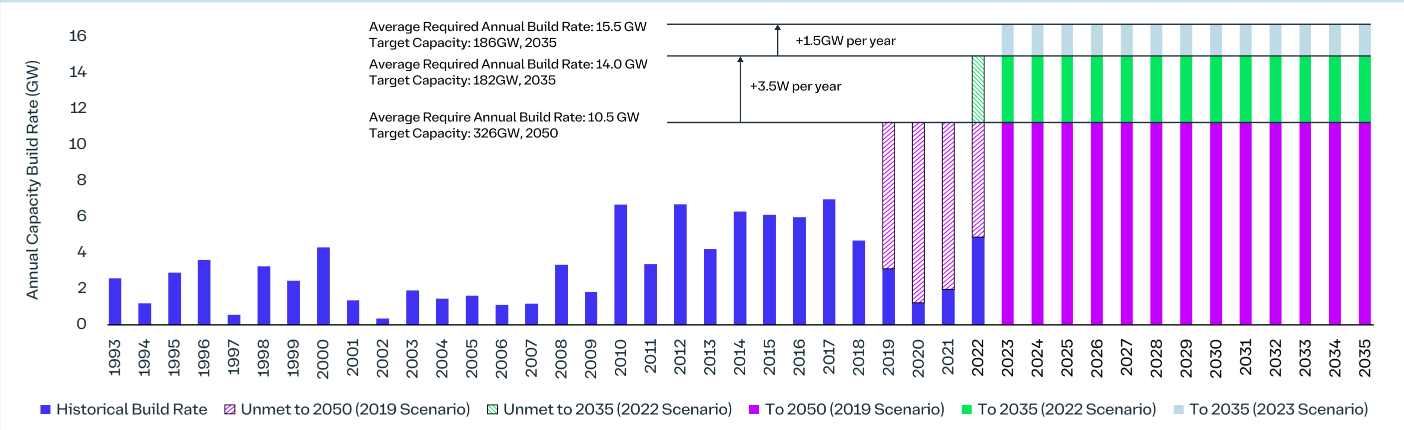

Figure 2: Comparison of AtkinsRéalis build rate analyses with historical build rates

What will it take to get there?

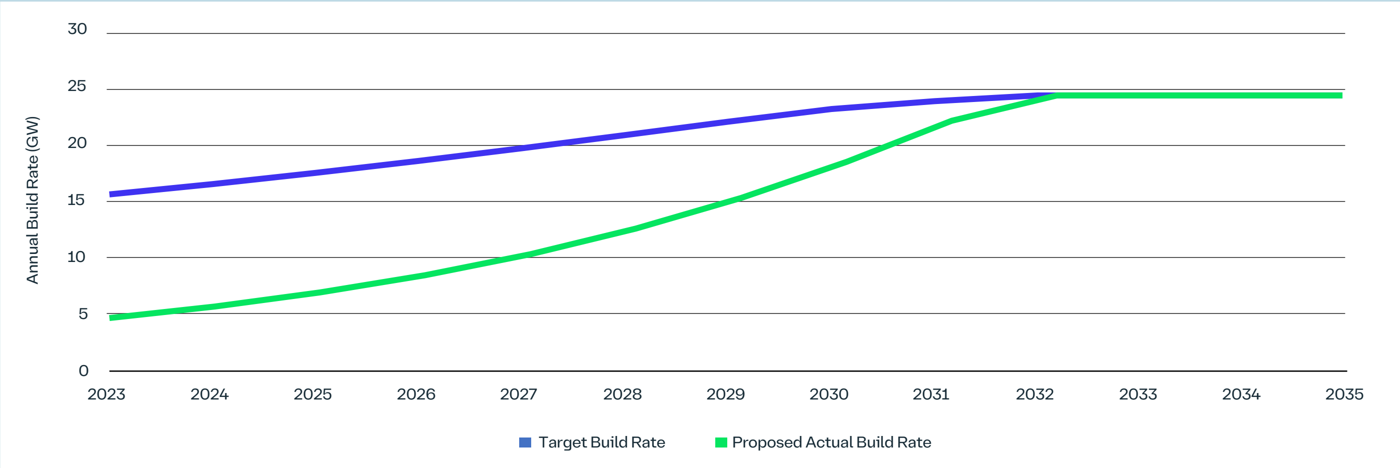

Figure 3: Build rate increasing at 15% per year to deliver the 2035 capacity target

How fast can we accelerate the build rate and what is the peak annual output that would be needed to reach the current 2035 target of ca. 260GW capacity?

While 15.5GW/year is now the average required build rate, it is extremely unlikely that the UK will more than triple the amount of new capacity connected to the system in one year. From reforming the planning system and strengthening the UK's energy networks, to bolstering the supply chain to be capable of delivering five-fold increases in output, a more gradual increase is the most likely scenario until we hit peak output (*peak build rate*) — the highest volume of new generating capacity connected to the system each year.

For illustrative purposes, let us assume that we can increase the UK's current build rate of 4.5GW/year by 15% each year, every year, until we hit a peak output that will deliver the 2035 capacity and meet our net zero targets.

Figure 3 above shows that this 15% year-on-year scenario would require an annual growth rate until 2032, when peak build rate of 25 GW/year would be reached, roughly five times our recent level, to respond to the capacity shortfall of each previous year.

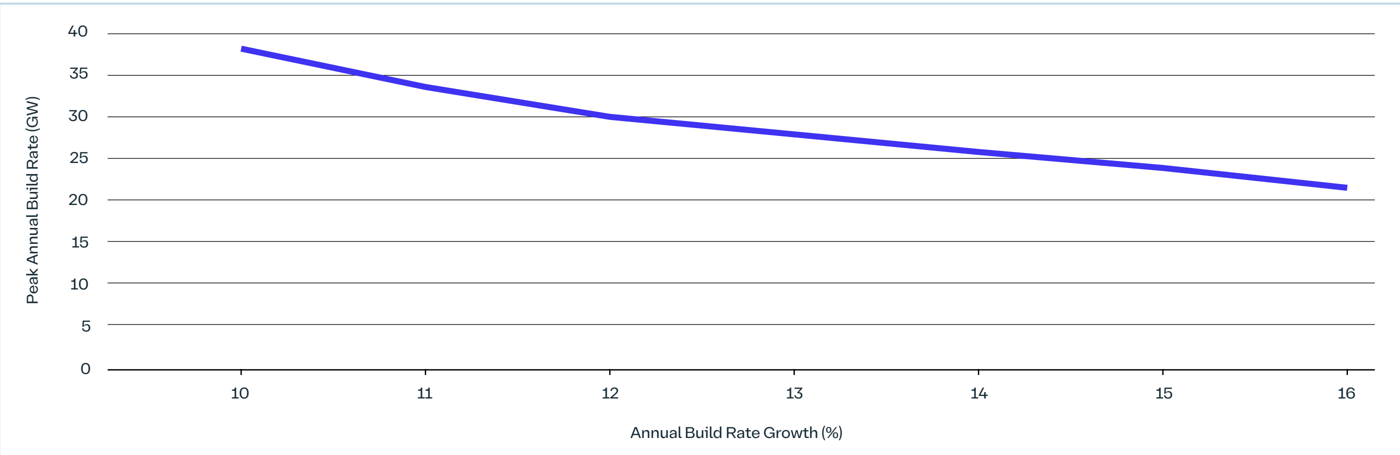

Figure 4: Compound annual growth rate percentage affecting peak annual build rate

However, if our annual growth rate is less than 15%, our required peak rate would be higher and would be achieved later. The graph in Figure 4 shows the variation in required peak output that a lower annual increase of the build rate causes.

If the annual growth in build rate falls from 15%/year to 10%/year, then the required peak output would almost double to an unimaginable 40GW/year in 2035 (nine times our current rate).

Put simply: the slower we ramp up the build rate now, the greater the challenge to meet 'peak output' in the future.

The Dominant Technology – Offshore Wind

There is no fixed plan that sets out what the electricity generating fleet should look like in 2035 or 2050, although the UK Government has stated a target capacity of 50GW of offshore wind by 2030 and 24GW of nuclear by 2050. Multiple scenarios predict multiple technology mixes, from high volumes of renewables requiring vast levels of energy storage, to scenarios reliant upon a greater number of large-scale and small modular reactor (SMR) nuclear baseload plants.

However, the 'central pillar' of the future energy system is expected to be the massive increase in offshore wind generation, and over recent years the target for offshore wind capacity by 2030 has increased significantly. Figure 5 shows the trajectories required to meet increasing target capacities compared to the actual historical delivery.

The UK's ambitious target of 50GW of offshore wind by 2030 will require a significant and sustained increase in delivery rate. However, recent events have provided a stark reminder that reaching this goal cannot be guaranteed; from the failure of the recent Contracts for Difference (CfD) allocation round, to the wider recognition that future offshore wind power prices must rise to bring forward new investment and ensure planned projects are delivered. When the financial case for offshore wind is combined with the uncertainty around radical reform of the planning system, the need for massive grid upgrades, and enhancing flexibility to integrate the offshore wind expansion; the conclusion must be that a detailed framework for delivery is urgently needed.

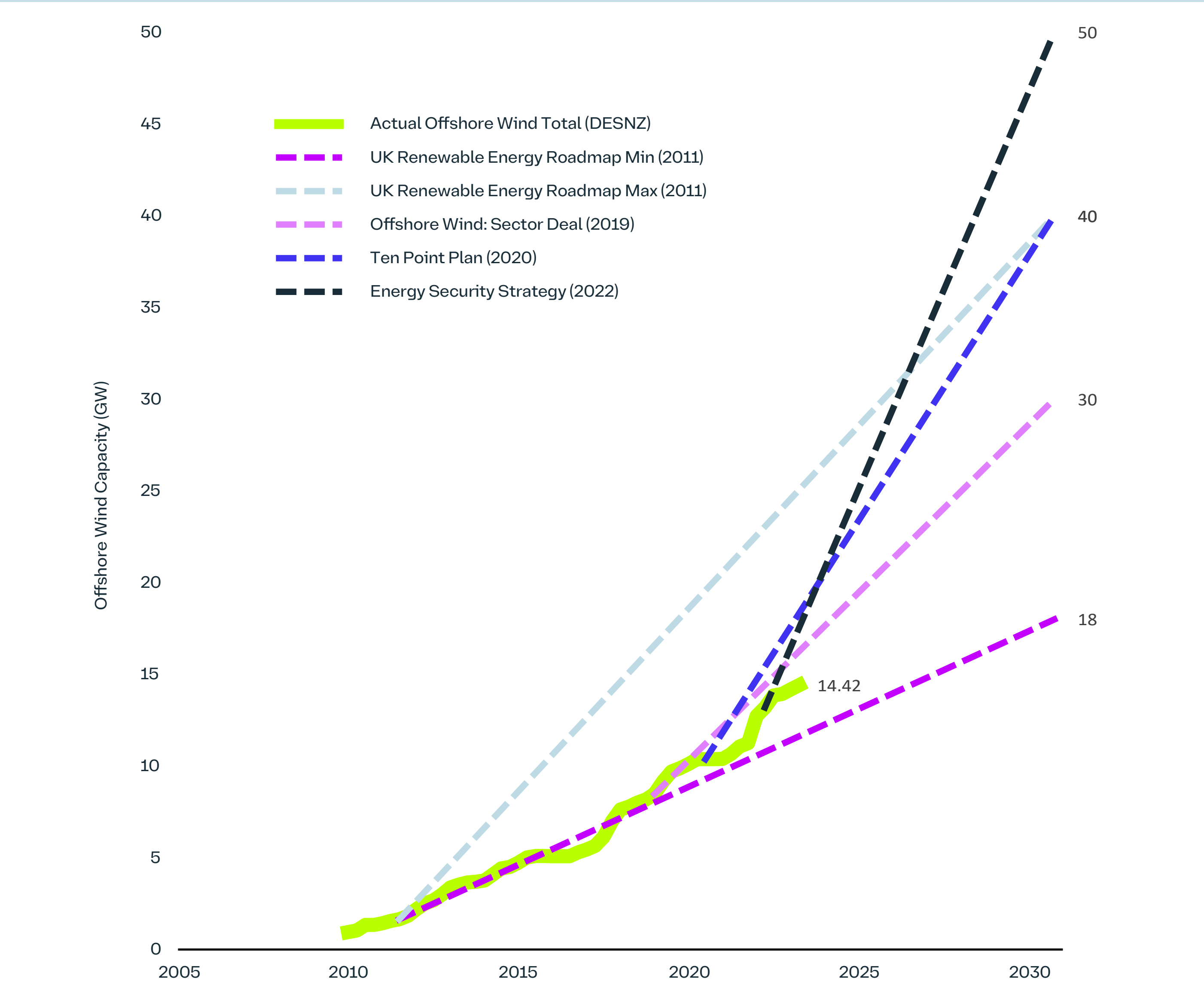

Figure 5: Offshore wind 2030 capacity targets and modelling, against actual capacity delivery

What if the expansion of renewables falls below target?

The interaction between offshore wind expansion and retirement of gas fired generating capacity illustrates the complexity of future system planning.

The major shift in our electricity consumption between now and 2035 is expected to be from a substantial increase in intermittent renewable power, driven mostly by increasing offshore wind, and a corresponding decrease in unabated gas fired generation. In the twelve months to the 1st December 2023, unabated gas fired plants provided 33% of our power, while wind provided 28% (Ref 3). The National Infrastructure Commission suggests that by 2035 the output from unabated gas should reduce to less than 2% of annual consumption (Ref 4).

The nominal design life of a combined cycle gas turbine power plant is 25 years and by 2035 almost all of our existing fleet will be well beyond the 25-year design life, thus requiring investment in life extension. If the expansion of offshore wind (and other low carbon sources) falls short during the next 12 years, it is unavoidable that the resulting energy shortfall will in large part be made up by greater use of the existing unabated gas generation fleet. This will increase the wear on these ageing plants, potentially increasing life extension costs and accelerating their retirement.

The reduction of our use of unabated gas generation to less than 2% of consumption might suggest that it will be of marginal significance by 2035 and its early retirement unimportant.

The annual build rate target can be misleading in one very important context: security of supply in a 'Dunkelflaute' event — a prolonged period of low wind. This was experienced in the UK in December 2022, where a sustained period of cold temperatures resulted in increased energy demand and lower outputs from wind energy. In such conditions in 2035 our security of supply could be far more dependent on unabated gas generation than the annualised 2% might imply.

An indirect impact of a shortfall of offshore wind deployment could therefore be the use of unabated gas for longer between now and 2035, speeding up its retirement without new capacity to fill in the gap. To reduce our dependence on unabated gas capacity now, and to ensure security of supply in a future 'Dunkelflaute', we are required to speed up our deployment of low carbon generation technologies. If we do not deliver more renewables, specifically offshore wind, or nuclear, then our energy capacity may not be sufficient to operate without unabated gas. Investment in long-term energy storage is also essential to meet the demand that cannot be achieved from low wind output during a 'Dunkelflaute' event.

Conclusions

The build rate of new generating capacity remains significantly below that needed to achieve a net zero electricity system in 2035. Each year the scale of the challenge becomes greater.

We have recently seen significant market signals that call into question some of the underlying assumptions that have driven energy policy in recent years. Gas price instability drove the marginal electricity price to new highs in winter 2022/23 and the Contract for Difference strike price offered for offshore wind projects has increased by two thirds to reflect changing market conditions.

Two legs of the energy trilemma, security of supply and affordability, are under pressure and this will inevitably put pressure on the third leg, sustainability. Whilst the end goal of Net Zero remains widely supported, the pace of change and the cost to consumers will inevitably be questioned.

In these circumstances our focus must move to projects with least 'time to market' and lowest deployment risk. The 2050 net zero goal remains achievable but the pathway towards it must be better defined and must recognise delivery risks. We must develop fall-back options.

We must urgently move away from using models to create scenarios that are 'Theoretically Feasible' and focus on delivery plans that are 'Realistically Achievable'.

Above all, we must shift to laser-like focus on the task of delivery — ramping up the build rate and removing obstacles to bring forward new generating capacity to remain on track for Net Zero.

References

1. The Race to Net Zero, SNC Lavalin, 2019
2. Towards Net Zero Energy Security: Are we building fast enough?, SNC Lavalin, 2022
3. Electric Insights, Drax, 2023
4. Second National Infrastructure Assessment, National Infrastructure Commission, 2023

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