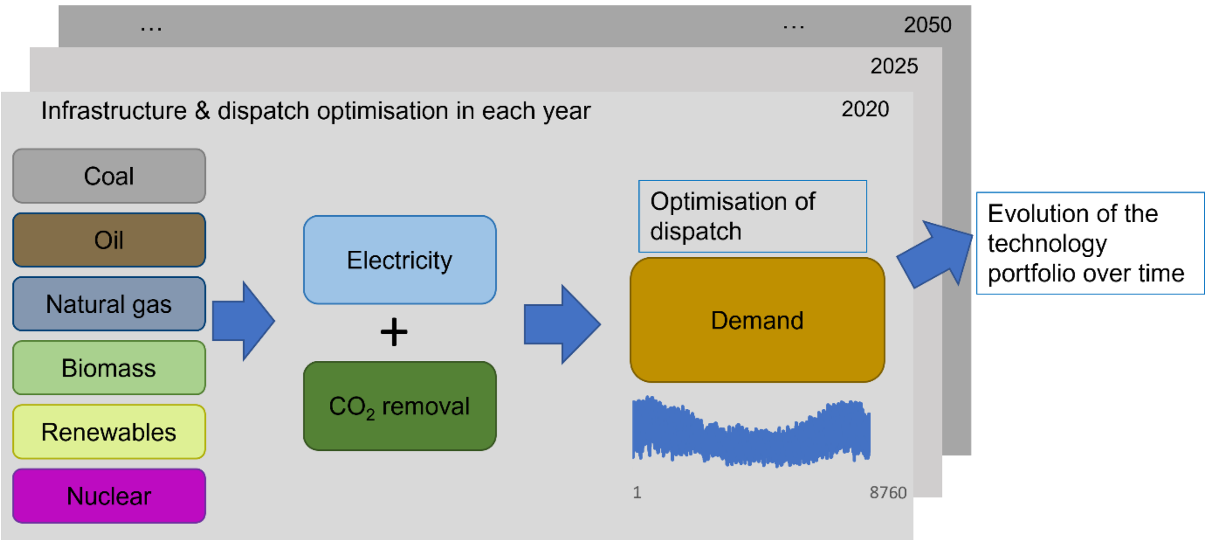
The role and value of BECCS in the USA

With countries needing to make actionable steps to reach a net-zero power system by 2035 in the US, what is the role of bioenergy with carbon capture and storage (BECCS)? What is the value of BECCS in the future energy system – does it help or hinder the transition? Does the existing policy and regulatory environment provide adequate incentive to reach net-zero by the required timelines? These are some of the questions being addressed in the study ('The role and value of BECCS in the USA').

The study performed a comprehensive assessment of fully decarbonising several electricity grids in the US by 2035, paying close attention to the minimum levels of BECCS investment for a cost-effective transition. Moreover, it estimated cost-optimal portfolios of power generation, storage, and negative emissions technologies to achieve a net-zero power system by 2035 and a wider net-zero economy by 2050.

The study used the ESO-JEDI framework to optimise the complex interactions between power generation sources, energy storage systems, and negative emissions technologies, given variabilities in supply and demand. The model evaluates both long- and short-term decisions, such as determining the capacities of each low-carbon generation technology to build, and how best to use it over time to achieve the lowest costs in meeting the demand. The CAISO, MISO, and ERCOT grids were analysed to capture the different regional characteristics in the US as part of the scenario analysis.

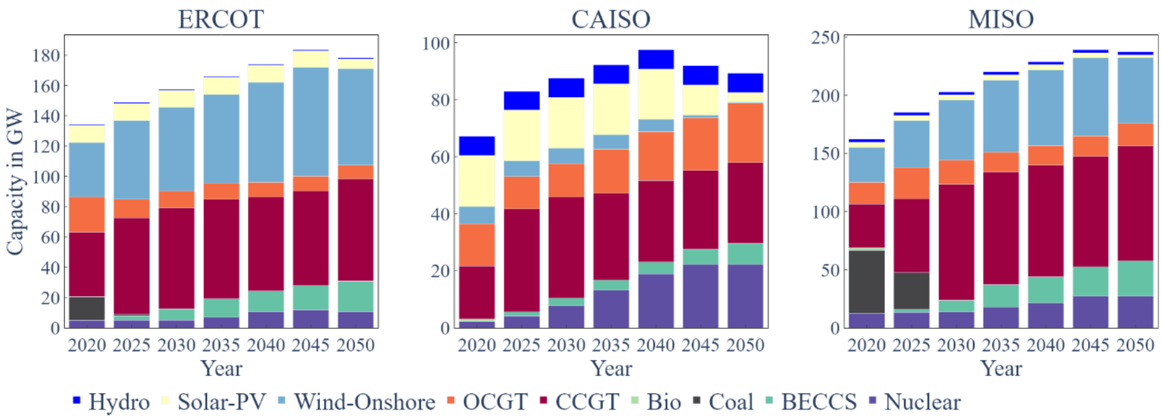


The analysis compared technologies such as renewables, nuclear, fossil-based power with and without CCS, and energy storage technologies to develop a cost-effective portfolio of generation whilst ensuring grid stability. These model scenarios were explicitly linked with a macro-economic impact assessment tool, which estimated the regional economic impacts associated with the transition. The model used the latest available evidence from regional authorities and the wider literature, capturing long-term trends on electricity demand, fuel pricing, and technology performance within the US.

The results were compared using key performance metrics such as the levelised cost of electricity supply, the aggregate installed capacity of renewable and other low-carbon generation sources, GVA impacts, as well as job preservation and creation over time.

Net-zero scenarios cannot be practically and cost-effectively delivered without BECCS.

The assessments suggest that power systems which achieve net-zero by 2035 show a notable reduction of approximately 51% to 66% in the share of unabated gas in power generation compared to a reference scenario without any emissions reductions. This decline is offset by a significant increase in renewable power generation, particularly from wind, which displaces natural gas and provides a source of low-carbon electricity in the ERCOT and MISO regions. CAISO relies more heavily on solar power due to lower wind availability. Furthermore, nuclear power contributes around 14 – 27 GW of capacity in all three energy systems, with a specific uptick in CAISO, stemming from the reduced availability of renewable resources in California.



Like nuclear power, BECCS provides valuable support for intermittent renewables as a baseload generator. BECCS is deployed in all three energy systems to offset residual emissions from the unabated gas-fired power plants. The installed capacity of BECCS in 2050 ranges from 4.6 GW (CAISO) to 21.5 GW (MISO). The levelised cost of electricity in a net-zero energy system is significantly higher than in a reference system without emissions abatement. **However, the inclusion of BECCS in the capacity mix dramatically reduces the overall cost associated with net-zero, making electricity cheaper. Additionally, BECCS provides valuable time to mature technology supply chains, reduce technology risks, and improve commercial confidence.**

BECCS played a more pronounced role when substantial negative emissions were required to counterbalance residual emissions from the economy. Specifically, the total BECCS capacity increased by 7 GW in ERCOT, 3 GW in CAISO, and 10 GW in MISO when the task involved offsetting not only residual emissions from the power sector but also those from the overall economy.

Investments in BECCS help diversify and improve the economic competitiveness of lagging sectors by providing both growth and jobs.

BECCS investments in the US have significant potential to create new jobs and accelerate regional economic development. Generally, BECCS investments, when supported by the appropriate incentives, are poised to play an imperative role in promoting economic growth whilst curbing emissions. The macro-economic impact assessment showed that job creation in the system is more resilient than GVA over time. While GVA may decrease, jobs either remain consistent or decrease at a slower rate, indicating their potential to offer long-term employment opportunities. **Moreover, investments in BECCS distribute the value over a greater range of economic sectors than in the present system, especially the agriculture sector.** Overall, early investments in BECCS (circa 2025) produced an increase in regional jobs and GVA by 38k job-years/ GW, and $6.7bn/ GW, respectively, by 2050. These figures can increase to 52k job-years/ GW and $8.0bn/ GW over the lifetime of the BECCS facility.

Alternatives to BECCS are more costly and more uncertain.

The findings suggest that BECCS offers unique value to the system by enabling deeper reductions in emissions more rapidly and cost-effectively than via other counterfactuals such as DACCS. **In fact, the CAISO and ERCOT regions are expected to be 25 - 31% more expensive to decarbonise in the absence of BECCS.** The MISO power grid is unlikely to reach net-zero by 2035, and the wider region may struggle to reach a net-zero economy by 2050 under historically relevant maximum build rate constraints. Accordingly, there is strong agreement on the role of BECCS across the different regions, which emphasise the importance of developing supportive policy measures.

The deployment of BECCS requires a stronger policy framework to be in effect as existing support is insufficient to incentivise investment.

The study assessed the role of incentive support measures such as the investment tax credits (ITC) and 45Q tax credits for CO_2 sequestration in the US. The results indicate that ITCs help accelerate the uptake of renewables, increasing their relative share to 20 – 45% of generation capacity by 2050. The combination of 45Q support and low coal prices supports the deployment of coal-fired power with CCS in the absence of other regulation. **The study found that none of the ESOs can achieve deep decarbonisation within the existing policy and regulatory environment. Further support of BECCS deployment is required.**

These findings suggests that IRA and BIL alone remain insufficient to incentivise a net-zero or net-negative power system. We assessed two specific policy interventions to close this cost gap: a) raising the value of the 45Q tax credit, and b) introducing a dedicated negative emissions credit. **We found that simply increasing the 45Q tax credit to $100 – 150/t CO_2 provides little value to the system as it enhances the economic viability of coal-CCS. In contrast, a specific negative emissions credit of $40/t CO_2 is required to facilitate a net-negative power system by 2050, largely delivered by BECCS.** This highlights the value of targeted policy measures to generate negative emissions in the system.