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# **REPORT** Understanding and addressing labour supply constraints and their impact on efforts to decarbonise UK industry clusters and the wider economy

Antonios Katris, Christian Calvillo, Hannah Corbett,
Paulina Gonzalez Martinez, Karen Turner, and Julia Race.
Centre for Energy Policy, University of Strathclyde

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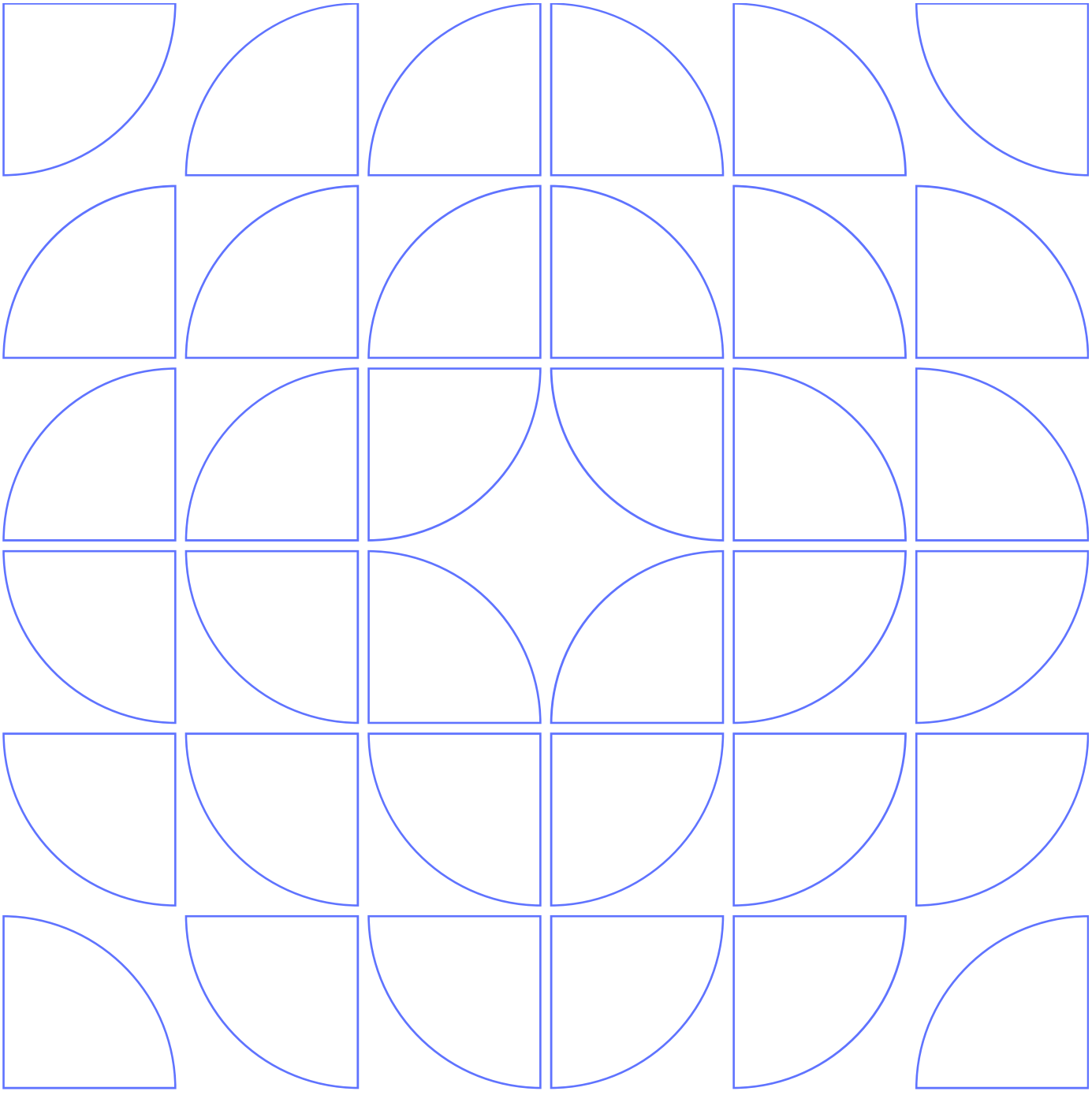


# Understanding and addressing labour supply constraints and their impact on efforts to decarbonise UK industry clusters and the wider economy

## Executive summary

Decarbonising industrial clusters is a critical component of the UK Government's efforts to transition to net zero by 2050. In its recently published (December 2023) Carbon Capture Utilisation and Storage (CCUS) Vision[i], the UK Government argues that establishing CCUS as an industrial decarbonisation measure could add £5BN to the economy by 2050 and support 50,000 jobs by 2030. Around 10,000 jobs of these are expected to relate to the activity of sequestering emissions from the UK's regional industry clusters, including the UK $CO_2$ Transport and Storage (T&S) sector, as well as other CCUS-related services and technological developments.

The Track 1 and Track 2 cluster sequencing process linked to CCUS deployment will involve various activities and different labour demands across an extended and dynamic time frame.[ii] The Centre for Energy Policy (CEP)'s research provides timely new analysis around these associated labour demand pressures and employment changes in the wider context of a supply constrained UK labour market characterised by both worker and skills shortages and multiple net zero/decarbonisation activities taking place in similar time periods. Furthermore, how these demands and changes could potentially impact on project delivery costs and the wider economy.

Importantly, our novel approach to modelling these impacts – through simulating the deployment of the four $CO_2$ T&S systems (Hynet, East Coast, Viking and Scottish) both individually (to assess the contributions from each subsector, and summing the jobs and GDP impact totals) and simultaneously – brings critical insights and learnings to a space where approaches to assessing the economic impacts (jobs and GDP) related to CCUS vary widely.[iii] [iv] In turn, potentially hindering efforts to deliver these projects in the most cost effective way as well as developing the necessary supply chains and maximising the associated economic gains to the wider economy.

There are three key findings emerging from our research as follows:

1. **Investment in enabling a nascent $CO_2$ Transport and Storage sector could deliver sustained economic gains as well as lead to new pressures on labour demand and changes in employment.**
   Our research finds that by 2035, the operational T&S industry could support around 4,000 full-time equivalent (FTE) jobs, with just over 400 FTE jobs within the T&S industry, while also enabling GDP gains of almost £900M. Alongside these economic gains, there could also be peaks in demand related to sectors such as construction. When each $CO_2$ T&S system is modelled individually, we find that the development of the Track 1 T&S systems (Hynet North West and East Coast Cluster) could require over 7,700 UK FTE construction jobs in the first year of development (2023). A second peak of 6,700 FTE jobs is observed as work starts on Track 2 (Acorn and Viking CCS) in year 5 of our analyses (2027). In addition, our research suggests regional employment shifts across the timeline. In 2023, Track 1 T&S will drive high demand for construction employment in northern regions. However, due to wage pressures, this causes displacement in sectors like services and hospitality and in the regions where these types of sectors are more prevalent, e.g., London and southern regions. This results in a net job creation of around 3,600 FTE. By 2027,

Track 2 T&S activities will create similar effects, with job displacement and a net increase in labour demand of just over 4,000 FTE jobs across the economy.

2. **The simultaneous staged introduction of four regional subsectors of a nascent UK $CO_2$ T&S sector could exacerbate competition for resources such as labour and, in turn, constrict economic gains.**
Our research finds that when the deployment of the four $CO_2$ T&S systems is modelled simultaneously as opposed to individually, a different picture begins to emerge in relation to the labour demand and wider economic impacts. As highlighted in our first finding, there are still peaks in labour demand which could raise wage costs and potentially constrain the wider economic expansion. However, the year 5 (2027) net economy-wide employment gains, for instance, are restricted to just over 3,000 FTE jobs, instead of over 4,000 FTE job in the case of systems being simulated individually. Thus, the simultaneous simulation better reflects activity in Track 1 and 2 systems and the level of competition emerging for the same pool of resources. It is also important to note here that this activity (which is relatively small in scale) will be set against the wider backdrop of competing and larger net zero projects including offshore wind development, electricity network upgrades and new nuclear.

3. **Efforts to respond to these labour demands and changes in employment through action on skills and worker shortages could help ease congestion and help maximise economic gains related to the establishment of a $CO_2$ T&S sector.**
Our research finds that in the case of a simultaneous simulation, where worker and skills shortages have been addressed and labour market pressures halved, a fully operational T&S industry could enable £1,046M in GDP gains and lead to the net creation of 6,806 FTE jobs across the economy by 2035. This compares to circa £900M GDP gains and circa 400 FTE jobs created where labour market pressures are not reduced. This could be achieved through a mix of policy measures including skills development, training and incentivising workforce participation. It is also worth noting that diminishing capacity requirements in oil and gas supply chains as the industry declines could potentially ease labour market and other capacity challenges for new greener activity (such as $CO_2$ T&S), while continuing to provide decent, well-paid jobs. However, the timing of the different activities is important with the potential for wage-driven pressures if there is a mismatch between labour capacity being freed-up and additional labour demand from new greener activity such as $CO_2$ T&S emerging.

## Policy implications

- **Policy frameworks must be informed by an understanding of how multiple net zero projects taking place at the same time could exacerbate competition for resources, drive up project costs and impact the wider economy and set out ways in which these challenges can be addressed.**
This includes the Net Zero and Nature Workforce Action Plan, informed through the work of the UK Government's Green Jobs Delivery Group, which is currently being developed, as well as the Scottish Government's forthcoming Green Industrial Strategy and Energy Strategy and Just Transition Plan. Policy interventions need to consider how industrial decarbonisation and other net zero projects can be sequenced, including the incentives that might be required to do this. This is in

addition to how the skilled workforce will be developed. This will also involve understanding how the decline of industries such as O&G could free up capacity that could be exploited by emerging sectors such as $CO_2$ T&S, but noting that timing in terms of available capacity vs additional labour demand will be key.

- **Coordination of different elements of the net zero transition needs to be considered as part of wider public policy decision making.**
  Overall, the type of results emerging around macroeconomic, sectoral and regional impacts including job displacement in relation to efforts to decarbonise industry clusters indicate the need to integrate the policy response to such challenges within wider economic and public policy decision-making, not least if 'just transition' and 'levelling up' outcomes are to be achieved.

- **Assessments of employment requirements and economic impacts across industry clusters and net zero projects more generally need be made more consistent, and approaches developed that consider the simultaneous introduction of multiple projects as well as individual projects in isolation.**
  This will be critical to informing effective action on addressing and mitigating labour shortages and other potential negative economic outcomes, as well as efforts to ease congestion and aid more effective net zero planning.

## Introduction

The UK Government considers decarbonising industrial clusters as pivotal for achieving its net-zero target by 2050. Its recent CCUS Vision outlines ambitious economic and environmental goals, including adding £5BN to the economy by 2050, supporting 50,000 jobs by 2030, and creating storage capacity equivalent to removing 6M cars from roads. However, achieving these gains requires collaboration across government, industry, and academia to consider how persistent skills and worker shortages can be most effectively addressed, particularly against the backdrop of multiple net zero projects coming online within similar timeframes. These efforts will be essential to successfully delivering industrial decarbonisation in ways that are economically and politically feasible, and that maximise the potential wider economy benefits.

The labour market and other wider economy challenges in decarbonising the UK's industry clusters (LAB-CLUSTER) project[v] was established to strengthen understanding around these issues and brings a much-needed, and to date missing, focus on how persisting labour market supply constraints may impact decarbonisation project delivery and sectoral/wider economy outcomes.

Our work on this project has focused on extending our scenario modelling to better capture the regional cluster context of the UK CCUS rollout, with a continued focus on the $CO_2$ T&S element therein. We aimed to add more depth and detail to understanding of the effect that persisting UK labour supply constraints and skills shortages might have on industrial decarbonisation project delivery and the wider economy and how these impacts may be mitigated to allow greater employment, revenue, and other economic gains to increase in all timeframes, all against the wider backdrop of a crowded net zero investment space between now and 2030. This report builds on previous research[vi][vii] [viii] which has sought to understand the potential economic benefits of deploying a $CO_2$ T&S sector and how these are shaped by labour market conditions.

## Project approach and methodology

By employing a multi-sector economy-wide scenario simulation model of the UK economy to capture and isolate the sectoral and broader implications of the introduction of a nascent UK $CO_2$ T&S sector[ix], our research enables consideration of how investment and deployment of industrial decarbonisation actions can be effectively delivered in a dynamic and challenging economic environment, where multiple net zero projects must compete for resources including labour. It is worth noting that the assumptions we made on the timing of these investments were based on the best information we had at the time, but during the course of the project investment timelines may have shifted. We have also considered this alongside a scenario of a decline in UK oil and gas industry activity, informed by projections by the UK's North Sea Transition Authority (NSTA) and consistent with projections of what is required, in terms of UK oil and gas demand, for net zero. [x]

We used the outputs of the national UKENVI Computable General Equilibrium (CGE) modelling analyses to inform, in terms of economy-wide impacts, consideration of sectoral and total jobs and other outcomes at the UK-wide level. However, the regional as well as sectoral location of labour demand in different time periods is likely to be important for workforce planning and the successful delivery of $CO_2$ T&S services and other industrial decarbonisation actions (UKRI, 2023)[xi]; hence, we extend to a regional mapping of employment impacts[xii]. This involved mapping the national-level employment impacts to different regions using ONS data on 'Workforce jobs by region and industry' (ONS, 2022b)[xiii]. We introduce a weighting factor to allocate a higher share of employment changes around cluster regions for the construction and T&S sectors, where activity will likely be physically concentrated around the clusters.

Critically, we have employed a novel modelling approach whereby we have looked at two broad sets of scenario simulations. The first simulates the deployment of the four $CO_2$ T&S systems (Hynet, East Coast, Viking and Scottish) individually to assess the contributions from each subsector and summing the jobs and GDP impact totals. The second simulates simultaneous deployment in line with the UK Government cluster sequencing process and allows us to understand how competition for resources including a limited pool of labour might play out and potentially constrict economic gains.

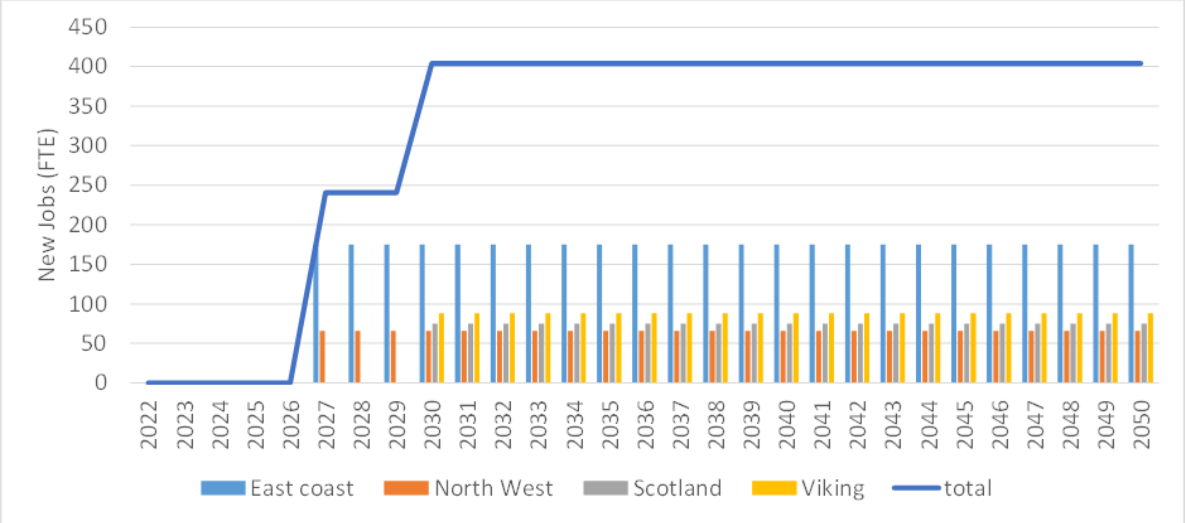
## Key findings

### 1. Investment in enabling a nascent $CO_2$ Transport and Storage sector could deliver sustained economic gains as well as lead to new pressures on labour demand and changes in employment.

Our research finds that by 2035, the operational $CO_2$ T&S industry could support around 4,000 full-time equivalent (FTE) jobs, with just over 400 FTE jobs within the T&S industry, while also enabling GDP gains of almost £900M. The infrastructure deployment of an emerging UK $CO_2$ T&S sector involving a total of £3,274M invested between 2023 and 2029 across the four Track 1 and 2 clusters will have also employment impacts. Our scenario simulations assume Track 1 investment activity began in 2023, with all infrastructure deployment occurring in 4 years up to 2027, when the operation of the Track 1 T&S systems begins as does the deployment of Track 2 (Viking CCS and Scottish cluster) infrastructure which is assumed to be completed by 2029. Consequently, all clusters will become operational in 2030.

Figure 1 shows the direct employment changes in the T&S sector where activity starts once all the infrastructure comes online, which for Track 1 clusters is from year 2027, and for Track 2 clusters from 2030. The level of people directly employed by the T&S sector is smaller but more stable, accounting for approximately 400 sustained jobs in total, 240 jobs linked to Track 1 and about 160 jobs linked to Track 2 T&S sector.

*Figure 1. $CO_2$ Transport & Storage sector employment changes (FTE) for Track 1 and Track 2 T&S activity relative to baseline.*




The simulated (where each $CO_2$ T&S system is modelled individually) total UK employment impacts and jobs in the construction sector can be observed in Figures 2 and 3, respectively. In the year 2023 (year 1 in our simulations), employment demand (Figure 3) in the construction sector is driven by the large investments introduced in the economy to implement the T&S infrastructure associated with the Track 1 Hynet North West and East Coast $CO_2$ T&S systems, reaching its peak at over 7,700 FTE jobs in 2023 before gradually falling back in subsequent years. The net total employment across the economy (Figure 2) shows a similar peak but of a smaller scale (around 3,600 jobs). This reduced overall employment results from job losses in other sectors of the economy (like 'accommodation & food service activities' and 'information & communication') are driven by wage pressures from the high demand for construction jobs.

In 2027, when the Track 2 $CO_2$ T&S systems (Acorn, Viking) start deploying their $CO_2$ T&S infrastructure, construction jobs peak at almost 6,700 FTEs (Figure 3), tailing off until construction activity is completed by 2030. Once again, the net peak in total UK employment peak is smaller by 2027, with just over 4,000 jobs supported across economy, as job displacement across other sectors offset the increased employment opportunities in construction. The projection is that from 2030 onwards, around 400 $CO_2$ T&S and 1,900 construction sector jobs will be sustained through the operation of the new T&S sector. Furthermore, as labour constraints relax, some of the sectoral job losses are reversed, and other supply chain-linked jobs (such as in 'transport equipment/other manufacturing' and 'finance/insurance' sectors) across the wider economy are supported in the long-term, reaching an increase of around 4,120 sustained jobs relative to the baseline (see Figure 2).

*Figure 2. Economy-wide employment changes (FTE) for Track 1 and Track 2 T&S activity relative to baseline.*

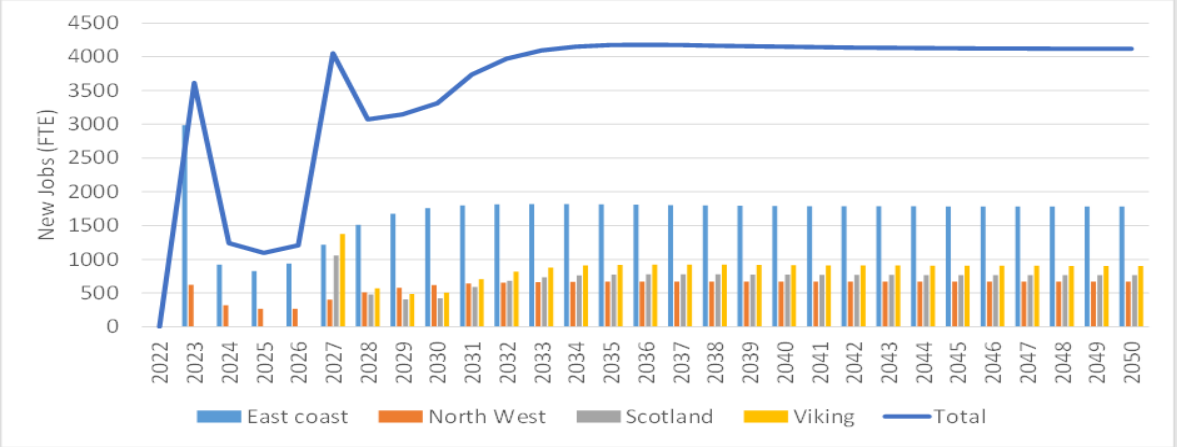
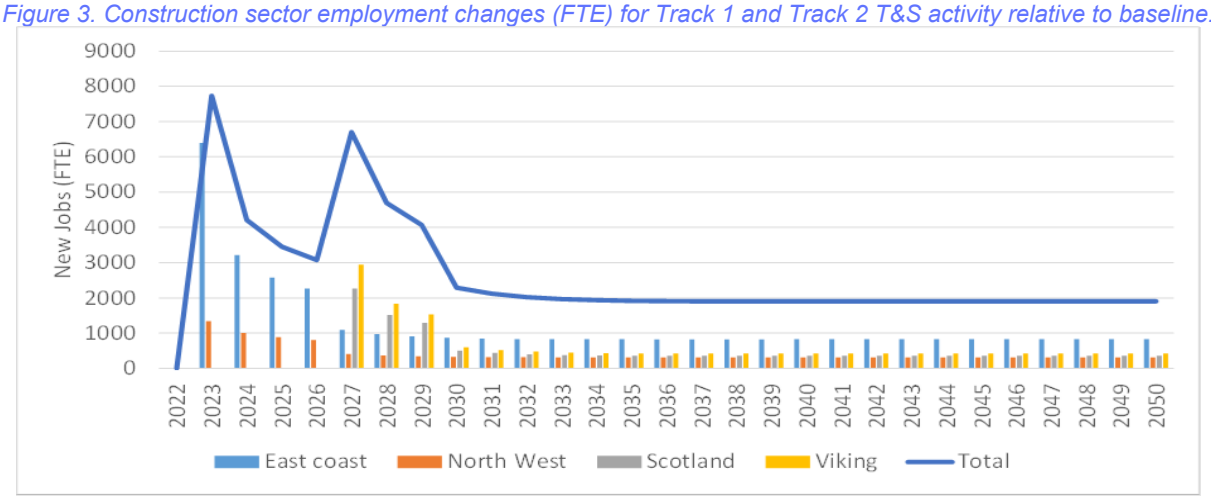
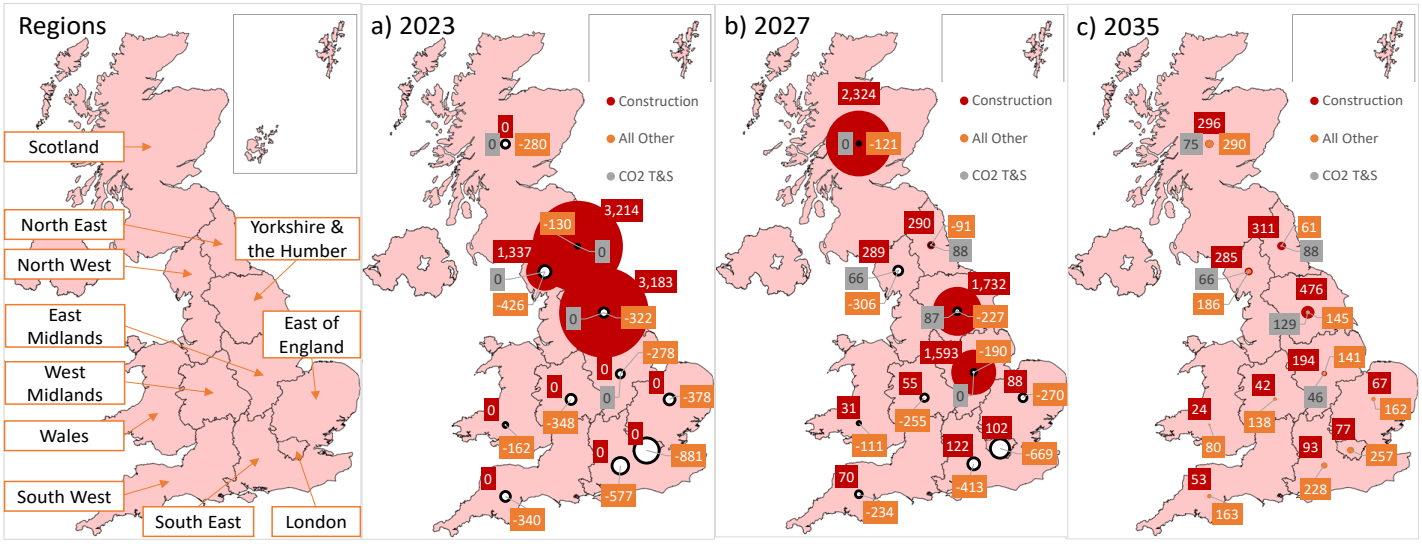



*Figure 3. Construction sector employment changes (FTE) for Track 1 and Track 2 T&S activity relative to baseline.*




The deployment of the $CO_2$ T&S sector servicing the Track 1 and Track 2 $CO_2$ T&S systems will also produce regional employment changes in peak activity years (2023, 2027) and in the long run (2035). Using Office of National Statistics (ONS) data, we developed regional mapping based on current exiting job shares per sector in 11 regions to show the sectors where employment changes will likely occur. In Figure 4, the first frame identifies the regions, the second and third frames show the distributed outcomes across sector groupings and regions in the peak years 2023 and 2027, and the fourth frame shows sustained employment changes in the long run.

*Figure 4. Regional employment changes (FTE) for Track 1 and Track 2 T&S activity relative to baseline – focus on key activity years: 2023 and 2027, and sectors: construction and $CO_2$ Transport & Storage.*



In 2023, Track 1 $CO_2$ T&S systems drive high employment needs for the construction sector of over 3,000 FTE jobs for each of the Yorkshire & the Humber and North East regions and over 1,300 FTE jobs for the North West region. At this time, with the Track 2 T&S systems not having started activity, wage-driven cost and price pressures triggered by the rise in labour demand associated with the investment activity around the Track 1 T&S activity will produce some employment displacement in the Scottish region (a net loss of around 260 jobs). Generally, the high demand for construction jobs in northern regions hosting the Track 1 and 2 T&S systems creates wage pressures that affect all sectors of the economy in all regions not directly benefiting from the T&S activity. This includes the construction industry, but there, the demand boost dominates. However, wage-driven costs and price pressures drive job and activity displacement in other sectors, especially in more wage- and/or labour-intensive ones, such as services and hospitality. Crucially, this leads to regional net employment losses being greater in the regions where these types of sectors are more prevalent, e.g., London and southern regions.

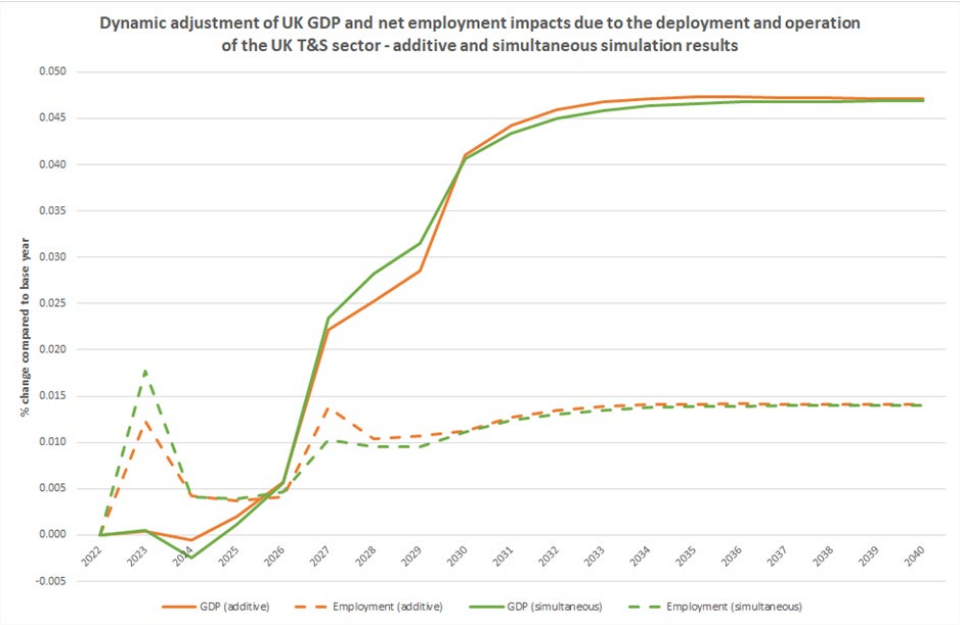
In 2027, when the investment activity starts around the Track 2 T&S systems, we observe the Scottish $CO_2$ T&S activity requiring over 2,300 construction jobs in Scotland and about 3,200 jobs linked to Viking CCS, located between Yorkshire and the Humber and the East Midlands regions. Like the first year of investment in the Track 1 T&S systems, job displacement in other regions and sectors happens, especially where more wage-and/or labour-intensive consumer-facing activity is concentrated.

The year 2035 shows the long-term regional employment changes with the $CO_2$ T&S sector operating across all clusters, supporting around 400 direct jobs across the clusters' regions. Here, construction jobs are sustained over time in these regions, primarily servicing the T&S infrastructure that was previously developed. However, the sector shows activity across all regions due to the general increase in economic activity across multiple sectors, albeit at a lower scale in southern areas due to the impact of wage cost-driven displacement and the smaller reliance on capital-intensive sectors which limits the need to maintain said capital. Crucially, and as labour market constraints relax, the job displacement previously seen is reversed, and other supply chain and induced jobs across the wider economy are supported in the long term, reaching an increase of employment relative to the baseline.

## 2. The simultaneous staged introduction of four regional subsectors of a nascent UK $CO_2$ T&S sector could exacerbate competition for resources such as labour and, in turn, constrict economic gains.

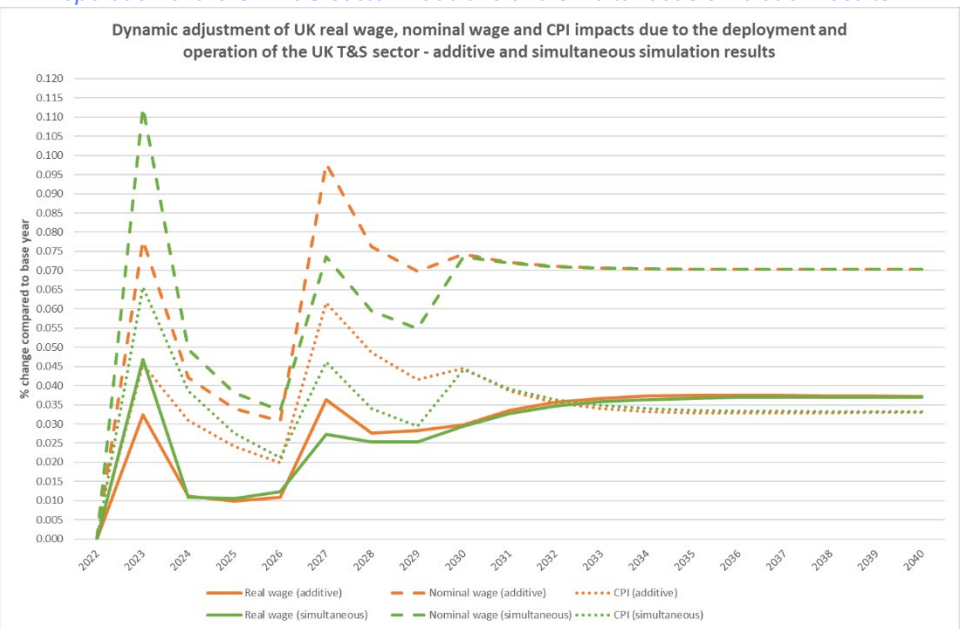
Our research has modelled the development and potential economic outcomes of regional T&S sectors emerging linked to the Track 1 and Track 2 CCUS projects, combining to constitute a nascent UK $CO_2$ T&S sector. In comparing the additive results of the individual simulations with one where the staged investment and deployment of all four are simultaneously simulated, a different picture begins to emerge in relation to the labour demand and wider economic impacts. This is demonstrated in Figure 5 below which shows how in the simultaneous case the net employment impacts in 2023 are larger than the additive case (where $CO_2$ T&S systems are modelled individually) indicating that the anticipated labour demand could be higher, leading to increased wage pressures, driven by competition for resources, and limiting economic gains. The effect of the labour market constraints biting can be seen in Figure 5, where we gradually observe a flip of the picture with total employment impacts in the simultaneous case become smaller compared to the additive case. For example, in 2027 the net employment impacts are restricted in the simultaneous case to just over 3,000 FTE jobs, instead of over 4,000 FTE job in the additive case.

*Figure 5. Dynamic adjustment of key UK economy variables due to the deployment and operation of the UK T&S sector – additive and simultaneous simulation results.*




Effectively, in Figure 6 it becomes clear from the comparison of the additive and simultaneous simulation results (across the four cluster cases) that the former initially underestimates the initial combined (simultaneous) pressures on labour/wage costs and, thus, also the wider CPI impacts. In turn this impacts headline measures of employment and GDP, both of which will be depressed (as shown in Figure 5) by greater cost and price impacts so that underestimating price pressures will lead to overestimating activity impacts at both sectoral and macro levels.

*Figure 6: Dynamic adjustment of UK real wage, nominal wage and CPI impacts due to the deployment and operation of the UK T&S sector – additive and simultaneous simulation results.*

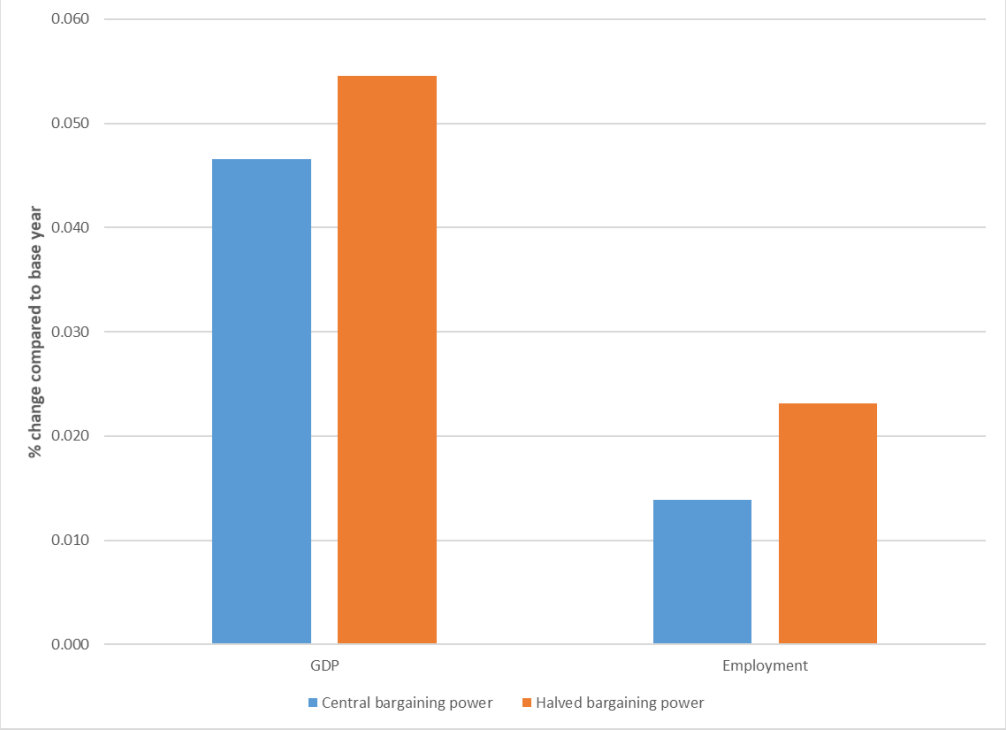


Thus, we conclude that the simultaneous simulation better reflects activity in Track 1 and 2 systems and the level of competition emerging for the same pool of resources. It is also important to note here that this activity (which is relatively small in scale) will be set against the wider backdrop of competing and larger net zero projects including offshore wind development, electricity network upgrades and new nuclear. We have not considered these wider net zero projects in this work, but our analyses show that there are tangible implications if even a set of small scale projects compete over the same pool of resources. It is therefore key to identify and understand the implications where much larger projects are developed in similar and/or overlapping timeframes.

### 3. Efforts to respond to these labour demands and changes in employment through action on skills and worker shortages could help ease congestion and help maximise economic gains related to the establishment of a $CO_2$ T&S sector.

Persistent skills and worker shortages could hinder industrial decarbonisation efforts and constrain the extent of wider economic gains if labour market shortages introduce wage cost-driven pressures. Our research shows that actions triggering an increase in labour demand, where supply is constrained, are likely to trigger real wage bargaining processes (where employees demand higher wages), which will, in turn, increase the costs of all producers and risk displacement of employment across multiple sectors of the economy. Moreover, cost increases feed through to price pressure, affecting the wider cost of living and doing business, exacerbating real wage demands in the labour market and bringing challenges for managing public budgets and real spending commitments.

In the case of a simultaneous simulation, where worker and skills shortages have been addressed and labour market pressures halved, a fully operational T&S industry could enable 0.055% (£1,046M) GDP gains and lead to the net increase of 0.023% (6,806 FTE) in employment across the economy by 2035. This compares to 0.047% (circa £900M) GDP and 0.014% (circa 4,000 FTE) employment gains where labour market pressures are not reduced. This could be achieved through a mix of policy measures including skills development, training and incentivising workforce participation.



It is also worth noting that diminishing capacity requirements in oil and gas supply chains as the industry declines could potentially ease labour market and other capacity challenges for new greener activity (such as $CO_2$ T&S), while continuing to provide decent, well-paid jobs.

Projections indicate that beyond 2050, only 13% of the 2022 oil and gas industry will remain operational in the longer term.[xiv] With the sector initially contributing to almost 1% of the UK gross value added (GVA), it is to be expected that a sharp decline in production will lead to economy-wide employment losses of around 120,840 FTE jobs. This includes a potential loss of 54,800 FTE jobs in the oil and gas industry and supply chain, with other sectors, including hospitality, construction, and wholesale and retail trade, likely to be significantly impacted, especially in regions and communities that depend on the oil and gas industry for income. (See Table 1)

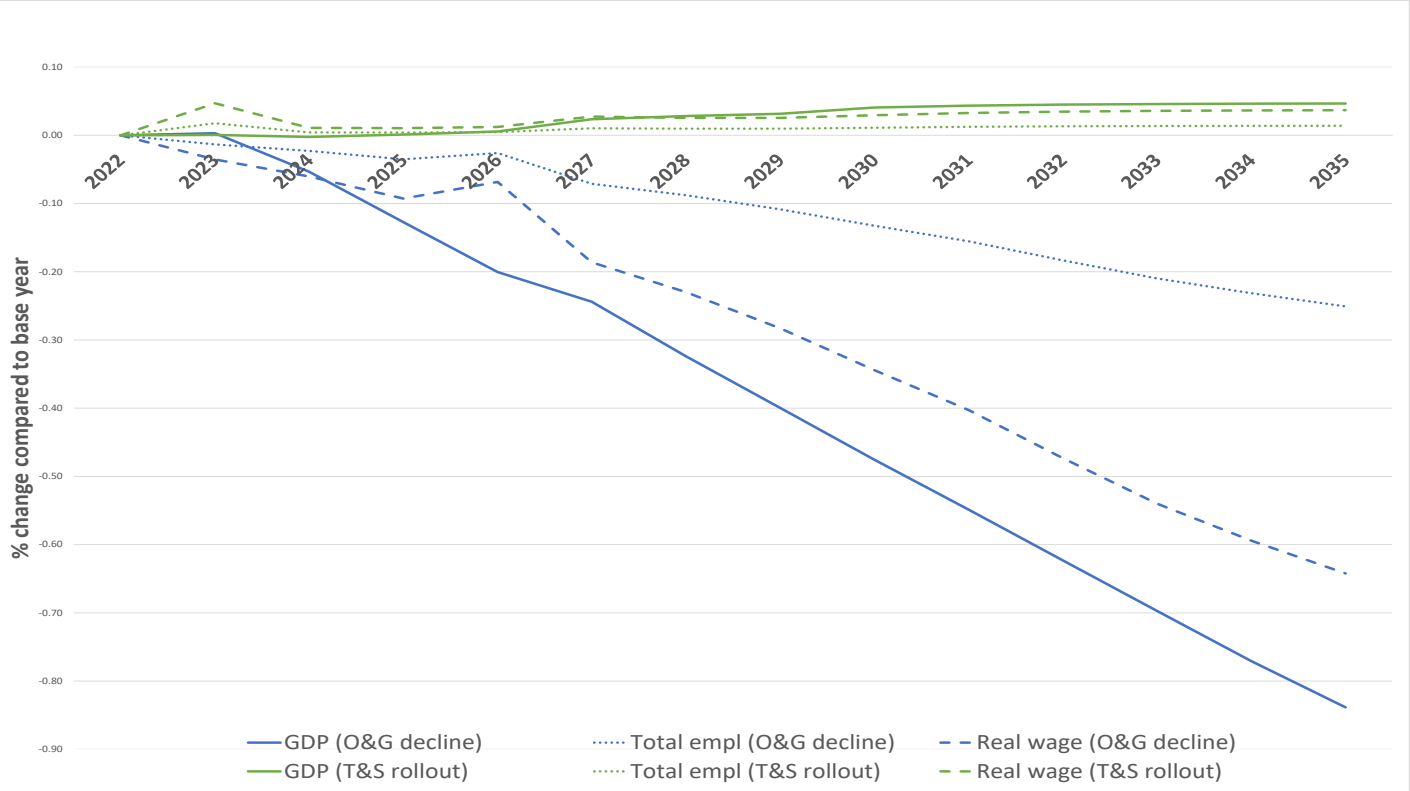
*Table 1: Key long-term economy-wide impacts due to reduced supply and demand for oil and gas in the UK.*

| | Decline of O&G supply and demand - BRW |
|---|---|
| **Net impact on government budget (£million) consisting of:** | -6,355 |
| **Change in government revenue (£million)** | -14,895 |
| **Nominal adjustments to meet real spending commitments (£million)** | -8,541 |
| | |
| **GDP (£million)** | -26,335 |
| **GDP (% change)** | -1.375% |
| | |
| **Total Employment (FTE)** | -120,841 |
| **Total Employment (% change)** | -0.410% |
| **Consumer Price Index (CPI - indexed to 1)** | -0.940% |
| **Real wage rate (indexed to 1)** | -1.029% |
| **Real household consumption (£million)** | -19,128 |
| **Real household consumption (% change)** | -1.483% |
| | |
| **O&G Employment (FTE)** | -11,539 |
| **O&G Output (£million)** | -26,548 |
| **O&G Exports (£million)** | -20,027 |
| **O&G Imports (£million)** | -250 |

An emergent $CO_2$ T&S sector could help mitigate the negative impacts of the decline of the oil and gas industry on macroeconomic gains and price pressures on a limited scale, given the size of the activity. The sector could support preserving around 4,000 FTE jobs and GDP of circa £900M per annum by 2035, when the UK Government aims for a self-sustaining CCUS sector to be in place. In opposition, the oil and gas decline could translate to 73,950 FTE job losses and GVA losses of £16.1BN per annum by 2035.

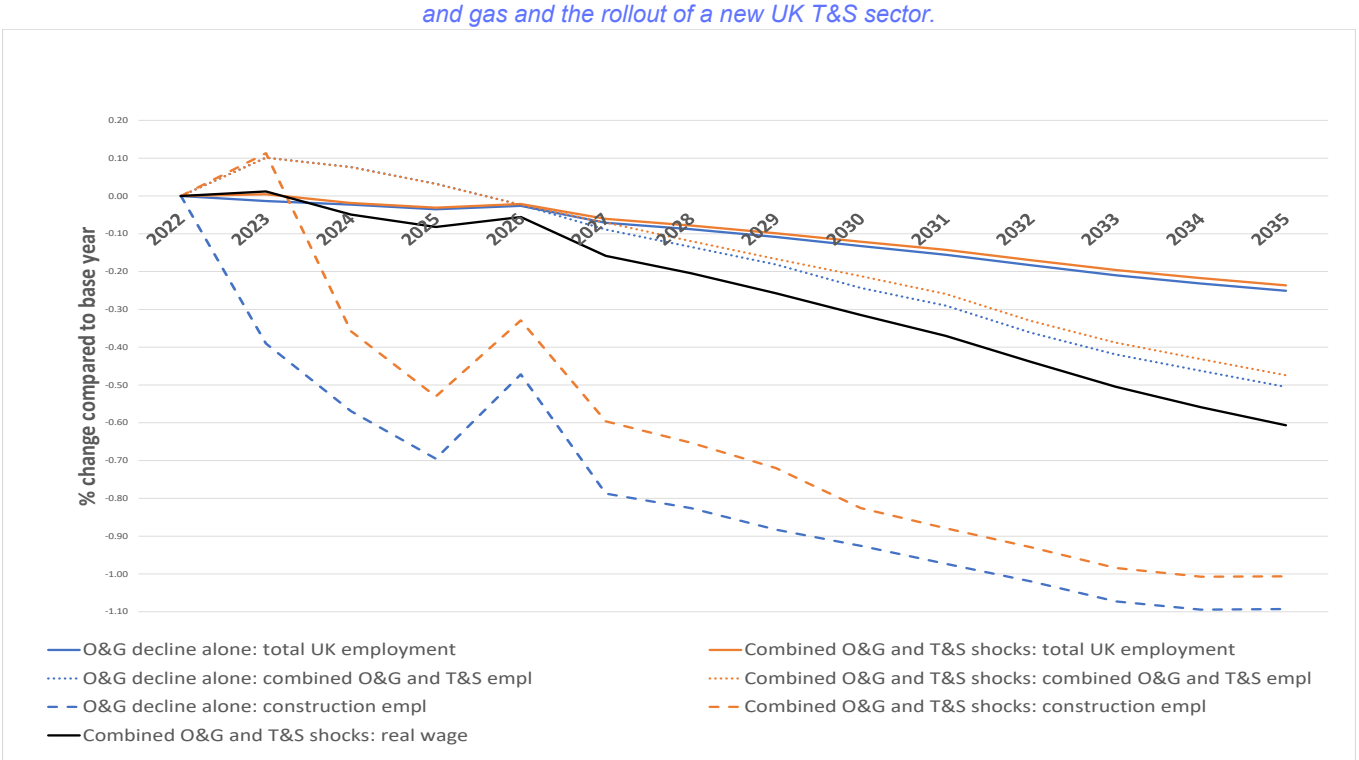
The employment mitigation will be concentrated in the T&S activity itself and the UK construction sector, requiring, however, that CCUS deployment go far beyond the targets of 20-30MtCO2e sequestered by 2030. For the nascent $CO_2$ T&S sector to support these many jobs and to offset around 5.6% of the GDP losses by 2035, it would need to sequester around 50MtCO2e per annum. Effectively, this would mean doubling the capacity of the CCUS coverage planned for the Track 1 and 2 clusters (Figure 8).

*Figure 8: Evolution of the UK GDP, employment and real wage due to the decline of UK supply and demand for oil and gas, persistently high oil and gas prices and the rollout of a new UK T&S sector.*




Crucially, the results reported in Figure 9 indicate that the expectation that the rollout of T&S could utilise some of the labour capacity freed-up as the current oil and gas industry declines is indeed valid.

*Figure 9: Evolution of the UK employment and net real wage due to the decline of UK supply and demand for oil and gas and the rollout of a new UK T&S sector.*



However, note that Figure 9 shows some transitory net increase in employment demand, and consequently in real wage demands in the constrained UK labour market, in the period to the mid-2020s. This is indicative of complex and dynamic workforce challenges associated with the mismatch of timelines for the $CO_2$ T&S rollout, at this stage concentrated in construction activity to enable deployment of the Track 1 clusters, and the oil and gas capacity freed up, where the pace of decline in the latter is relatively slow at in this timeframe. Thus, other strategies will be required to address worker availability and wage cost challenges associated with the emergence of a UK $CO_2$ T&S sector linked to industrial decarbonisation.[xv] [xvi]

## Policy implications

Based on these research findings, there are three key policy implications arising which need be considered by decision-makers across national, devolved, and local governments as well as other organisations including industry responsible for net zero delivery.

- **Policy frameworks must be informed by an understanding of how multiple net zero projects taking place at the same time could exacerbate competition for resources, drive up project costs and impact the wider economy and set out ways in which these challenges can be addressed.**
  This includes the Net Zero and Nature Workforce Action Plan, informed through the work of the UK Government's Green Jobs Delivery Group, which is currently being developed, as well as the Scottish Government's forthcoming Green Industrial Strategy and Energy Strategy and Just Transition Plan.

  Policy interventions need to consider how industrial decarbonisation and other net zero projects can be sequenced, including the incentives that might be required to do this. This is in addition to how the skilled workforce will be developed. This will also involve understanding how the decline of industries such as O&G could free up capacity that could be exploited by emerging sectors such as $CO_2$ T&S, but noting that timing in terms of available capacity vs additional labour demand will be key.

- **Coordination of different elements of the net zero transition needs to be considered as part of wider public policy decision making.**
  Overall, the type of results emerging around macroeconomic, sectoral and regional impacts, including job displacement, in relation to efforts to decarbonise industry clusters indicate the need to integrate the policy response to such challenges within wider economic and public policy decision-making, not least if 'just transition' and 'levelling up' outcomes are to be achieved.

- **Assessments of employment requirements and economic impacts across industry clusters and net zero projects more generally need to be made more consistent, and approaches need to be developed that consider the simultaneous introduction of multiple projects as well as individual projects in isolation.**
  This will be critical to informing effective action on addressing and mitigating labour shortages and other potential negative economic outcomes, as well as efforts to ease congestion and aid more effective net zero planning.

# Endnotes

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[ix] Our methodology is detailed in the published peer-reviewed article: Turner, Karen, Antonios Katris, Abdoul Karim Zanhouo, Christian Calvillo, and Julia Race. 'Industrial Carbon Capture Utilisation and Storage in the UK: The Importance of Wage Responses in Conditioning the Outcomes of a New UK CO2 Transport and Storage Industry Emerging in a Labour Supply Constrained Economy'. Journal of Cleaner Production 434 (January 2024). Available at: https://doi.org/10.1016/j.jclepro.2023.140084.

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[xv] We have explored the implications of labour market conditions and responses on the expected economy-wide outcomes driven by the development and operation of a nascent $CO_2$ T&S sector. Our analyses are detailed in this peer-reviewed paper: https://doi.org/10.1016/j.jclepro.2023.140084

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