



Policy Brief

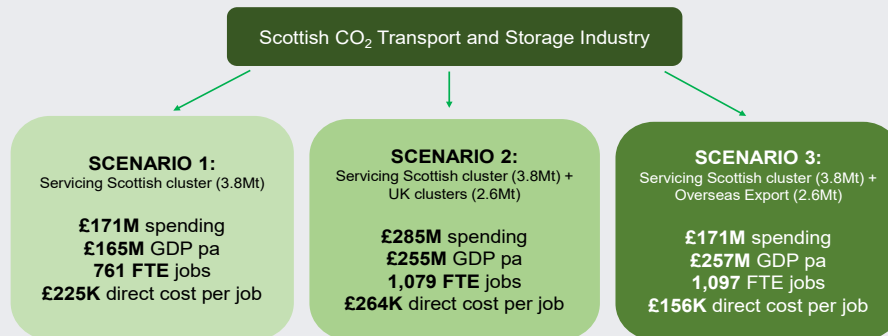
Developing and export base for Scottish CCUS: Maximising returns on investments and costs to public budget

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Summary of key findings

By 2035, a new Scottish CO₂ Transport and Storage (T&S) industry linked to the Acorn CCS project, with capacity to sequester 3.8Mt (mega/millions of tonnes) of emissions from the Scottish cluster and a further 2.6Mt from elsewhere in the UK or from overseas, could generate a sustained uplift in UK GDP of just over £250million per annum and support almost 1,100 jobs across the economy.ⁱ Moreover, if an overseas export base is developed, the burden on the public budget to support Scottish T&S could be reduced with the direct 'cost per job' falling by up to 31% and by more (up to 43%) if the full impacts on government revenues and spending are considered.

Figure 1. Scottish CO₂ Transport and Storage industry emissions sequestering scenarios



Exploiting export opportunities in an international marketplace could also support the generation of new real revenue flows with the potential to be targeted at improving absolute and distributional outcomes of net zero actions. Our research finds that:

- The direct public spending requirement to guarantee demand for a Scottish T&S industry that services the Scottish cluster only (3.8Mt) is £171M per annum. By 2035, the 'return' is an additional £165M in UK GDP per annum and 761 full-time equivalent (FTE) jobs supported. The implied direct 'cost per job' is £225K. However, if we take account of an additional £40M in real disposable public income (adjusted for increased nominal government spending requirements) created, this falls to £172K.
- However, if capacity is increased to service an additional 2.6Mt in overseas export demand, the direct public spending requirement will be unchanged while the return increases to £257M additional GDP per annum, 1,097 FTE jobs and £63M in real disposable public income. Thus, the 'cost per job' in terms of the direct spending requirement falls by 36% (to £156K) and by 43% (to £99K) if the full net public budget outcome is considered.
- If the additional capacity is directed towards sequestering an additional 2.6Mt of UK emissions, the GDP, jobs and revenue/net public income gains are similar. However, the additional government spending requirements (+£92M per annum) in supporting UK industry to use Scottish T&S capacity increase the direct cost per job to £265K and the net deficit measure to £207K. Such outcomes must be examined in the context of corresponding metrics emerging from scenarios considering the use of T&S capacity elsewhere in the UK. This is the focus of the next stage of our research.



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Research and scenario simulation approach

This brief builds on results explored in a [previous publication](#), where we use results from an economy-wide scenario simulation modelⁱⁱ to consider the potential impacts of establishing a new Scottish CO₂ Transport and Storage (T&S) industry on key sectoral and macroeconomic indicators of investing and operating that new sector of the economy. There, we focussed in particular on the potential for a Scottish T&S industry build around the [Acorn CCS project](#) to greater capacity than what is required to service the Scottish cluster. We equate this to the potential to service emissions generated by in other UK industry clusters and/or to export T&S services abroad (e.g., shipping CO₂ captured on mainland Europe for Scottish North Sea storage).

Table 1: Key economic characteristics of a Scottish CO₂ Transport and Storage industry

Key T&S industry investment and operational characteristics	Domestic transportation via pipelines without exports	Domestic transportation via pipelines and exports via shipping
Total capital stock created (£m)	494	797
Pre-operation investment (£m) - Staged 10/20/30/40% over 4 years to 2026	582	940
Ongoing additional annual investment (£m)	74	120
Total output/demand serviced (£m)	171	285
International shipping services imports (£m)	0.2	23
Direct employment (FTE)	74	116
Value added (GDP) (£m)	108	173
Total industrial emissions serviced (Mt, millions of tonnes of CO₂)	3.83	6.38

As in the previous brief, we identify the main economic characteristics of a new Scottish T&S industry by first scaling investment in capacity commensurate with sequestering emissions generated within the Scottish cluster and then rolling out an operational industry with a domestic supply chain similar to that of the existing oil and gas industry. See Table 1, noting that we assume the plan is for the Scottish T&S industry to be operational by 2027.ⁱⁱⁱ

Crucially, in the time frame studied (up to 2035), we assume that the UK Government guarantees UK demand for the industry's output. That is, it subsidises all domestic users, with an estimated annual cost of £171M if the Scottish industry only services Scottish cluster demand (first data column of Table 1).

Our analysis involves then involves setting out scenarios where the Scottish Cluster expands its original capacity by just under 67% to enable the new Scottish T&S industry to split its activity 60%/40% between servicing emissions generated by Scottish industries (transported via pipelines) and emissions generated outside Scotland (and transported via international shipping). In the previous brief we reported how this could enable a greater sustained uplift in UK GDP and support more jobs while reducing the near- to mid-term public deficit implications of supporting Scottish T&S.

However, the crucial question in terms of public budget implications is where the required demand for output (an additional £114M to sum to the £285M in the final column of Table 1) comes from.

Here we extend on our previous analysis to consider the differential implications of an extended Scottish T&S industry providing services to other UK or overseas users. The crucial difference is that the requirement for public spending to guarantee the £114M additional demand for T&S output is avoided if overseas demand can be secured. We also focus specifically on the public budget implications of creating/supporting UK jobs associated with T&S industry activity, through calculation and reporting of direct 'cost-per-job' metrics.



Sustained GDP, jobs and public budget impacts by 2035

The results reported in Table 2 show how our economy-wide scenario simulations suggest that extending the Scottish T&S industry built around Acorn CCS to a level where 40% of activity and output is dedicated to 'importing CO₂' from elsewhere in the UK or from overseas could deliver a sustained uplift in UK GDP per annum by 2035 of between £255million (Scenario 2, servicing other UK demand) and £257million (overseas demand). This compares to £165m p/a if the Scottish industry only services Scottish demand (Scenario 1).

The larger GDP uplift is associated with supporting almost additional 1,100 full-time equivalent (FTE) jobs across the economy (1,079 in Scenario 2 and 1,097 in Scenario 3), compared to 761 in the Scotland only Scenario 1 case.

Table 2: Key macroeconomic and public budget impacts in the UK by 2035 of introducing a Scottish CO₂ Transport and Storage industry (alternative export and CO₂ assumptions)

	Scottish cluster only (3.83 Mt CO ₂)	Scottish cluster PLUS external demand (6.38Mt CO ₂)	
	Scenario 1 - Scottish T&S industry services Scottish cluster demand with PIPELINE TRANSPORT ONLY	Scenario 2 - Scottish T&S industry also services some other UK demand with SHIPPING	Scenario 3 - Scottish T&S industry also services some overseas demand with SHIPPING
Net public deficit impact (£million), composed of:	-131	-223	-108
Direct spending on T & S (£million)	-171	-285	-171
Net additional government revenues	96	129	131
Nominal adjustments to meet real spending commitments	-56	-66	-68
Net change in real public income (additional revenue net of nominal adj.)	40	62	63
GDP (£million)	165	255	257
Employment (FTE)	761	1079	1097
CPI - Index to 1 (%change)	0.006%	0.008%	0.008%
Direct public spending cost per job (£thousand per FTE job)	225	264	156
FTE jobs per £million spent	4.44	3.78	6.41
Public deficit requirement per job (£thousand per FTE job)	172	207	99
FTE jobs per £k net deficit incurred	5.81	4.84	10.12

However, the public budget outcome differs quite radically depending on where demand for the additional Scottish T&S output comes from. Under Scenario 2, the UK Government must guarantee demand for the greater £285M of Scottish T&S output, so that the overall annual net public deficit implication is £285M per annum by 2035. Here, where we assume international shipping services rather than pipelines are used to transport CO₂ captured elsewhere in the UK (or from overseas), the domestic economic 'multiplier' impacts are constrained relative to the Scottish only case.

The implication in Scenario 2 (with additional demand for Scottish T&S coming from within the UK) is that both the greater direct public spending requirement and the additional real revenue generation are spread across more limited job creation so that the annual (year-on-year) direct 'cost per job' outcomes worsen. However, to get a full picture, these outcomes would need to be compared with counterfactuals where T&S services are provided by other UK (or overseas) actors (where shipping would similarly be required).

On the other hand, a much clearer and more positive picture emerges if the additional Scottish T&S capacity is used to service overseas export demand. Here, our Scenario 3 results suggest that the wider economy expansion triggered could reduce the near- to mid-term annual net public budget deficit implications of supporting Scottish T&S capacity by 17% (from £131M in Scenario 1 to £108M in Scenario 2). This is because, despite the impacts of import leakage on additional multiplier effects) increased real revenue generation no longer has to offset an additional public sector spending requirement.

The improvement in the public budget picture (where we account for nominal adjustments in government spending required to offset a marginal increase in consumer prices) can be reflected through metrics such as the direct 'cost per job'. If we focus on the direct government spending in T&S, the crucial point about the overseas export case in Scenario 3 is that the £171M per annum required to guarantee domestic (Scottish cluster) demand for T&S is spread over more jobs (1,097 rather than 761). Thus, the direct 'cost per job' falls from £225Kk to £156Kk. Put another way, 6.41 FTE jobs are created per £1M of spending rather than 4.44.



Evolution of public budget impacts

So far, we have focussed on sustained outcomes by 2035 (after which the picture will change again if government support for the T&S industry/its users ends or changes). However, it is useful to consider the evolution of all wider economy outcomes, particularly employment and the public budget implications, as key variables of political and policy interest. Here the key point is that the initial stage of investing in Scottish T&S capacity – incentivised by guarantees of UK government support once the industry is operational – will have transitory employment and net real revenue impacts that may be important in considering the wider economic picture (including the calculation of cost-per-job metrics beyond the annual/year-on-year measures reported here).

Figure 2: Evolution of UK Government revenue and spending through the investment and operation of the Scottish CO₂ Transport and Storage Industry to 2035 (base year given by 2018 UK Social Accounting Matrix)

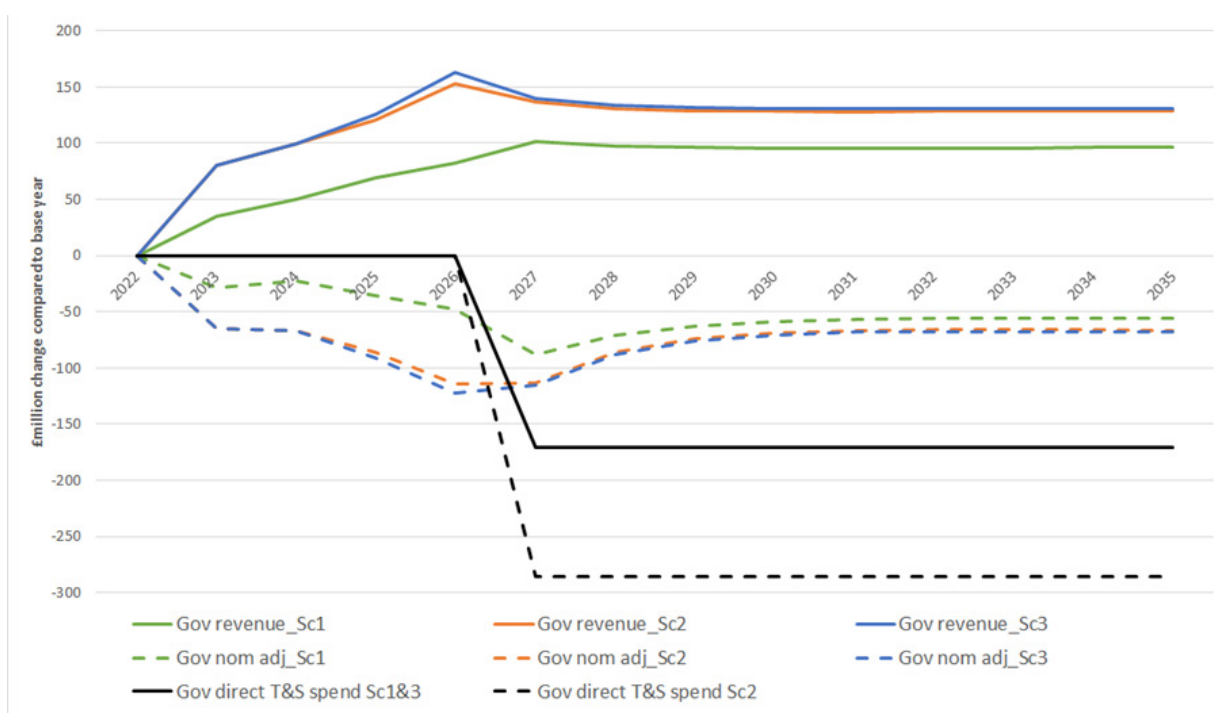


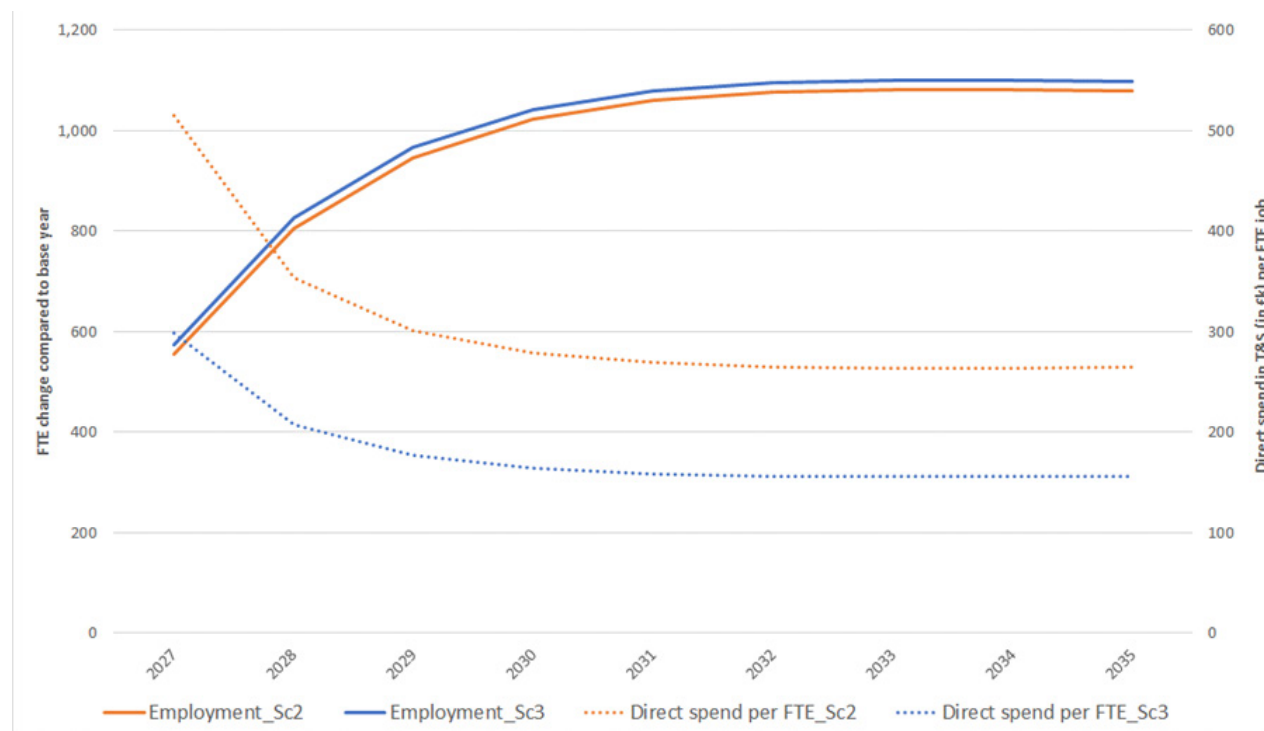
Figure 2 shows the transition path of the different drivers of the net public budget impact reported in Table 2. Here, given the positive employment impacts, and also wage rate increases in the context of the UK’s persisting labour supply constraints (and skills shortages), income tax gains will be a key component of additional revenues generated. However, the trade-off is some upward pressure on costs and prices across all sectors of the economy, as reflected in the marginal sustained CPI increase reported for all scenarios in Table 2. The main implication of this is an additional negative pressure on the public budget as government needs to adjust nominal spending (on goods, services and transfers to households) to meet real spending commitments. Figure 3 shows that these spike at points where additional revenue generation is greatest, at the point when investment activity is ending, and the new Scottish T&S industry starts to move into its operational phase.

However, the key point emerging from Figure 3 is that there is no direct government support requirement until the new Scottish T&S industry becomes operational, which limits negative impacts on the public budget. On the other hand, the negative impacts of adjusting for CPI increases are large enough to absorb a large (but not full) share of the revenue gains during the investment period. Going forward, our research will consider how the wage-cost pressure triggered by worker and skills shortages during the investment period in particular may be mitigated and thus allow more revenue generation with reduced CPI adjustments in the public budget.

At this stage, let us focus once again on the comparative outcomes across Scenarios 2 and 3, where a larger Scottish T&S industry can service additional emissions from elsewhere in the UK or from overseas. The main point reflected in Figure 2 is that while the adjustment pathways for government revenue and nominal spending are broadly the same throughout in each of the two cases, once the industry becomes operational, the direct public spending commitment is substantially larger where the industry only services UK demand (Scenario 2).



Figure 3: Evolution of net UK employment impacts and direct public spending requirements driving cost-job metrics to 2035 following the introduction of the Scottish CO₂ Transport and Storage industry - servicing UK (Scottish and RUK) industries only vs. exporting 40% overseas



The main implication is that the trajectory of cost-per-job metrics is dominated by the level of direct spending on what share of the Scottish industry output demand has to be guaranteed (via user subsidies). That is, while the net public budget impact will reduce the cost-per-job in all periods as in Table 2, the adjustment pathway is determined by the direct spending requirement, so we focus on this in Figure 3.

Here we see that in Scenario 2 - where the UK government has to support a greater level of UK demand, but this is spread over the same level of created/supported employment - the cost-per-job is higher in all periods. Moreover, as shown in Figure 3, it takes time for employment gains to build so that the cost-per-job is higher until around 2031 than what is reported for 2035 in Figure 3.

This is the case under both Scenarios 2 and 3, but more so under the former, with the wedge between the Scenario 2 and 3 direct cost-per-job outcomes being as large as £217K per job in the first year of T&S operation (here assumed to be 2027) before falling to the £108K reflected in the 2035 outcomes in Table 1 by the early 2030s.

Conclusions and next steps

The finding reported in this brief reiterate and expand on those reported in the one published in [March 2023](#). They reiterate that the operation of a new T&S industry to service the Scottish Cluster has the potential to drive a relatively small but sustained economy-wide expansion in the UK. Furthermore, incorporating transportation via shipping into the Scottish Cluster’s network design can help increase the economy-wide gains by providing access to markets of captured CO₂ that are not accessible via a pipeline transportation network.

However, if shipping is provided by international shipping companies, as is commonly the case for the current UK oil and gas industry from which T&S is expected to transition, the additional gains are not proportionate to the increase in the emissions sequestered as some of the benefits are directed in the countries where the ships are registered.



We have also shown that it is possible to evaluate the cost of creating FTE jobs via the operation of T&S by using metrics associated with the direct spending or the net deficit incurred per FTE job created. The main finding comparing these metrics across the scenarios we consider here is that if the Scottish T&S industry gains access to international markets of captured CO₂ there is a scope to reduce the cost per job created, particularly in terms of the reduction in direct public spending costs incurred.

On the other hand, expanding the capacity Scottish T&S to service other UK capture demand industries does not reduce the cost per FTE job and in fact it slightly reduces the FTE jobs created per £K net deficit incurred as some of the benefits from the transportation activity are lost to whichever country provides the shipping services. However, any assessment of such metrics would need to be set in the context of comparable outcomes if T&S services were provided at other UK locations or overseas.

In further developing our work on the [SNZI project](#), and other UK-wide work on a [project funded by the Industrial Decarbonisation Research and Innovation Centre](#), we will both broaden our scenarios to investigate the potential economy-wide and public spending impacts of alternative, and potentially competing, T&S industry activity built up in an initial regional cluster context.

We are also exploring how and to what effect persisting UK labour supply constraints and skills shortages may be mitigated, allowing employment, revenue and other economic gains to grow in all timeframes, but with particular attention to the initial investment activity where direct demands on the public purse are more limited.

At this stage we invite input from our stakeholders both to better inform our scenarios and to explore what results and metrics would be most useful in informing the broader decision-making process.

End notes

- i [CEP policy brief linked to the SNZI project](#) where we have begun to consider the wider economy impacts of increasing Scottish CO₂ Transport and Storage capacity to service overseas export demand.
- ii See our research published in the Local Economy journal, available at <https://doi.org/10.1177/02690942211055687>
- iii In current work, as part of a [project funded by IDRIC](#), we consider a different timeline for the Scottish cluster within potential Track 2 plans.

Acknowledgements and contact

- This brief was produced as part of the [UK Research and Innovation \(UKRI\) Industrial Strategy Challenge Fund](#) via [Scotland's Net Zero Infrastructure](#) programme.
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