



Policy Brief

Could the introduction of a new CO₂ Transport and Storage industry in Scotland service decarbonisation, ‘green growth’ and ‘just transition’ agendas?

Summary

Following our initial project briefing published in June 2021¹, this policy brief is the first in a series to be published as part of the Centre for Energy Policy’s role in the Scotland’s Net Zero Infrastructure (SNZI) project. Our first research challenge is to understand how a new CCS Transport and Storage (T&S) industry servicing a Scottish regional cluster links into the Scottish and UK economies. The first question is what does the T&S supply chain look like? As a benchmark, we consider how introduction of a new T&S industry, initially servicing industrial capture in the Scottish Grangemouth cluster, might impact the wider UK economy if it shared the same supply chain structure as the existing Oil and Gas (O&G) industry.

This is a useful starting point, given the role many hope that CCS can play in utilising the existing O&G industry and supply chain capacity in Scotland, but in a way that helps transition the industry away from fossil fuel extraction and distribution. However, the aim of this brief is to initiate discussions with project partners and wider stakeholder communities around what the UK T&S supply chain may actually look like, particularly in terms of the Scottish part of the industry, building up around the Acorn project. We set our initial scenarios in terms of how the key impacts of introducing a new T&S industry on the economy will differ depending on how Government decides to fund the need to guarantee demand for the output of what is likely to be initially oversized T&S capacity.

Key findings and insights so far

- We find that introduction of the T&S industry does indeed have the potential to enable a wider economy-wide expansion and to create new jobs, locally and across the UK, in a range of sectors, including many higher wage and/or labour-intensive service activities.
- However, the outcomes will be limited relative to what simple multiplier metrics may predict given constrained labour market conditions and what this may mean for wage rates and price levels across the economy, combined with the likely need for government to recover the costs of guaranteeing demand for T&S output at least in the medium to longer term.
- The magnitude and distribution of costs and benefits emerging across the economy depends on how the government covers its T&S expenditure, and there are some crucial trade-offs. For example, a public deficit funding option delivers the best economy-wide outcomes at the expense of an increased budget deficit, while an ‘industry pays’ approach could lead to an economic contraction and net employment losses.
- Crucially, we find that where cluster industries are required to cover the costs of guaranteeing demand for T&S industry outputs, this introduces real tensions for the Scottish ‘just transition’ and UK ‘levelling up’ agendas. Cost-driven industry price rises trigger international competitiveness losses that cause some off-shoring of cluster activity, with consequent impacts likely to fall predominantly on Scottish supply chains and consumer spending.



Depending on how the CO₂ transport and storage sector is funded, the trade-offs involved could fall on and be more prominent at the regional industrial clusters”

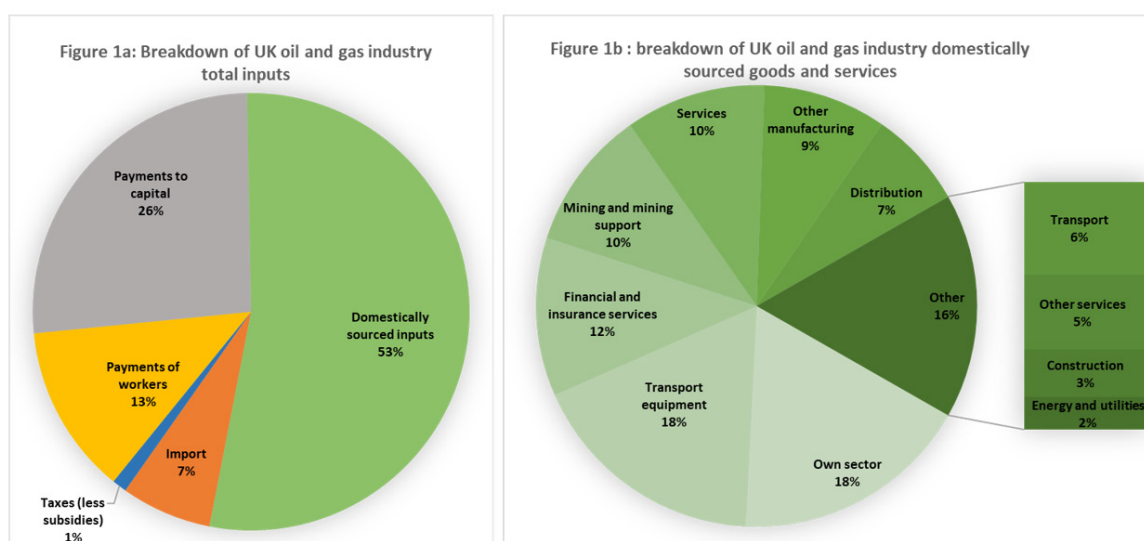
Key research questions and findings

1. What might the supply chain of a new T&S sector servicing a Scottish cluster look like?

Many studies use multipliers as a simple and straightforward metric to understand the demand driven economy-wide impacts, on variables of policy interest, including value-added and employment.

For instance,^{2,3} our own research has shown that energy/emissions-intensive industries, such as UK chemicals, currently support up to 4 indirect and induced supply chain jobs for every direct industry employee, with the Scottish sector supporting higher than national average wages through upstream supply chain linkages to the Scottish energy, service and construction industries.

Furthermore, in other analyses,^{4,5} we have considered how the UK O&G industry supports up to 10 indirect and induced jobs across the UK economy per direct job in O&G. These jobs span across key regions of the UK (for example, the North East of Scotland), and in numerous sectors, including multiple high wage and/or labour-intensive service industries.



Figures 1a and 1b illustrate the upstream supply chain structure of the UK O&G industry, which underlines the scale and/or size of the economy-wide multipliers. It is important to note that the industry's supply chain is not limited to technical or manufactured requirements. It also relies on often relatively high wage components, such as Services, Financial and Professional Services, and lower wage but labour-intensive ones such as distribution (including Wholesale and Retail Trade) activities. This is crucial in understanding and tracking impacts of such an industry and how it transitions, on key economy wide indicators such as jobs, earnings and GDP.

As a starting point in understanding the role and implications of CO₂ T&S in delivering industrial decarbonisation through CCS, but doing so in a way that ideally draws on existing strengths and capacity already heavily embedded in the Scottish and UK economies, we assume that a new UK T&S sector could have the same (or very similar) structure as that of the existing O&G industry. This is motivated by similarities in the sector's function, where T&S would involve sending CO₂ to offshore sites, rather than extracting fossil fuels.

Thus, we use the O&G industry's previously reported employment multiplier as a useful benchmark of the type of employment impacts that the operation of a T&S sector may trigger, and how these impacts are distributed across the UK sectors. We note that such multipliers are generated by ONS using simple (input-output, IO) modelling methods designed to 'look back' at past contributions rather than estimate what may happen if new activity emerges in a constrained economy.

Thus, we embed more up-to-date ONS input-output data (for 2016) within the structural data base of our own economy-wide scenario simulation framework model⁶, then take the first step of considering how such a multiplier outcome may emerge, and over what time frame. Essentially, this involves setting a benchmark case where the T&S industry is introduced in an entirely unconstrained manner (particularly in terms of UK labour market conditions, and assuming there are no funding constraints requiring reduced consumption elsewhere in the economy to enable the guaranteeing of demand for T&S output).

Crucially, this allows consideration of how the T&S sector could in principle help to deliver a 'Just Transition', by contributing to the transition of the current O&G sector, before considering how different conditions may control the wider economy response and, thus, effect the actual nature of the distribution of costs and benefits emerging.



2. Could the operation of a T&S sector to service decarbonisation of the Scottish cluster deliver net gains for the wider UK economy?

Scenario set-up and key assumptions

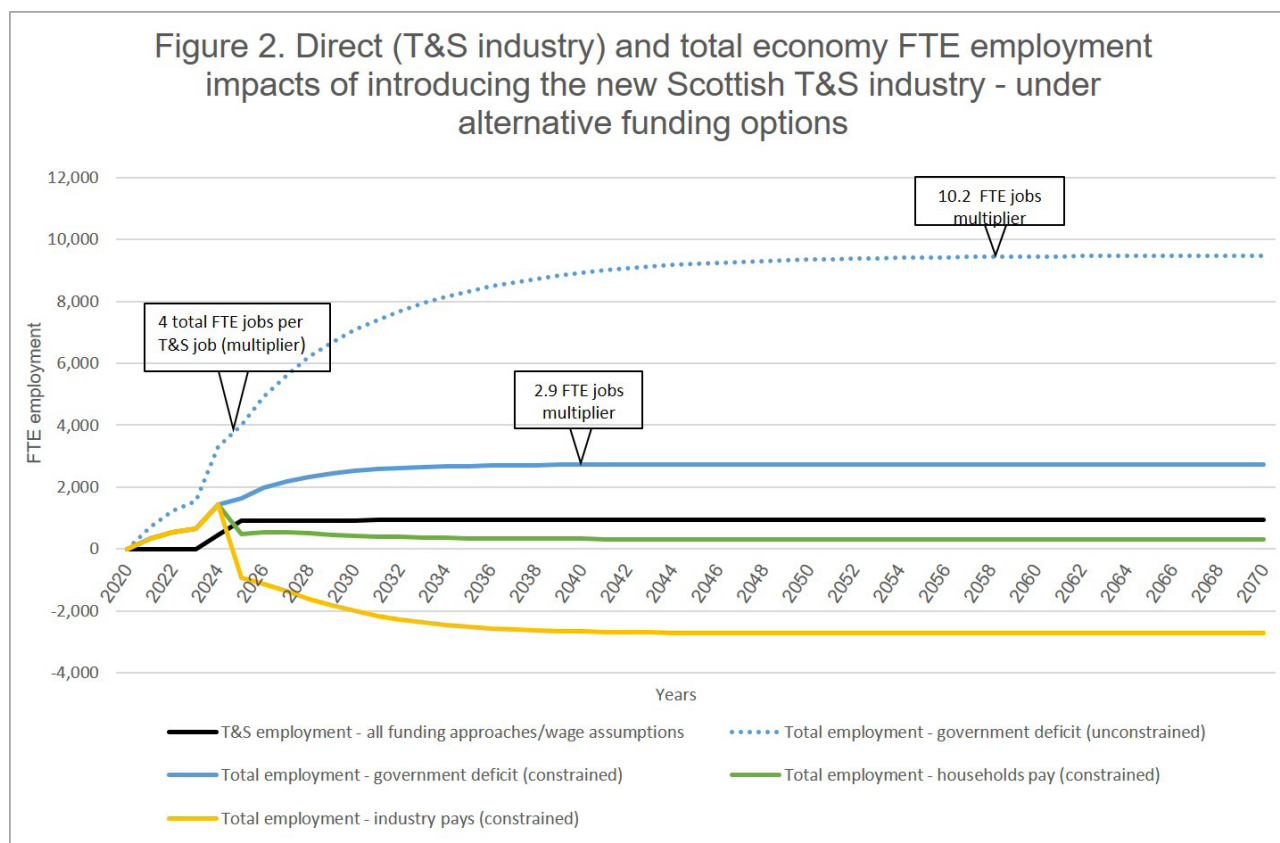
Current [BEIS CCUS Business Models](#) consultation and documentation prioritise the role of T & S activity in the context of supporting the delivery of domestic decarbonisation efforts. The core challenge is to ensure that there is sufficient demand for the services of the T&S sector, which, at least initially, could be larger than the emerging capture capacity.

Here, we explore a basic scenario where the UK Government steps in to directly pay for T&S services, thereby guaranteeing the demand for T&S output, but with the ability to recover the costs from emitters or UK households. This sets the foundation to consider the nature of trade-offs that may emerge in addressing the challenge of managing the distribution of costs in ensuring the operation of a new T&S industry.

We use our multi-sector economy wide simulation model of the UK⁷ to simulate the impacts of guaranteeing demand for the UK T&S sector, where this is initially introduced to service the Scottish cluster, requiring an estimated initial £500m investment.⁸ Ahead of, and hoping to help inform the specific policy approaches to be adopted, we focus on the trade-offs involved in three basic domestic funding approaches enabling government to pay and/or recover the costs of guaranteeing demand for the services provided by the new T&S industry. The approaches are:

1. UK Government makes direct expenditure, financed by a budget deficit to guarantee the demand for T&S output - a 'deficit funding' approach
2. The government employs a 'households pay' approach, passing, and essentially socialising, the cost of T&S services directly to taxpayers. The mechanism by which this could be done is not yet clear, but the fundamental implication is that households will have less money to spend on goods and services. At this stage we focus on this basic concern by simulating a simple lump sum transfer.
3. The government passes the cost to emitting/capturing industries in the Scottish cluster via increased indirect taxes – i.e. employing an 'industry pays' approach. Under this approach, and assuming no change in current carbon pricing regimes, the additional cost will impact firm prices and competitiveness. In turn, the affected industries will attempt to pass the cost to downstream users of their products.

Crucially, we explore how the varying assumptions regarding the funding approaches and labour market responses affect the simulated outcomes. This involves taking into consideration changes in labour costs and consequent impacts on UK prices more generally, as reflected by CPI, and the extent to which employment multipliers deviate from what has been observed in the past for O&G.



As shown in Figure 2, the deficit funding approach enables the best net employment gains of up to almost 9,500 full-time equivalent (FTE) jobs, equating to an employment multiplier of 10.2 which is similar to the one calculated for the O&G industry. However, when we consider the full effect of labour market constraints, the employment gains are eroded to just over 2,700 FTE jobs, with a multiplier of 2.9. Here, while T&S industry employment is unaffected, and its supply chain requirements are fully met, the price pressures induced by changing wage rates has implications for activity levels in all other sectors of the economy, more so where there is no direct link to T&S.

Passing the cost to UK households, further erodes the total employment gains to just 319 FTE jobs due to reduced household consumption. This means that there is a net negative multiplier effect, despite the fact that there is marginal positive expansion in GDP, due to the shedding of jobs in more labour-intensive and consumer-facing activities. On the other hand, an 'industry pays' approach triggers a process of 'off-shoring' of industry cluster activity - associated with industry output prices rising. This causes a net contraction across the wider UK economy, leading to net employment losses of around 2,700 FTE jobs.

These employment impacts are associated with what may be considered relatively marginal overall GDP impacts. In our simulations, deficit funding enables the greatest per annum GDP gains over the longer term, equating to 0.038% over what it would otherwise be in the absence of labour market constraints effects, but eroding to 0.017% when the effects of the labour market constraints are considered. A 'households pay' approach only enables 0.007% GDP gains, while 'industry pays' triggers per annum -0.011% GDP losses over the long term (with the economy largely fully adjusted by the early 2050s).

Crucially, even marginal GDP gains are associated with additional revenues to the public purse, so that in the deficit funding case, the net impact on the public purse is reduced relative to the direct spending requirement, and a small net surplus is generated when households pay. However, when 'industry pays', a net deficit outcome is delivered despite the absence of any direct deficit spending requirement.

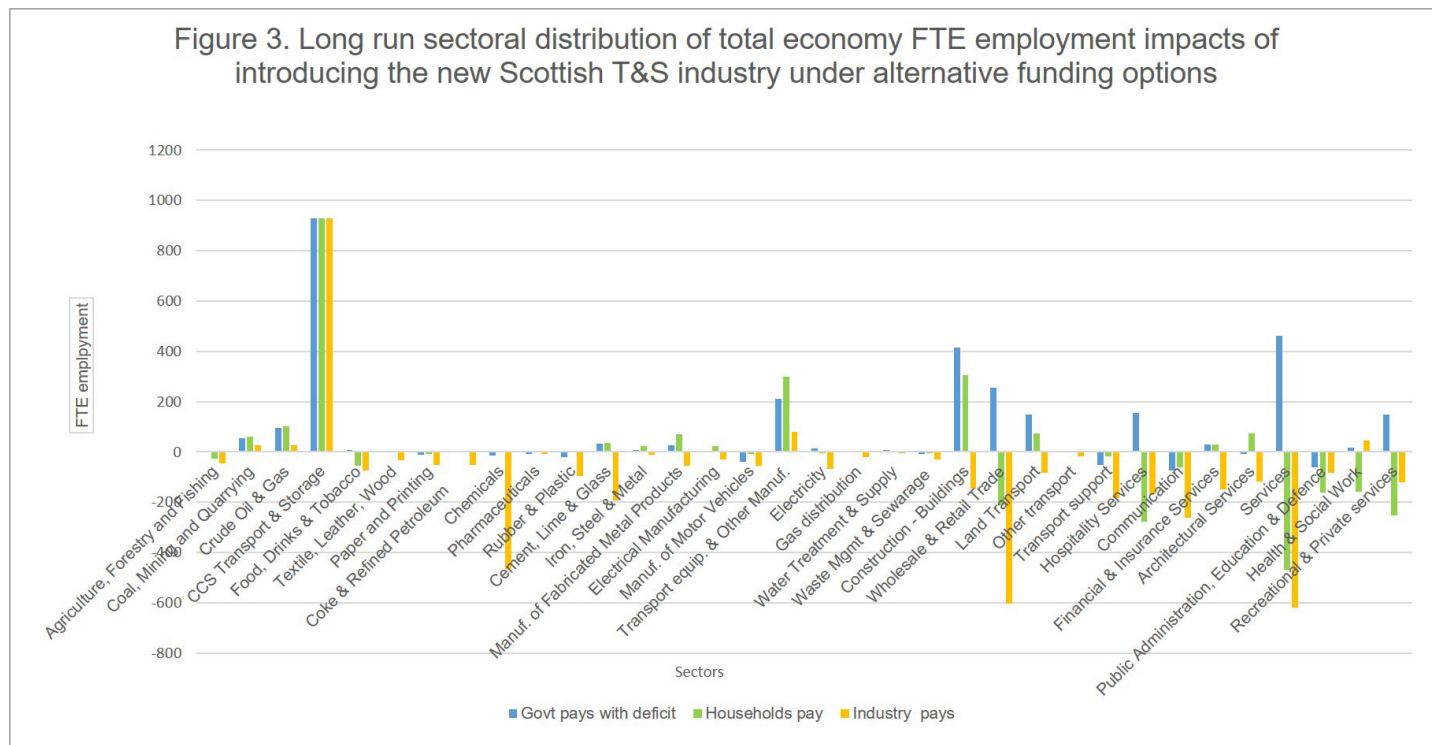
We recognise that a T&S sector might also aim to access external markets and export its services to industries abroad. The impacts of exports of T&S services, and how they spill across the entire UK economy, is broadly similar but varying in some key regards from the case where the government steps in to guarantee demand (given that neither approach requires a sacrifice of demand for other types of UK production).

While information on the role that exports will play in T&S operations is still emerging, we have explored an extreme case of exports providing 100% of the necessary T&S sector demand, as a useful comparison in framing the evidence. The key difference from the deficit funding case is simply that, in the absence of a domestic funding requirement, the expansion associated with introducing the new industry delivers a net surplus, though some price effects do come into play. As soon as more information associated becomes available, we will explore the role of exports in more detail.

3. How might the impacts be distributed across UK production sectors and regions?

As we saw in the previous section, the total UK employment impacts driven by the T&S sector depend on how the government recovers the cost of supporting T&S sector demand, controlled by the impact of the labour market constraints on wages and prices, which will affect different sectors and activities in different ways.

Figure 3 shows the employment impacts under the different funding scenarios where wage pressures are accounted for. Note that our scenarios involve imposing the over-sized T&S industry on the economy so that its employment outcomes are not affected by the funding scenario.



Under the deficit funding case, we observe employment gains in the supply chain of the T&S sector (e.g. 'Transport Equip.' & Other Manuf.), and in sectors indirectly benefiting from increased activity (e.g. 'Construction') or from the additional incomes generated by the wider economic expansion (e.g. 'Wholesale & Retail Trade'). However, increased labour costs do negatively affect some sectors and therefore we observe some very marginal employment losses (e.g. 'Communication').

In the 'households pay' case, the key driver of outcomes is the fact that household disposable income falls, with consequent reductions in consumer spending meaning that employment losses are concentrated in the sectors (e.g. 'Hospitality Services', 'Wholesale & Retail Trade') where households spend most of their income.

In the 'industry pays' case we observe employment losses across most sectors due to four main drivers. Crucially, the only emitters serviced by the new T&S industry in our scenarios are those based in the Scottish cluster. Thus, the first driver is that the industries government passes the cost of T&S purchases to experience competitiveness loss impacting both export and domestic demands, which shift in favour of foreign production. This 'off-shoring' is associated with employment losses within the Scottish cluster.

Second, the sectors in the supply chains of the Scottish cluster industries suffer a consequent reduction in demand for their own output and are forced to reduce the number of people employed.

Third, while there is a marked substitution in favour of imports to avoid the price pressures passed on by the cluster industries, and while all UK industries (including within the Scottish cluster) can attempt to cushion required price increases by reducing wage costs as unemployment rises, many downstream actors will need to increase their own prices.

Fourth, the wage and other income losses associated with wider economy-wide contraction - where the CPI actually increases due to the effective greater reflection of carbon prices in UK production - leads to a reduction in household consumer spending. Thus, under 'industry pays' employment losses are also observed in the sectors where households spend their income but this time, in contrast to 'households pay' (where T&S costs are passed to the wider tax base), there will be greater losses in the Scottish economy due to the location of the core employment losses.



Conclusions and way forward

- This initial scenario simulation analyses demonstrates that the introduction of a new UK CO₂ Transport and Storage industry initially focussed on servicing decarbonisation in the Scottish industry cluster at Grangemouth has potential to deliver economy-wide and employment gains. Crucially, if the T&S industry is able to replicate the strength of domestic supply chain linkages delivered by the existing oil and gas industry, benefits are likely to emerge in safeguarding such activity and employment through the transition.
- However, the more optimistic projections associated with consideration of employment 'multiplier' metrics are only achievable under specific and likely quite unrealistic conditions. Crucially, the fact that UK labour markets are constrained is starkly apparent at present, with many sectors of the UK economy struggling to recruit even in the context of the Covid-19 slump.
- The fundamental point is that any wage pressure in an expanding economy leads to producer cost and consumer price pressures and potential 'overheating' of the economy. Combined with the likely need for government to recover the costs of guaranteeing demand for T&S output through the utilisation build-up of the sector, and in tackling business model challenges going forward, such cost and price pressures will ultimately erode employment multipliers and the associated economy-wide and employment impacts.
- Moreover, where emitting cluster industries need to bear costs that reduce their competitiveness in international markets, this will introduce tensions and conflicts across decarbonisation, 'green growth' and 'just transition' agendas, particularly where risks of off-shoring of emissions, investment and employment come into play. Crucially, note that we have focussed attention here on the T&S costs that the Scottish cluster industries may face. Previous work⁹ suggests that the impacts reported here may be exacerbated and potentially dwarfed by those from industries meeting capture costs.
- What is the way forward with this research? Throughout the 3-year timeframe of the SNZI project, we aim to add depth and detail to our economy-wide scenario simulations, and to introduce consideration of issues emerging in the fast-moving industrial decarbonisation and CCS arena – for example, around the potential for shipping rather than pipeline transport of captured CO₂ and how this may enable opportunities for the Scottish T&S industry to 'export' its services to other UK clusters and/or internationally.
- However, as a first important step, we have noted that positive outcomes linked to the T&S industry supply chain depend on our initial assumption that the new T&S sector will have the same input structure as the existing O&G sector. This is a useful benchmark, but it is key to identify what the structure of a T&S sector may look like so that we can conduct more accurate analyses. We aim to facilitate our understanding of the T&S sector's structure by engaging with other partners in the SNZI projects.
- If you are interested in engaging in this conversation and/or keeping updated on findings and routes to involvement with our continuing work on the SNZI project, we will be regularly reporting on further research insights, key messages and continuing this series of briefings – click [here](#) to join CEP mail list for regular newsletters



References

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- 5 Turner, K., Alabi, O., & Race, J. (2020). Nudging Policymakers: A Case Study of the Role and Influence of Academic Policy Analysis. <https://doi.org/10.1080/13501763.2020.1742774>
- 6 Our model – named UKENVI – is a more flexible and theory consistent 'computable general equilibrium' (CGE) model, with similarities to that employed by HM Treasury, e.g. in analysing impacts of fuel duty reductions at <https://www.gov.uk/government/publications/analysis-of-the-dynamic-effects-of-fuel-duty-reductions>. Details of the UKENVI model and scenarios discussed here are available on request from cep@strath.ac.uk.
- 7 A previous paper applying the UKENVI model to a net zero infrastructure-intensive challenge is publicly available at <https://www.sciencedirect.com/science/article/pii/S0301421519307049>. The peer reviewed paper detailing the model and scenarios discussed here is available to download at <https://journals.sagepub.com/doi/10.1177/02690942211055687>.
- 8 Details of how the investment requirement was determined are provided in a paper available at <https://strathprints.strath.ac.uk/77310/>.
- 9 The findings of our previous work considering the impacts of introducing carbon capture in the Scottish Chemicals on the Scottish economy are summarised in our Project Brief at https://strathprints.strath.ac.uk/76832/1/Turner_etal_CEP_2021_Investigating_wider_economy_impacts_of_net_zero_industry_development.pdf. The associated peer reviewed journal paper is available at <https://doi.org/10.1016/j.ecolecon.2021.106978>.

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