Presentation to PLATON workshop 19/11/21

Could a new Scottish CO2 transport and storage industry deliver employment multiplier and other wider economy benefits to the UK economy?

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Research on the wider economy implications of CCS supported by Bellona and Children's Investment Fund Foundation, InnovateUK (SNZI) and PLATON

1. Research Challenge: How do we consider the role of CCS in an economy-wide setting?
2. Initial work focussing on potential impacts of :
   a. **Introducing carbon capture in the Scottish Chemicals industry** – published in Ecological Economics at https://www.sciencedirect.com/science/article/pii/S0921800921000367
   b. **Potential impacts across the UK economy of introducing a CO_2 transport and storage industry to service Scottish industry cluster** – published in Local Economy at https://journals.sagepub.com/doi/10.1177/0269094221105568 7

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Methodological and Ideological Options

Policy options for funding carbon capture in regional industrial clusters: What are the impacts and trade-offs involved in compensating industry competitiveness loss?

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LOCAL ECONOMY

Feature article

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Carbon Capture and Storage in the economy?

- **What are the implications of introducing CCS in an economy like the UK?**
  - Cannot limit to considering upfront capital requirements/investment ⇒ operational implications
- How do we model the introduction of a CCS system in our economy-wide modelling/scenario simulation framework?
- Introducing a two-step process in our UKENVI multi sector computable general equilibrium (CGE) model

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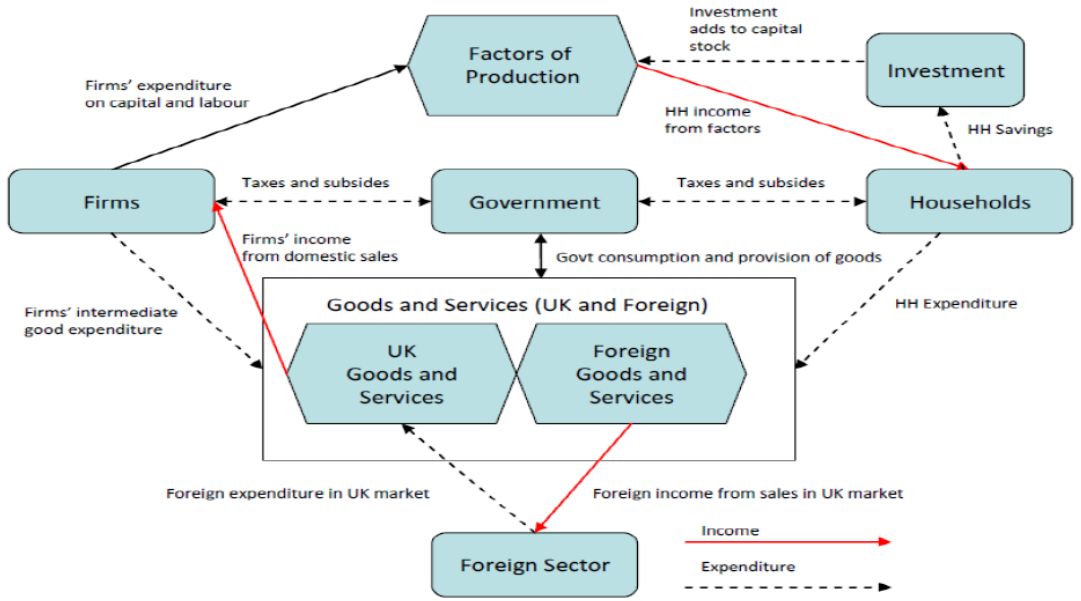
Computable general equilibrium (CGE)

- Multiple sectors (industries and consumer) and markets
- ‘General equilibrium’
- Options regarding specification at industry/sector and final consumer level, in different markets, and macroeconomic model ‘closure’
- Aim to avoid ‘black box’

- **Simple basis – circular flow of income https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/263652/CGE_model_doc_131204_new.pdf**

Figure 2.1: Circular flow of income



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Carbon capture, transport and storage

- ‘End-of-pipe’ treatment commonly adopted in CGE studies to consider impacts of CCS is most relevant for carbon capture
- **Capture equipment not just an upfront investment cost**
- **Ongoing operational capital cost implications**
- E.g. if carbon capture doubled the capital equipment required to produce one unit of output – capital efficiency falls by 50%
- Impacts price of output, with competitiveness implications if relative price change impacts downstream demand – risk of ‘offshoring’ emissions and activity, including jobs (‘just transition’ implications)
- See our paper published in Ecological Economics earlier in 2021.

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Carbon capture, transport and storage

- Transport and storage may have additional equipment requirements for capture firms – further operational cost and efficiency implications
- **But main implication is that another sector/industry needs to provide a new (utility?) service in the economy?**
- **How is this delivered and who pays for it?**
- Delivery requires both upfront investment in infrastructure…
- … and new operational and supply chain activity
- A new 'large scale' CO_2 management industry?
- What markets might this industry serve? In what ways? Drawing on or exploiting what existing or new capacity, skills and supply chains?

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UK context for CCS analysis

- 2021 - UK Government commences a CCS 'cluster sequencing' initiative to identify early movers in delivering carbon transport and storage (T&S) services to proximate regional industry clusters with capture potential.
- 2nd stage/reserve Scottish proposition links Grangemouth industry cluster to North Sea storage, and potential to transition Oil and Gas industry capacity to deliver CO2 T&S
- Potential to transition and create new direct industry and supply chain jobs, set against risks of displacing jobs in different sectors and regions of the UK – particularly around the Scottish cluster itself
- Our work focussed on assessing the extent of potential expansion and job creation in the presence of supply-side and funding constraints
- Crucially, no potential for export of T&S services currently considered

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Table 1. Scottish regional cluster emissions sources and interventions/impacts of linked CO2 Transport and Storage capacity.

Key T&S industry investment and operational characteristics	
Total capital stock created (£m)	430
Pre-operation investment (£m) - Staged 10/20/30/40% over 4 years to 2024	500
Ongoing additional annual investment (£m)	65
Annual output to demand (£m)	381
Direct employment (FTE)	929
Value-added (GDP) (£m)	131
Grangemouth cluster emission sources (tonnes CO2)	
Chemical	1373
Coke and refined petroleum products	1638
Cement, lime and glass	731
Others	83

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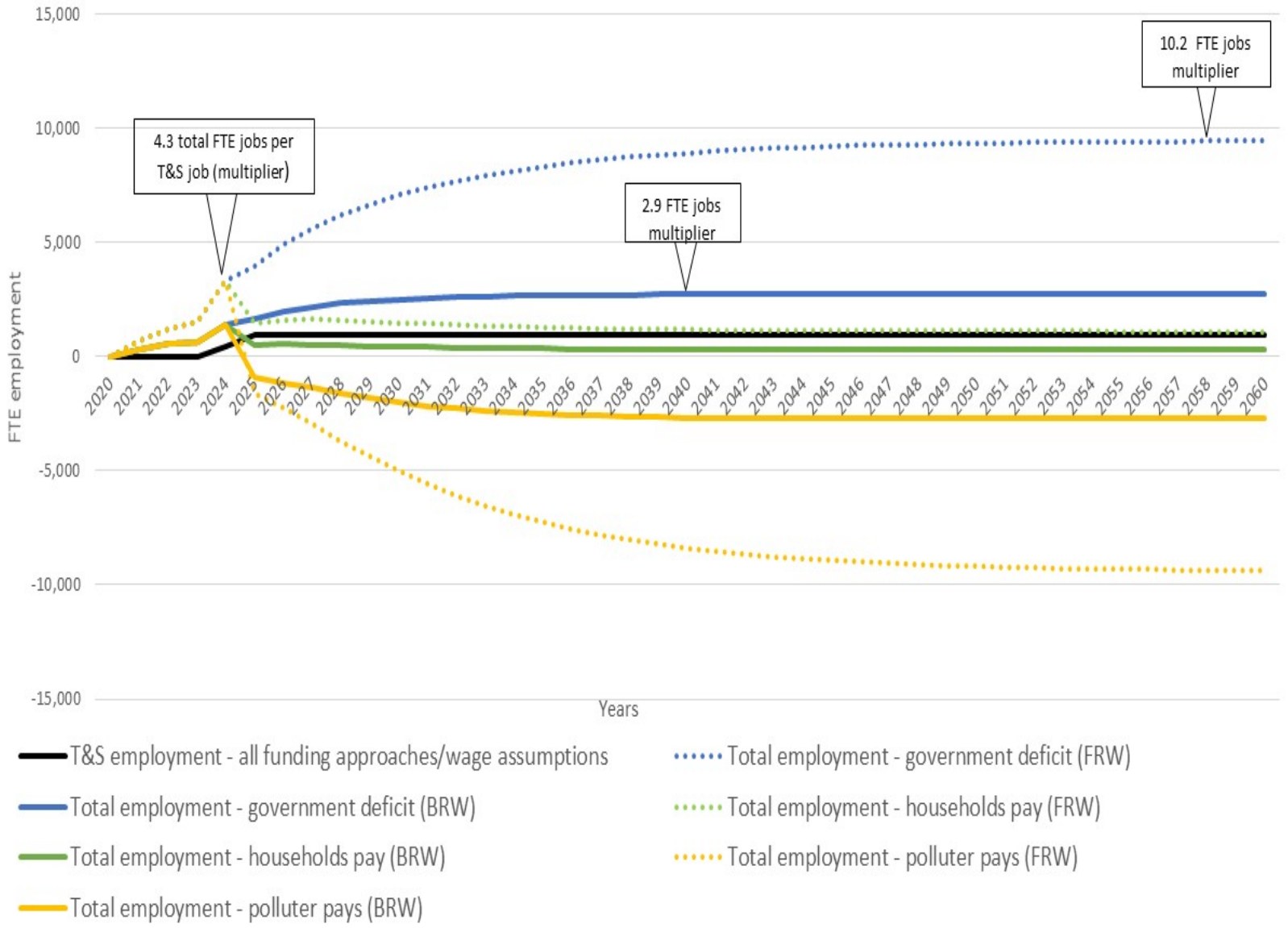
Key Lesson 1 - large employment ‘multiplier’ gains registered in previous studies only apply over the very long term and in the absence of labour market and funding constraints

Figure 1. Direct (T&S industry) and total economy FTE employment impacts of introducing the new Scottish T&S industry - central bargained real wage (BRW) and alternative fixed real wage (FRW) assumptions

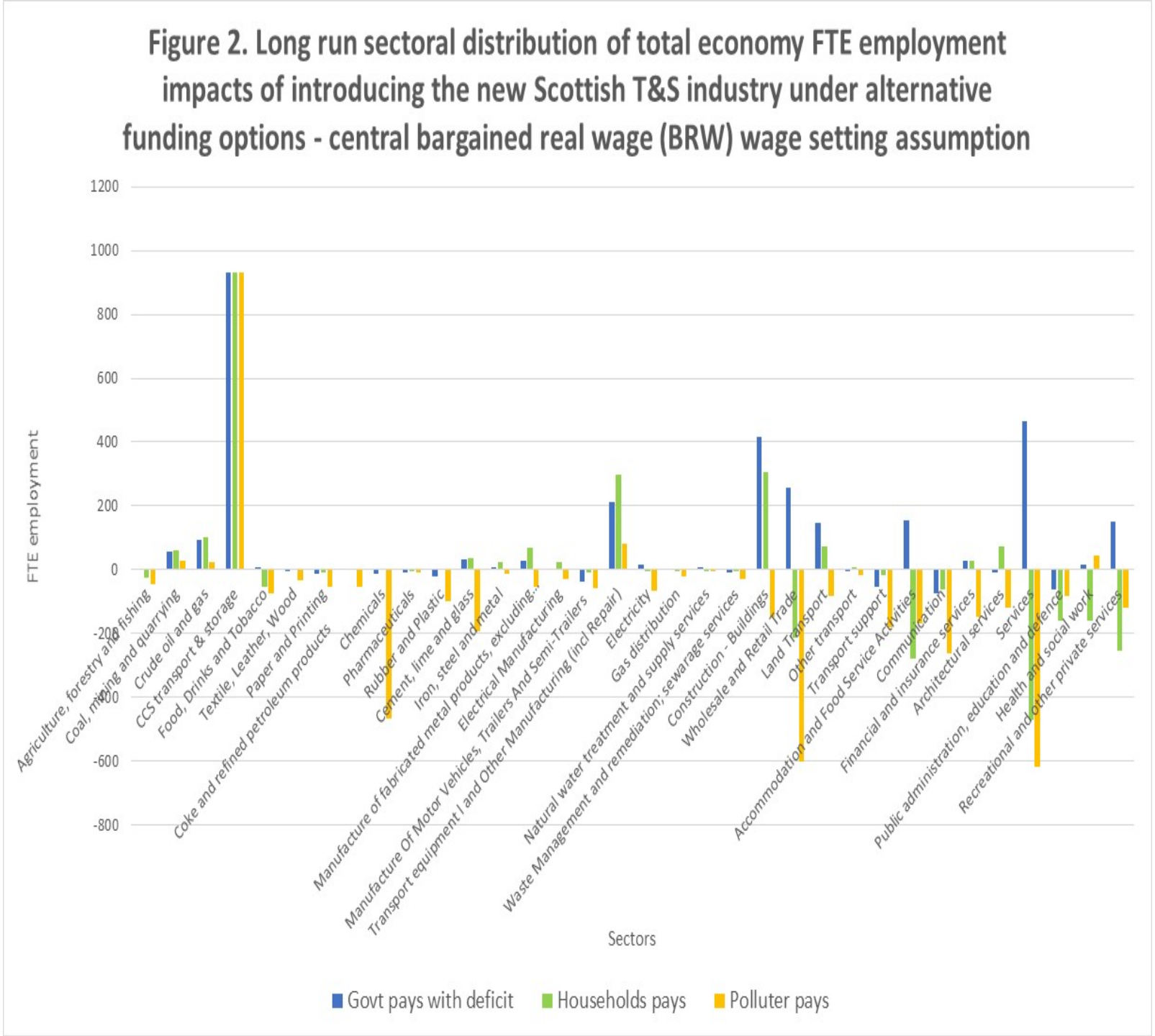


Key Lesson 2: any need to recover demands on the public purse severely constrains and potentially negates possible positive macroeconomic gains

Table 2. Long run key UK macroeconomic impacts of introducing the Scottish T & S industry

	Base values (2016)	Bargained Real Wage		
		Public funding approach		
		Deficit	Household Transfer	Polluter pays
Government demand for T & S (£million)	21	402	402	402
Government budget balance (£million)	-517	-292	36	-150
GDP (£million)	1,751,690	295	121	-185
GDP (% change)	1,751,690	0.017	0.007	-0.011
Employment (FTE)	29,300,731	2736	319	-2724
Employment (% change)	29,300,731	0.009	0.001	-0.009
Employment multiplier (Total/ T&S industry employment)	1	2.9	0.3	-2.9
Unemployment (% change)	5%	-0.177	-0.021	0.093
Nominal wage - index to 1 (% change)	1	0.040	0.005	0.008
Real wage - index to 1 (% change)	1	0.020	0.002	-0.020
CPI - index to 1 (% change)	1	0.020	0.002	0.028
Exports (% change)	477,563	-0.038	-0.005	-0.092
Imports (% change)	515,335	0.048	0.002	0.042
Household consumption (% change)	1,185,745	0.028	-0.021	-0.011
Total investment (% change)	310,036	0.025	0.010	-0.011

Key Lesson 3: imposing ‘polluter pays’ leads to net economy-wide contractions triggered by competitiveness losses concentrated in Scottish cluster industries, leading to offshoring of production and jobs, potentially skewed within the localities hosting the clusters



Conclusion – generic insights

- Crucial problem in repurposing oil and gas industry capacity and workforce/skills for delivery of CO_2 T&S services – where does demand come from/how is output 'valued'?
- Not yet considered capture from thermal power generation (Peterhead – gas-fired) – 'who pays' potentially brings challenge of industry costs passed onto consumers via energy bills (different and more regressive form of socialisation)
- In scenarios not reported in the Local Economy paper, we considered how exporting T&S services/importing CO_2 to Scottish/UK storage could negate the need for public funding/recovery
- Similar outcomes to 'government deficit' case, but without the deficit
- What would Norwegian scenarios look like?

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Thanks for listening!
Happy to answer questions

- Contact me at karen.turner@strath.ac.uk

- Also see non-technical report on linked work at UK level (currently under peer review) at https://strathprints.strath.ac.uk/78347/

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