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IS THERE A NEED FOR POLICY INTERVENTION TO OFFSET COSTLY CAPITAL REQUIREMENTS TO SUPPORT INDUSTRIAL DECARBONISATION IN PURSUING A JUST TRANSITION TO NET ZERO?

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Carbon Capture and Storage in the economy?

- **What are the implications of introducing CCS – through distinct elements of carbon capture and transport & storage (T&S) - in an economy like the UK?**
  - Should not limit to considering upfront capital requirements/investment – crucial to set in context of operational challenges and implications
- Introducing a two-step process in our UKENVI CGE model, initially for (1) industrial capture, (2) new sector delivering T&S
- Scenario simulations year-by-year to full 'long-run' adjustment
- Initial peer reviewed publication on capture approach (Scottish application for Chemicals industry) in Ecological Economics: https://www.sciencedirect.com/science/article/pii/S0921800921000367

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Carbon capture, transport and storage

- Driver of competitiveness implications the UK Industrial Capture Contract is being designed to address – capital efficiency.
- 'End-of-pipe' treatment - **ongoing operational capital cost implications -** e.g. if carbon capture doubles capital equipment required to produce one unit of output, capital efficiency halves (falls by 50%)
- Impacts price of output, with competitiveness implications (relative price change) via impacts on both export and domestic downstream demand (investment/jobs leakage through import substitution)
- Latest results for average 30% capital efficiency contraction UK Chemicals – systematic sensitivity analysis for different current (potential future?) trade response as other international competitors bear similar costs and/or 'green markets' emerge (challenging for process industries in complex international supply chain context?).

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UKENVI CGE scenario simulation approach

- Focus on carbon capture only in UK Chemicals industry
- Industry input suggests average 30% capital efficiency loss in production – build up over 10-years to 2030 (UK Industrial Clusters Mission target timeframe)
- With no policy intervention gives broad 'polluter pays' outcome – capital efficiency loss forces increase in price of output, with economy-wide impacts triggered by consequent domestic and export demand contraction (assumption that UK Chems an early adopter and/or competitor prices protected)
- Policy intervention in the form of a subsidy just sufficient to offset the need for an increase in Chemicals industry output price in response to the reduction in capital efficiency – aligns with proposed ICC approach)
- Here funded through lump sum tax to UK households – impact on real take home income that funds household spending across multiple sectors redistributes costs and the type of activity/jobs affected

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Table 1: Percentage changes in key macroeconomic and socio-economic indicators for the reference 'polluter pays' and 'income tax funded subsidy' cases (changes compared to base year values, CET 2 and CES K-L elasticity of substitution 0.3)

		2030			2050	
Year	Base (2016) values	Households pay subsidy directly, Import & Export price unchanged, 30% efficiency reduction	Polluter pays, Import & Export price unchanged, 30% efficiency reduction		Households pay subsidy directly, Import & Export price unchanged, 30% efficiency reduction	Polluter pays, Import & Export price unchanged, 30% efficiency reduction
GDP (£million)	1,751,690	-0.063	-0.113		-0.042	-0.118
CPI (indexed to 1)	1	-0.003	0.035		-0.014	0.047
Nominal wage pre-tax (indexed to 1)	1	-0.035	-0.062		-0.029	-0.056
Real wage pre-tax (indexed to 1)	1	-0.032	-0.097		-0.015	-0.104
Total Imports (£million)	515,335	-0.027	0.001		-0.037	0.007
Total Exports (£million)	477,563	-0.040	-0.299		0.026	-0.293
Total Employment (FTE)	29,300,731	-0.015	-0.045		-0.007	-0.049
Investment (£million)	310,036	0.206	0.072		0.171	0.065
Real Earnings - employment (£million)	967,471	-0.047	-0.160		-0.018	-0.169
Real Earnings per employee (£)	33,019	-0.032	-0.115		-0.011	-0.120
Productivity (£ GDP per FTE)	59,783	-0.048	-0.068		-0.035	-0.069
Real Household Expenditure (£million)	1,185,745	-0.096	-0.052		-0.089	-0.055
Imports of Chemicals (£million)	6,532	1.225	6.312		0.146	5.472
Chemical industry exports (£million)	12,907	-1.682	-9.327		-0.001	-8.211
Chemical industry employment (FTE)	90,445	-0.810	-5.452		0.133	-4.795
Chemical industry investment (£million)	2,047	34.187	26.350		28.526	22.161
Price of Chemical industry output (indexed to 1)	1	0.852	5.017		0.000	4.377
Chemical industry output (£million)	31,785	-1.073	-6.848		0.124	-6.026

What if the international situation changes?

- Simulations to 2030 assume competitors in other countries do not impose carbon capture or act to cushion price impact
- First question, what if UK continues to ‘go alone’, but acts to address price differentials via import tariff? In our model import tariff has to be 6.9% (greater than direct price implications of capture) due to ‘world price multiplier’ process – UK Chemicals directly and indirectly import-intensive
- Second question, what if other nations follow in adopting carbon capture/polluter pays?
- Third question, what if UK gains comparative advantage in operating carbon capture, thereby reducing the capital efficiency loss?

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Table 2: Percentage changes (2050) in key macroeconomic and socio-economic indicators for reference 'polluter pays' and 'income tax funded subsidy' cases - comparing outcomes with changing import/export prices and/or UK gains in comparative advantage

		Polluter pays			
Year	Households pay subsidy directly, Import & Export price unchanged	Import & Export price unchanged	Import price +6.9%	Import & Export price +6.9%	Import & Export price +6.9%
Efficiency reduction in Chemical industry	30% efficiency reduction	30% efficiency reduction	30% efficiency reduction	30% efficiency reduction	15% efficiency reduction
GDP (£million)	-0.042	-0.118	-0.167	-0.112	-0.041
CPI (indexed to 1)	-0.014	0.047	0.063	0.126	0.099
Nominal wage pre-tax (indexed to 1)	-0.029	-0.056	-0.111	0.016	0.052
Real wage pre-tax (indexed to 1)	-0.015	-0.104	-0.174	-0.110	-0.047
Total Imports (£million)	-0.037	0.007	-0.092	0.114	0.115
Total Exports (£million)	0.026	-0.293	-0.426	-0.209	-0.030
Total Employment (FTE)	-0.007	-0.049	-0.082	-0.052	-0.022
Investment (£million)	0.171	0.065	-0.004	0.078	0.042
Real Earnings - employment (£million)	-0.018	-0.169	-0.274	-0.165	-0.062
Real Earnings per employee (£)	-0.011	-0.120	-0.192	-0.113	-0.040
Productivity (£ GDP per FTE)	-0.035	-0.069	-0.085	-0.060	-0.020
Real Household Expenditure (£million)	-0.089	-0.055	-0.119	-0.040	-0.005
Imports of Chemicals (£million)	0.146	5.472	2.233	3.889	0.755
Chemical industry exports (£million)	-0.001	-8.211	-12.405	0.004	5.099
Chemical industry employment (FTE)	0.133	-4.795	-5.885	-0.215	2.719
Chemical industry investment (£million)	28.526	22.161	20.732	28.031	15.073
Price of Chemical industry output (indexed to 1)	0.000	4.377	6.847	6.898	4.274
Chemical industry output (£million)	0.124	-6.026	-7.767	-2.187	1.453

Carbon capture – lessons emerging in current UK policy context

- Capital efficiency loss has negative industry and wider economy impacts – trade off against likely limited *capture* supply chain gains, with any potential for supply chain gains a challenge for UK T&S (oil and gas industry evolution)?
- Negative impacts greater the more responsive export and domestic demands to relative price changes, but reducing if gain comparative advantage through improving technology to limit capital efficiency loss
- Challenge for UK ICC – no fixed timeframe, depending on evolution of market conditions (follower CC uptake, emergence of 'green markets' – more challenging for process industries selling into complex global supply chains)
- Likely relatively frequent evaluation of market conditions required
- Predictability vs. investability challenge for policy vs. industry?
- Subsidy will have economy-wide implications – trade off in distribution (e.g. extent GDP/total employment loss vs industry) and extent of losses over time

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