UNITED NATIONS UNIVERSITY
World Institute for Development Economics Research

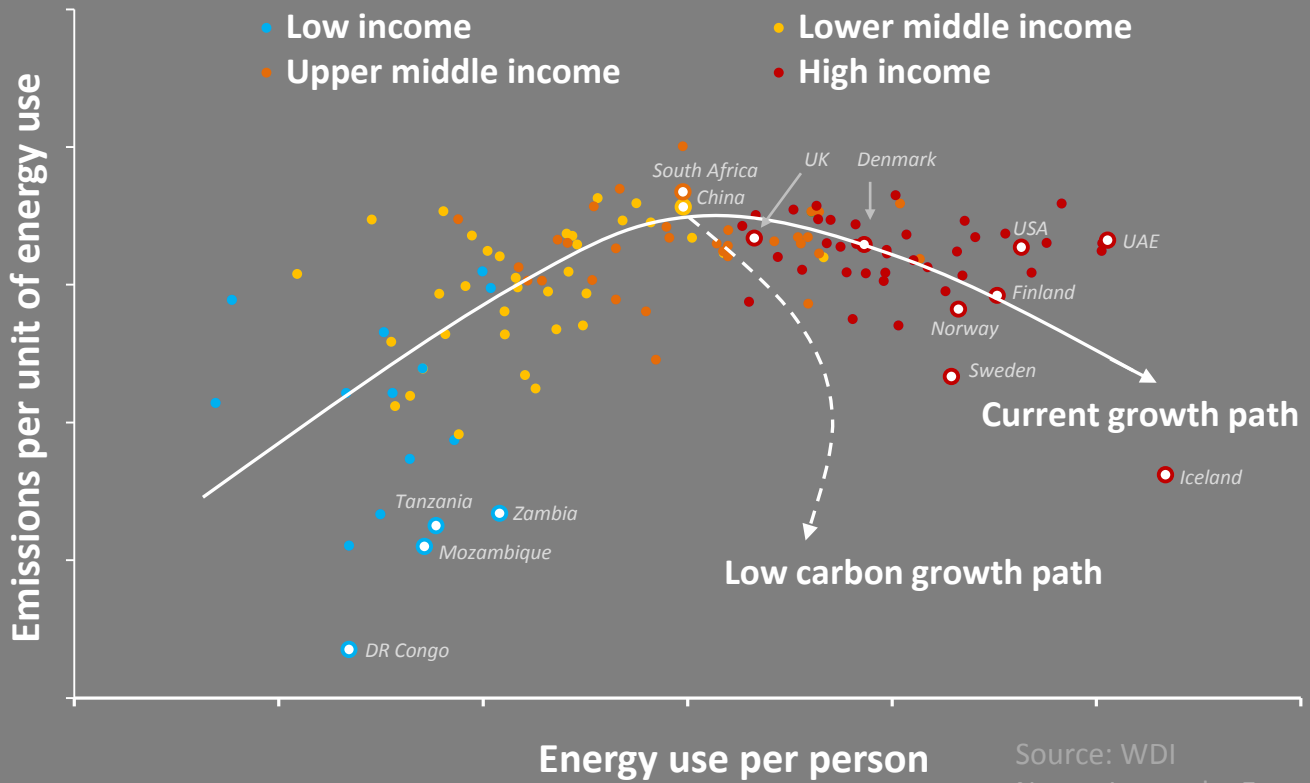
Economic Implications of Carbon Taxes in South Africa

James Thurlow, UNU-WIDER

Coauthors: Theresa Alton, Channing Arndt, Rob Davies, Faaiqa Hartley, Konstantin Makrelov, Dumebi Ubogu

Carbon Emissions

- South Africa must produce more energy but also reduce emissions
  - Pledged to lower emissions by 42% by 2025 (relative to business-as-usual)

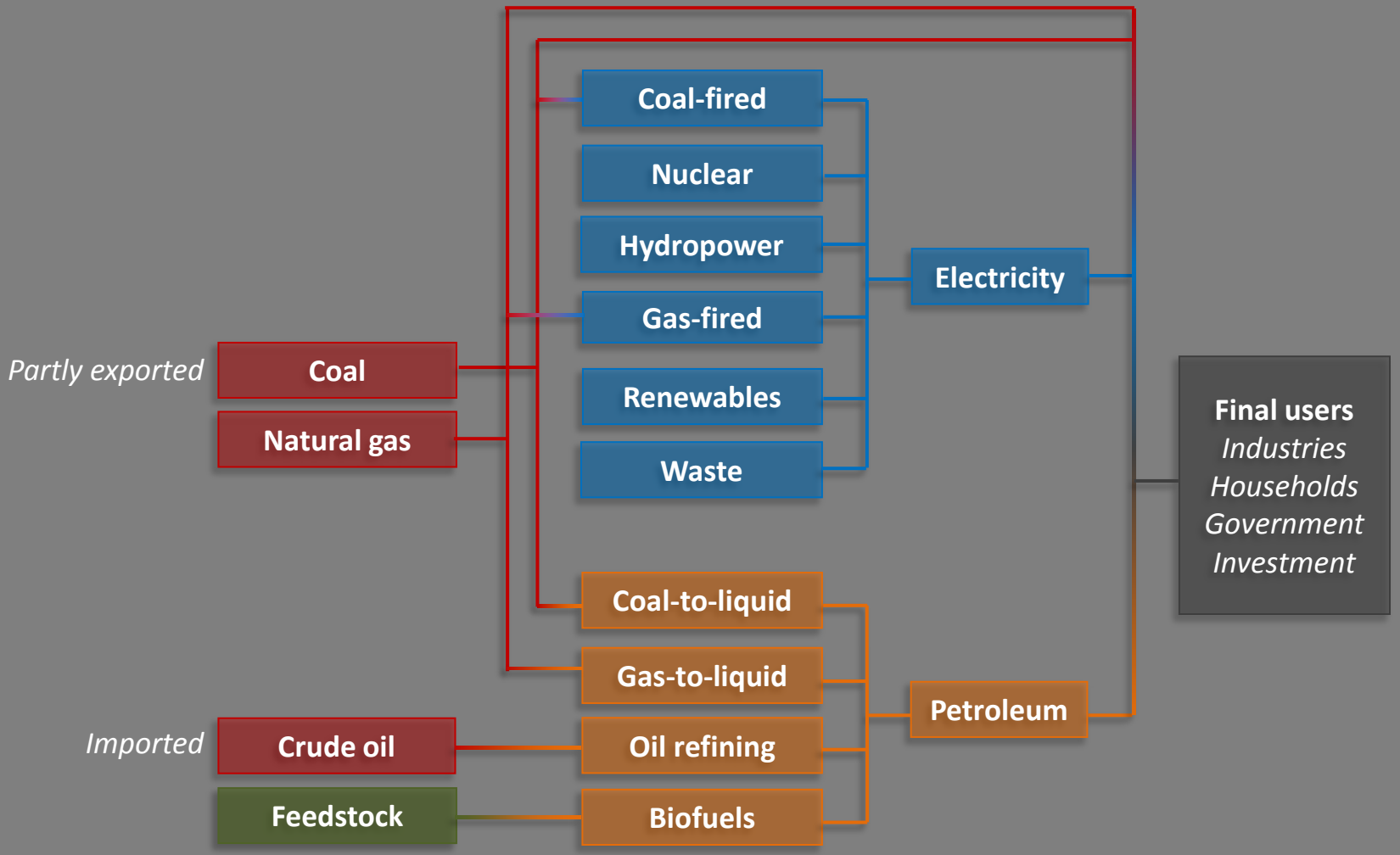


Source: WDI
Notes: Log scale, Energy use in oil equiv.

Energy-Economy Model

- South African General Equilibrium (SAGE) model
- 2005 social accounting matrix (SAM)
  - 54 industries, 7 factors of production, 14 household groups
- Resource constraints
  - Upward sloping labor supply curves for less-educated workers
  - “Putty clay” capital and endogenous capital accumulation
- Macroeconomic closures
  - Fixed current account with flexible real exchange rate
  - Savings-driven investment

Energy Production



Energy Use

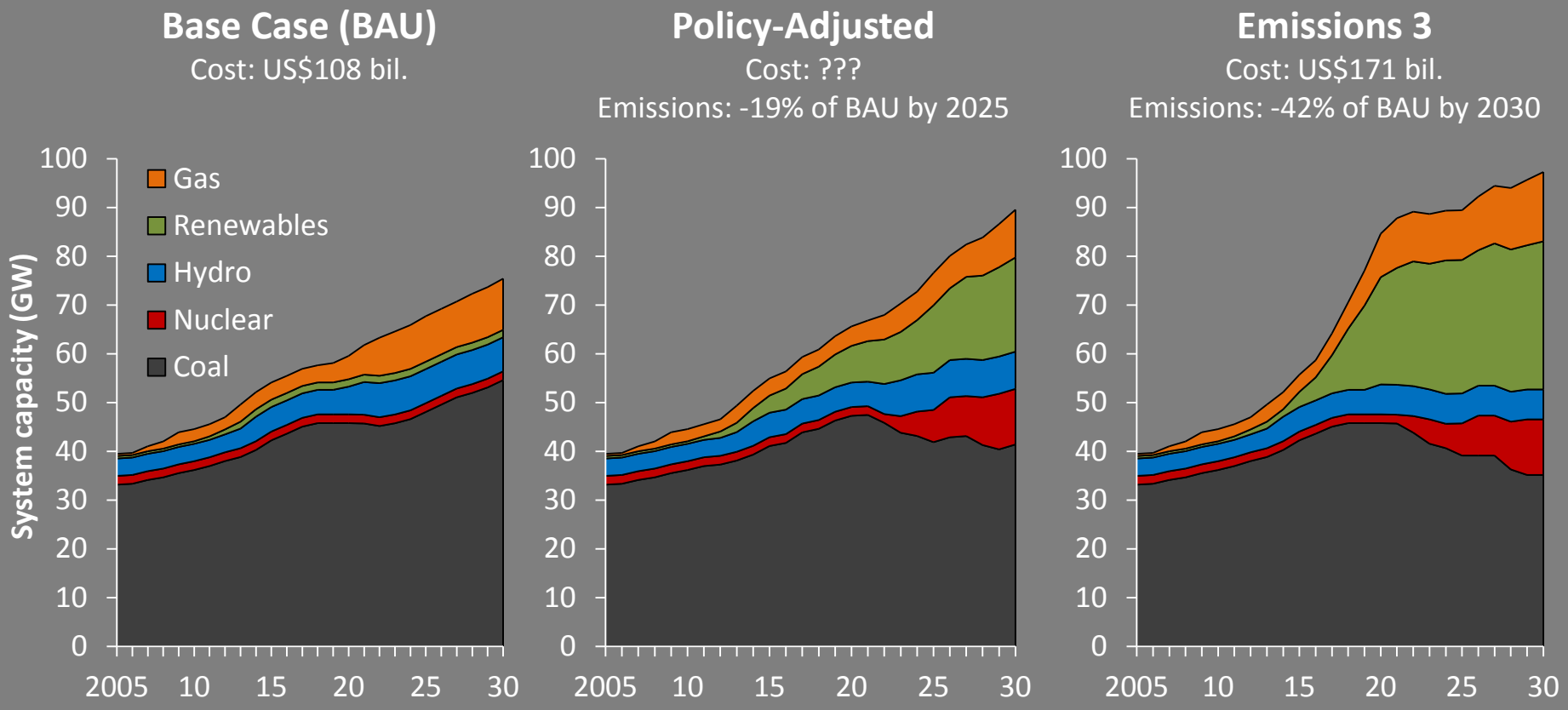
$$\text{Energy efficiency} = \frac{\text{Energy input}}{\text{Industry output}}$$

- Energy efficiency determined by…
  - Existing technologies
  - Energy prices (provided there is new investment)
  - New investment (provided the price rises)

Simulations

1. Domestic carbon tax
   - Applied to all fossil fuels burned in South Africa
   - Starts at US$3 per ton CO_2 in 2012 and rises gradually to US$30 in 2022
   - Uniform reduction in indirect sales tax rates (distribution neutral)
2. Domestic border tax adjustment on embodied carbon
   - As above, but rebate exporters and tax imports at same carbon tax rate
3. Foreign border tax adjustment
   - South African exports are taxed at foreign border
   - Starts at US$1.5 per ton CO_2 in 2012 and rises gradually to US$15 in 2022
4. Recycling revenues
   - Instead of sales taxes, reduce corporate taxes or increase social transfers

Electricity Investments



Results: Emissions Reductions

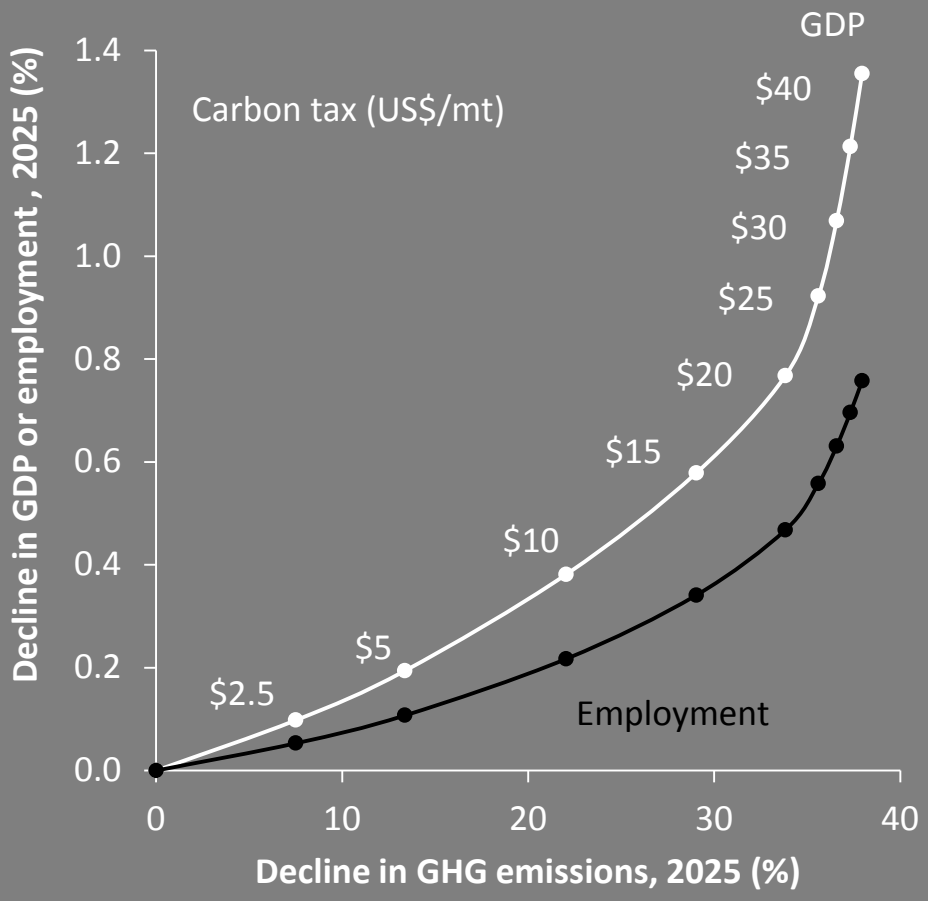
- A US$30 per ton CO2 carbon tax achieves emissions targets
- Ring-fencing of electricity means large reduction in other sectors

Changes in GHG emissions, 2010-2025

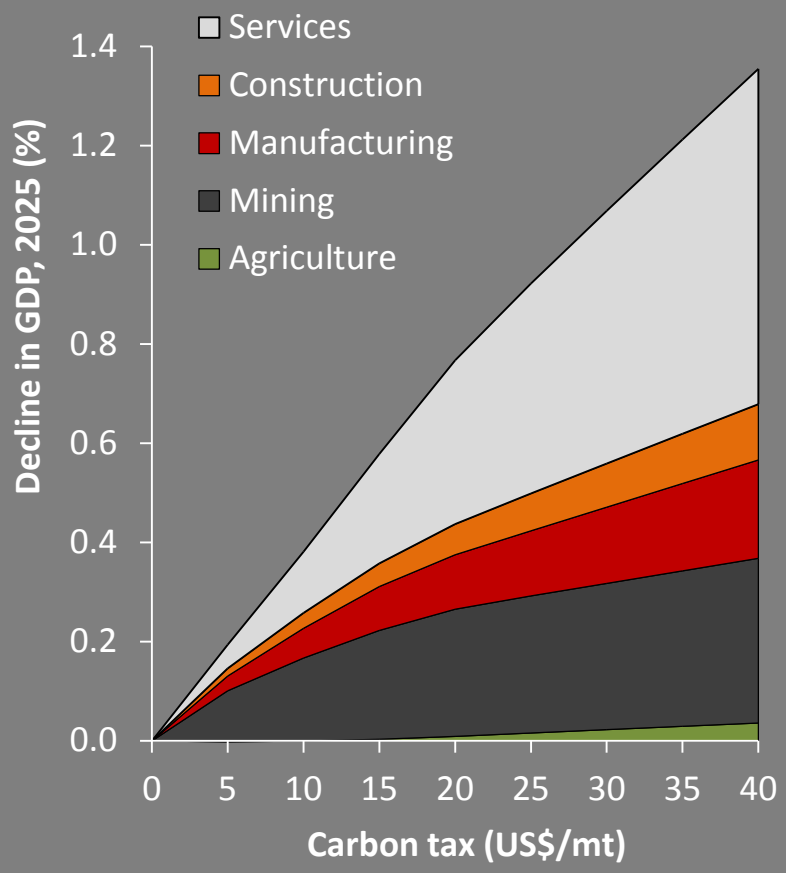
	Business-as-usual, 2010	Deviation from "business-as-usual" scenario, 2025 (%)			
		Policy-Adjusted	Production carbon tax	Consumption carbon tax	Foreign carbon tax
CO_2 emissions (mil.mt) using the reference approach	**447.5**	**-8.6**	**-36.6**	**-36.2**	**-19.6**
Electricity generation	237.0	-19.0	-19.0	-19.0	-19.0
Other sectors/households	210.5	0.0	-51.3	-50.5	-20.1
CO_2 emissions (mil.mt) using the sectoral approach	**397.4**	**n.a.**	**-40.4**	**-41.4**	**-21.0**

Results: GDP and Employment Losses

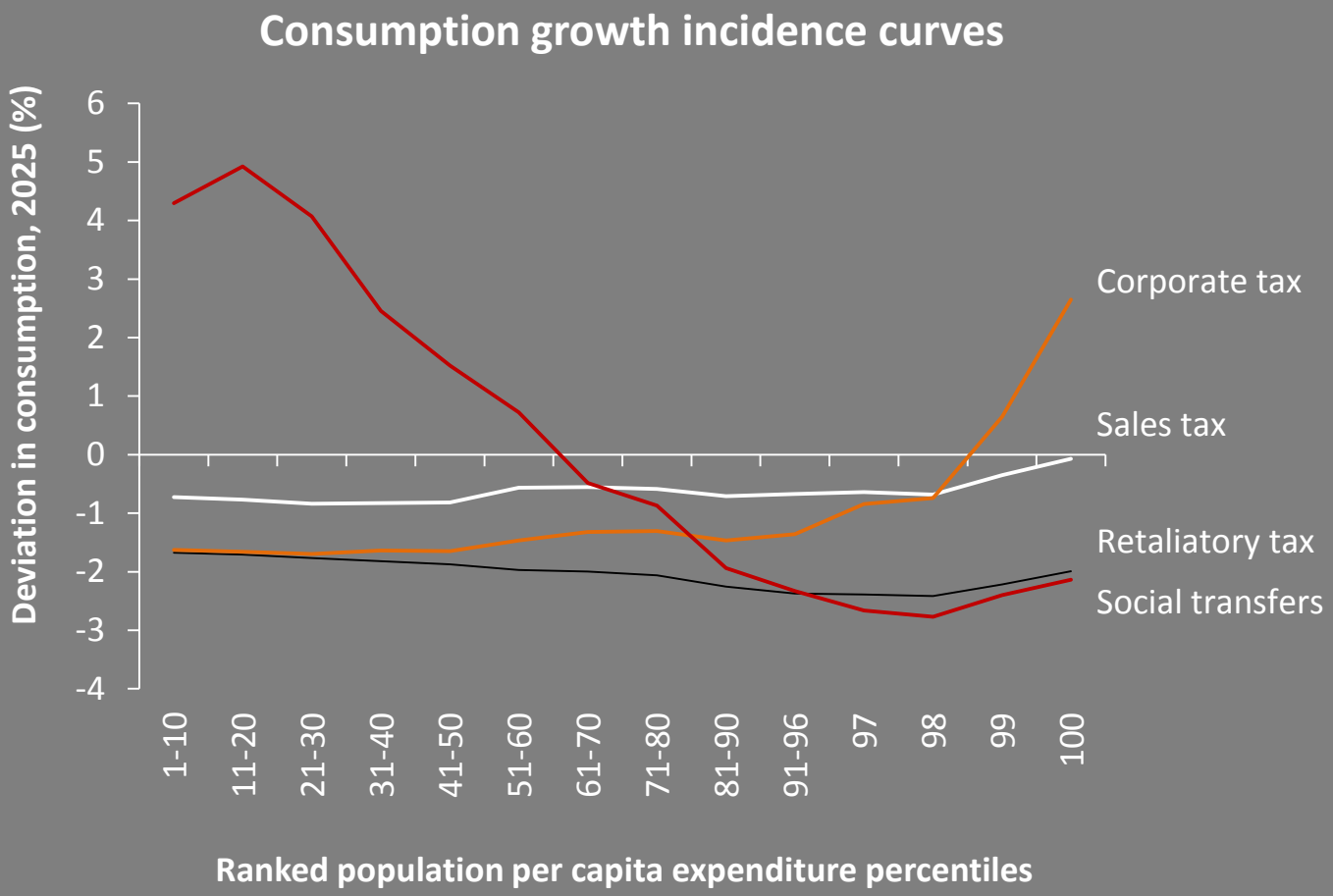
Economywide abatement costs



Sectoral sources of losses



Results: Income Distribution



Conclusions

- Carbon taxes reduce national welfare and employment
  - Absorption and employment fall by 1.2 and 0.6 percent, respectively, by 2025
  - These effects are small in annual growth rate terms (less than 0.1 %-points)
- Welfare and employment losses are larger if RSA's trading partners unilaterally impose BTAs on South African exports
- Domestic BTAs reduce welfare and employment losses while maintaining the same emissions reductions
- Mode of revenue recycling strongly influences growth and distributional outcomes (i.e., trade-offs)