Climate Change Mitigation Policies: Distributional and Allocative Effects

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Motivation

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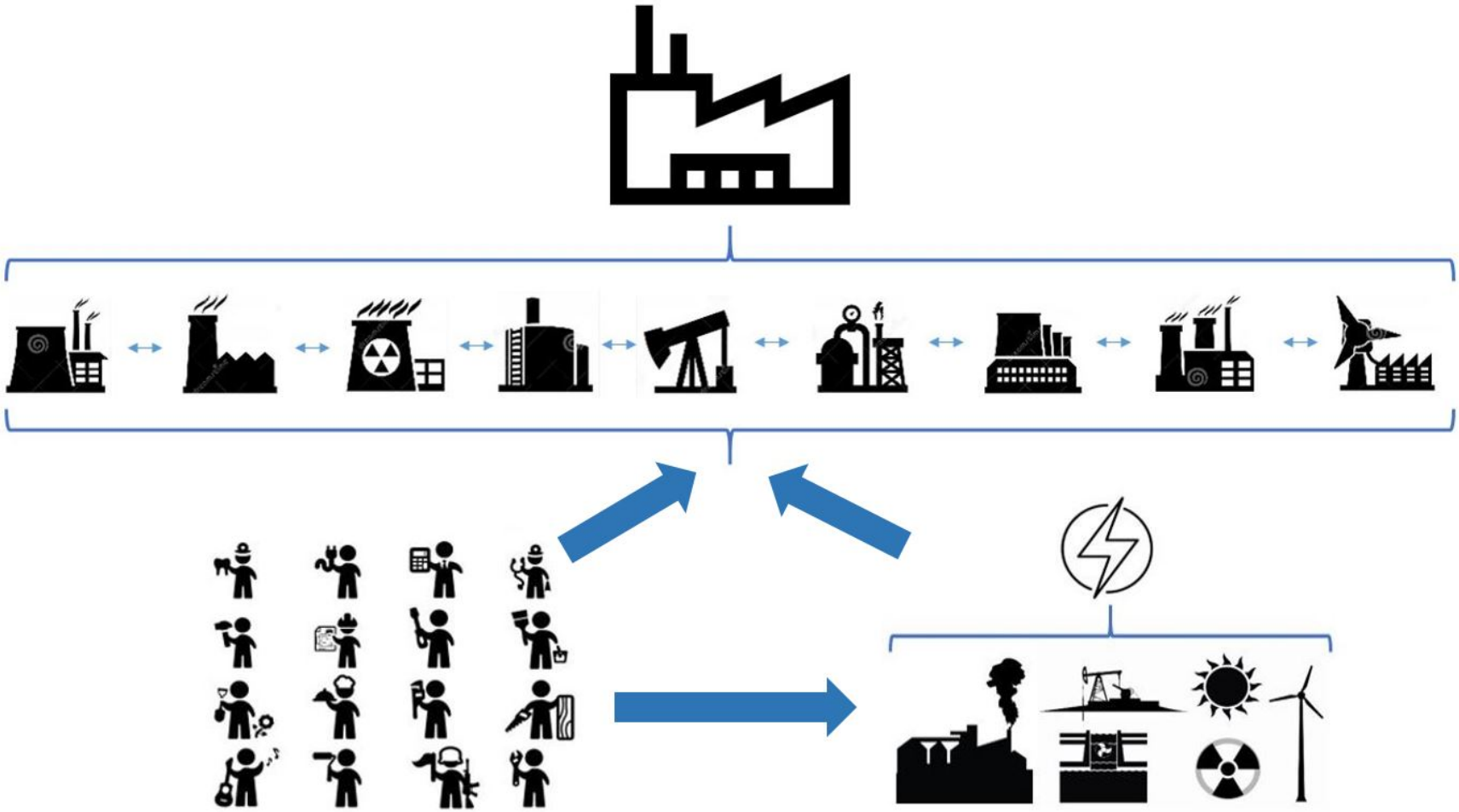
- Climate change mitigation policies have distributional effects *(Büchs et al., 2011; Dennig et al., 2015; Fried et al., 2016)*
  - **Our finding:** By focusing on labour markets and considering heterogeneity in workers' abilities, the biggest losers are the workers with a comparative advantage in the fossil fuel sectors

Model Setup



Example on Heterogeneity in Workers' Skills

- Suppose there are two sectors:
  1. Finance and Accounting sector, which offers 100\$/day
  2. Graphic design sector, which offers 80\$/day

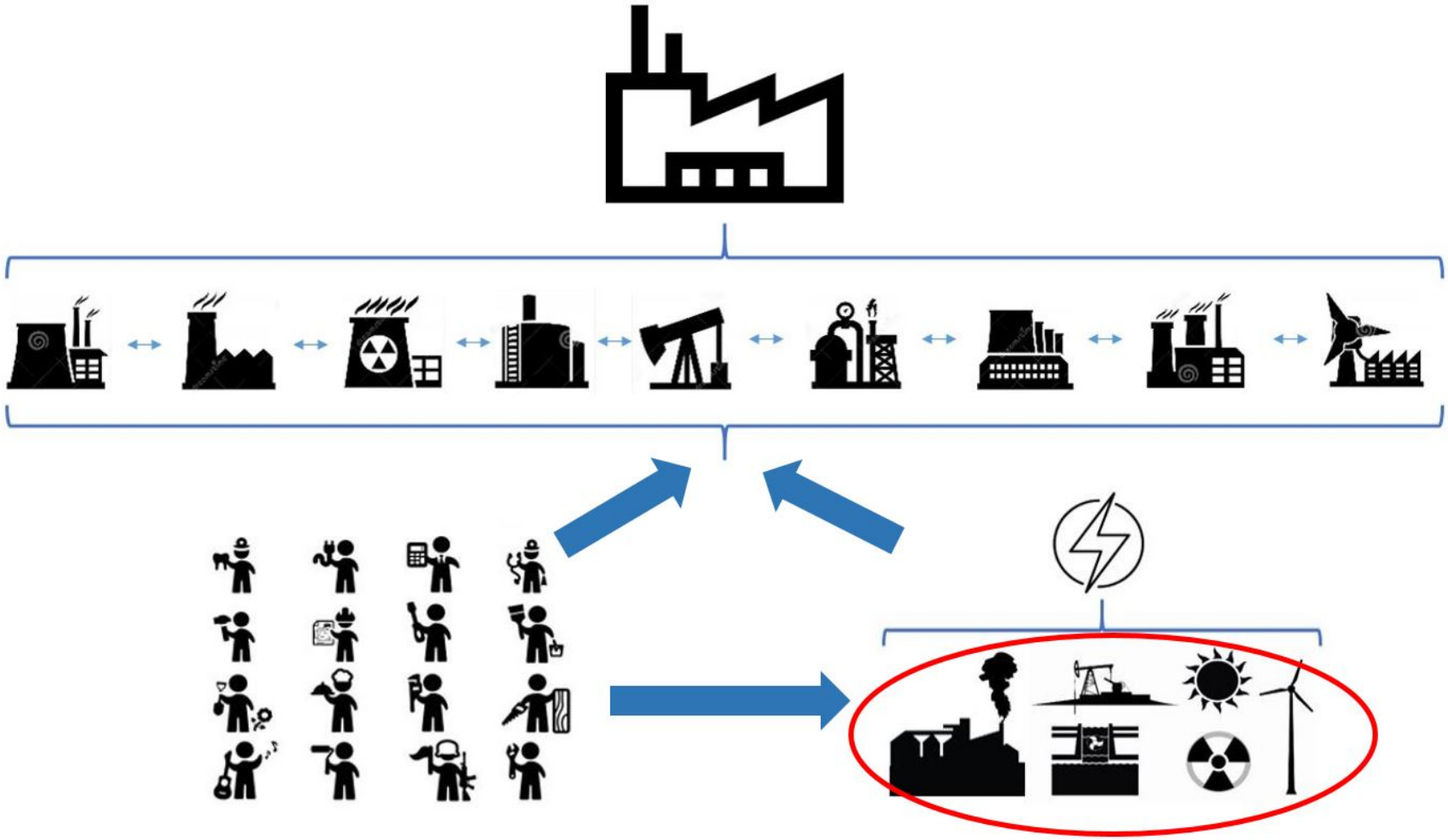
- I draw two independent skill-specific abilities:
  $\{z_{finance} = 0.5, z_{graphics} = 1\}$

- I will earn:
  $\begin{cases} 100\$/\text{day} * 0.5 = 50\$/\text{day from the Financial Sector} \\ 80\$/\text{day} * 1 = 80\$/\text{day from the Graphic design sector} \end{cases}$

- I will choose to work in Graphic design despite the higher gross wage in Finance and Accounting

Key Takeaway: Occupational distribution is driven by **skill-adjusted returns** and **not absolute returns**

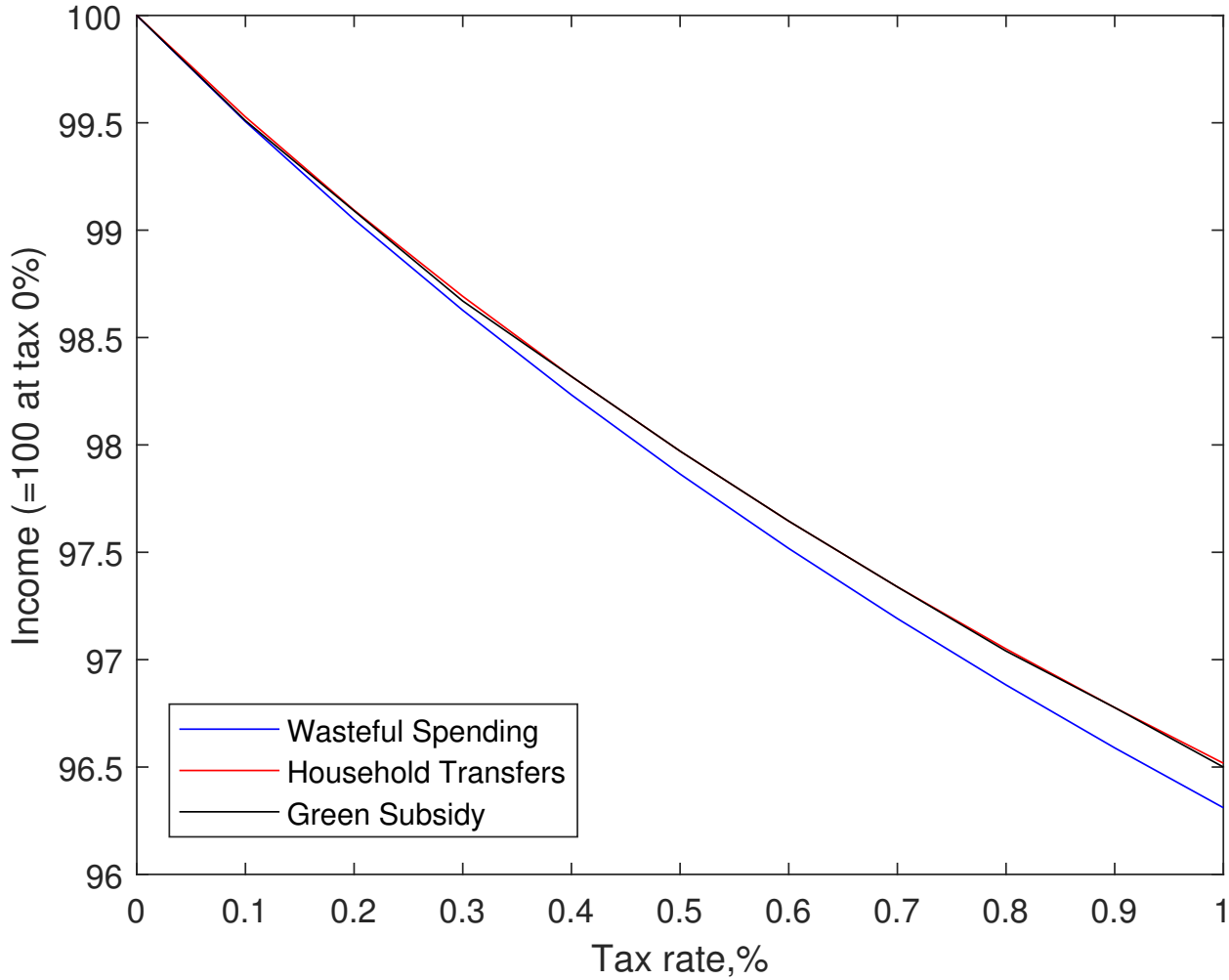
Back to Model Setup



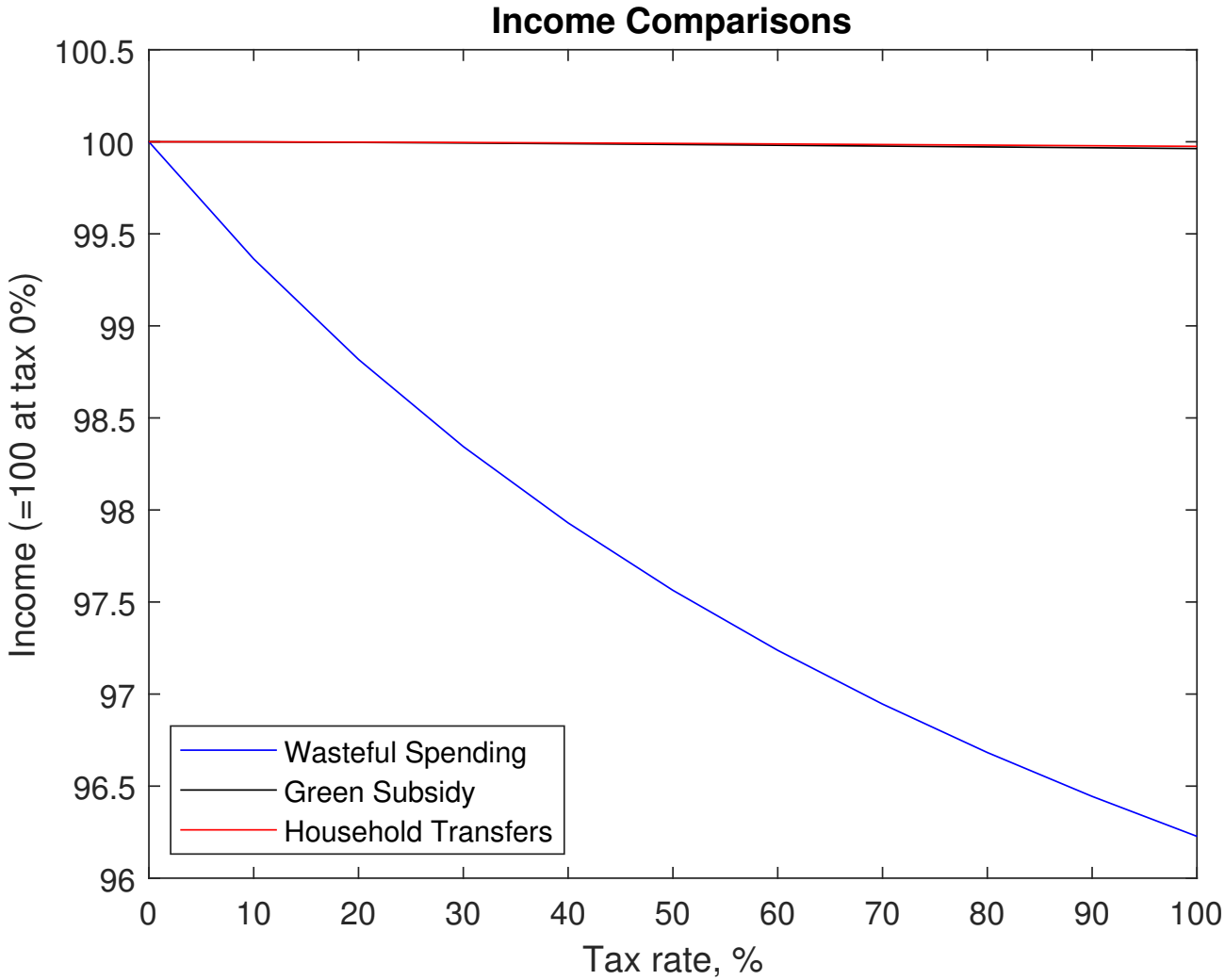
Quantitative Example

- We consider three types of energy sources: oil, coal and green
- We investigate the distributional effects of carbon taxes under three policy scenarios:
  - Policy 1 - Household Transfers
  - Policy 2 - Green Subsidy
  - Policy 3 - Wasteful Spending
- Computational Experiments:
  1. Increase tax rate from 0% (benchmark model) to 100%
  2. Present comparative statics for Mexico under each policy scenario

In the short run, income drops with all three policy scenarios



In the long run, the effect of carbon taxes on income is mitigated by the tax revenue recycling schemes considered



Downward pressures from wages and oil & coal profits on income are largely offset when tax revenue is recycled

Table: Decomposing Income Growth by Percentage Point Contribution

Percentage Point Contribution	Wasteful Spending	Household Transfers	Green Subsidy
Wages	-1.4 pp	-0.3 pp	-0.1 pp
π Oil Production	-2.0 pp	-1.9 pp	-1.9 pp
π Coal Production	-0.3 pp	-0.3 pp	-0.3 pp
π Green Production	-0.04 pp	-0.004 pp	+2.4 pp
Transfers	-	+2.5 pp	-
%ΔIncome	**-3.8%**	**-0.02%**	**-0.04%**

Real wages in oil and coal sectors are hit most severely

Table: Percent Change in Wages from tax 0% to tax 100%

Sector	Wasteful Spending %Δ Wages	Household Transfers %Δ Wages	Green Subsidy %Δ Wages
1. Agriculture, forestry and fishing	-1.39%	-0.13%	-0.08%
2. Mining and Quarrying	-1.40%	-0.13%	-0.09%
3. Manufacturing	-1.40%	-0.14%	-0.09%
4. Electricity, gas and water	-1.45%	-0.19%	-0.12%
5. Construction	-1.36%	-0.10%	-0.06%
6. Wholesale and retail trade	-1.40%	-0.14%	-0.09%
7. Restaurants and hotels	-1.39%	-0.13%	-0.08%
8. Transportation, storage and communication	-1.39%	-0.13%	-0.08%
9. Financial and insurance services	-1.39%	-0.13%	-0.08%
10. Public administration and defence	-1.39%	-0.13%	-0.09%
11. Real estate and business activities	-1.32%	-0.06%	-0.04%
12. Education	-1.33%	-0.06%	-0.04%
13. Human health and social work activities	-1.33%	-0.07%	-0.04%
14. Other service activities	-1.39%	-0.13%	-0.08%
15. Private households activities	-1.31%	-0.04%	-0.03%
Oil energy production	**-35.80%**	**-34.97%**	**-34.93%**
Coal energy production	**-32.43%**	**-31.57%**	**-31.53%**
Green energy production	-1.44%	-0.17%	**+50.93%**

Appendix

Labour outflows from oil and coal sectors into other sectors in the economy

Table: Percent Change in Labour Supply from tax 0% to tax 100%

Sector	Wasteful Spending %Δ Labour Supply	Household Transfers %Δ Labour Supply	Green Subsidy %Δ Labour Supply
1. Agriculture, forestry and fishing	0.07%	0.07%	0.03%
2. Mining and Quarrying	0.07%	0.07%	0.02%
3. Manufacturing	0.07%	0.07%	0.02%
4. Electricity, gas and water	0.05%	0.05%	0.01%
5. Construction	0.09%	0.09%	0.04%
6. Wholesale and retail trade	0.07%	0.07%	0.02%
7. Restaurants and hotels	0.07%	0.07%	0.03%
8. Transportation, storage and communication	0.07%	0.07%	0.03%
9. Financial and insurance services	0.07%	0.07%	0.03%
10. Public administration and defence	0.07%	0.07%	0.03%
11. Real estate and business activities	0.10%	0.10%	0.05%
12. Education	0.10%	0.10%	0.04%
13. Human health and social work activities	0.10%	0.10%	0.04%
14. Other service activities	0.07%	0.07%	0.03%
15. Private households activities	0.11%	0.11%	0.05%
Oil energy production	**-16.71%**	**-16.71%**	**-16.74%**
Coal energy production	**-14.87%**	**-14.87%**	**-14.90%**
Green energy production	0.05%	0.05%	**+19.32%**

Only the most skilled workers stay in the oil & coal sectors ...and bear the full brunt of the drop in wages!

Table: Percent Change in Average Productivity from tax 0% to tax 100%

Sector	Wasteful Spending %Δ Avg Productivity	Household Transfers %Δ Avg Productivity	Green Subsidy %Δ Avg Productivity
1. Agriculture, forestry and fishing	-0.17%	-0.17%	-0.06%
2. Mining and Quarrying	-0.16%	-0.16%	-0.06%
3. Manufacturing	-0.16%	-0.16%	-0.06%
4. Electricity, gas and water	-0.11%	-0.11%	-0.02%
5. Construction	-0.20%	-0.20%	-0.08%
6. Wholesale and retail trade	-0.16%	-0.16%	-0.05%
7. Restaurants and hotels	-0.17%	-0.17%	-0.06%
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9. Financial and insurance services	-0.17%	-0.17%	-0.06%
10. Public administration and defence	-0.16%	-0.16%	-0.06%
11. Real estate and business activities	-0.24%	-0.24%	-0.11%
12. Education	-0.23%	-0.23%	-0.10%
13. Human health and social work activities	-0.23%	-0.23%	-0.10%
14. Other service activities	-0.17%	-0.17%	-0.06%
15. Private households activities	-0.25%	-0.25%	-0.12%
Oil energy production	**+53.33%**	**+53.33%**	**+53.47%**
Coal energy production	**+45.70%**	**+45.70%**	**+45.83%**
Green energy production	-0.12%	-0.12%	**-33.84%**

Key Takeaways

- **At the aggregate level:**
  1. Carbon taxes affect output adversely
  2. However, this effect can be mitigated in the long run by recycling tax revenues, either by:
     - returning revenue back to households as lump sum transfers
     - subsidising green energy

- **At the micro level:** Biggest losers from taxing dirty energy production are the workers with a comparative advantage in the dirty energy sector
  - Policymakers need to focus on re-training these workers to facilitate their transition into other sectors in the economy!

Real wages in oil and coal sectors are hit most severely

Table: Percent Change in Wages from tax 0% to tax 100%

Sector	Wasteful Spending %Δ Wages	Household Transfers %Δ Wages	Green Subsidy %Δ Wages
Intermediate Sectors Avg	-1.4%	-0.1%	-0.1%
Oil energy production	**-35.8%**	**-35.0%**	**-34.9%**
Coal energy production	**-32.4%**	**-31.6%**	**-31.5%**
Green energy production	-1.4%	-0.2%	**+50.9%**

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