Mitigating Climate Change: Growth- and Distribution-Friendly Strategies

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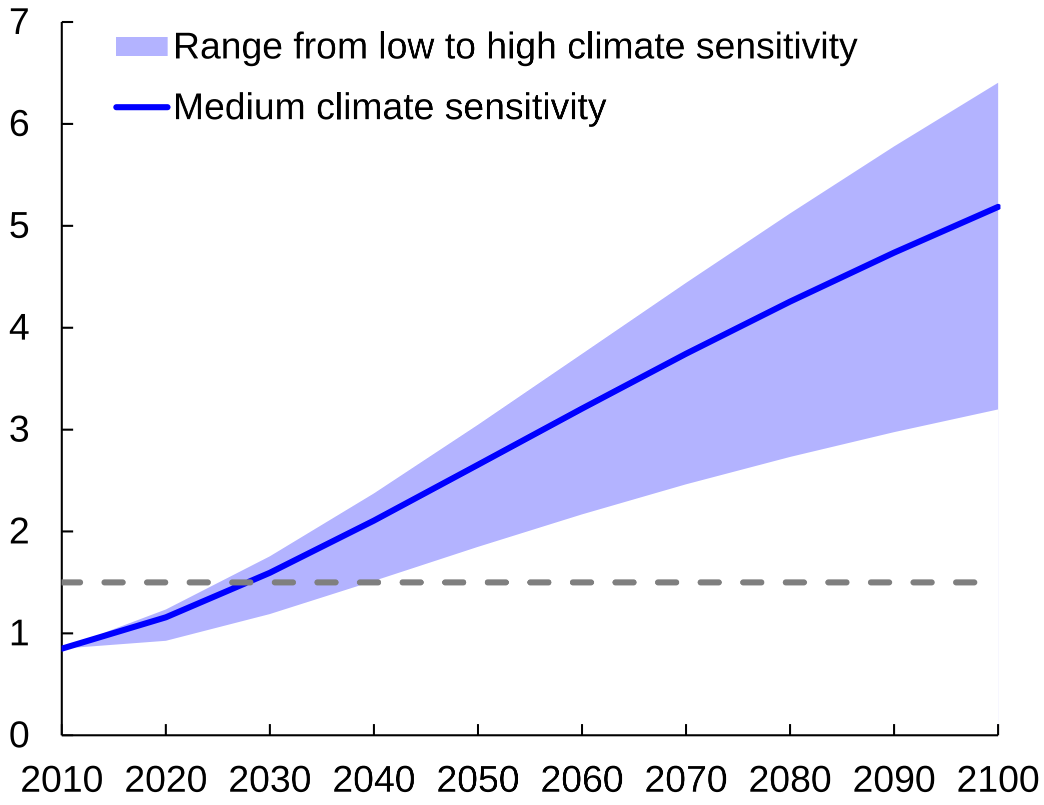
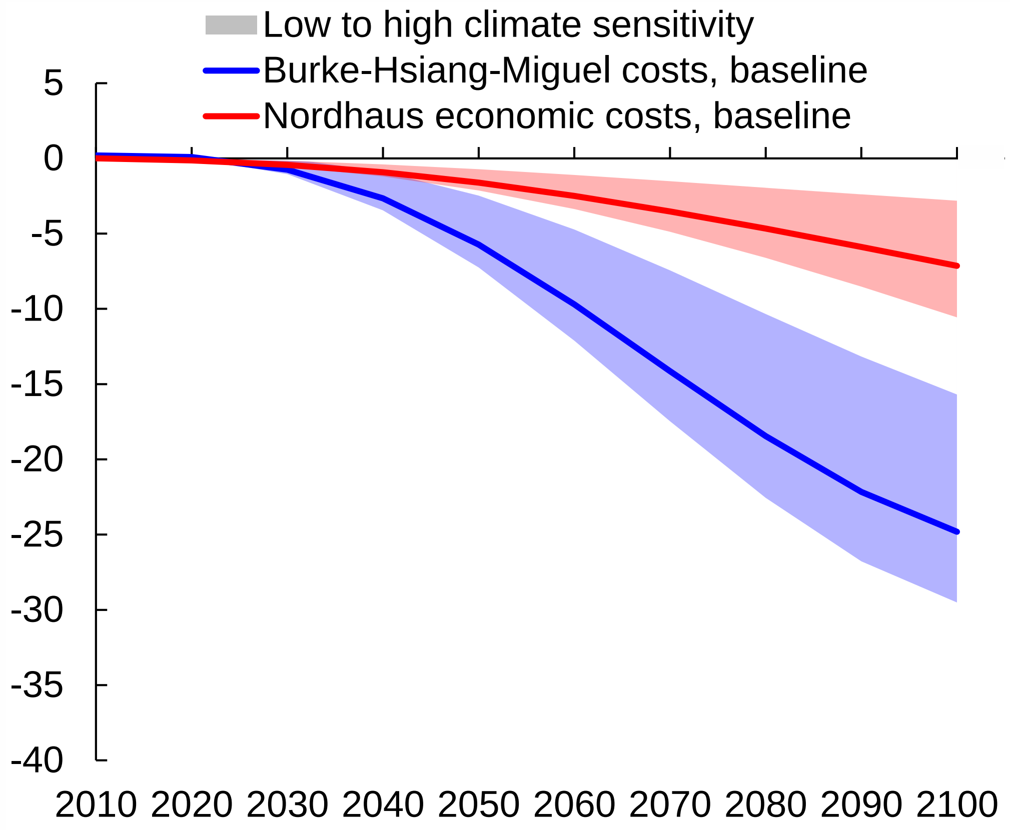
Authors: *Philip Barrett, Christian Bogmans, Benjamin Carton, Johannes Eugster, Florence Jaumotte (lead), Adil Mohommad, Evgenia Pugacheva, Marina M. Tavares, and Simon Voigts*
External Consultants: *Weifeng Liu and Warwick McKibbin*
Support: *Srijoni Banerjee, Eric Bang, and Jaden Kim*

A rapidly closing window

Temperature under "Business-as-Usual"
(Degrees Celsius above preindustrial average)



Output Losses of Climate Change
(Percent)



Source: Burke, Hsiang, and Miguel 2015; Nordhaus 2010; and IMF staff calculations.

Opportunity to green the recovery

Urgent to act on climate: emissions are on course to raise temperature by 3-6C by 2100. The window for limiting warming to 1.5-2C (net zero emissions in 2050) is closing rapidly.

Opportunity to "green" the recovery: *Recovery stimulus* can be designed to boost green and resilient public infrastructure; policies can ensure composition of recovery in capital spending is consistent with decarbonization by providing *correct price signals* or other financial incentives.

Questions:

- How can we reach net zero carbon emissions by 2050 in a **growth, employment and distribution friendly** way?

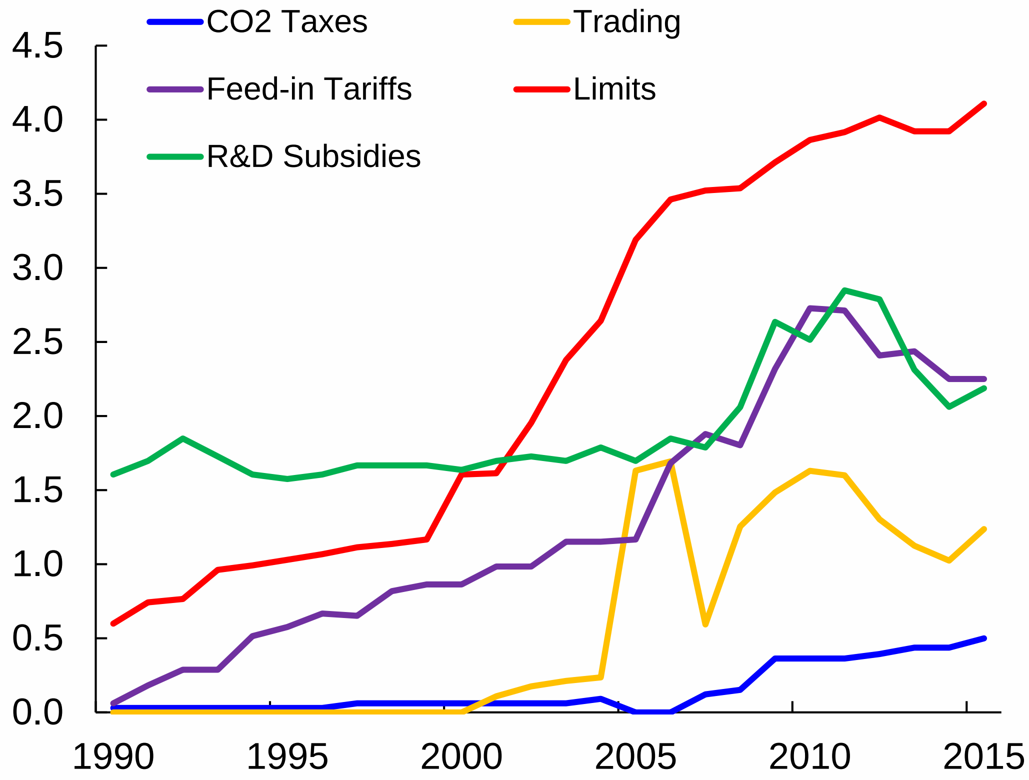
- Can well-designed and sequenced mitigation policies help with the economic repair from the Covid-19 crisis?

Main takeaways

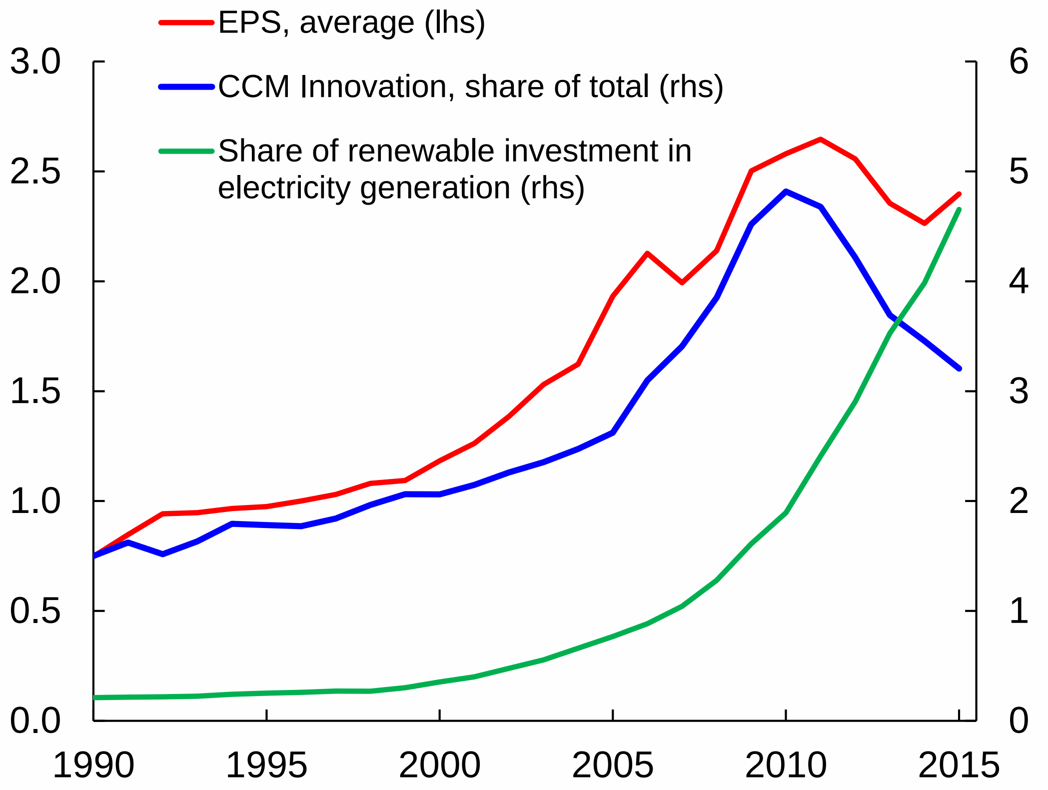
- NZE by 2050 feasible and would boost incomes in the long run and avoid catastrophic risk.
- An initial green investment push combined with steadily rising carbon prices would deliver the needed emissions reductions at reasonable output effects (initial boost to global GDP and employment followed by moderate output losses in the medium run).
- Large cross-country differences in output effects, with most oil producers and countries with fast population growth bearing large costs in the medium run (but need to weigh these against avoided damages from climate change and co-benefits).
- Carbon-revenue recycling can compensate poor households and support job transitions.

The low-carbon transition has started

Average Policy Stringency for Selected Environmental Policies *(Index)*



Clean Innovation, Electricity Generation, and Policies *(Index; percent on right scale)*



Sources: IEA; OECD; PATSTAT; and IMF staff calculations.

Environmental policies support innovation in clean energy

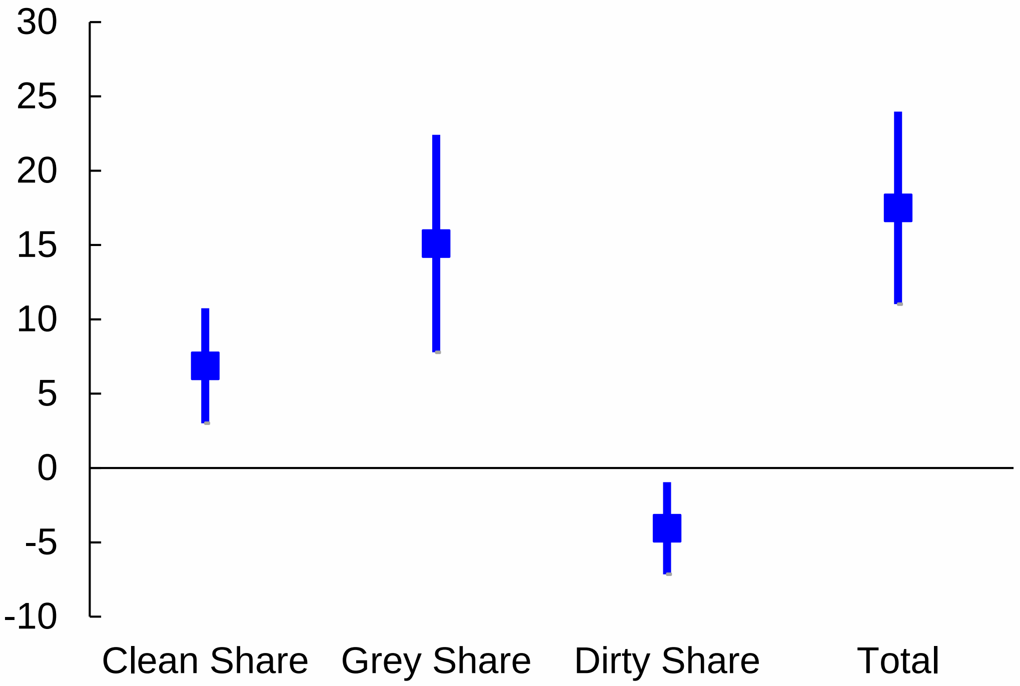
More stringent environmental policies are estimated to have contributed to

- 30 percent of the increase in ***global clean energy*** innovation
- increase the share of clean and grey innovation (grey innovations reduce the pollution of dirty technologies) in the ***electricity sector,*** while boosting overall electricity innovation.

Market and non-market policy instruments are effective. **R&D subsidies** appear most effective

Effect of policy tightening on shares of technology in electricity innovation and on total innovation

(Percent)



Sources: Dechezlepretre et al. (2017); IEA; OECD ; PATSTAT; Penn World Tables; and IMF staff calculations.
Note: This shows the effect of a one-unit tightening in the environmental policy index on innovation in the respective types and total electricity innovation. The dot (line) shows point estimate (90 percent confidence internal).

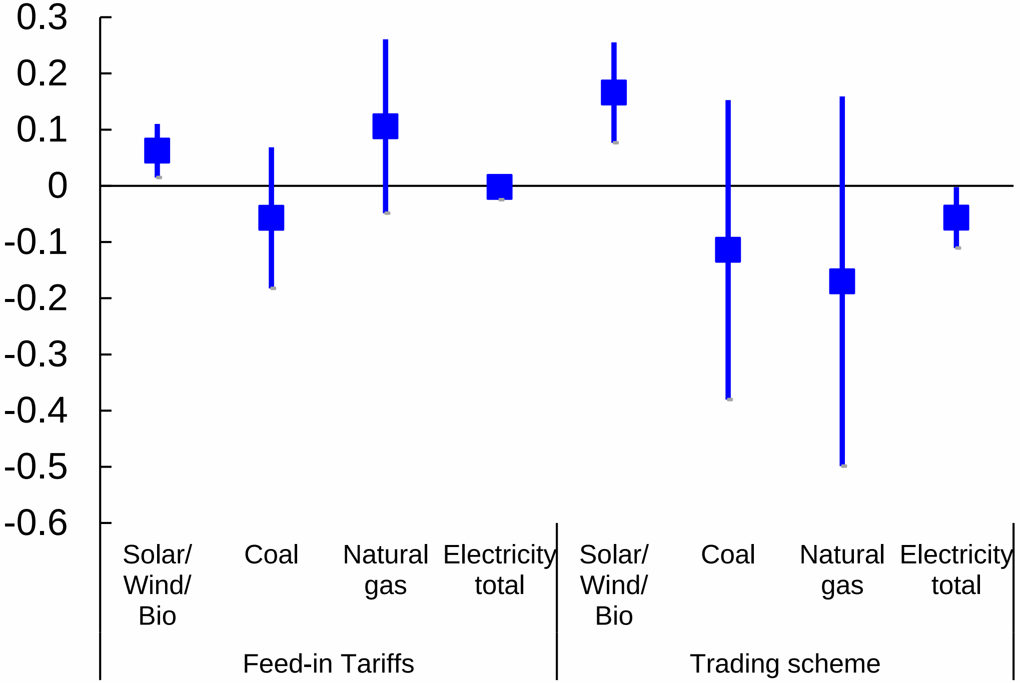
Environmental policies support investment in renewable electricity generation

More stringent environmental policies are estimated to have contributed to:

- **55 percent** of the increase in the **share of renewables** in electricity generation.
- **declines in the share of coal** and an ambiguous effect on the share of natural gas—often a complement to renewable energy
- no discernible negative impact on total electricity generation

Feed-in tariffs and trading schemes are found to be the most effective policies.

Effect on Shares of Primary Energy Source in Electricity Generation and Total Electricity Generation
(Percentage points; megawatt hour per capita for electricity total)



Sources: Dechezlepretre et al. (2017); IEA; OECD ; PATSTAT; Penn World Tables; and IMF staff calculations.
Note: This shows the effect of a one-unit tightening in the policy indicator on the electricity share of the respective primary energy sources and on total electricity generation per capita. The dot (line) shows point estimate (90 percent confidence internal).

Environmental policies lead to job reallocations

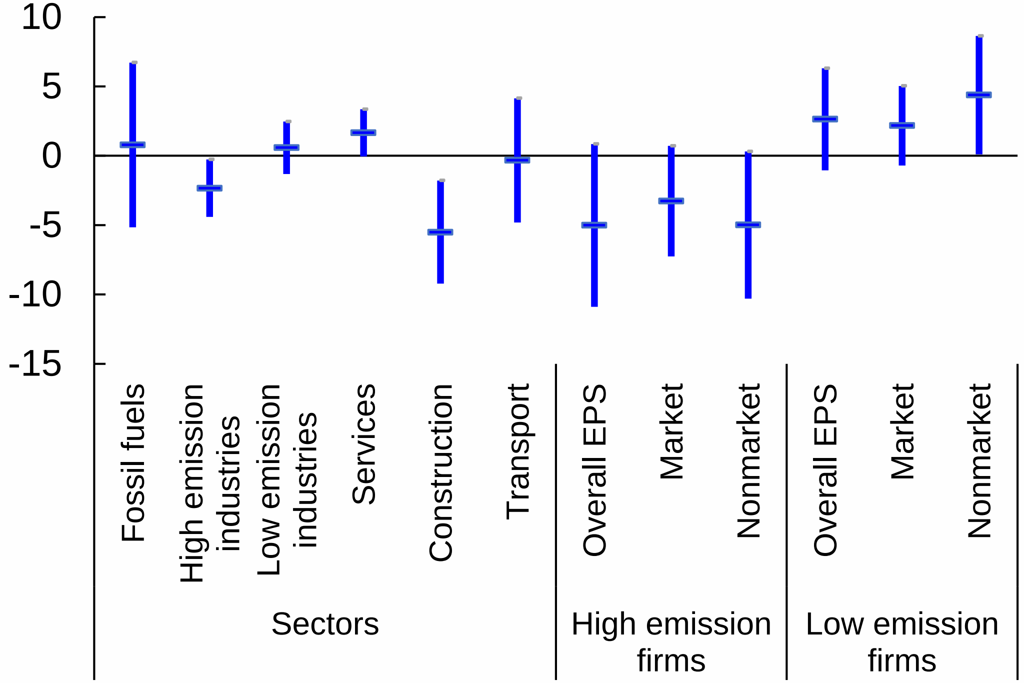
Concern that climate policies will lead to job losses in carbon-intensive activities

- coal mining, shale oil and gas production
- carbon-intensive manufacturing
- transport

Econometrics suggests that policies have succeeded in **reallocating jobs** from high- to low-carbon sectors

However, job transitions can still involve **costs** for the workers affected

Effect on Employment, by Sector and Emission Intensity
(Percent)



Source: Worldscope database; and IMF Staff calculations.
Note: This shows the effect of tightening policies by one standard deviation on employment. The dot (line) shows point estimate (90 percent confidence internal).

How to get to net zero emissions by mid-century?

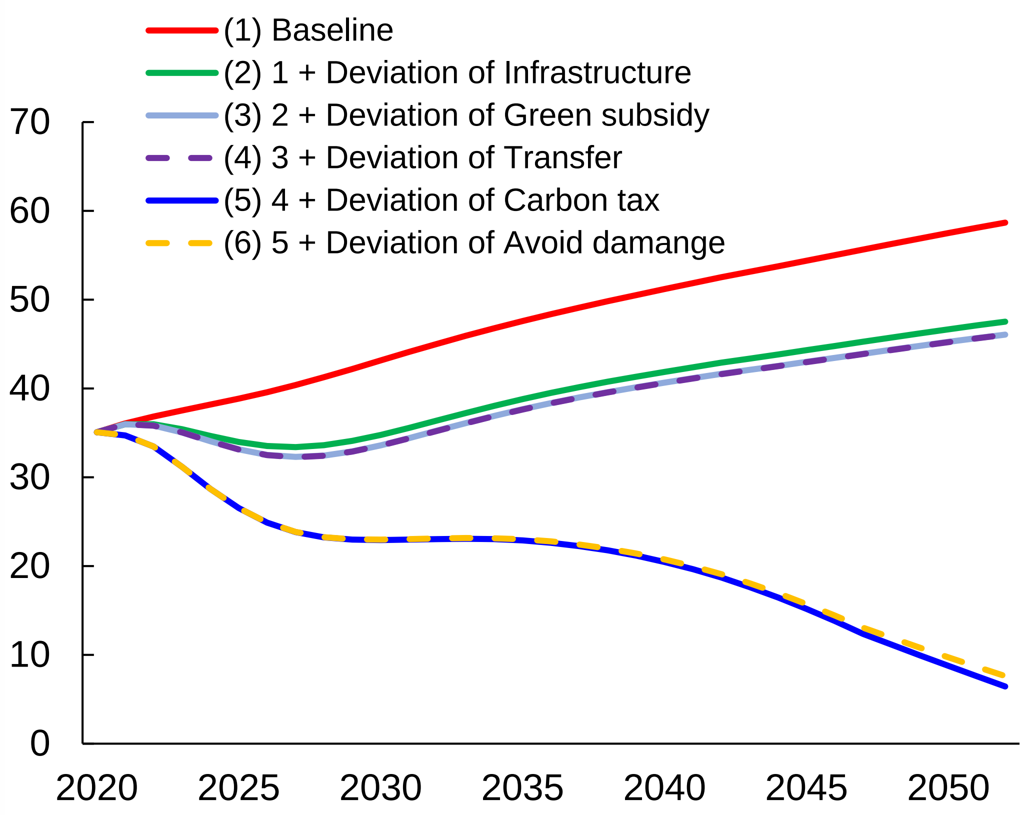
- **Objective** Reaching net zero emissions by mid-century in a growth, employment, and distribution-friendly way.

- **Policy** Comprehensive macro package
  1. *Green supply policies:* subsidy on renewables production + 10-year green public investment program
  2. *Carbon tax:* gradual (low starting levels, high growth rate). Between $40 and $150 a ton of CO_2 in 2050
  3. *Compensatory transfers to households:* ¼ of carbon tax revenues to protect the purchasing power of poor households
  4. *Supportive macro policies*: fiscal easing that requires debt financing for the first decade and occurs amid low-for-long interest rates (given low-inflation context)

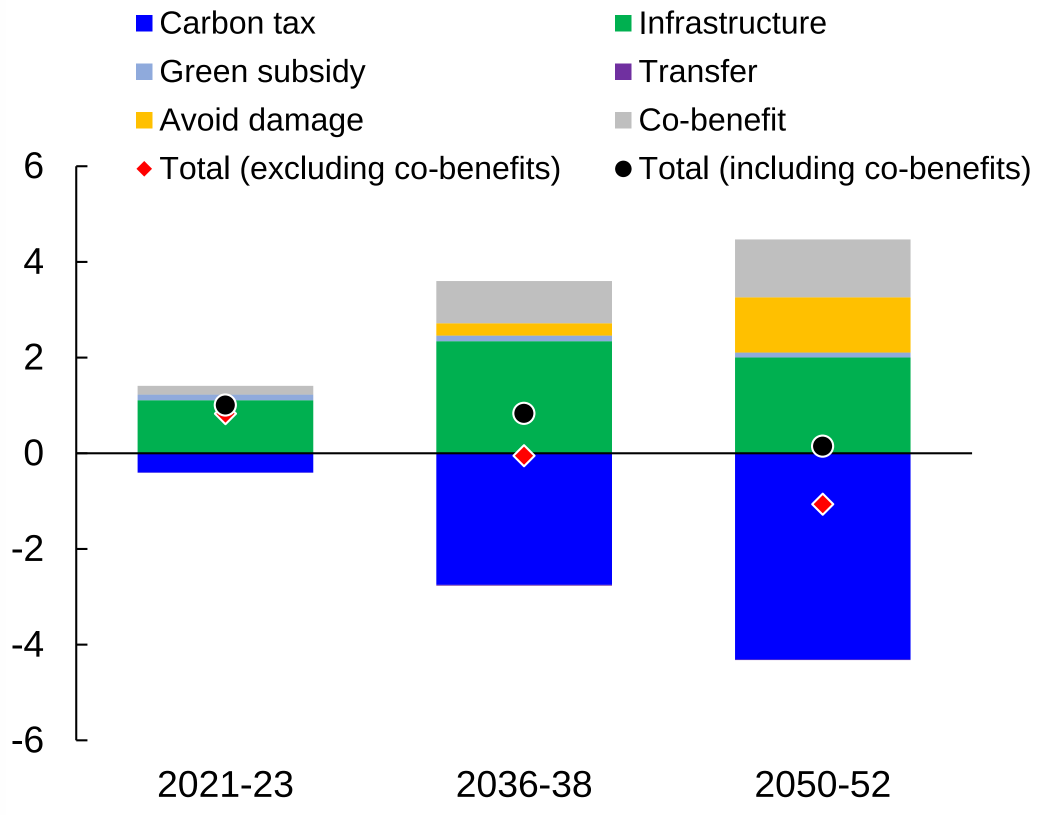
- **Models** ***G-cubed*** global macro model with sectoral detail (McKibbin and Wilcoxen 1999, 2013; Liu and others 2020) and a stylized ***Integrated assessment model*** (Hassler, Krusell and Olovsson 2020) with possibility of endogenous technological change.

Policy package: CO2 emissions and real GDP

Global CO2 Emissions
(Gigatons of CO2)



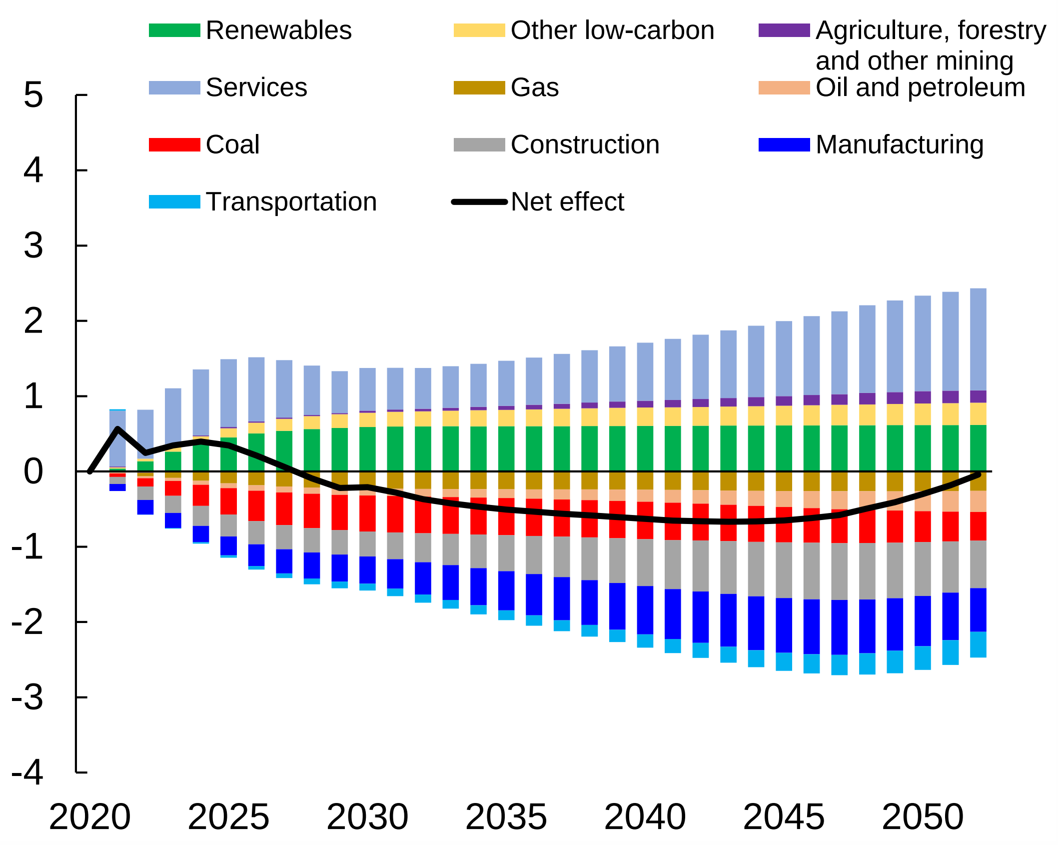
Impacts on Real GDP
(Deviation from baseline, percent)



Source: IMF staff calculations.

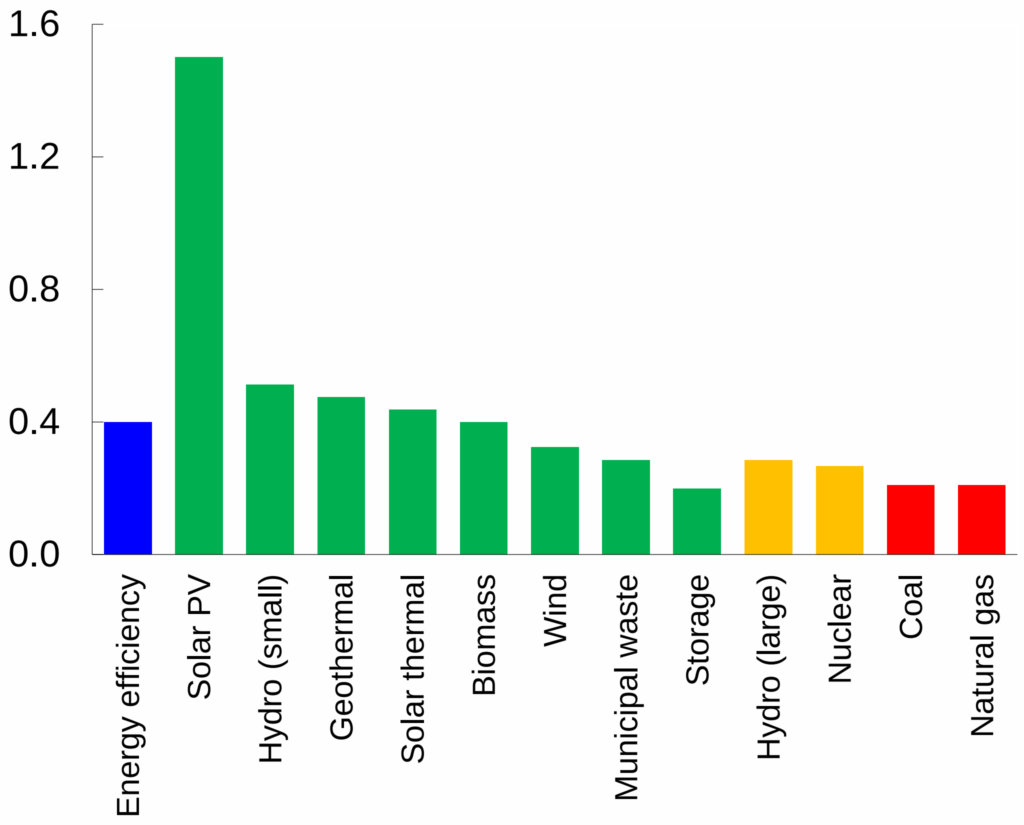
Policy package: employment effects

Global Employment, by Sector
(Contribution to deviation of total employment from baseline, percent)



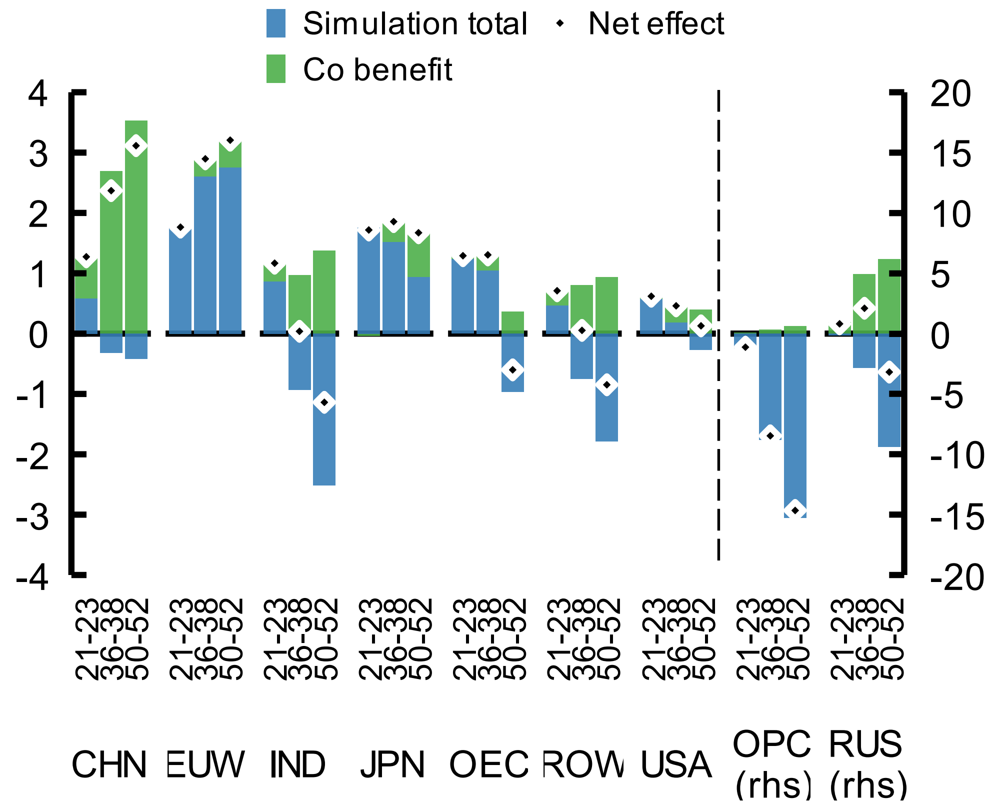
Source: IMF staff calculations.

Job Multipliers
(Job-years per gigawatt hour; levelized over lifetime of utility)

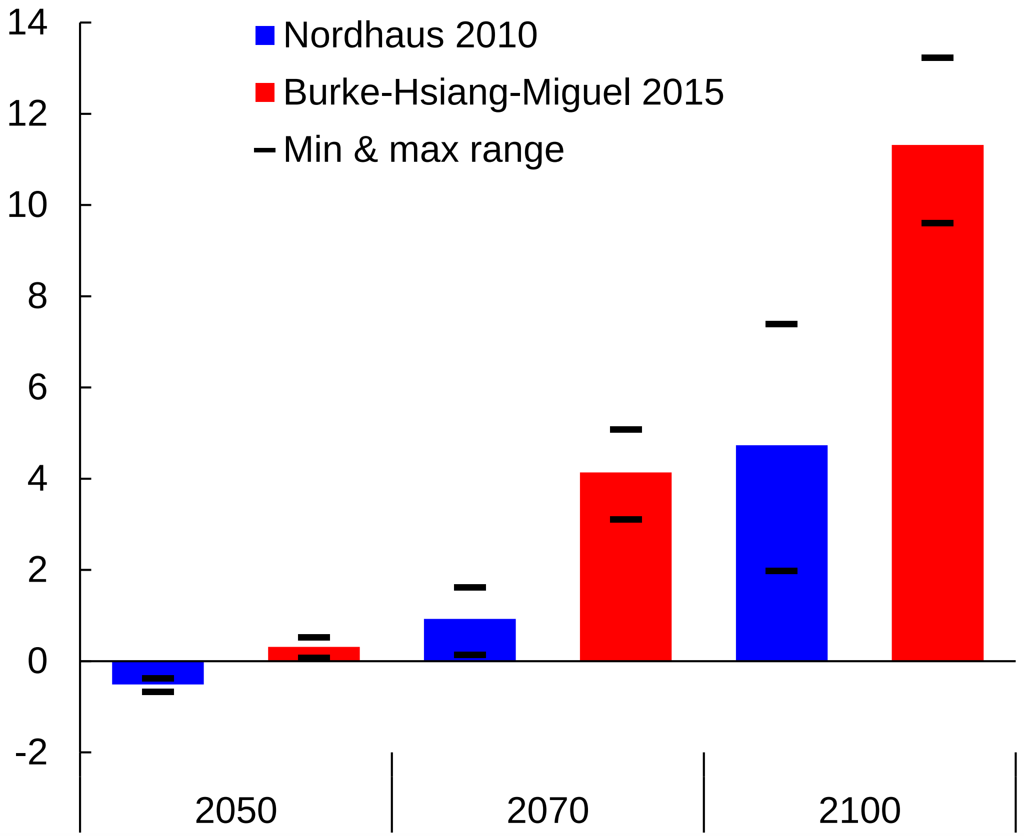


Policy package: medium- to long-term output gains and fiscal balance

Real GDP and Co-benefits, Three-Year Average *(Percent deviation from baseline)*



Medium- to Long-Term Output Gains
(Percent of baseline GDP)



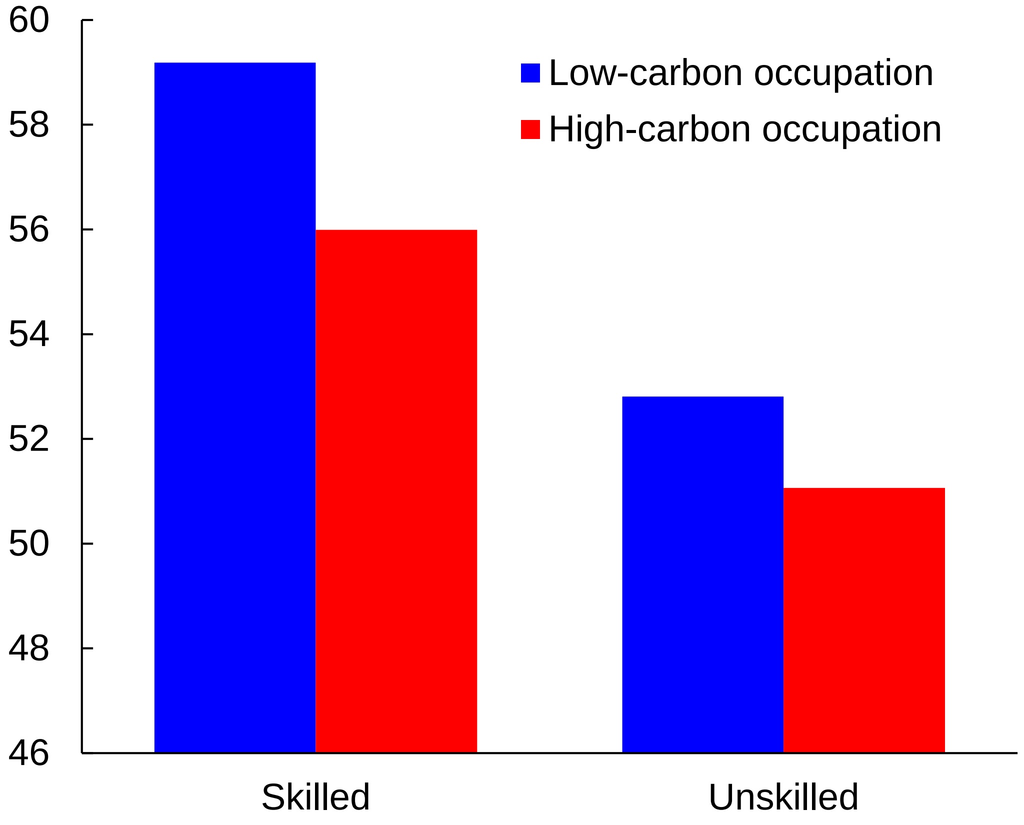
Source: IMF staff calculations.

How to build inclusion?

Low-income households are more impacted

- spend a relatively larger share of their income on energy-intensive goods
- tend to be employed in low-skill occupations in carbon-intensive sectors

Public Opinion in Support of Environmental Protection *(Percent)*

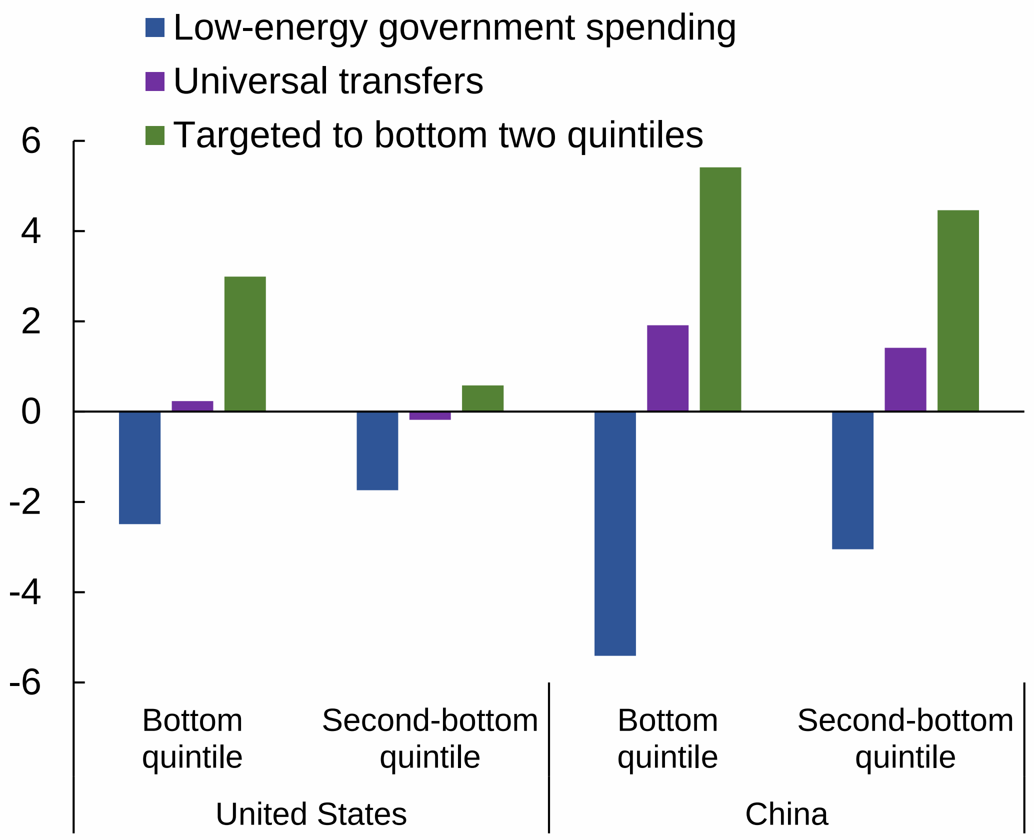


Source: European Values Study (2017); World Values Survey, wave 7 (2017–20); and IMF staff calculations.

Distributional impact of a carbon tax

Impact of a 50 USD Carbon Tax under different recycling options for revenues

Consumption of Bottom Two Quintiles
(Percent deviation from baseline)



Source: IMF staff calculations.

Policies to protect low-income households:

- Redistributing about 1/6 to 1/4 of the carbon revenues in targeted transfers to protect consumption of bottom quintile [40 to 55 percent to protect bottom two quintiles]
- Increasing government spending on low-carbon sectors to support job transitions

Conclusions

- Net zero emissions by 2050
  - Feasible objective that would boost incomes in the long run and avoid catastrophic risk.
  - But the window is rapidly closing.

- An initial green investment push combined with steadily rising carbon prices would deliver the needed emission reductions at reasonable transitional output effects.
  - A green fiscal stimulus would support output and employment in the recovery from the Covid-19 crisis, and help lower the costs of adjusting to higher carbon prices.
  - Carbon pricing is critical to mitigation because higher carbon prices discriminate better and incentivize energy efficiency in addition to reallocating resources from high- to low-carbon activities.

- A fair transition requires compensating lower-income households for higher carbon prices and supporting job transitions to low-carbon sectors.