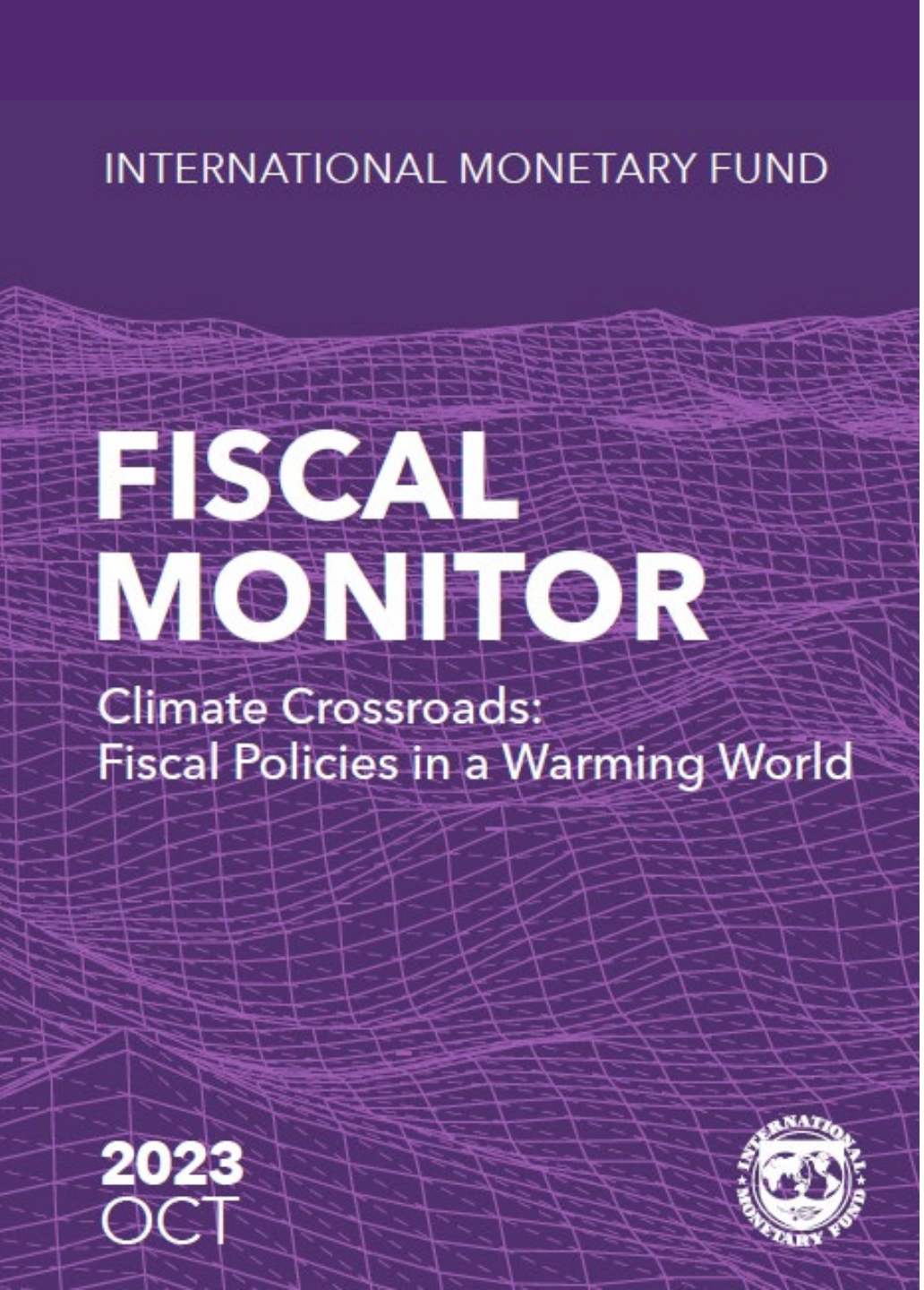


FISCAL AFFAIRS

Climate Crossroads:
Fiscal Policies in a Warming World

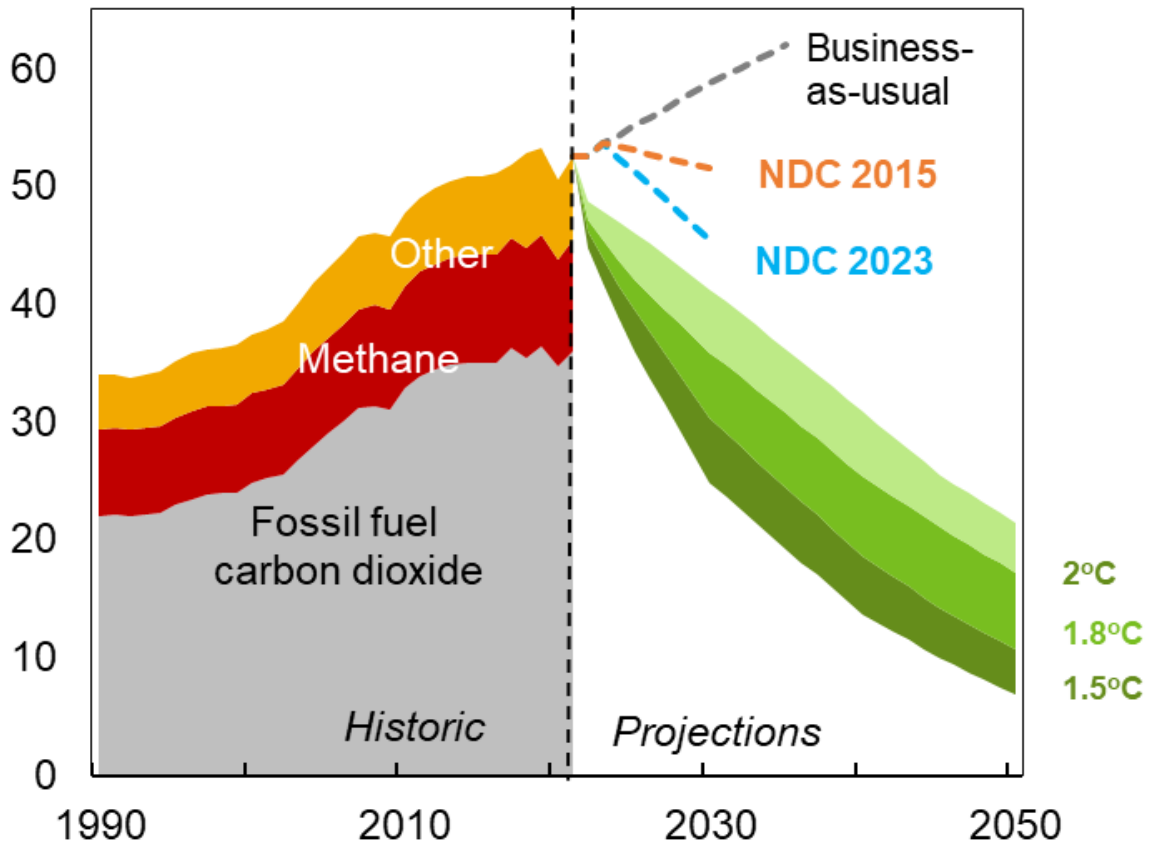
October 2023 Fiscal Monitor Analytical Chapter

Fiscal Affairs Department
International Monetary Fund

Countries pursue different climate policies but still leaving significant gaps to reach climate goals

Annual Global Greenhouse Gas Emissions, 1990–2050

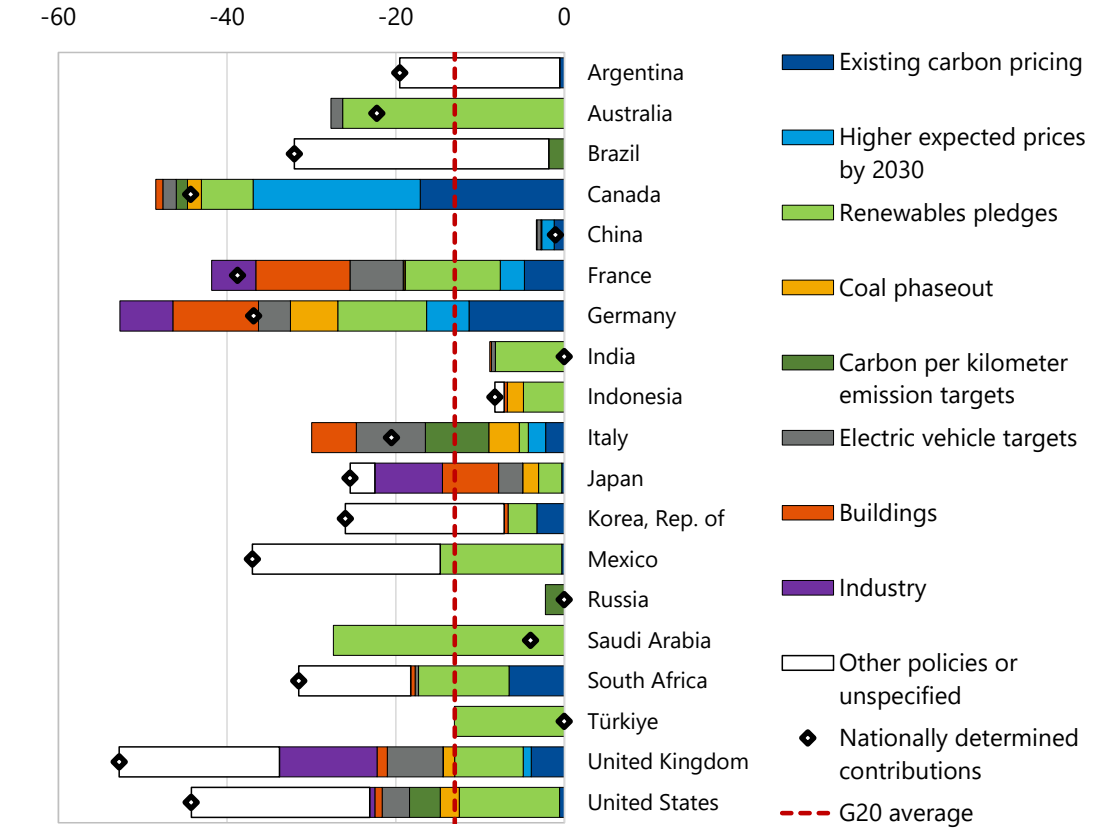
(Billions of tons of carbon dioxide emissions equivalence)



Sources: Intergovernmental Panel on Climate Change; Black, Parry, and Zhunussova 2023; and IMF staff estimates.

Impact of Current Policies on Emission Reduction

(Percent Reduction Below No-Pricing Counterfactual)



Source: IMF staff estimates using IMF-World Bank CPAT.
Note: Other policies or unspecified includes policies not quantified in this exercise or not yet specified by the authorities.

Key Questions of the Fiscal Monitor

1. **Can countries rely mostly on spending-based climate policies to achieve net-zero emissions?**

2. **How can policymakers design politically feasible climate policies in a cost-effective and fiscally sustainable way?**

3. **How can governments facilitate the green transition among firms?**

Preview of Key Messages of the Fiscal Monitor

1. **Can countries rely mostly on spending-based climate policies to achieve net-zero emissions?**

   No. Scaling up spending-based policies would magnify inefficiency and put debt sustainability at risk.

2. **How can policymakers design politically feasible climate policies in a cost-effective and fiscally sustainable way?**

   The only way is to have an appropriate mix of policies, in which carbon pricing plays an integral part of the policies, supported by complementary policies.

3. **How can governments facilitate the green transition among firms?**

   Policies such as regulations and fiscal incentives can impact firm investment in low-carbon technology.

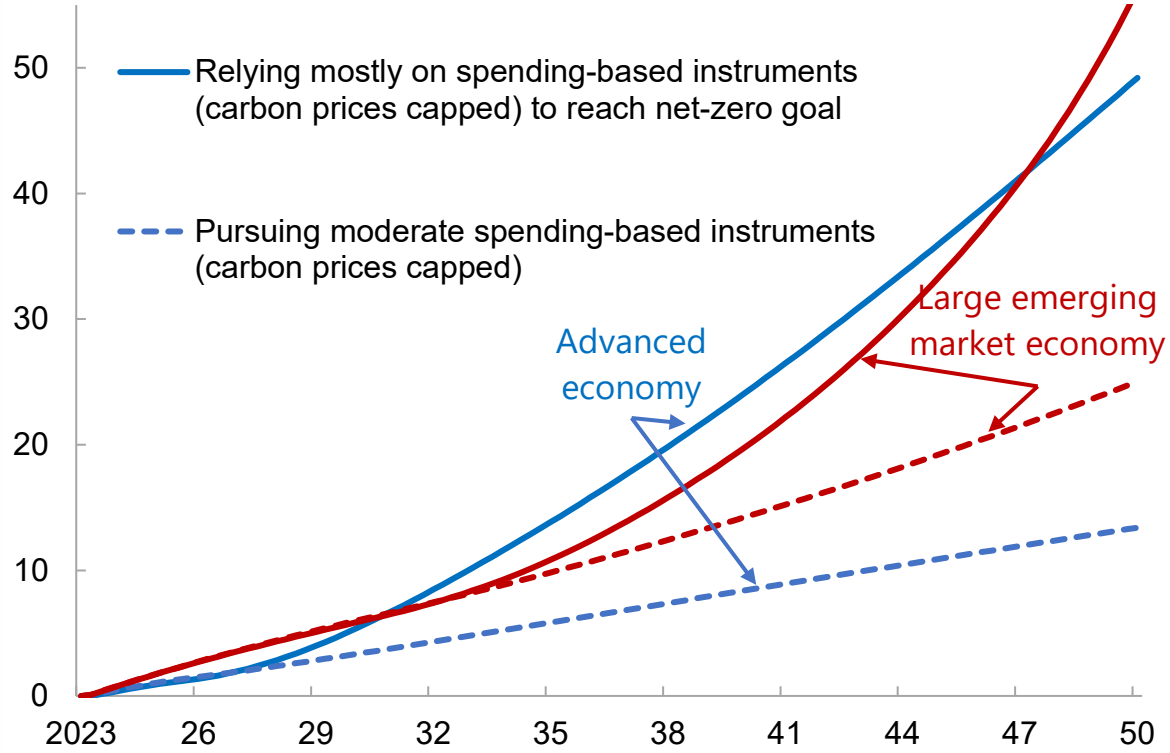
   Green subsidies could work to promote the adoption of low-carbon technology if done well but also carries large risk.

1. Can Countries Scale Up Spending Measures to Reach Climate Goals?

Scaling up current spending-based policies put debt sustainability at risk

Illustrative Debt Dynamics when Expanding Expenditure-Based Climate Policies

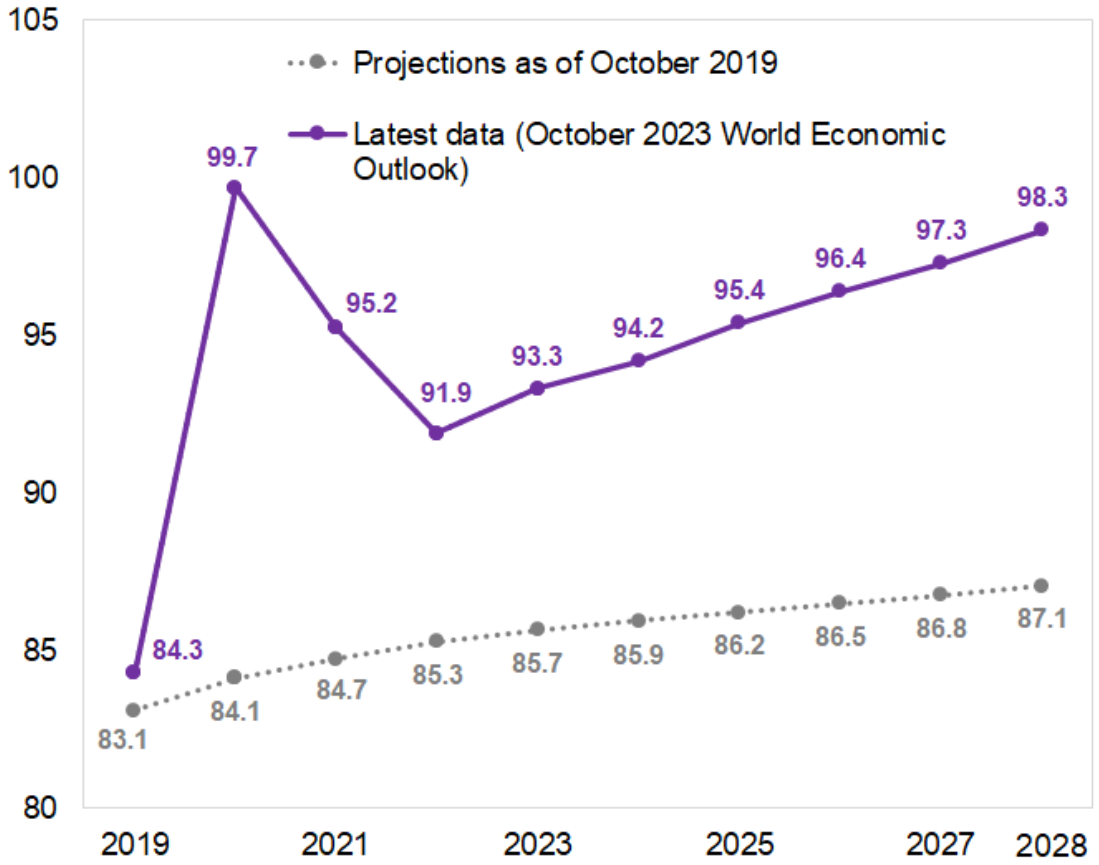
(Percent of GDP, cumulative change relative to 'business-as-usual' baseline)



Source: IMF staff simulations.
Simulations from a dynamic general equilibrium model. The lines for the advanced economy (large emerging market economy) cap the carbon price at $75 ($45) a ton. The solid lines scale up green public investment and subsidies (at 2 percent of GDP a year on average) to meet the net zero emissions target by 2050 (2060 for the emerging market economy), while the dashed lines have the same profile on carbon prices and a moderate rise in investment and subsidies, in line with International Energy Agency estimates.

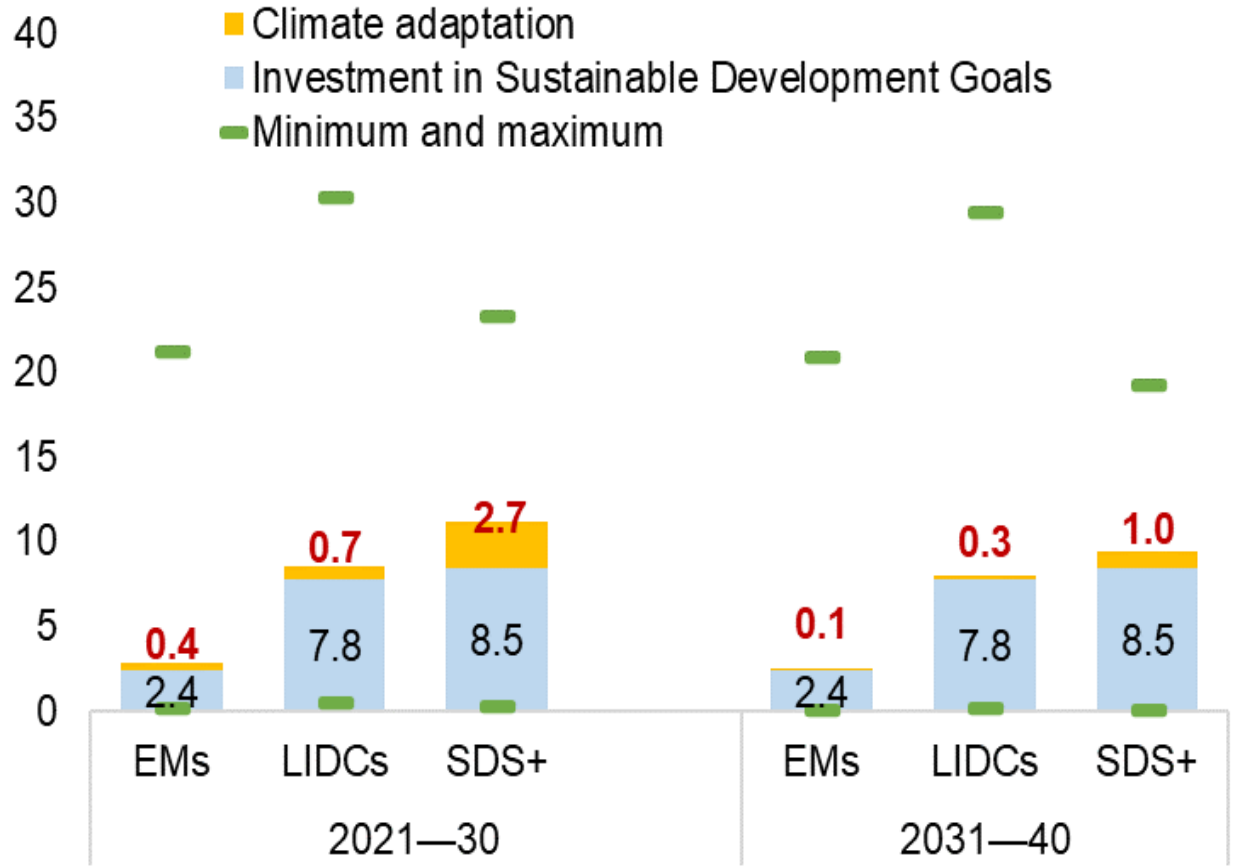
Government debt is rising faster than previously projected, while sizable investment needs among developing countries

Global Government Debt, 2019-28 (Percent of GDP)



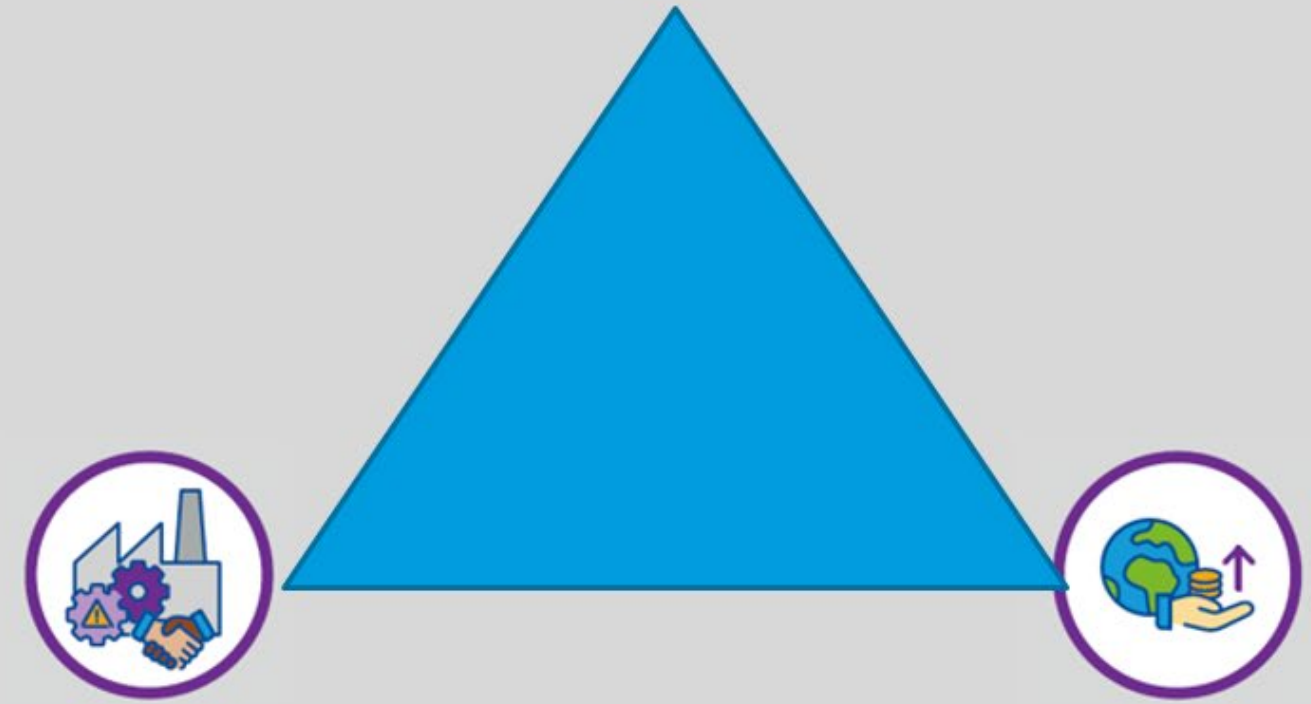
Sources: IMF World Economic Outlook database.

Annual Investment Needs for Climate Adaptation and Sustainable Development Goals, 2021–40 (Percent of GDP)



Sources: Aligishiev, Bellon, and Massetti 2022; and IMF staff estimates based on IMF's SDG Financing Tool.

Countries are facing a policy trilemma



Political feasibility

- Respecting political constraints on taxation and spending

Climate goals

- Delivering the Paris agreement on temperature ceilings

Debt sustainability

- Containing sovereign debt risks and building buffers

Source: IMF staff compilations.

2. How to Strike a Balance on the Policy Trilemma?

Policies need to balance efficiency in climate mitigation, fiscal sustainability, and political feasibility

Mitigation Instruments		Desirability and Feasibility				Environmental Effectiveness by Sector						
Coverage	Instrument	Economic Efficiency	Revenue Mobilization	Administrative Practicality	Political Acceptability	Power	Industry	Transport	Buildings	Forestry/ Land use	Extractives (CH_4)	Livestock (CH_4, NO_x)
Economywide policies	Carbon taxes					✓✓✓	✓✓✓	✓✓	✓✓	✓	✓✓✓	✓✓✓
	Emission trading systems					✓✓✓	✓✓✓	✓✓	✓✓	✓	✓✓	✓✓
Sectoral policies	Feebates (fees/rebates for dirty/clean firms/ products/activities)					✓✓	✓✓	✓✓✓	✓✓	✓✓	✓✓	✓✓
	Tradable performance standards					✓✓	✓✓	✓✓			✓	✓
	Green subsidies					✓✓	✓✓	✓✓	✓	✓	✓	✓
	Requirements for green technologies/ activities					✓	✓	✓✓	✓✓	✓	✓	✓

Complementary policies	Issue	Network externalities for clean technologies	Innovation market failures	Burdens on households	Burdens on firms
	Instruments	Public investments	R&D incentives, timebound technology subsidies	Targeted assistance, equitable revenue use	Output-based rebates, tax relief, border adjustments

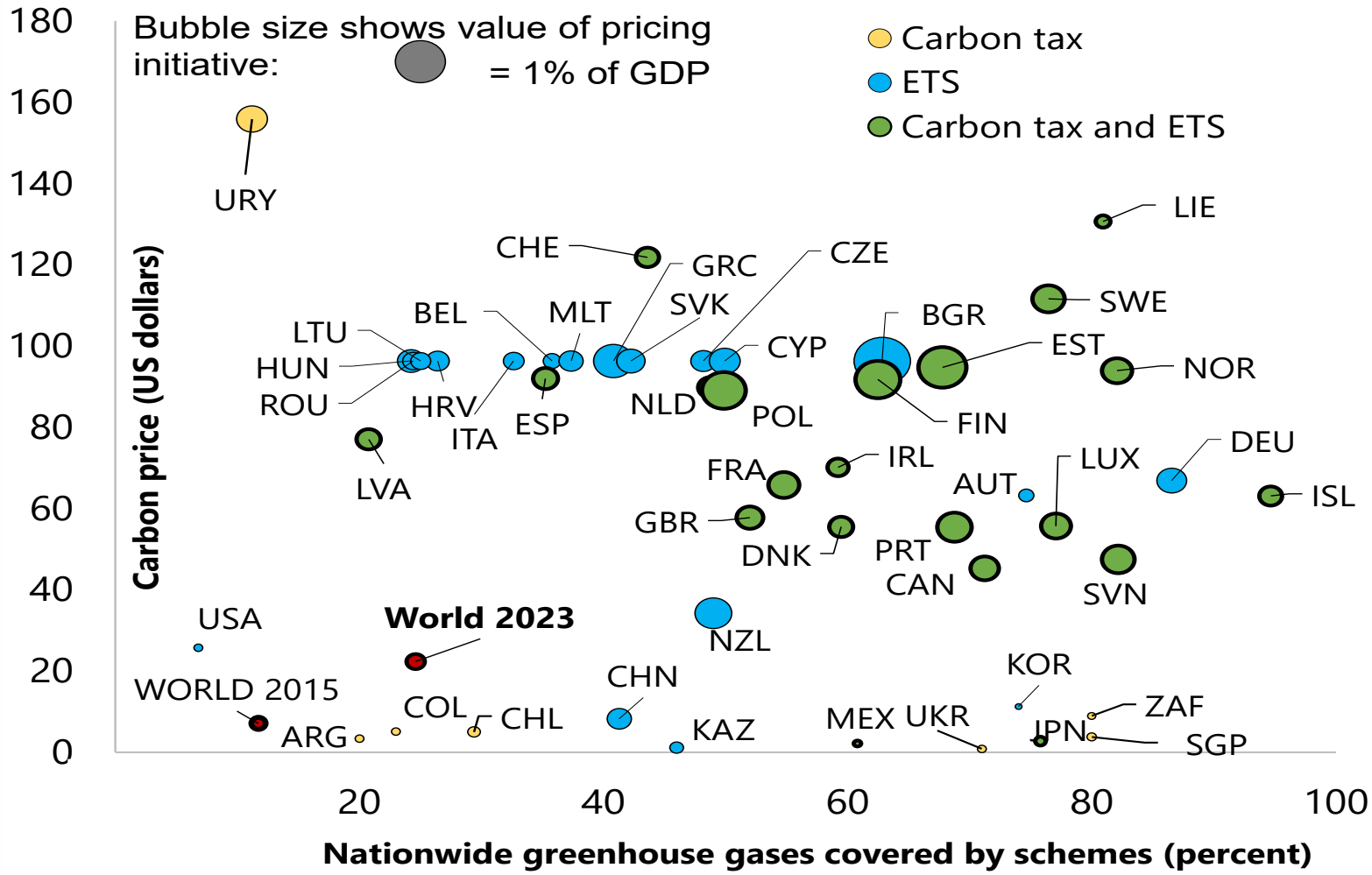
Declining efficiency/revenues/practicality/acceptability

✓ = Somewhat environmentally effective
✓✓ = Effective
✓✓✓ = Very effective

Carbon pricing has become more common but still at low levels and varying coverage

Explicit Carbon Pricing Schemes, 2022

(National, subnational, and regional)

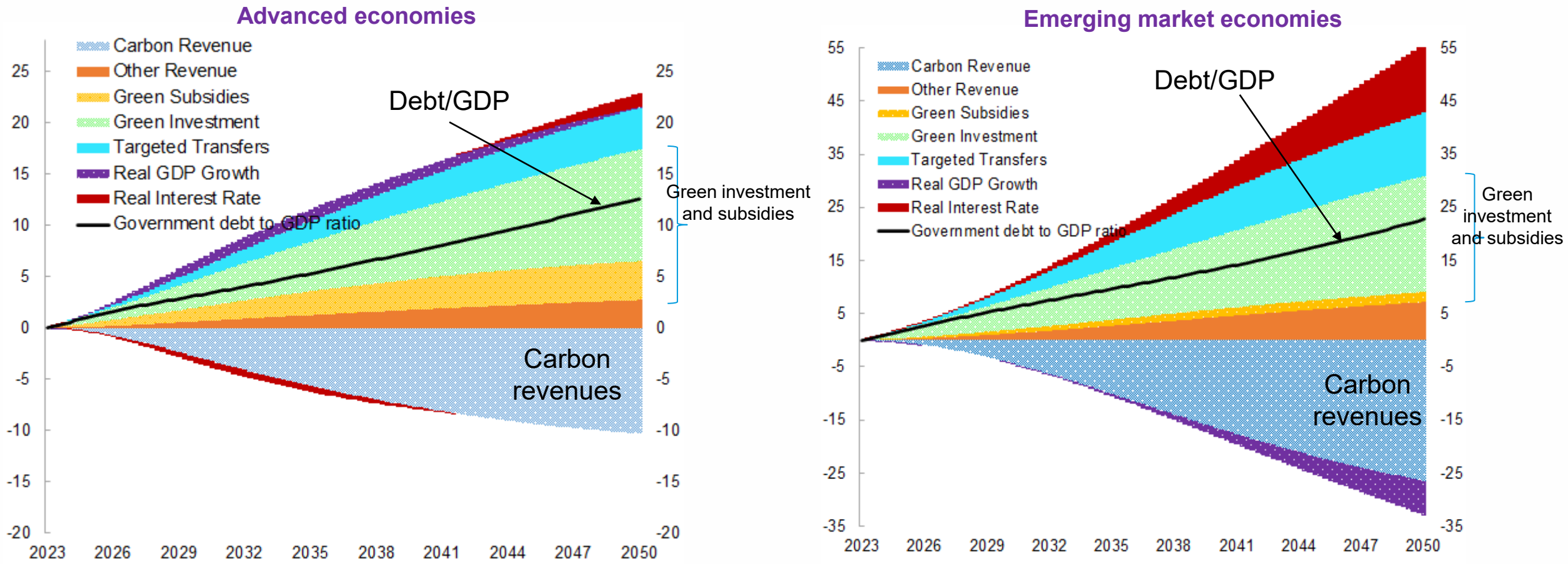


Source: National sources; World Bank, Carbon Pricing Dashboard; IMF staff calculations.

Combination of balanced and well-sequenced instruments limits the rise in debt ...

Illustrative Public Debt Dynamics and Composition

(cumulative deviation from 'business-as-usual scenario'; percent of GDP)



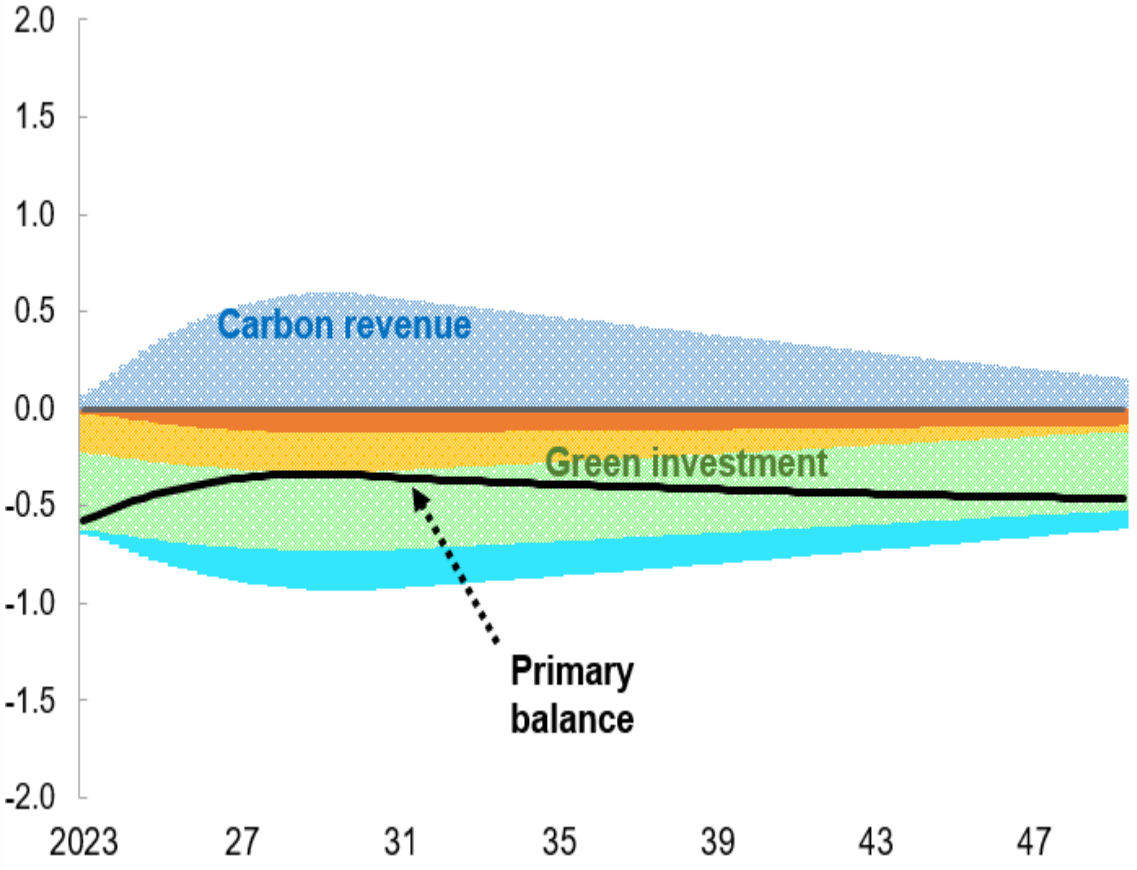
Source: IMF staff simulations.

… and depends on countries' fiscal space, investment needs, and dependence on fossil fuels

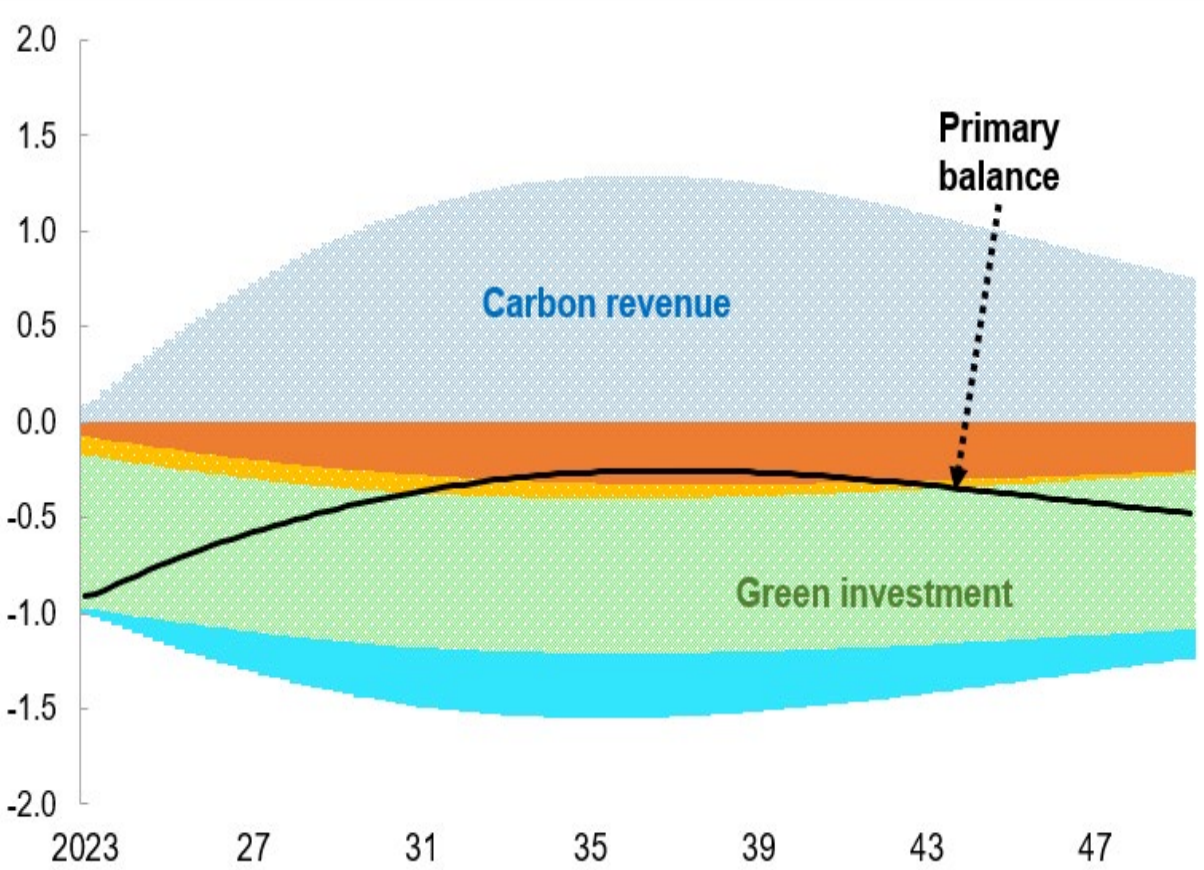
Illustrative Fiscal Balance and Composition

(cumulative deviation from 'business-as-usual scenario'; percent of GDP)

Advanced economies



Emerging market economies

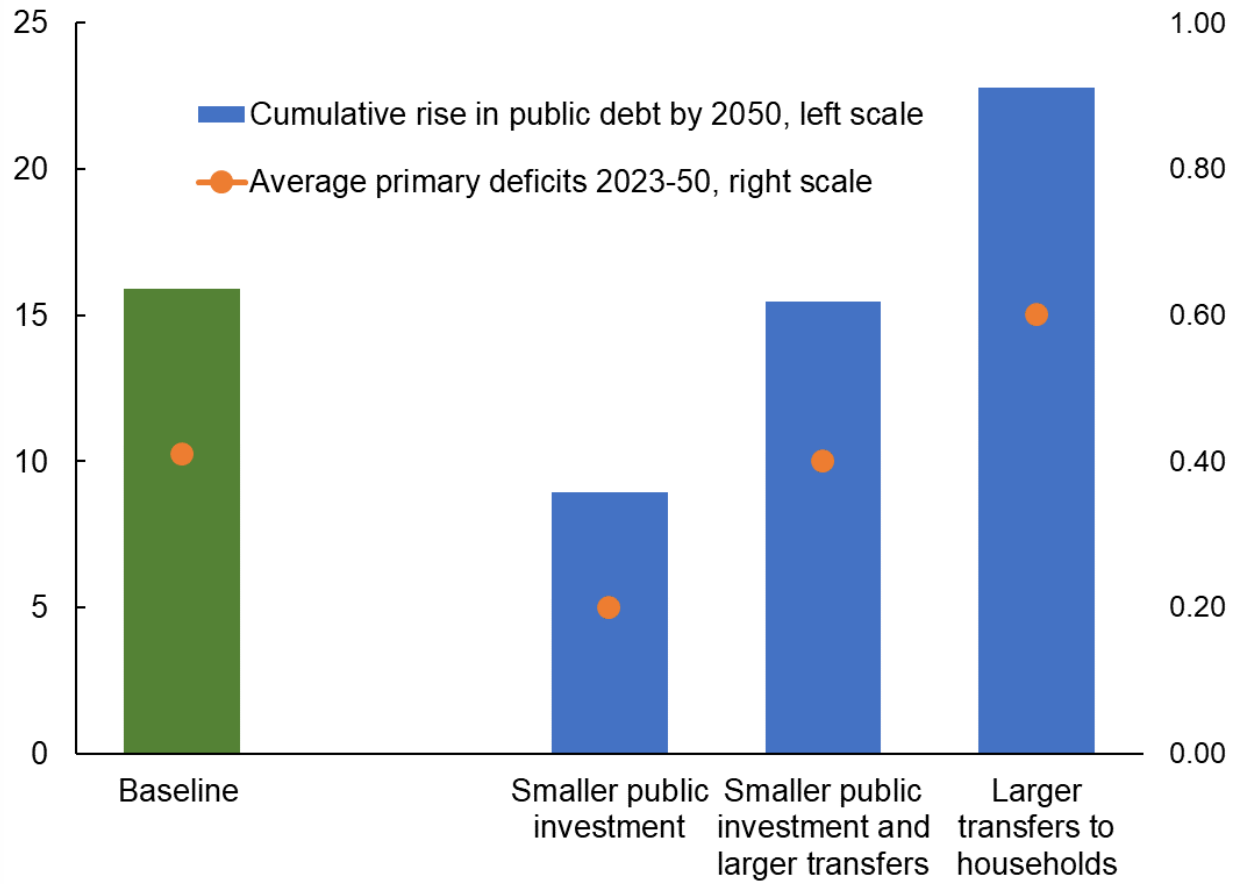


Source: IMF staff simulations.

Uncertainty surrounding the estimates of fiscal cost is large

Sensitivity of Public Debt to Public Investment and Transfers for Emerging Market Economies

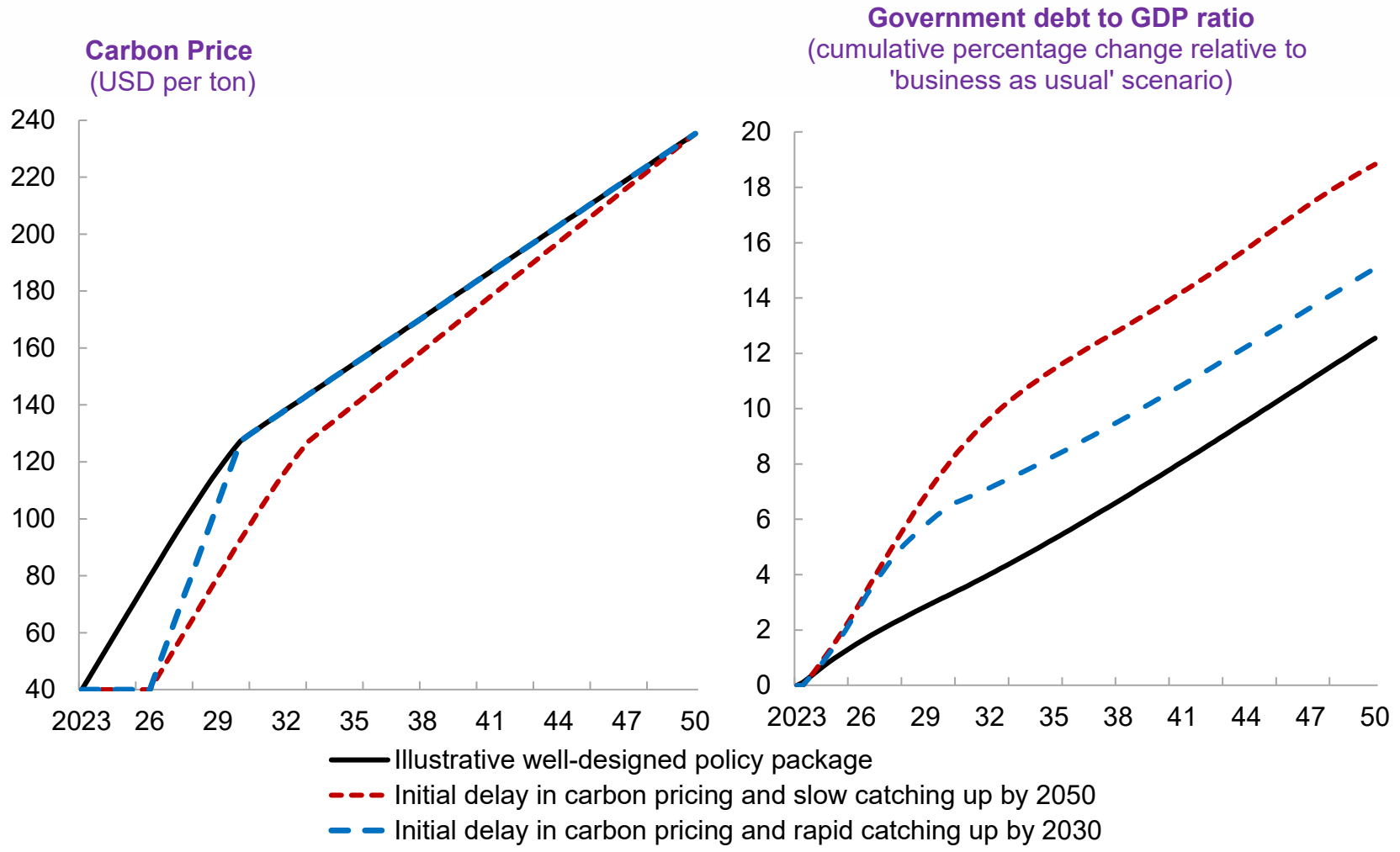
(Percent of GDP relative to the business-as-usual scenario)



Source: IMF staff compilation.

Policy packages are set to reach net zero emissions by 2060. Parameters and fiscal instruments are calibrated to a representative emerging market, assumed to be the weighted average of large emerging market economies (Argentina, Brazil, China, India, Indonesia, Mexico, South Africa, and Türkiye). The baseline is the well-sequenced policy package discussed in the chapter, which consists of transfers at 30 percent of carbon revenues and public investment at about ¾ percent of GDP. Alternative scenarios explore sensitivity on the size of transfers (higher at 50 percent of carbon revenues) and public investment (lower at ½ percent of GDP per year).

Delaying carbon pricing is costly

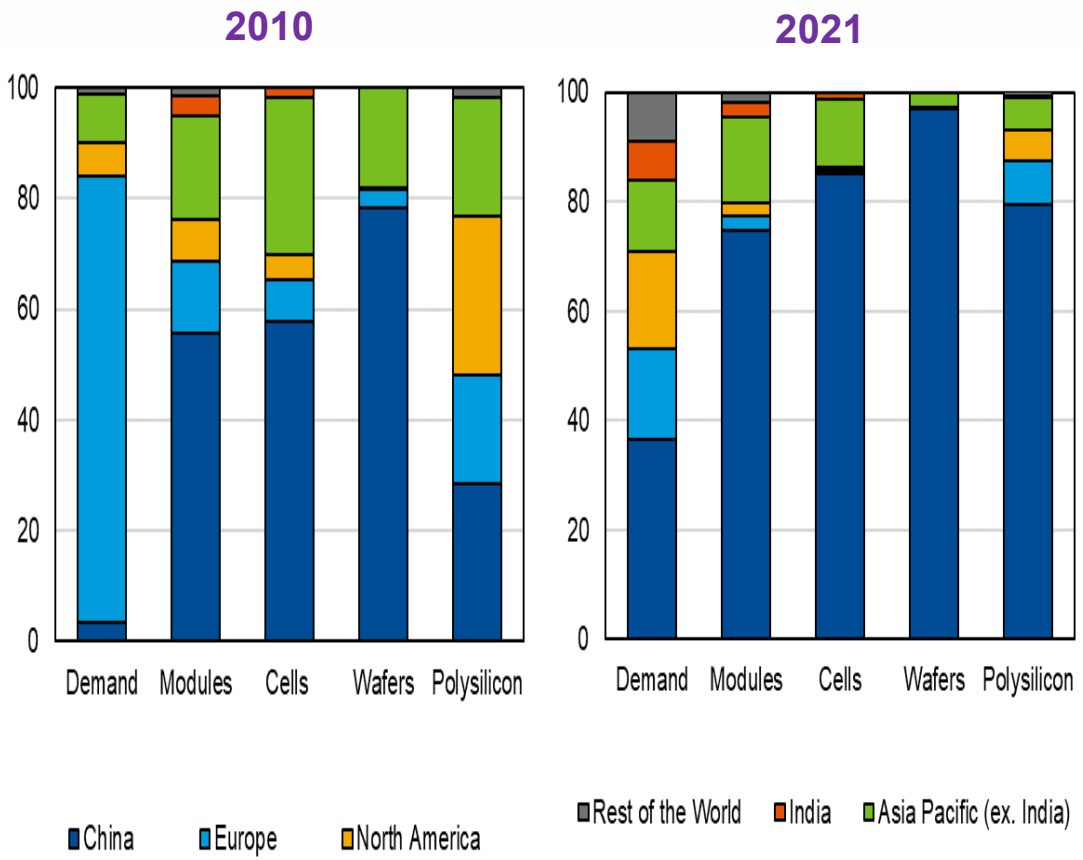


Source: IMF staff simulations.

Low-carbon technologies present opportunities and challenges

Solar Photovoltaic Manufacturing Capacity

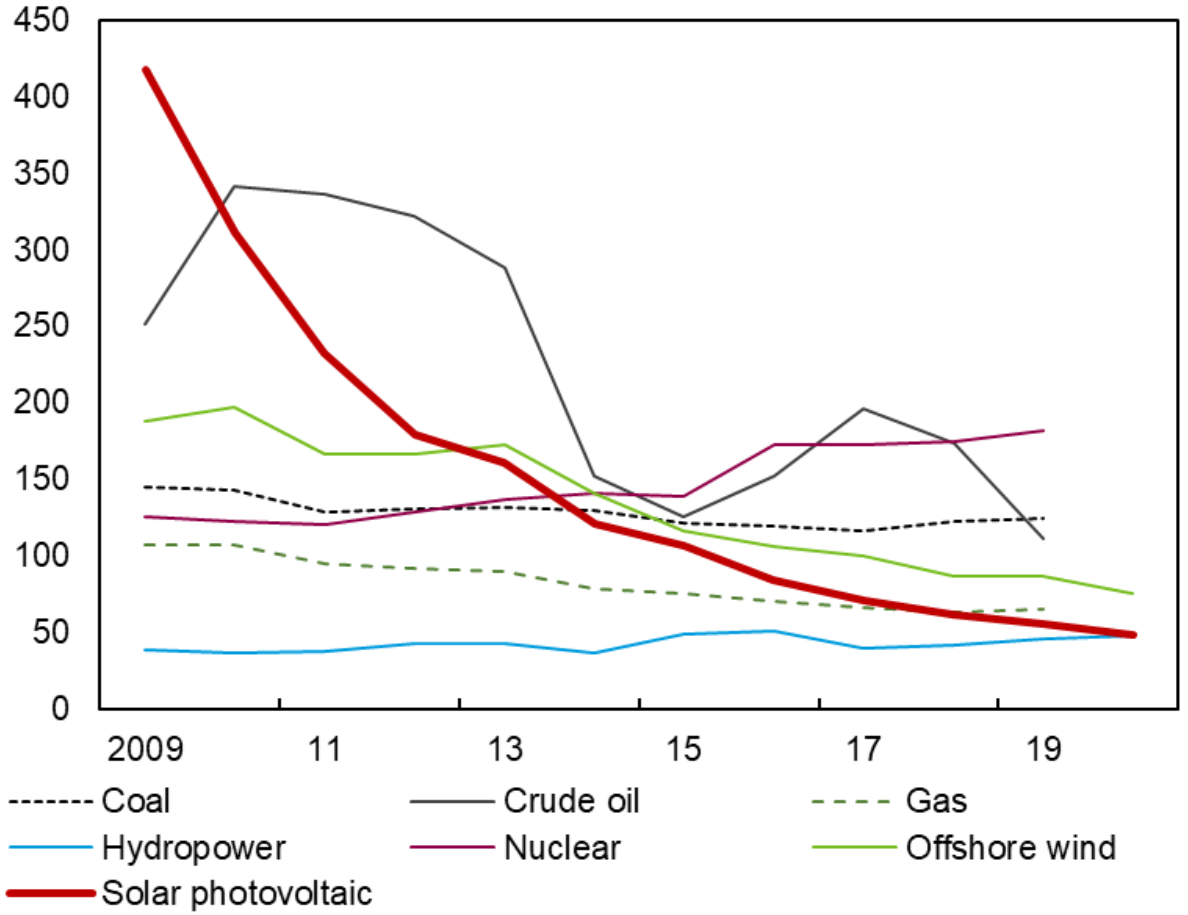
(Share in percent)



Source: International Energy Agency 2022.

Learning Curves for Power Generation, by Technologies

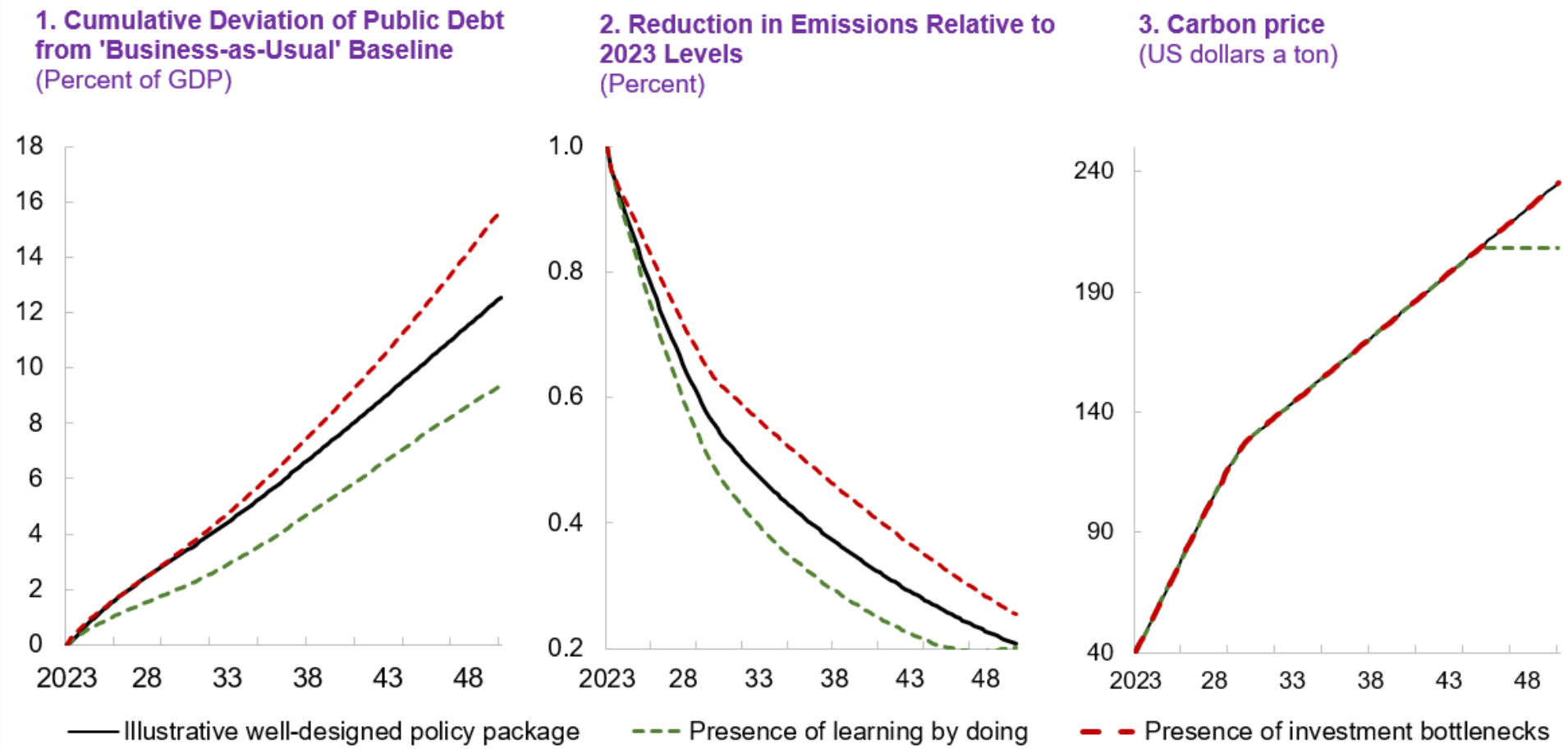
(US dollars per megawatt-hour)



Sources: IRENA 2022; Way and others 2022; and Ziegler and Trancik 2021a, 2021b.
Note: The figure shows the levelized cost of electricity: The average net present cost of electricity generation over the lifetime of the generator.

Green subsidies can accelerate LCT adoption if done well and limit need for high carbon prices

Impact of Technology Spillovers and Investment Bottlenecks on Debt Dynamics



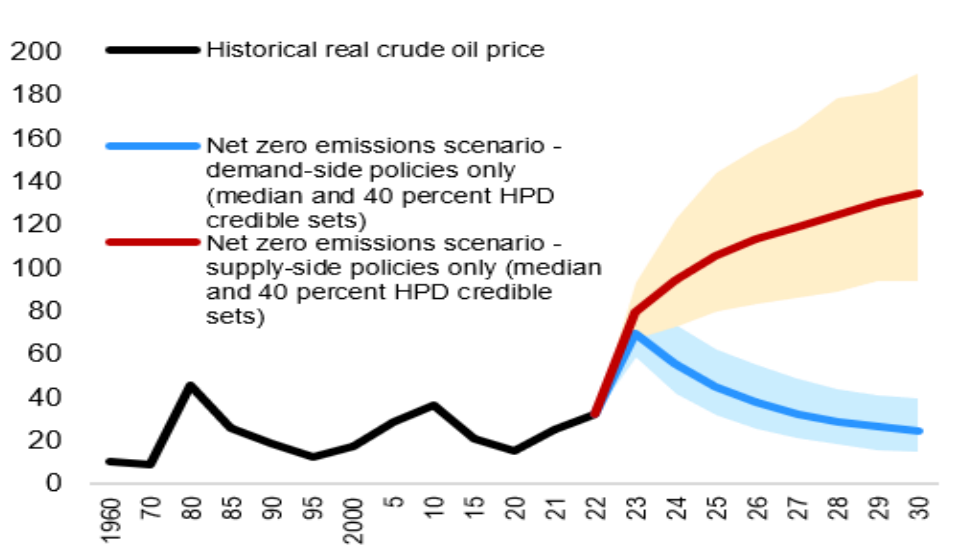
Source: IMF staff estimates.

Note: The figure assumes carbon prices are the same across scenarios before reaching net-zero-emission goals and is calibrated to a representative advanced economy (that reflects the average of the data for Group of Seven economies). When learning by doing is present, a 1 percent increase in energy capital is assumed to raise total factor productivity by 0.1 percent in the energy sector, in accordance with Chang, Gomes, and Schorfheide (2002) and Dietz and Stern (2015).

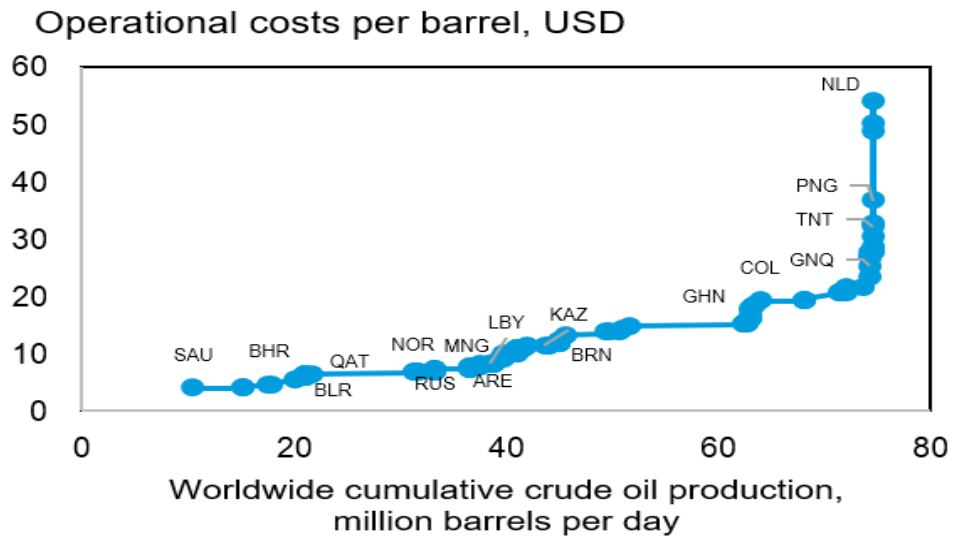
The impact on fossil fuel exporters will vary

While global fossil fuel demand is expected to decline over the long-run, demand and supply movements during the transition are difficult to predict. Key factors:

- The pace of policy commitments and implementation around the globe
- Technological change
- Investment in fossil fuel supply
- Type of fossil fuel
- Extraction costs

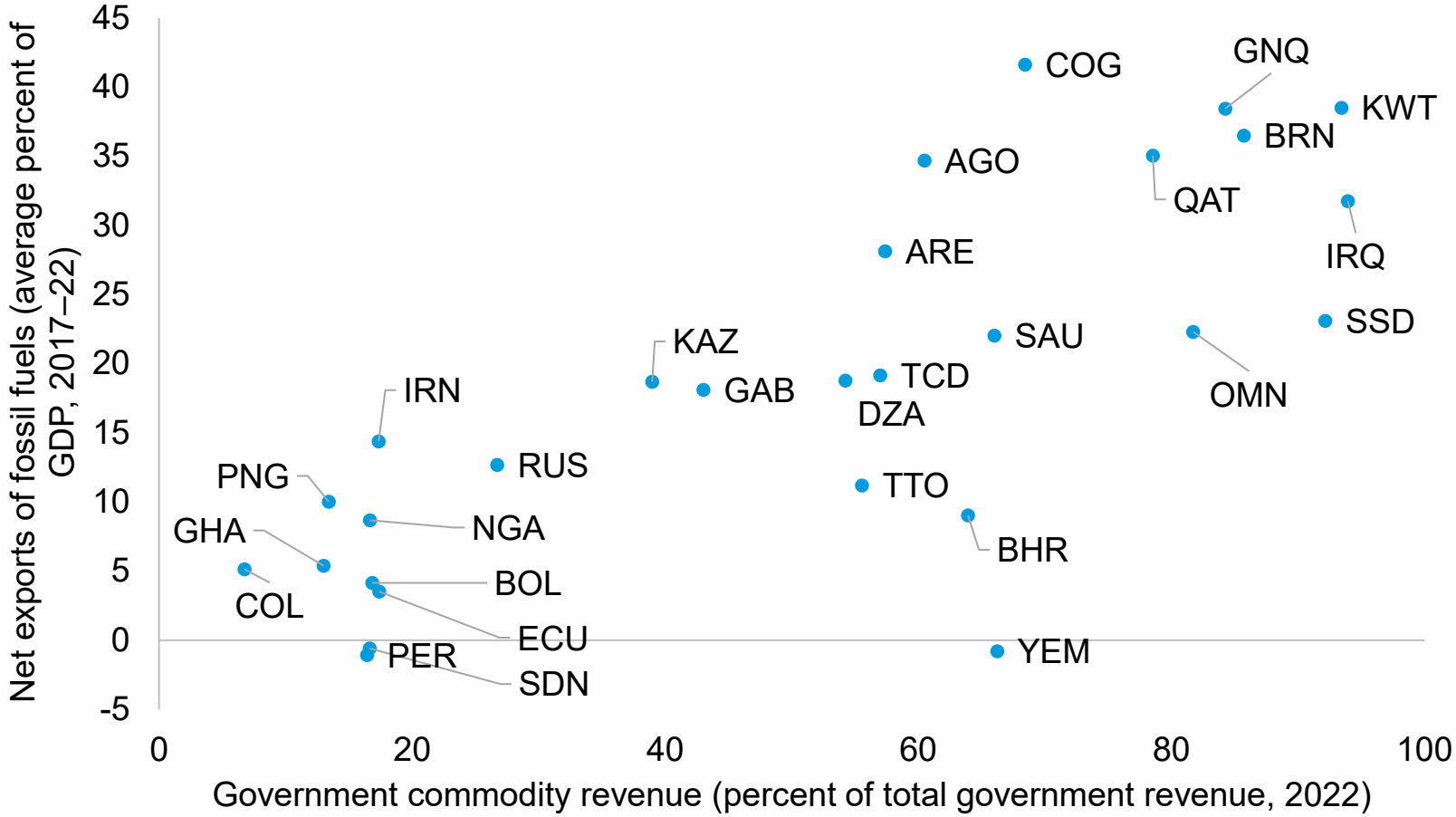


Source: Boer and others (2023a).



Source: IMF April 2022 WEO; Rystad Energy Ucube; IMF Staff calculations;

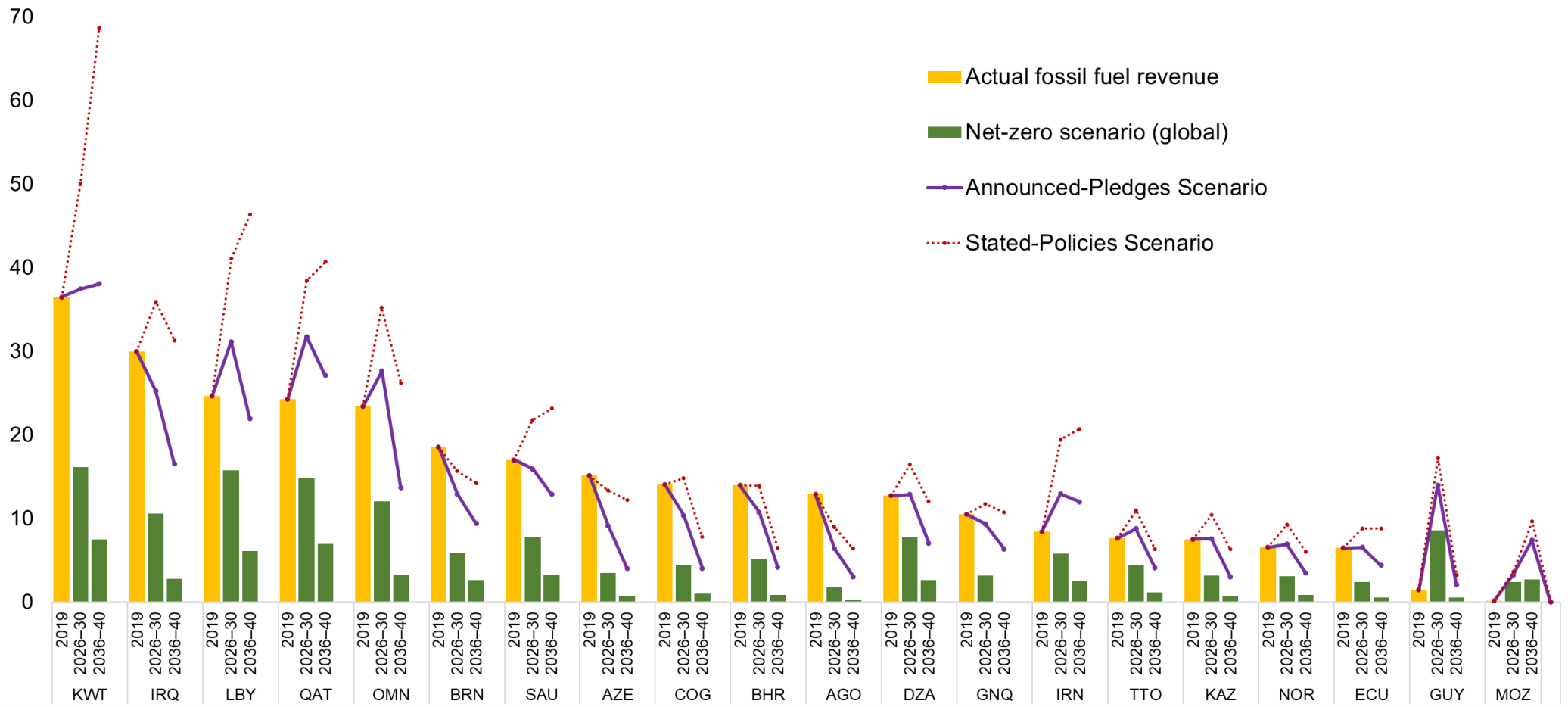
Some fossil fuel exporters are more exposed than others



Sources: IMF, World Economic Outlook database; UN Conference on Trade and Development; and IMF staff calculations.
Note: Commodity revenue includes all exploitable resources and fossil fuel revenue predominant among surveyed countries. Exports include other related primary products but exclude petrochemicals. Data labels in the figure use International Organization for Standardization (ISO) country codes.

Revenue impact will vary under different energy transition scenarios for fossil fuel exporters

(Percent of GDP)



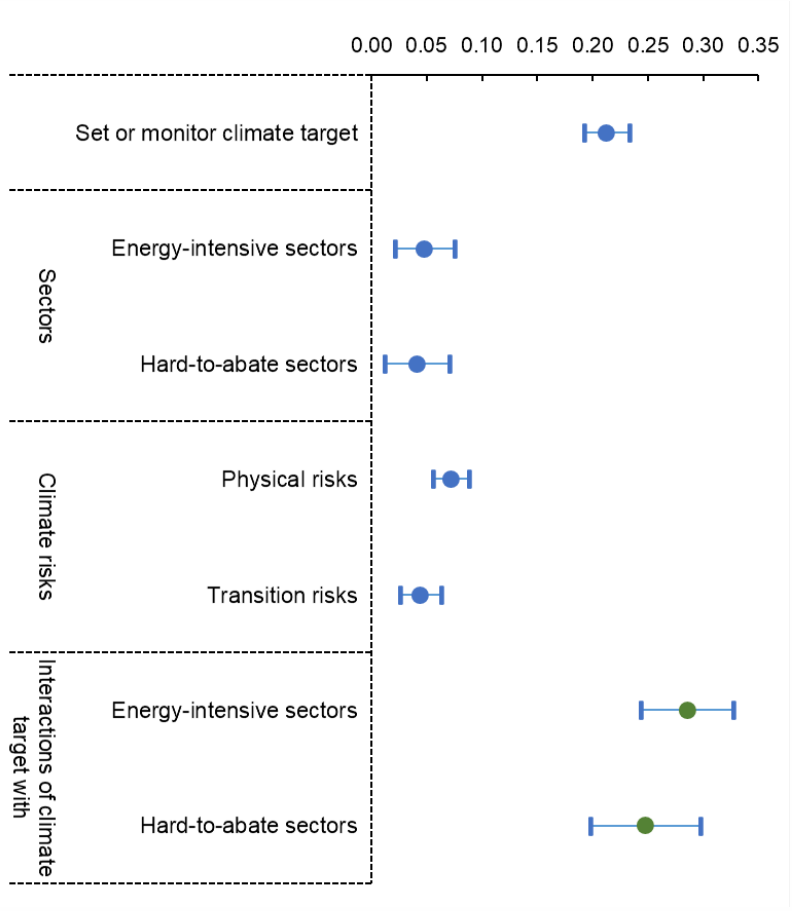
Source: IMF staff calculations.

Note: The figure shows selected fossil fuel-producing countries where fossil fuel revenues make the highest contribution to total revenue as well as large new producers such as Guyana and Mozambique. The outlook in regard to energy markets is based on International Energy Agency (2022b), which considers scenarios involving "stated policies," "announced pledges," and net zero emissions. The green bar for the net-zero-policy scenario shows the revenue decline for most countries relative to actual fossil fuel revenues in 2019. The purple and red lines show the revenues generated in the announced-pledges and the stated-policies scenarios. Data labels in the figure use International Organization for Standardization (ISO) country codes.

3. How can Governments Facilitate the Green Transition among Firms?

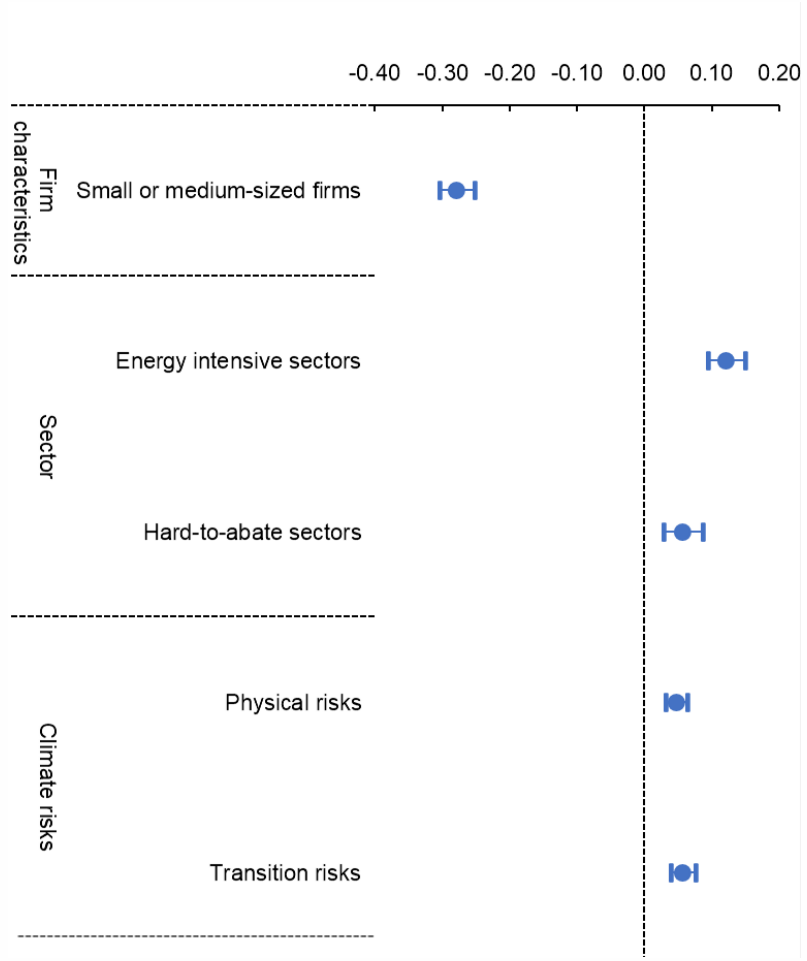
Policies impact firm investment in LCTs : Setting climate targets

Likelihood of Investing in Mitigation: Low-Carbon Technology
(Coefficient estimates)



Sources: European Investment Bank Group Survey on Investment and Investment Finance 2022;
IMF staff estimates.

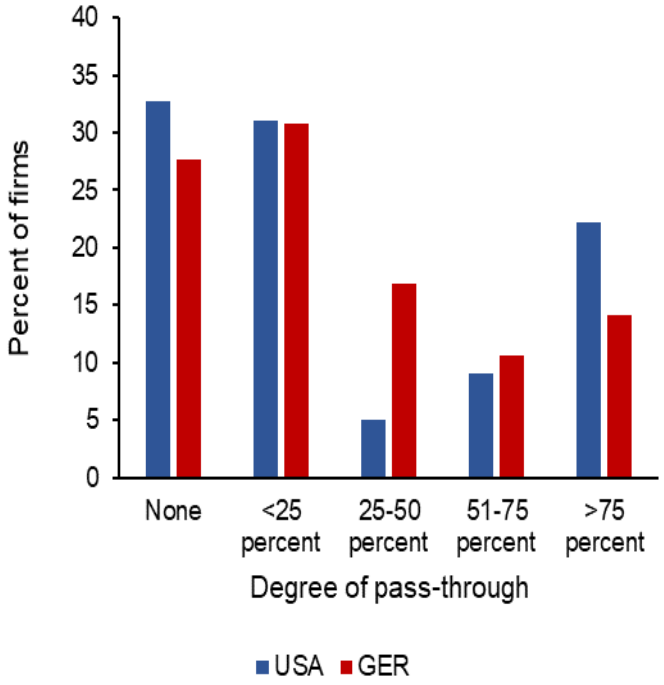
Correlates of Firms Setting Climate Targets
(Coefficient estimates)



Sources: European Investment Bank Group Survey on Investment and Investment Finance 2022;
IMF staff estimates.

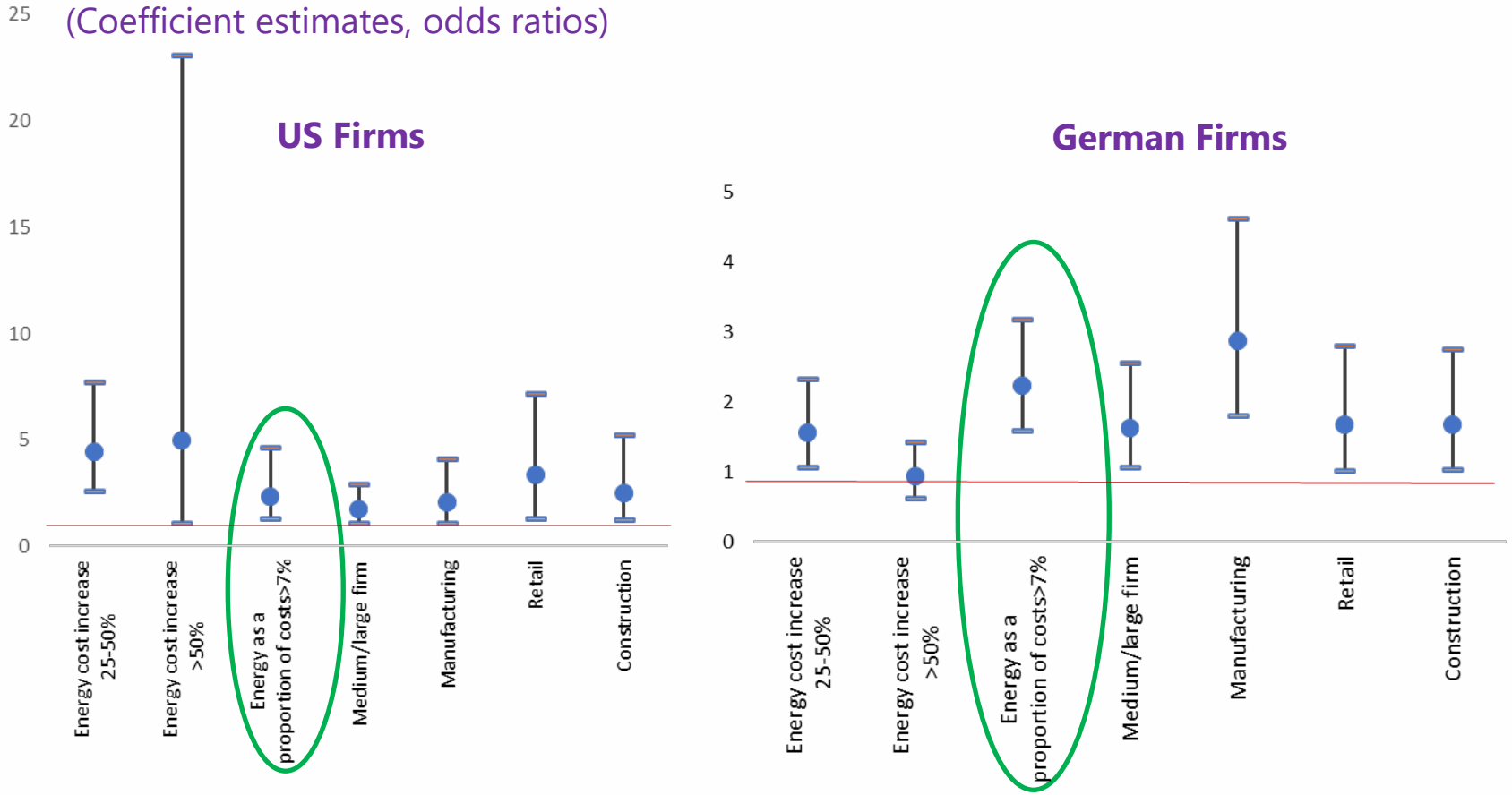
Firms have been resilient during the recent energy price shocks with most firms passing through a portion of their cost increase

Firms Passing Through Increases in Energy Costs
(Percent of firms surveyed)



Sources: The CFO Survey (Duke University, Richmond Fed, and Atlanta Fed) and the BIE (Atlanta Fed), Bundesbank and IMF staff estimates.
Note: The bars represent the proportion of firms who report passing on energy cost increases downstream

Correlates of Pass-Through of Increase in Energy Costs
(Coefficient estimates, odds ratios)



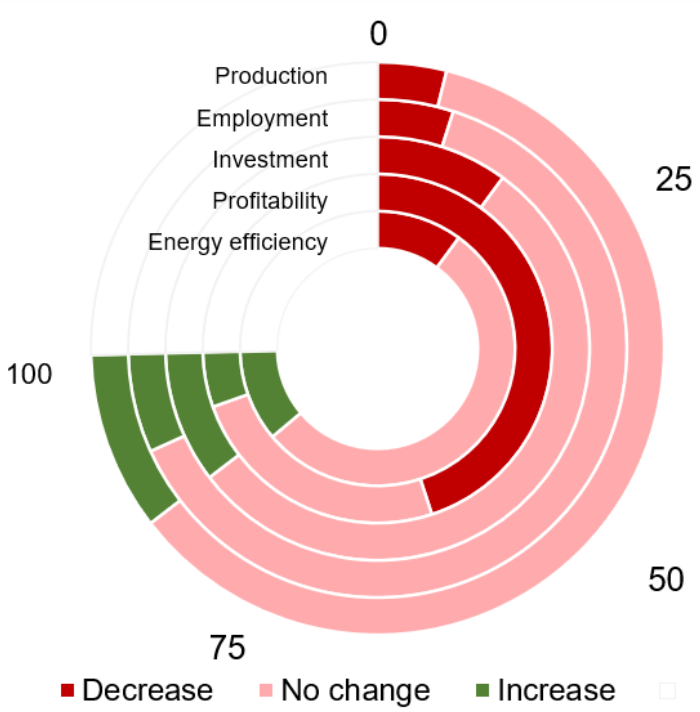
Sources: The CFO Survey (Duke University, Richmond Fed, and Atlanta Fed) and the BIE (Atlanta Fed), Bundesbank and IMF staff estimates.
Note: The dots represent the coefficient estimates (odds ratios) of a logistic regression and the bars represent the upper and lower bounds of the 95 percent confidence interval. The outcome variables is whether the firm passed through any energy cost increase

Other adjustment margins included investment in energy efficiency

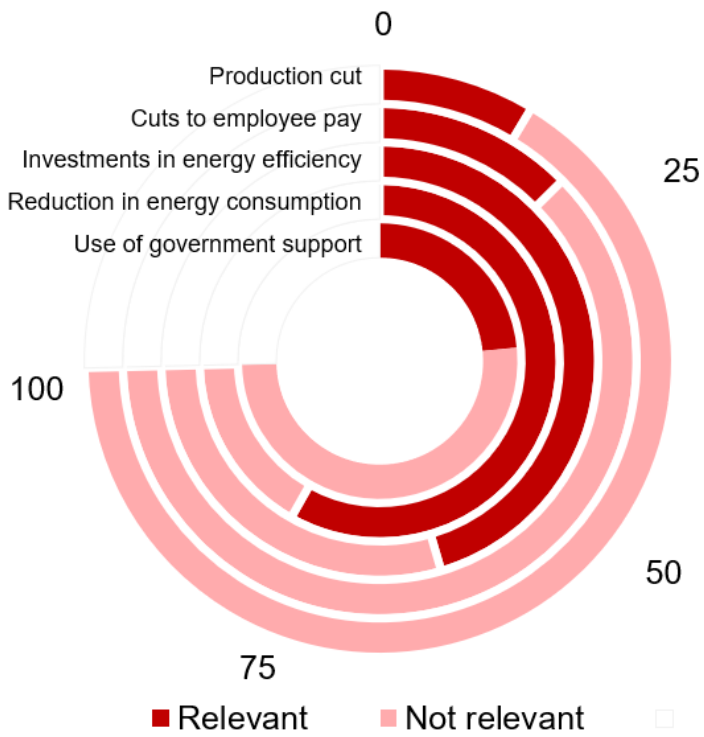
Impact of Energy Cost Increase on Firms' Performance and Adjustment Margins

(Percent of sampled firms)

US Firms' Adjustment Margins



German Firms' Adjustment Margins



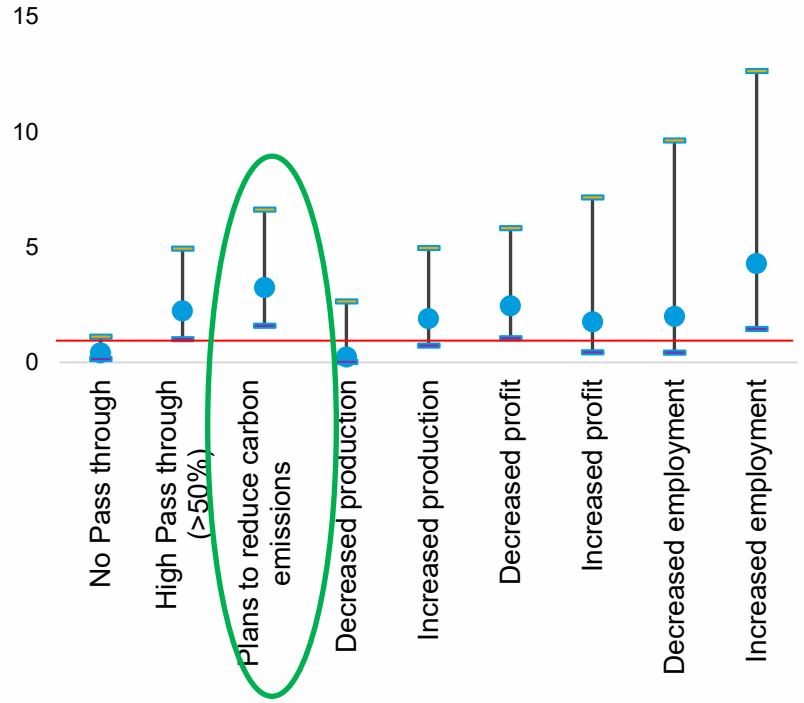
Sources: Business Inflation Expectations survey (Federal Reserve Bank of Atlanta); Deutsche Bundesbank Online Panel; CFO survey (Duke University, Federal Reserve Bank of Atlanta, Federal Reserve Bank of Richmond); and IMF staff estimates.

Note: The figure shows the proportion of firms experiencing a rise in energy costs that indicated a change in output, employment, investment, profitability, energy consumption, energy efficiency, or the use of government support measures.

Improvements in energy efficiency more likely for firms with plans to reduce emissions

Correlates of Firms Reporting Increase in Energy Efficiency - US

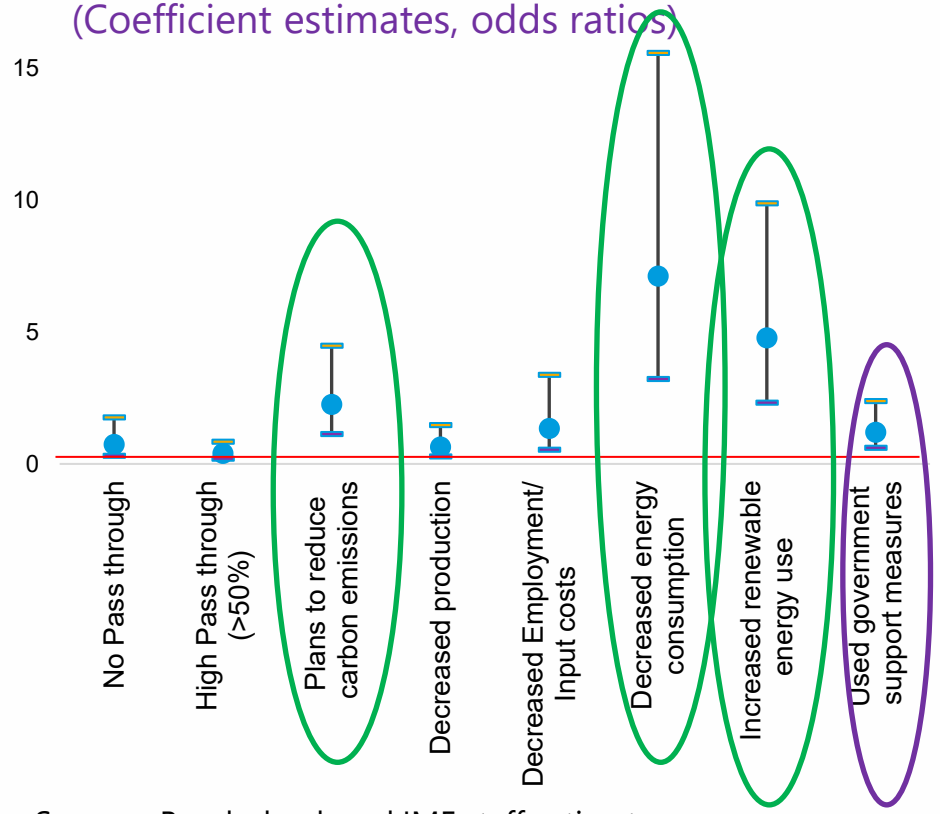
(Coefficient estimates, odds ratios)



Sources: The CFO Survey (Duke University, Richmond Fed, and Atlanta Fed) and the BIE (Atlanta Fedand IMF staff estimates.
Note: The dots represent the coefficient estimates (odds ratios) of a logistic regression and the bars represent the upper and lower bounds of the 95 percent confidence interval. The outcome variables is whether the firm passed reports increasing energy efficiency during the energy cost shock

Correlates of Firms Reporting Increase in Energy Efficiency - Germany

(Coefficient estimates, odds ratios)

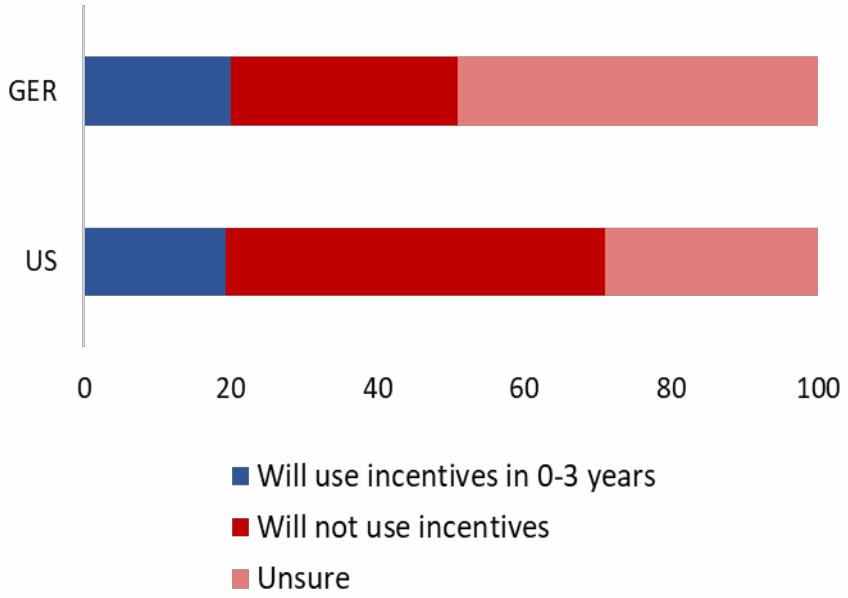


Sources: Bundesbank and IMF staff estimates.
Note: The dots represent the coefficient estimates (odds ratios) of a logistic regression and the bars represent the upper and lower bounds of the 95 percent confidence interval. The outcome variables is whether the firm passed reports increasing energy efficiency during the energy cost shock

Uncertainty regarding incentives provided by the Inflation Reduction Act and EU Green Deal will need to be resolved

Firms Planning on Utilizing Incentives of EU Green Deal/US Inflation Reduction Act

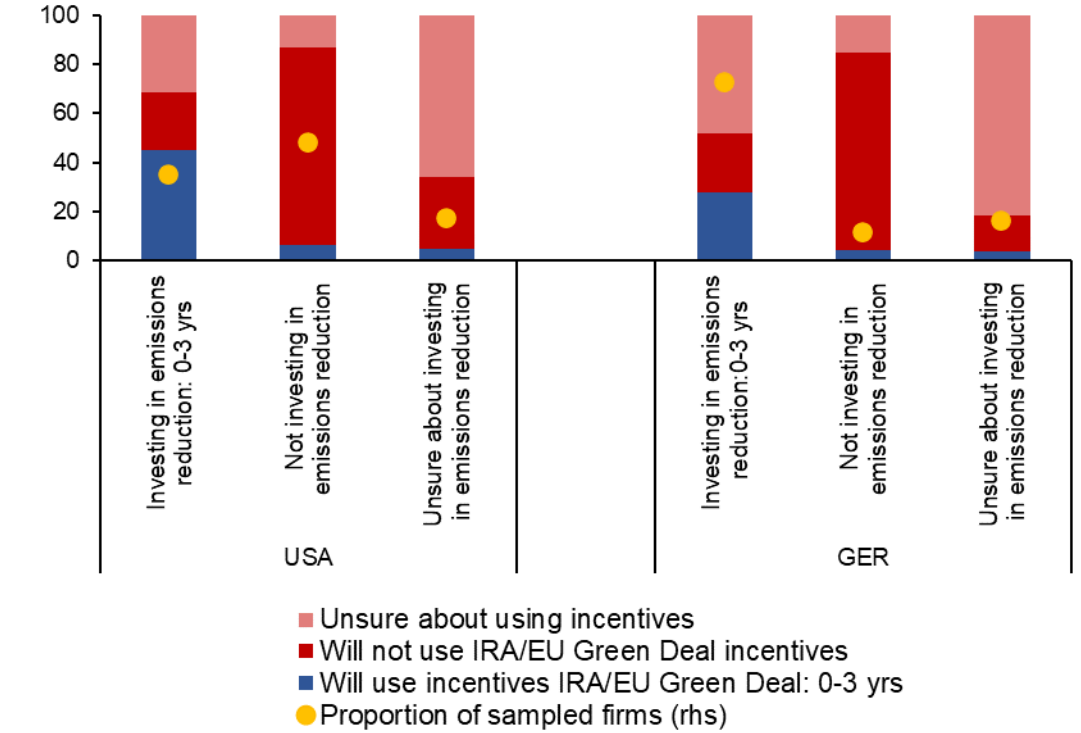
(Percent of firms surveyed)



Sources: The CFO Survey (Duke University, Richmond Fed, and Atlanta Fed) and the BIE (Atlanta Fed), Bundesbank and IMF staff estimates.
Note: The chart represents the proportion of sample firms that report experiencing an increase in energy costs in 2022. The cost shock is further differentiated (right) into firms facing a small increase (<=50%) and a large increase (>50%)

Firms' Plans for Utilizing Incentives of Climate Policy Packages in United States and Germany

(Percent of sampled firms)



Sources: The CFO Survey (Duke University, Richmond Fed, and Atlanta Fed) and the BIE (Atlanta Fed), Bundesbank and IMF staff estimates.
Note: The bars reflect the proportions of sampled firms who indicate that they will use incentives provided by the Inflation Reduction Act (US) and Green Deal (DEU) relative to whether they have indicated having plans for investment in emissions reduction. The dots represent the proportion of sampled firms who have indicated whether they have plans to invest in emissions reduction

Key takeaways

1. Policymakers face a difficult trilemma. Current climate action insufficient to achieve a viable path to net zero emissions. Scaling up primarily through spending could put debt sustainability at risk. Raising revenue often crosses political red lines.

2. Countries have better, more-viable options but the devil is in the design.

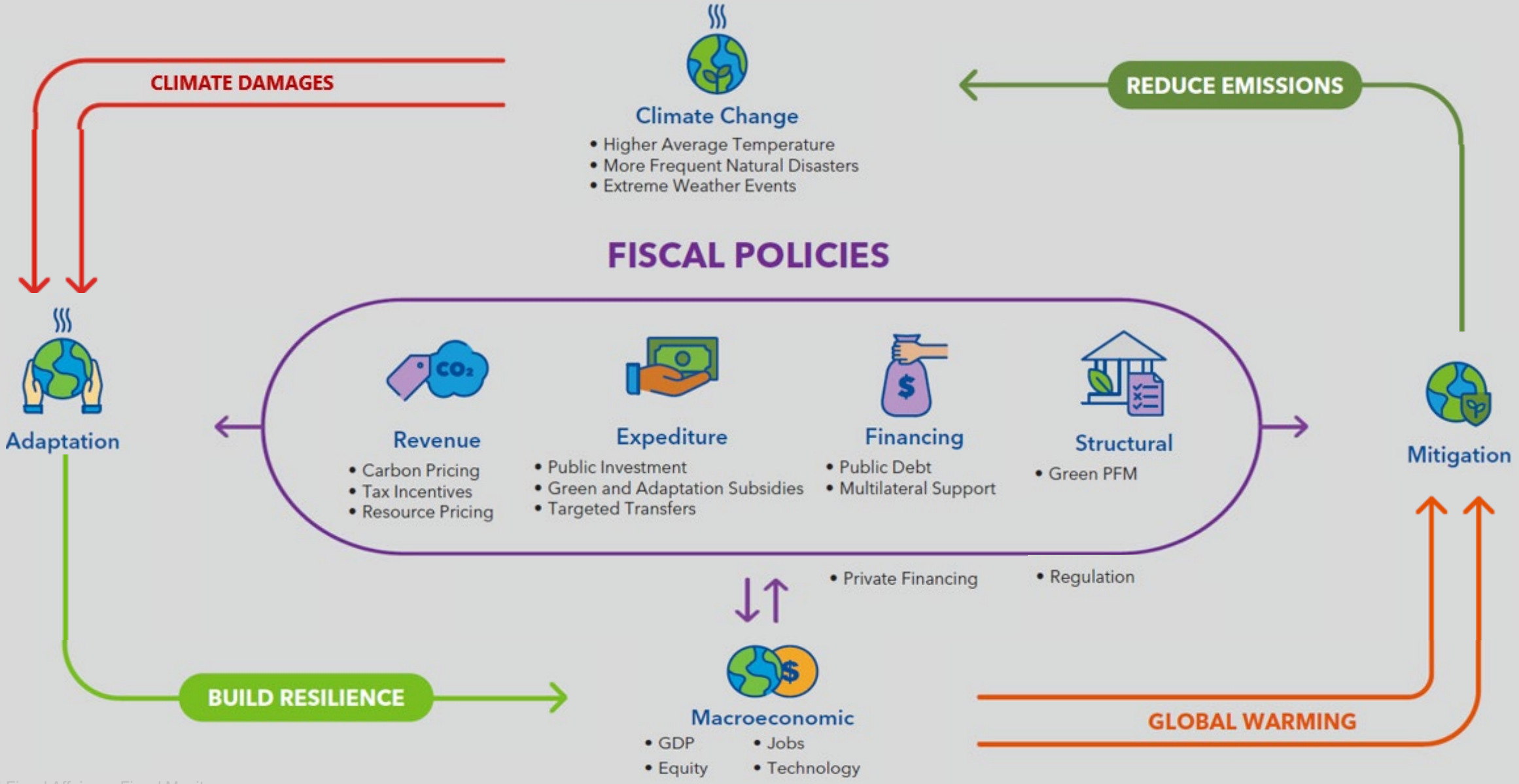
3. The rise in debt during the green transition will be smaller if policy packages contain robust carbon pricing. Delayed action is costly.

4. Private sector should play a large role in climate actions and financing. Well-designed green subsidies and appropriate regulatory policies can encourage firms to invest in and adopt LCTs.

Thank you

Background Slides

The green transition brings close interactions among fiscal policies, climate, and macroeconomy.



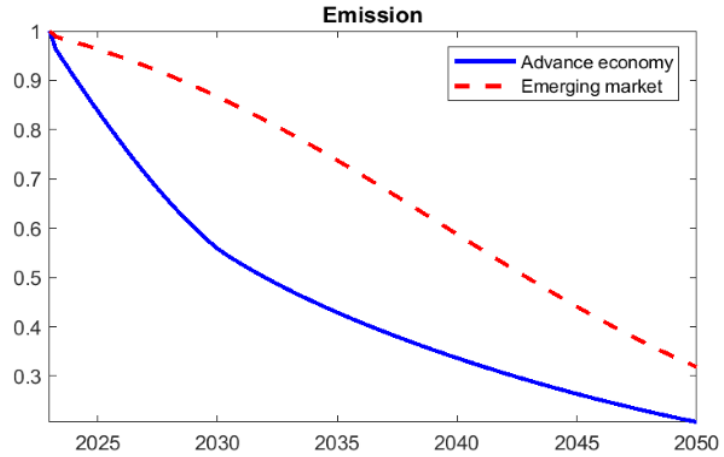
Modeling macro-fiscal and debt implications of net zero policies

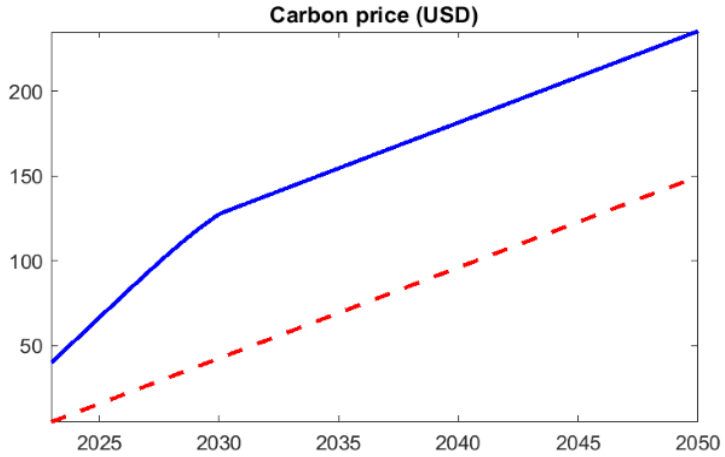
New-Keynesian dynamic general equilibrium Model (Traum and Yang, 2015) adding **climate features:**

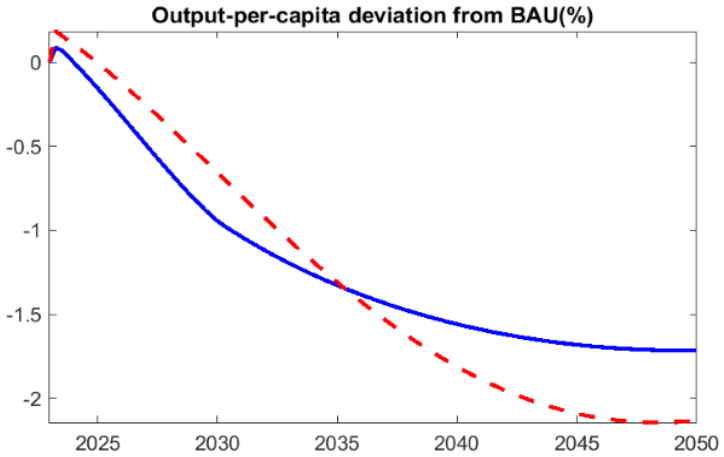
- **Energy** as a production function input, combines green and brown sources (CES):
  - **Green energy**: no emissions; requires public capital (complementary to private capital)
  - **Brown energy**: emissions proportional to output
- **Technology spillovers**: learning by doing in green and brown energy
- **Adjustment costs** to private investment to consider possible investment bottlenecks and stranded assets.
- **Hand-to-mouth households:** illustrate regressive aspects and need for transfers
- Accounts for household expectations and endogenous effects of policies on output, interest rates, and debt.
- **Fiscal policies**: carbon pricing, green public investment, green subsidies, transfers to households; other typical taxes (consumption, labor, and capital income).
  - Interest rates rising with debt-to-GDP ratio—particularly relevant for EMs with limited fiscal space.

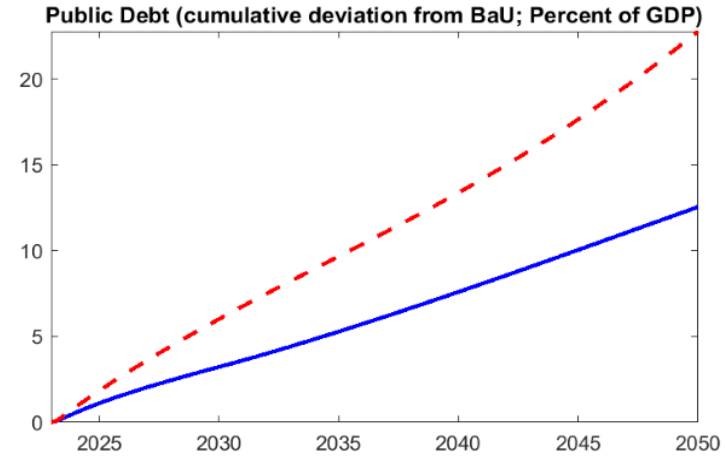
Simulated impact of policy package that contains both revenue and expenditure measures

Key Dynamics on the Impact of Policy Package Combining Different Fiscal Instruments





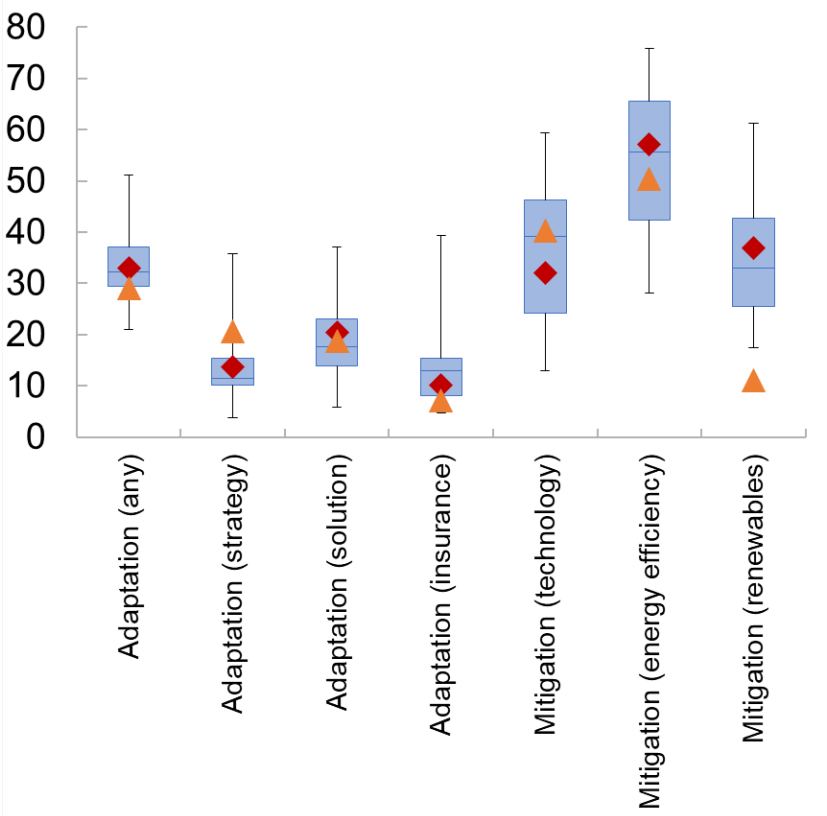




Sources: IMF staff simulations.

Firms' Investment in Adaptation and Mitigation

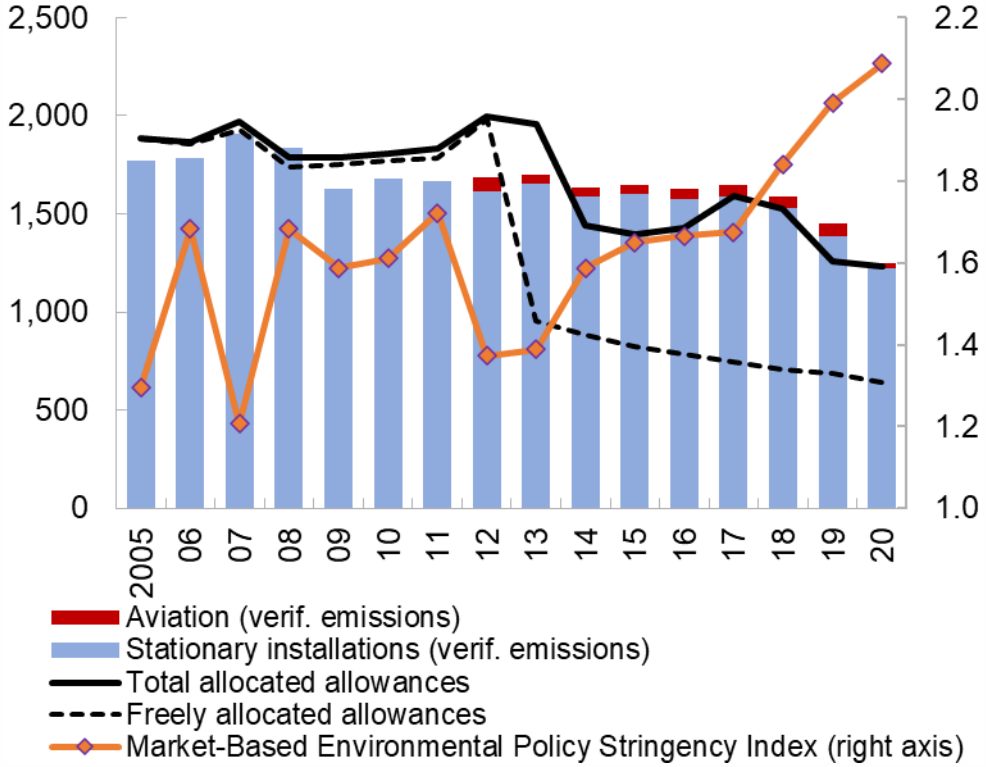
(Percent of firms surveyed in 2022)



Sources: European Investment Bank Group Survey on Investment and Investment Finance 2022; and IMF staff estimates.
Note: The graph shows the distribution of the country level share of firms investing in the corresponding climate measure across the European Union. The box and whiskers represent the interquartile range and lowest/highest share in the European Union, while red and orange dots represent the EU and US averages, respectively. EU = European Union; US = United States.

Europe: ETS Emissions and Climate Policy Stringency

(Metric tons of carbon dioxide equivalent, left scale; index, right scale)

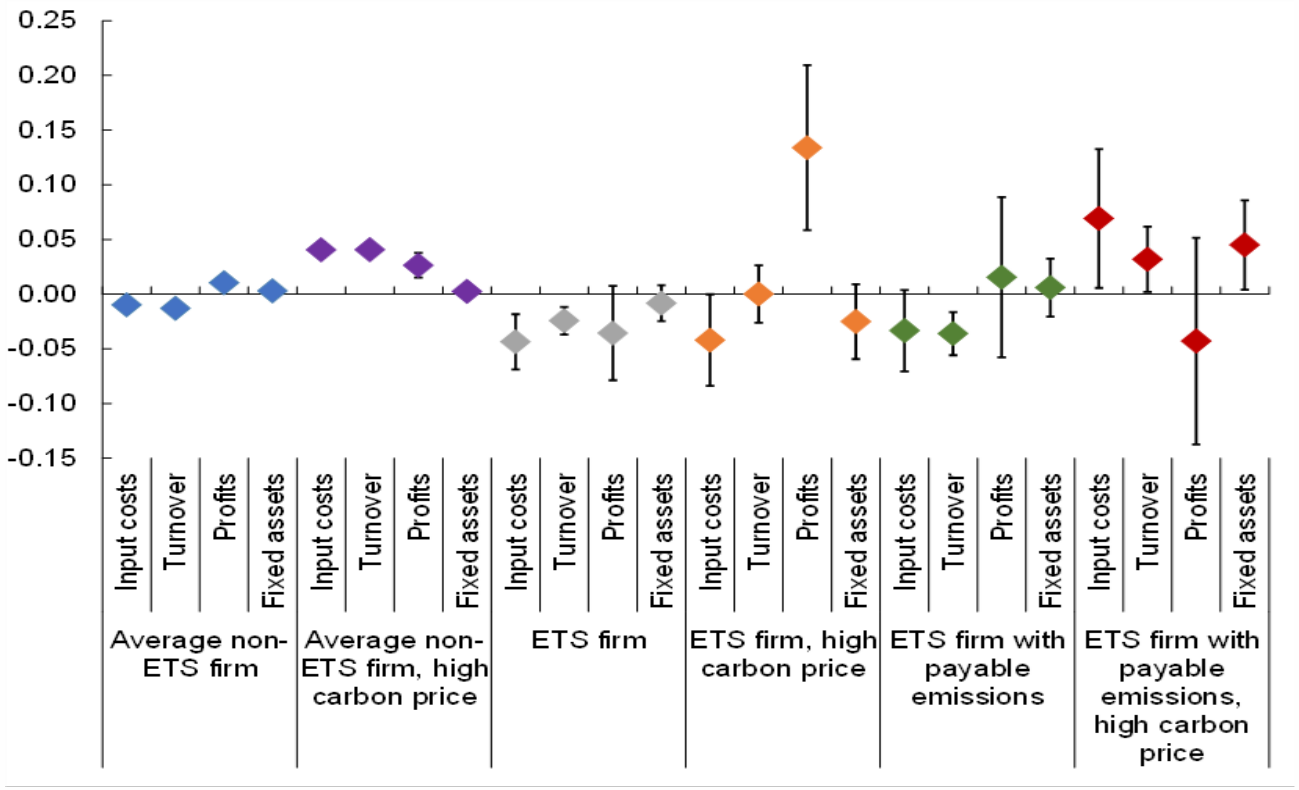


Sources: European Union Transaction Log; Organisation for Economic Co-operation and Development; and IMF staff calculations.
Note: The figure shows a simple average of market-based Environmental Policy Stringency indices of 21 European countries with available data. ETS = emission trading system.

EU firm balance sheets have been resilient to environmental regulation

Environmental Policy Stringency and Changes in EU Firms' Financials

(Coefficient estimates)



Sources: EU Emission Trading System; IMF, World Economic Outlook database; ORBIS; and Organisation for Economic Co-operation and Development.

Note: Figure shows estimated coefficients from a panel regression of 12 European countries over 1995–2020 based on EU ETS and Bureau van Dijk ORBIS data. Both panels include firm, country-sector, and year-sector fixed effects and robust standard errors clustered at the firm level. The dependent variables are changes in input costs (material costs), turnover, profits (EBITDA), and fixed assets (in logarithms). Each coefficient estimate represents the impact from a change in OECD's market-based Environmental Policy Stringency index on the corresponding dependent variable. ETS-regulated firms are those with ETS-registered installations. Payable carbon emissions are calculated as the difference between verified emissions and free allowances. "High carbon price" is a dummy variable that takes on a value of 1 in years with the carbon prices exceeding the 75th percentile. The whiskers indicate the 95 percent confidence interval of the estimated coefficients. ETS = emission trading system.