The Macroeconomic Implications of a Transition to Zero Net Emissions
Approaches of and lessons from Country Climate and Development Reports
WHY CCDRs?

Integrating climate and development is a pillar of the World Bank Group’s new Climate Change Action Plan 2021–2025. To advance its implementation, the WBG has launched a new, core diagnostic tool: the Country Climate and Development Report (CCDR).

WHAT ARE CCDRs?

Diagnostic that focuses on the interplay between development (including poverty reduction, growth, inequality), climate change and climate policies in the context of the Paris Agreement.

OPERATIONALIZING THE ACTION PLAN

1. Integrating Climate and Development
   - Country climate and development diagnostics, planning, and policies
   - Alignment with the Paris Agreement
   - Climate finance and impact

2. Prioritizing Key Systems Transitions
   - Energy
   - Agriculture, Food, Water and Land
   - Cities
   - Transport
   - Manufacturing

3. Financing to Support the Transitions
   - Boosting client countries’ public domestic resources
   - Mobilizing and catalyzing private capital
   - Concessional finance
25 countries covered with CCDRs represent

34% of global population
36% of global emissions
23% of global GDP
Key findings from the first batch of CCDRs
CCDR low-emissions scenarios would lead to declines in emissions by mid-century

70% emissions reduction across the first batch of 25 countries
CCDR low-emissions scenarios have more modest reductions in emissions for lower-middle-income countries

70% emissions reduction across the first batch of 25 countries
Macroeconomic impacts of climate policies would be low or positive

-0.1% to 3.3%

GDP impacts of climate action

<table>
<thead>
<tr>
<th>GDP</th>
<th>Low income</th>
<th>Lower middle income</th>
<th>Upper middle income</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>-0.1</td>
<td>0.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.5</td>
<td>3.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-1.2</td>
<td>-1.7</td>
</tr>
<tr>
<td>Household consumption</td>
<td>Low income</td>
<td>-1.2</td>
<td>-1.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.0</td>
<td>2.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-0.2</td>
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</tbody>
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Impacts from climate change policy (%)
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A Modeling Framework

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Resilient Net zero Pathway (RNZP) for Türkiye

Cumulative gross emissions (MtCO2e):
- Strategy: BAU
  - 2022-2053: 18,055
- Strategy: RNZP
  - 2022-2053: 10,153

Cumulative net emissions (MtCO2e):
- Strategy: BAU
  - 2022-2053: 15,352
- Strategy: RNZP
  - 2022-2053: 6,905
Four techno-economic models: Examples of energy and transportation

Energy
- least-cost power sector planning model EPM (Chattopadhyay, de Sisternes, & Oguah, 2018) to meet 90% reduction by 2040
- calculates the consumption of different fuels, distinguishing between imported and domestically produced fuels, operating costs and simple estimates of air pollution costs

Transportation
- A simple sectoral roadmap combining modal shift, energy efficiency, and electrification in transport.
- The shift affects total energy consumption, the energy mix used in transportation, as well as energy costs for households and firms as well as imports.
- calculates the consumption of various fuels, distinguishing imported and domestically produced fuels, the operational costs, and simple estimates for air pollution costs, as well as congestion and road fatalities
Main inputs for macroeconomic models

Complemented by an economywide carbon tax that starts from USD 11 in 2022 and gradually reaches USD 211 dollars by 2040.

<table>
<thead>
<tr>
<th>Table S.1: Investment needs and economic costs in the RNZP (additional compared with baseline)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>POWER</strong></td>
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<tr>
<td>Additional investment: new generation and storage capacity</td>
</tr>
<tr>
<td>Additional investment: transmission and distribution</td>
</tr>
<tr>
<td>Other economic costs: operational and fuel costs</td>
</tr>
<tr>
<td>Other economic costs: air pollution externality costs from coal</td>
</tr>
<tr>
<td>Other economic costs: decommissioning of coal plants and mines</td>
</tr>
<tr>
<td><strong>RESIDENTIAL</strong></td>
</tr>
<tr>
<td>Additional investment: energy efficiency, electrification, and resilience</td>
</tr>
<tr>
<td>Other economic costs: gas imports</td>
</tr>
<tr>
<td>Other economic costs: lives lost and injuries</td>
</tr>
<tr>
<td><strong>TRANSPORT</strong></td>
</tr>
<tr>
<td>Additional investment: new resilient infrastructure</td>
</tr>
<tr>
<td>Other economic costs: fuel imports</td>
</tr>
<tr>
<td>Other economic costs: cost of disruptions</td>
</tr>
<tr>
<td>Other economic costs: air pollution, congestion, and road fatalities</td>
</tr>
<tr>
<td><strong>FOREST LANDSCAPES</strong></td>
</tr>
<tr>
<td>Additional investment: restoration, reforestation, and fire management</td>
</tr>
<tr>
<td>Other economic costs: loss of harvest revenues</td>
</tr>
<tr>
<td><strong>AGRICULTURE</strong></td>
</tr>
<tr>
<td>Other economic costs: on-farm emissions reductions</td>
</tr>
<tr>
<td><strong>INDUSTRY AND MANUFACTURING</strong></td>
</tr>
<tr>
<td>Other economic costs: cement, iron, and steel</td>
</tr>
<tr>
<td><strong>TOTAL INVESTMENTS AND ECONOMIC COSTS</strong></td>
</tr>
<tr>
<td>Net economic costs</td>
</tr>
<tr>
<td>includes: additional investment</td>
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</tbody>
</table>

Notes: All amounts are discounted using a 6 percent discount rate. Decommissioning costs do not include the social expenditures to facilitate the transition of affected workers and communities. Numbers in red are net costs; numbers in green are net benefits.
A hybrid modeling approach combining sectoral roadmap with macro modeling

1. A sequence of models rather than a single integrated framework (Bataille, Jaccard, Nyboer, & Rivers, 2006; Bosetti, Carraro, Galeotti, Massetti, & Tavoni, 2006; Böhringer & Rutherford, 2008; Hourcade, Jaccard, Bataille, & Ghersi, 2006; Kim, Edmonds, Lurz, Smith, & Wise, 2006; Köhler, Barker, Anderson, & Pan, 2006)

2. Plausible rather than optimal decarbonation path (Pindyck, 2013; IMF, 2022)

3. Many market failures rather than one (Lipsey & Lancaster, 1956; Batten 2018; Pisani-Ferry 2021)
Flow of information in scenarios

Sector policies
- Transport
- Buildings
- Energy
- Forestry

Additional policies/measures
- Remove fossil fuel subsidies
- Carbon tax

Labor Market Frictions
- co-benefits from air pollution
- Investment crowding out (fixed savings)
- Electricity prices

Sensitivity analysis

RNZP scenario
- GDP
- Consumption
- Distribution
- Employment
- Debt
- Current account
## Scenarios: Inputs from sector models to CGE

<table>
<thead>
<tr>
<th>Sector</th>
<th>Storyline</th>
<th>Exogenous (i.e., change in CGE parameters informed by the sectoral scenarios)</th>
<th>Endogenous (i.e., changes in CGE parameters to match the sectoral scenarios)</th>
<th>Additional investments or costs to trigger the transition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>Renewables grow</td>
<td>Power mix (from power model)</td>
<td>Productivity of power activities</td>
<td>Investment for renewables &amp; early coal retirement</td>
</tr>
<tr>
<td>Buildings</td>
<td>Heat is electrified; energy efficiency improves</td>
<td>Share of fossil fuels in energy demand</td>
<td>Energy Efficiency</td>
<td>Investment for retrofitting</td>
</tr>
<tr>
<td>Transport</td>
<td>Transport is electrified; shift to public transport; railways</td>
<td>Electricity demand by transport</td>
<td>Energy efficiency and transport sector productivity</td>
<td>Investment in transport infrastructure</td>
</tr>
<tr>
<td>Land Use</td>
<td>Sequestration increases due to better forest management</td>
<td>Output of forest management activity</td>
<td>Subsidies to forest management activity</td>
<td>Subsidies</td>
</tr>
<tr>
<td>Other Sectors</td>
<td>Carbon saving technological change and CCS</td>
<td>Emission per unit of FF used/output produced decrease</td>
<td>Emission coefficients</td>
<td>Investment for technological change (USD40 per ton reduced)</td>
</tr>
</tbody>
</table>
Sensitivity analysis

- **Labor market frictions**: Assuming perfect labor mobility

- **Renewable energy subsidies**: Adding policy to keep electricity prices constant

- **Crowding out**: From financing 100% investments with endogenous domestic savings (baseline) to financing investments through domestic savings (fixed rate) and crowding out investment to close the financing gap

- **Lack of air pollution benefits**: Assuming a 1 percent decrease in PM2.5 concentration would increase labor productivity by 0.3 percent (Jooste, Loch Temzelides, Sampi Bravo, & Dudu, 2022)
Figure 4.1: Projected growth benefits of transitioning to RNZP

Source: World Bank staff estimates
Consumption is affected more than growth, but the RNZP is progressive.

Figure 4.3: Impact on welfare for poor, middle, and rich households, in three scenarios

(a) Impact by 2030

(b) Impact by 2040
Significant reallocation of jobs from emission intensive sectors to services, renewables, agriculture and construction by 2040 (RNZP)

Cumulative jobs created/destroyed by sector until 2040

- Metals
- Coal Power
- Chemicals
- Textile
- Coal
- Road Trans.
- Wind Power
- Health
- Public Administration
- Crop Production
- Construction

The chart shows the cumulative number of jobs created or destroyed by sector from 2022 to 2040.
A macrostructural model to explore implications for debt and current account... and the importance of the financing channel

• Additional infrastructure capital is financed 50 percent by public.

• Two extreme scenarios for the remaining 50 percent of investment:
  • **TFP scenario** - reforms and investments boost TFP to incentivize more private investment
  • **Carbon tax incentive scenario** – with revenues used to incentivize green private investment

• Non-infrastructure investments by the private sector are crowded out
A macrostructural model to explore implications for debt and current account... and the importance of the financing channel
Fuel imports play a key role: big difference between fuel exporters and importers

Figure 4.2: Current account balance in the RNZP, compared with the baseline
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