Enhancing Climate Change and Energy Transition Policy Design through a Flexible Input-Output Simulation Model applied to Argentina

Topic: Energy Policies
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Motivation

Designing and evaluating potential impacts of climate change and energy transition policies aligned with climate change international commitments requires a dynamic and adaptable simulation tool to support policymakers in the current changing context. Each policy formulation and simulation requires the management of intricate interactions of factors for a comprehensive understanding of direct and indirect effects across sectors. To address this technical need, we propose a novel approach by constructing a flexible simulation model within an input-output framework.

Case study

To demonstrate the practical application of this simulation tool, we examine the case of Argentina and calibrate the model to represent the base year in 2022. Argentina consistently commits to addressing climate change through key international agreements, such as the United Nations Framework Convention on Climate Change, the Kyoto Protocol, and the Paris Agreement. These agreements signify Argentina's acknowledgment of the imperative to implement measures curbing global temperature rise and mitigating climate change's adverse impacts on its population's well-being.
This commitment is evident in tangible actions and policies integral to Argentina's sustainable and equitable development strategy. Examples include the Nationally Determined Contribution, the National Action Plan for Energy and Climate Change (2017 and 2019), and sectoral plans (2019) from the National Climate Change Cabinet. These plans encompass policies and actions targeting environmental pressure while considering economic impacts.

Objective

Aligned with climate change objectives, this paper aims to provide a friendly tool to help policymakers to assess cross-sectoral impacts of climate actions and to identify the most effective policies or projects to achieve these goals.

Methodological approach

The methodological tool developed for evaluating policies outlined in national sectoral action plans for climate change has several objectives. These include generating an input-output matrix with a suitable sectoral breakdown to assess environmental policies, constructing satellite accounts for employment, land use and greenhouse gas (GHG) emissions compatible with the Social Accounting Matrix (SAM), and developing a user-friendly simulation model. The input-output model developed is tailored to simulate sectoral policies aimed at reducing GHG emissions while evaluating their socio-economic impacts.
The toolâ€™s key innovation lies in the calibration process, integrating an updated 69-sector SAM for Argentina in 2022, incorporating the aforementioned satellite accounts in a consistent manner. The model's granularity is enhanced by introducing crop-level disaggregation. By considering changes in the electric generation matrix, land use and productivity, the model captures a wide spectrum of potential policy interventions. Results emphasize effects on GDP, employment, tax revenues and emissions. Therefore, the tool developed is flexible enough to analyse the impact of the various climate change policies currently being considered thanks to its multi-sectoral disaggregation, its inclusion of potential price changes in some scenarios, through a pricing model,

and the ability to estimate the impact of implementing multiple measures simultaneously.

Simulated scenarios and results

Among the simulated scenarios, we can mention:

â€¢ The change in the electricity generation matrix (allowing the modification of the electricity generation structure, including the investment requirements by generation technology implied by changes in generation, changes in the final demand for electricity, development of distributed generation, and improvement in landfill capture),

â€¢ The changes in land use (allowing the modification of the distribution of hectares to different crops and activities such as livestock and forestry, the incorporation of new hectares and deforestation),

â€¢ The increase in biofuel cut and efficiency improvements in energy consumption by productive activities, among other scenarios programmed.

Among various simulations for reducing GHG emissions by 2030, trade-offs between GDP growth and emissions reduction are evident in scenarios like electricity generation matrix modification, carbon tax, and land use change. Nonetheless, certain scenarios, such as green hydrogen development, offer a dual gain with no trade-off between economic growth and emissions.

The simulation model is a potent tool for policymakers, providing a comprehensive understanding of diverse policy scenarios and their consequences. It enables the evaluation of direct and indirect effects, aiding informed decision-making in the pursuit of sustainable climate change and energy transition strategies. Despite focusing on Argentina's climate policies, this tool can assist others facing similar resilient challenges.