Achieving a balance between SDGs & Climate impacts across Energy, Water Land nexus

Muhammad Awais, Adriano Vinca, Edward Byers, Isabela Schmidt Tagomori, Mathjis Harmsen, Volker Krey, Keywan Riahi

November 29,2022

Summary

Combining climate action with sustainable development objectives requires accessing multiple crises simultaneously. Representation of the United Nation's Sustainable Development Goals (SDGs) indicators and proxies along with climate impacts have been less explored in the global scenarios. Developing these scenarios requires quantitative coverage of the SDGs and translating complex sectoral interactions using spatial and temporally resolved multi-sectoral systems. This study compares two Integrated Assessment Models; MESSAGEix-GLOBIOM & IMAGE scenarios and compares the results in order to identify challenges and limitations of scenarios in integrating multi-sectoral impacts and SDG dimensions. Moreover, the preliminary results provides insights in identifying model limitations as well as the challenges of these complex synergies.

Scenario Design

SDGs [1]

- 2 ZERO HUNGER: Heathy (EAT-Lancet) diet, food waste reduction
- 6 CLEAN WATER AND SANITATION: Efficiency improvements, environmental flows, access to water, wastewater treatment
- 7 AFFORDABLE AND CLEAN ENERGY: Maximized electrification, phase-out traditional bio, cooling gap
- 15 LIFE ON LAND: Protected natural land (>30%)

Climate Impacts [2]

- •Hydrological variation
- •Crop Yield changes
- •Renewable energy
- •Cooling/heating demand
- •Desalination potential
- •Power plant cooling capacity

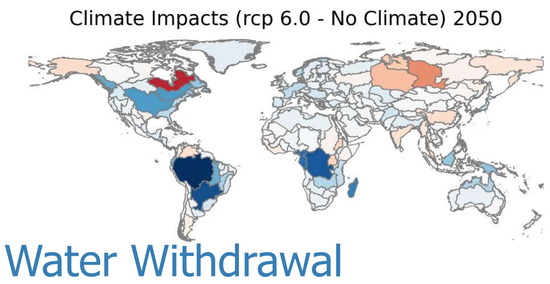
Climate Policy

- 13 CLIMATE ACTION: 2.6 W/m2 target

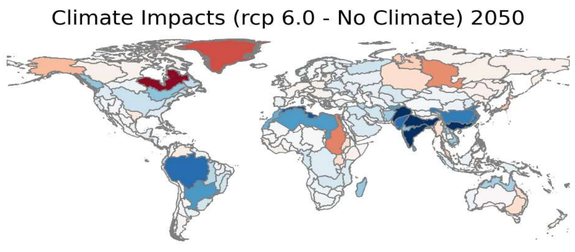
The scenarios are based on the SSP2 scenario. The scenarios are set up using different assumptions along three dimensions: Climate policy, SDG measures and climate impacts/feedbacks. All assumptions have been, as much as possible, aligned between the two models, to allow for a scenario comparison that mostly reflects model differences.

Preliminary Results

I) Water Resources



II) Water Withdrawal



III) Cooling Demand Gap

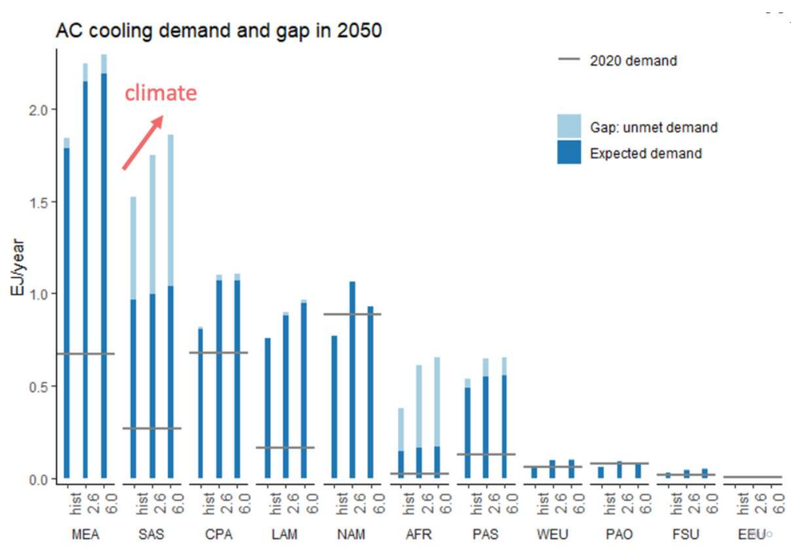


Figure A: Examples of some of the biophysical impact indicators used within the MESSAGEix-GLOBIOM model. Both model use different assumptions. We found more significant variability of hydrology related parameters. I) Hydrological variability from LPjML model across different climate scenarios for 2050. II) Climate impacts on water withdrawals for 2050 III) AC cooling demand gap and how climate impact affects the cooling demand gap (Mastrucci et al. 2021)

Key indicator results

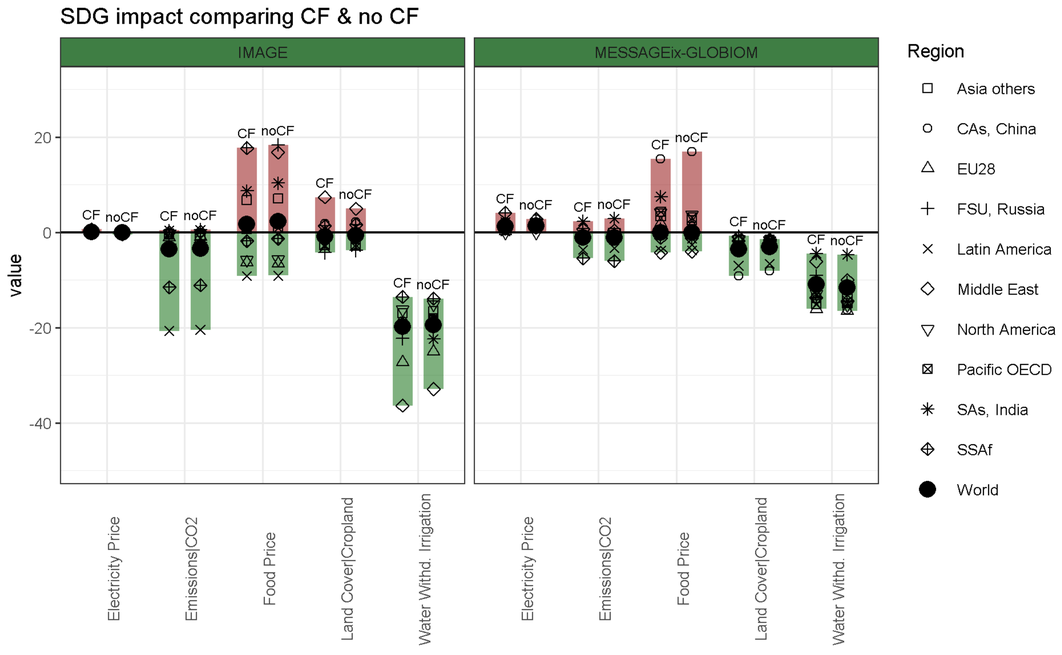


Figure B: Key indicators related to Impacts & SDGs from both models are reported. The bars show the percentage difference increase or decrease from a baseline scenario (no SDG & no climate feedbacks) .CF & noCF here represents the difference between only SDG and the combined effect of SDG and climate feedbacks. The percentage difference is averaged from 2030 onwards till the end of century to include short term SDG impacts and long term climate impacts in the results.

Key Insights

- Vulnerable regions show more sensitivity to climate impacts.
- SDG targets in land sector reduces the overall SDG policy costs and impacts energy & water expenditures.
- Reductions in irrigation withdrawals from land sector helps balancing out the limited water in vulnerable regions.
- Identifying causality between climate impacts and SDGs is complicated due to large number of variables and sectoral dimensions

Take-aways

- Multi-sector climate feedbacks in Integrated Assessment Model scenarios can be included in various sectoral processes.
- It increases complexity, but improves reliability of climate and SDG policy analysis and helps to derive
- It is still to be discussed how biophysical approaches to CI assessment compare to macro-economic assessments

Acknowledgment

The authors acknowledge the funding rom the NAVIGATE project of the European Union's Horizon 2020 research and innovation program.

[1] Based on: Doelman et al. 2022, MESSAGE-ACCESS, Van Vuuren et al., 2019, Parkinson et al., 2019, Frank et al., 2021, Hasegawa et al., 2015, Pastor et al., 2019

[2] Based on various literature sources and methodologies for different impact indicators from ISIMIP 2b (Frieler et al. 2017), Byers et al., 2018, Gernaat et al., 2021 etc.)