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SDG synergies and trade-offs on the road to Paris

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Sustainability, that's it!

INTRODUCTION

- The SDGs and Paris Agendas call for an integrated approach to assess how multiple goals can be met simultaneously.

- There is a risk of following a silo approach considering SDGs as individual elements which would fail to maximise synergies and detect trade-offs.

- Trade-offs happened during recent lock-down periods evidence the need of this approach (GHG reductions – economic & health implications).

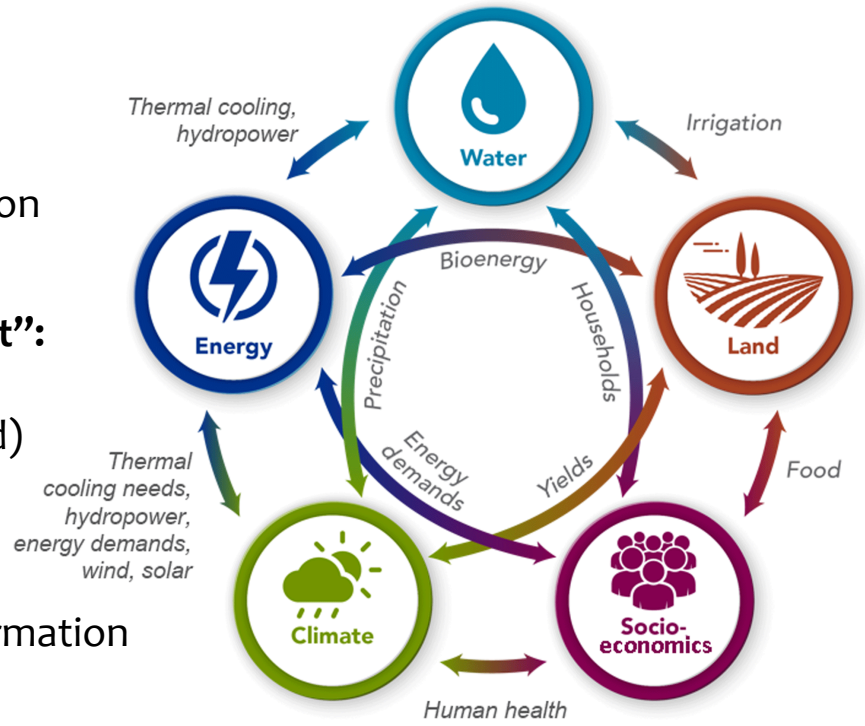
- Nexus approach to support policymaking when dealing with complex interactions between policy sectors.

Source: UN

- Integrated Assessment Models (IAMs) can offer a holistic vision on specific aspects of human earth interactions by combining scientific knowledge on different domains.

MODEL - GCAM

- GCAM represents **interactions** of 5 systems: energy, water, agriculture and land use, economy and climate.
- Operates with **market equilibrium**. Representative agents in each of the systems use prices (and others) to allocate resource.
- Agents: **electricity** sectors, **energy** demand sectors or **land** users:
  - Allocate e.g. land among competing crops within any given land region
  - Interact through markets to balance supply and demand.
- Suitability of allocation choice based on **choice indicator** and **"shareweight":**
  - Choice indicator incudes costs and other factors
  - "Shareweight" includes factors not captured in the model (calibrated)
- **Economic** systems (population and GDP) are the exogenous drivers for activities.
- **Energy** system cover primary energy resource production, energy transformation and final energy demands.
  - Depletable resources: oil, gas, coal, uranium
  - Renewable resource: biomass, wind, geothermal, hydropower, PV



Source: Calvin et al. (2019). GCAM v5.1: representing the linkages between energy, water, land, climate, and economic systems. Geosci. Model Dev. 12, 677–698. https://doi.org/10.5194/gmd-12-677-2019

MODEL - GCAM

- **Land use** module land is divided into different land use cat
  - Commercial uses (crops, forestry)
  - Non-commercial uses (natural forest, scrubs)

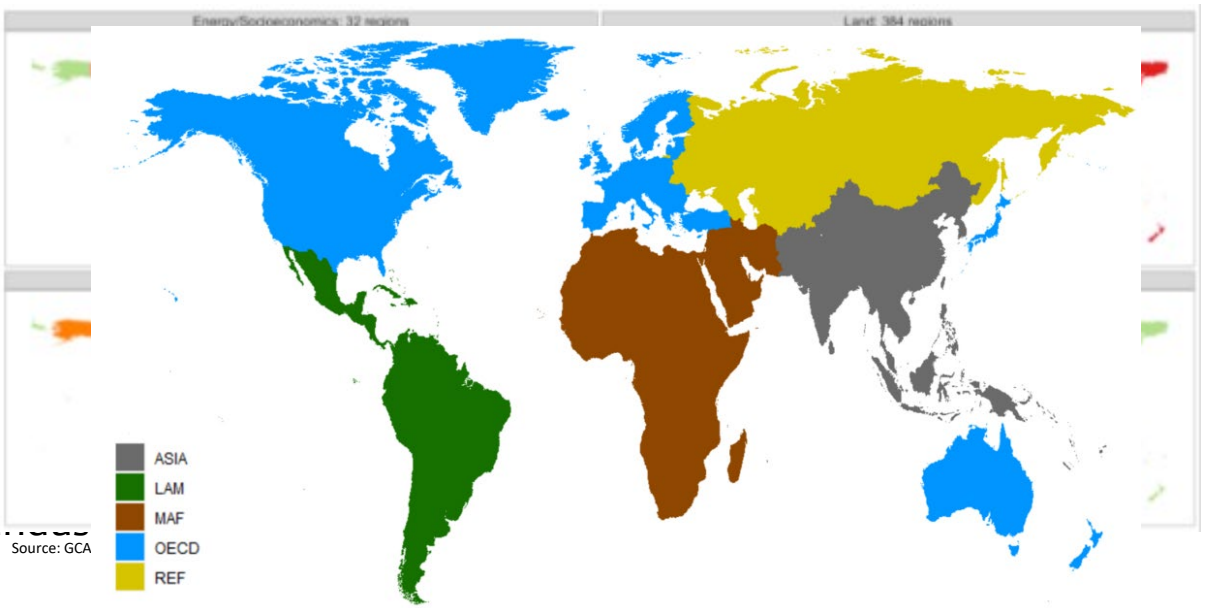
  Crops:
  - Staple crops: grains and roots commodities (corn, ric
  - Non-staple crops: oil/sugar crops, palm fruit, and anin

- The **water** module balances water supply and demand in t
  agricultural systems.

- The **climate** module tracks GHGs both from fossil fuel and i
  land uses.

- The energy-economy system operates at **32 regions globally**, land is divided into **384 sub regions**, and water is tracked for **233 basins** worldwide. The climate module operates at a global scale.

- Study aggregates R5 regions following SSP database: ASIA, LAM, MAF, OECD and REF.

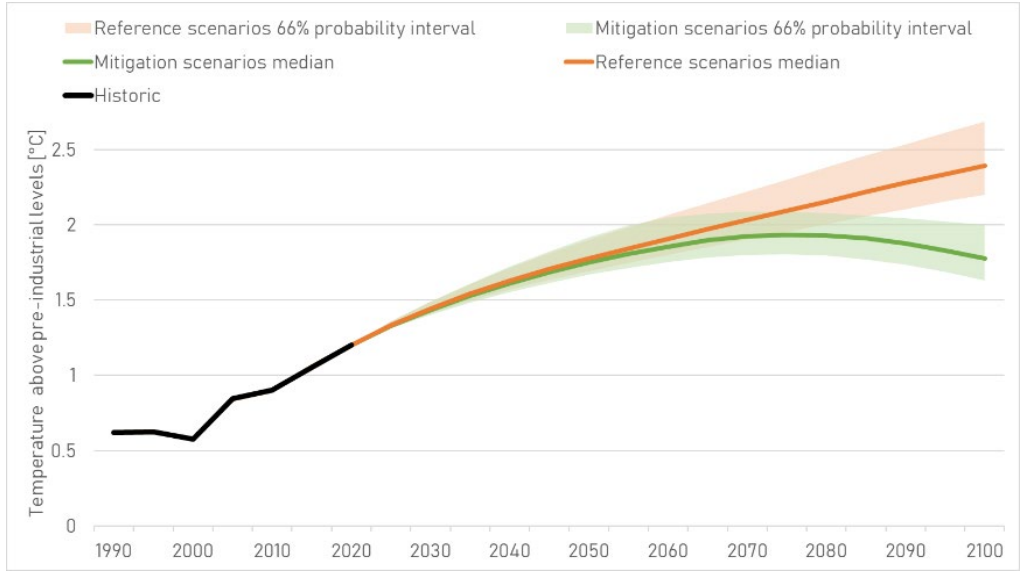


Source: GCA

Source: Authors' calculations

SCENARIO DESIGN

- **Baseline:**
  - SSP2 assumptions for socioeconomic inputs, income elasticities, food preferences and resource use
  - Region-specific INDCs are met through 2030.
- **Reference scenario:** Regional post-2030 emission intensities (GHG/GDP) are assumed to evolve with the same pace as in 2020-2030. (Fawcett et al., 2015).
- **Bioenergy & Capture:**
  - Unconstrained bioenergy production
  - Moderate carbon capture and storage (CCS)
- **Forest & Fossils:**
  - Extensive CCS deployment
  - Incentives for afforestation
  - Bioenergy constraints
- **Electrification & Conservation:**
  - Extensive deployment of solar and wind technologies
  - No CCS
  - Bioenergy constraints
- **Lifestyle:** SSP1 assumptions on consumers' demand:
  - Households energy consumption
  - Diet choice
  - Modal shift



Source: Authors' calculations

All the mitigation scenarios were designed in order to stay within the 1.63°C-2°C range in 2100 with 66% probability

SDG IMPACT FRAMEWORK

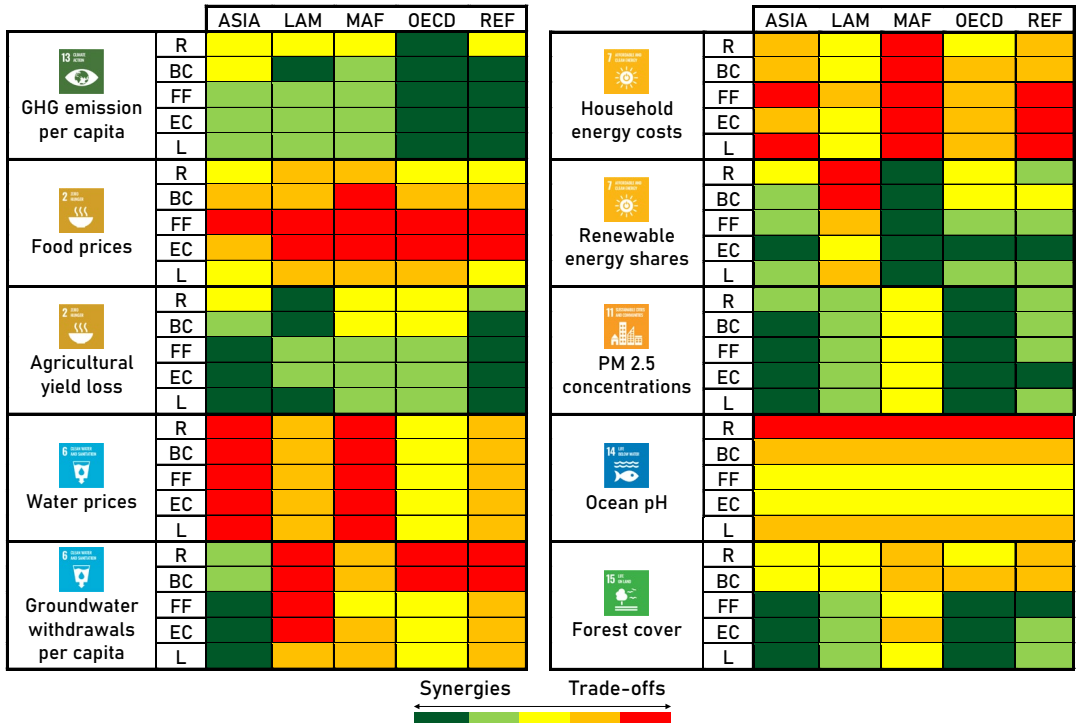
	OFFICIAL SDG INDICATOR	INDICATOR USED
	**2.c** Indicator of food price anomalies **2.3** Agricultural productivity	Food prices Relative agricultural yield loss attributable to ozone
	**6.4.2** Equitable access to affordable drinking water **6.4.2** Level of water stress: freshwater withdrawal as a proportion of available freshwater resources	Water prices Per capita groundwater withdrawals
	**7.1.1** Proportion of population with access to electricity **7.2** Renewable energy share in the total final energy consumption	Household energy costs Renewable energy share
	**11.6.2** Annual mean levels of particulate matter in cities	PM2.5 concentration
	**13** GHG emissions reductions*	Total and per capita GHG emissions
	**14.3** Minimise the impacts of ocean acidification	Ocean pH
	**15.1.1** Forest area as a proportion of total land area	Relative forest cover

*Not officially part of the 2030 Agenda for Sustainable Development. SDG 13 was further elaborated for the Paris Agreement

RESULTS

- **Bioenergy & Capture:**
  - ✚ GHG reductions in LAM and OECD
  - ➖ Delays mitigation: yield losses, PM2.5, ocean pH
  - ➖ Water stress in OECD, LAM and REF
- **Forest & Fossils:**
  - ✚ SDG 15 – Forest Cover
  - ✚ Reduces water stress in regions with higher forest coverage (Asia)
  - ➖ Shifts agricultural land and increase food prices
- **Electrification & Conservation:**
  - ✚ SDG 7 – Renewable energy share
  - ✚ GHG reductions in REF
  - ✚ PM2.5 concentration and ocean pH
  - ➖ Increases food prices
- **Lifestyle:**
  - ✚ Single scenario not increasing water and food prices with respect to R scenario
  - ✚ Quickest impact reduction of PM2.5 and yields
  - ✚ Similar forest cover in MAF and ASIA as FF

Summary of SDG impacts averaged for the period 2025-20100 with respect to 2020



Source: Authors' calculations

R = Reference, BC = Bioenergy & Capture, FF = Forest & Fossils, EC = Electrification and Conservation, L = Lifestyle

CONCLUSIONS

- Roads to a Paris-compatible world do not come at a **sustainable zero cost**, potential **consequences** of mitigation scenarios need to be carefully assessed.

- It is unlikely that the world follows **exactly** one of the suggested pathways, but scale of the challenge calls for the assessment a **combination of strategies** to anticipate their impacts.

- Mitigation shifted almost exclusively to the **supply side** may increase impact on natural resources and limit access of vulnerable populations to basic services.

- Encourage shifts on the **demand side** may limit unintended consequences of mitigation strategies.

THAT'S IT! =)

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