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Modelling uncertain economic impacts of climate change under a multi-regional and multi-sectoral bottom-up perspective

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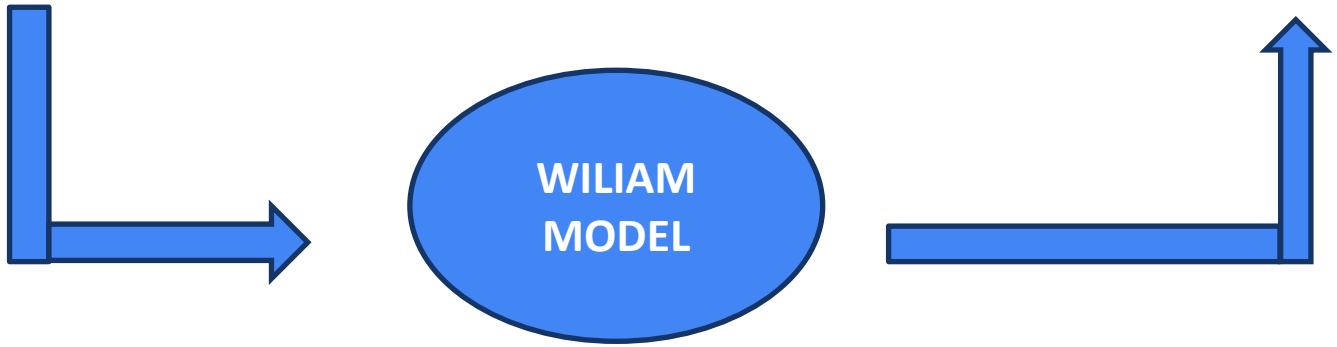
Background

Low-carbon society:
an enhanced modelling tool for the transition to sustainability

LOCOMOTION

New Enabling Visions and tools for End-useRs and stakeholders thanks to a common MOdeling appRoach towards a climatE neutral and resilient society

NEVER MORE

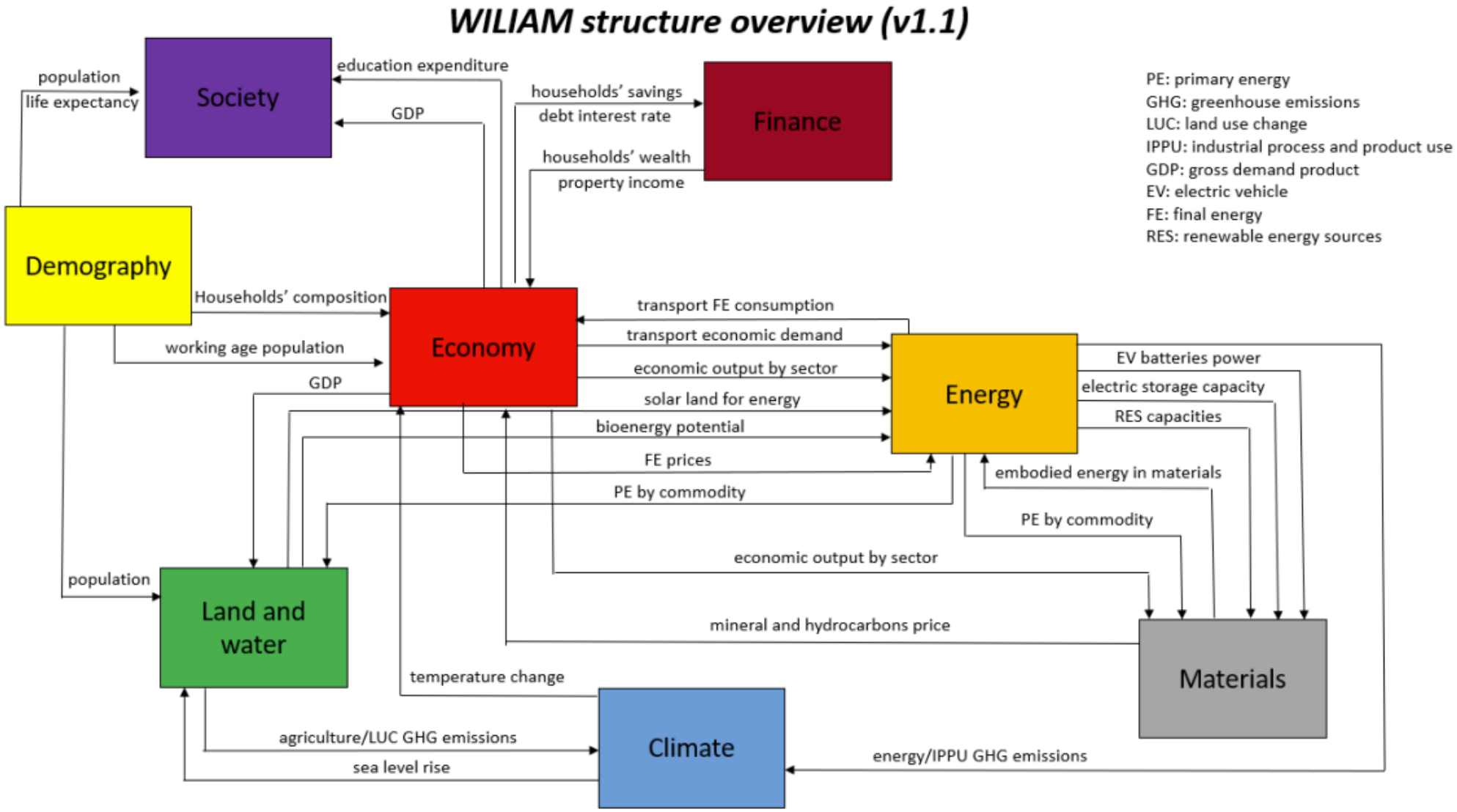


Objectives

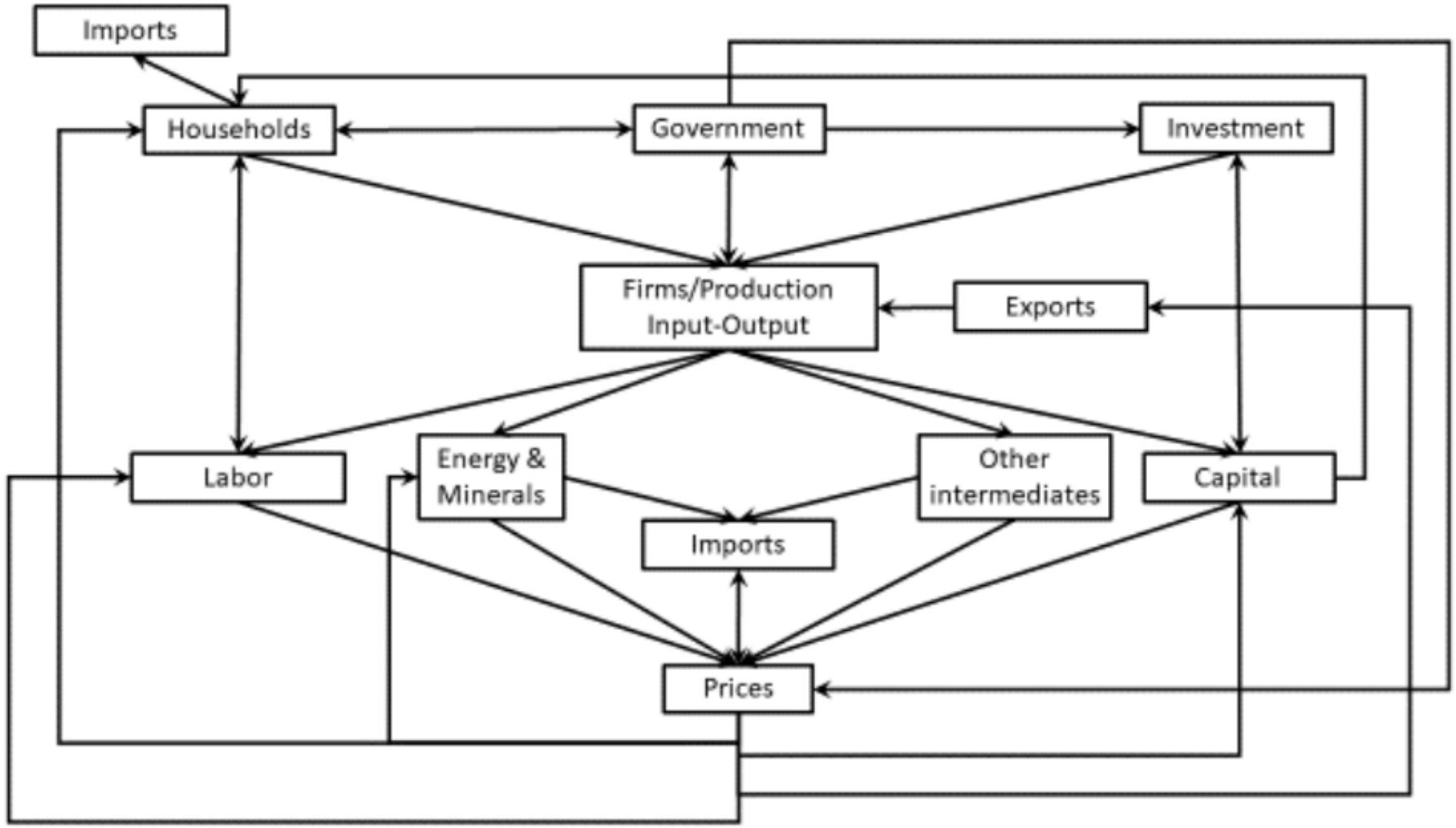
This work aims to contribute to improving the state-of-the-art in the representation of economic impacts of climate change in IAMs by:

- Affecting capital (productive factor) instead of level of production directy, as other IAMs usually do.
- Capturing a wide set of indirect and cascading economic effects.
- Explicitly representing different types of uncertainty.
- Using up-to-date and highly disaggregated direct damage estimates of capital impacts due to heat-related extreme weather events.

For doing this, we include disaggregated climate change direct impacts on WILIAM and we use it to evaluate macroeconomic effects and indirect impacts.



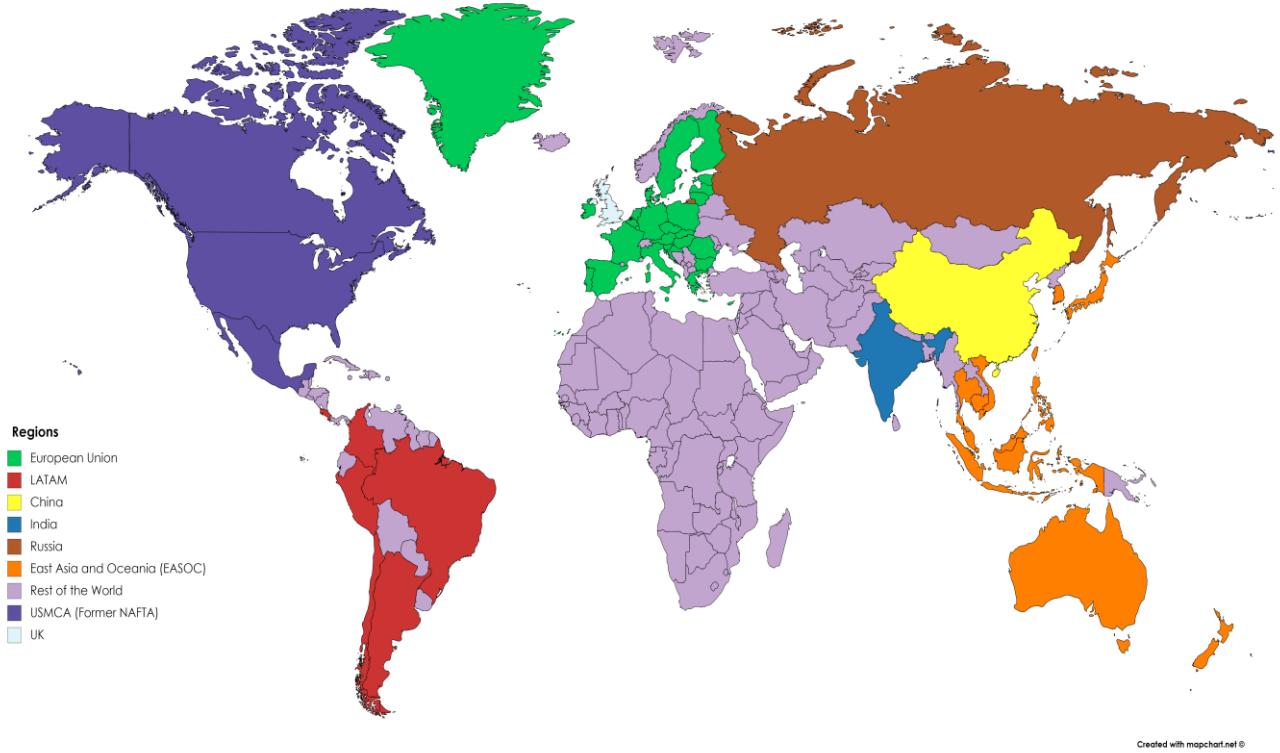
WILIAM simplified structure overview. Source: Deliverable 11.2 of the LOCOMOTION H2020 Project.



Main components and relationships of the economic module. Source: Deliverable 11.2 of the LOCOMOTION H2020 Project

WILIAM Economic Module disaggregation: 35 regions.

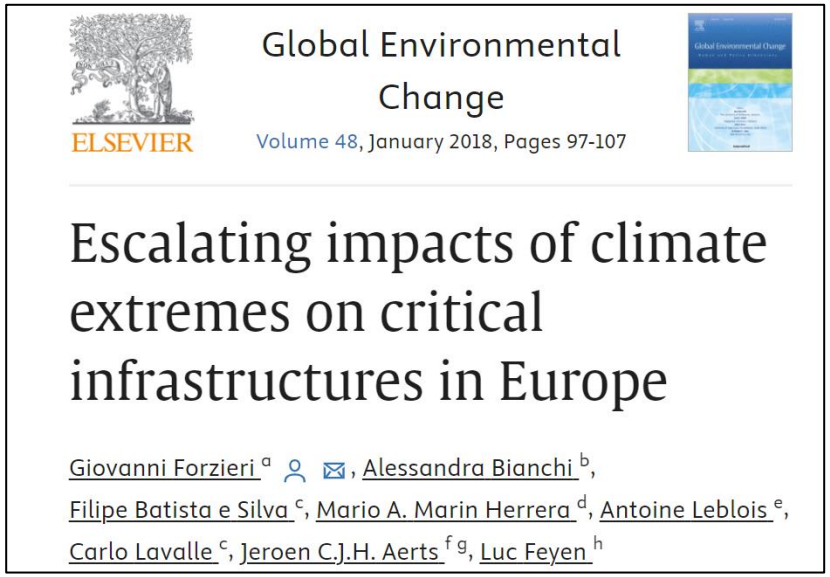
- **35 Regions.** EU-27 countries; United Kingdom (UK); China; Russia; India; LATAM; United States, Mexico & Canada (USMCA); East-Asia & Oceania (EASIC); Rest of the World (ROW).



WILIAM Economic Module disaggregation: 62 economic sectors.

CROPS	MANUFACTURE_FOOD	ELECTRICITY_WIND	ACCOMMODATION
ANIMALS	MANUFACTURE_WOOD	ELECTRICITY_OIL	TELECOMMUNICATIONS
FORESTRY	COKE	ELECTRICITY_SOLAR_PV	FINANCE
FISHNG	REFINING	ELECTRICITY_SOLAR_THERMAL	REAL_ESTATE
MINING_COAL	MANUFACTURE_CHEMICAL	ELECTRICITY_OTHER	OTHER_SERVICES
EXTRACTION_OIL	MANUFACTURE_PLASTIC	DISTRIBUTION_ELECTRICITY	PUBLIC_ADMINISTRATION
EXTRACTION_GAS	MANUFACTURE_OTHER_NON_METAL	DISTRIBUTION_GAS	EDUCATION
EXTRACTION_OTHER_GAS	MANUFACTURE_BASIC_METALS	STEAM_HOT_WATER	HEALTH
MINING_URANIUM_THORIUM	MANUFACTURE_METAL_PRODUCTS	WASTE_MANAGEMENT	ENTERTAIMENT
MINING_IRON	MANUFACTURE_ELECTRONICS	CONSTRUCTION	PRIVATE_HOUSEHOLDS
MINING_COPPER	MANUFACTURE_ELECTRICAL_EQUIPMENT	TRADE_REPAIR_VEHICLES	
MINING_NICKEL	MANUFACTURE_MACHINERY	TRANSPORT_RAIL	
MINING_ALUMINIUM	MANUFACTURE_VEHICLES	TRANSPORT_OTHER_LAND	
MINING_PRECIOUS_METALS	MANUFACTURE_OTHER	TRANSPORT_PIPELINE	
MINING_LEAD_ZINC_TIN	ELECTRICITY_COAL	TRANSPORT_SEA	
MINING_OTHER_METALS	ELECTRICITY_GAS	TRANSPORT_INLAND_WATER	
MINING_NON_METALS	ELECTRICITY_NUCLEAR	TRANSPORT_AIR	
	ELECTRICITY_HYDRO		

Climate damage feedback.



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Escalating impacts of climate extremes on critical infrastructures in Europe

Giovanni Forzieri [a], Alessandra Bianchi [b], Filipe Batista e Silva [c], Mario A. Marin Herrera [d], Antoine Leblois [e], Carlo Lavalle [c], Jeroen C.J.H. Aerts [f g], Luc Feyen [h]

Impact-curves representing capital depreciation and destruction:

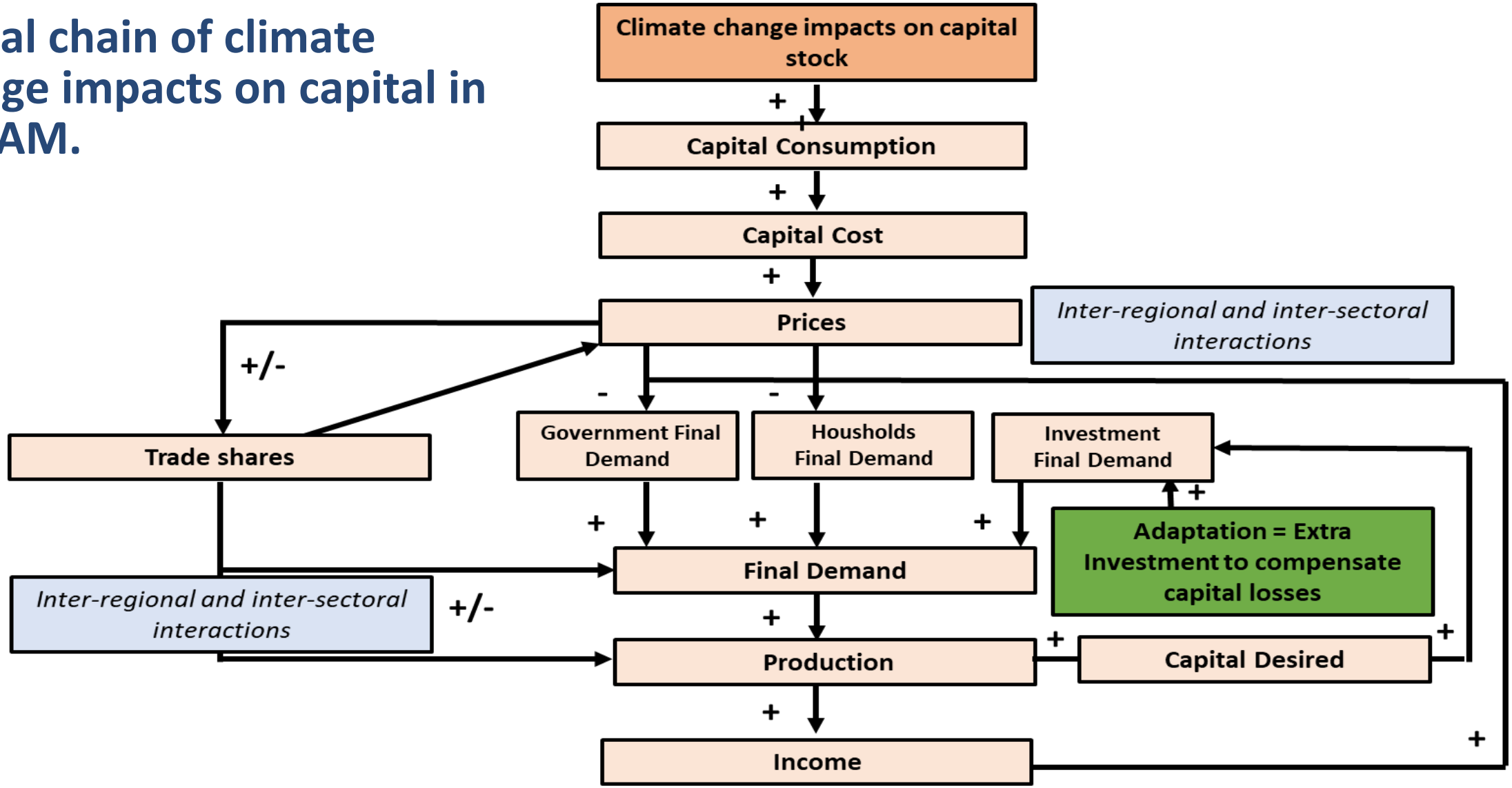
- The 27 EU countries
- 30 sectors representing critical infrastructures
- 3 heat-related extreme weather events (heatwaves, droughts, wildfires)
- 3 uncertainty levels (maximum, minimum and median estimates)

Scenario setting

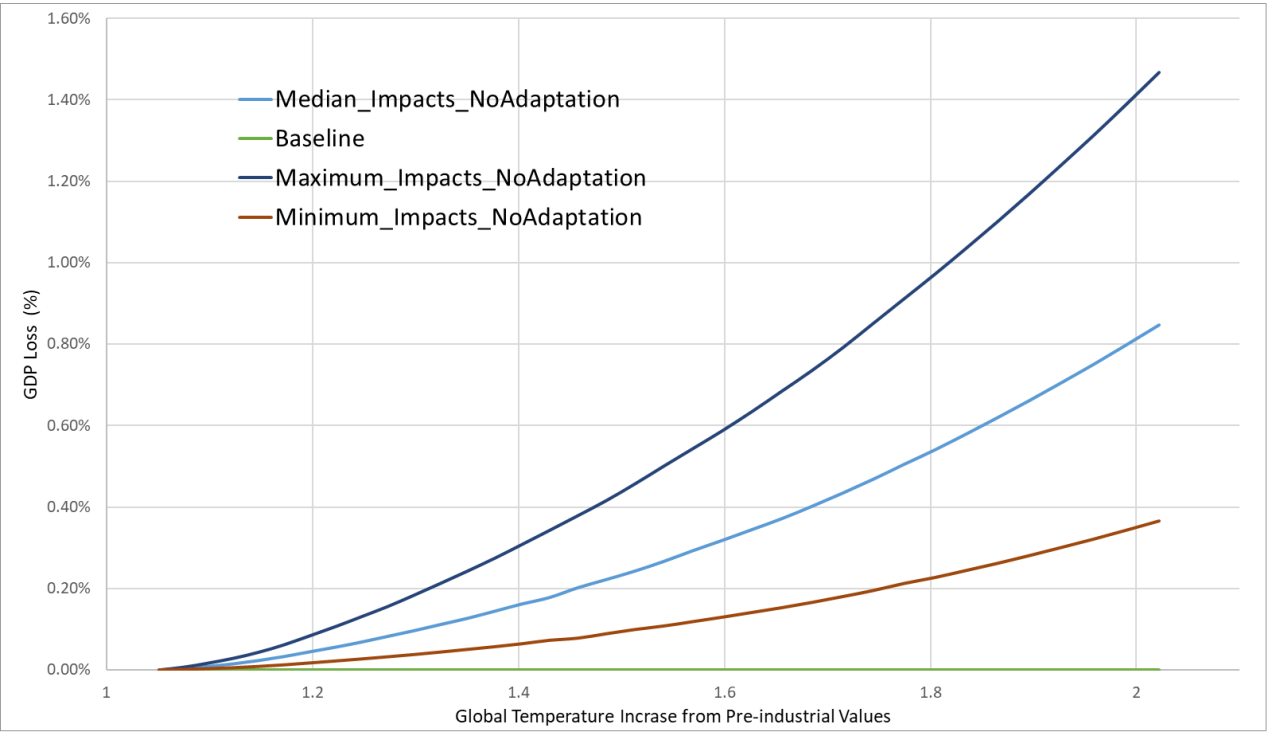
- Here, we only parametrize climate change damages-related parameters, keeping other parameters constant, and we run the economic module alone keeping the exogenous inputs from other modules exogenous. In this way, we isolate net climate change impacts on the economy.
- Thus, we consider the following six scenarios:

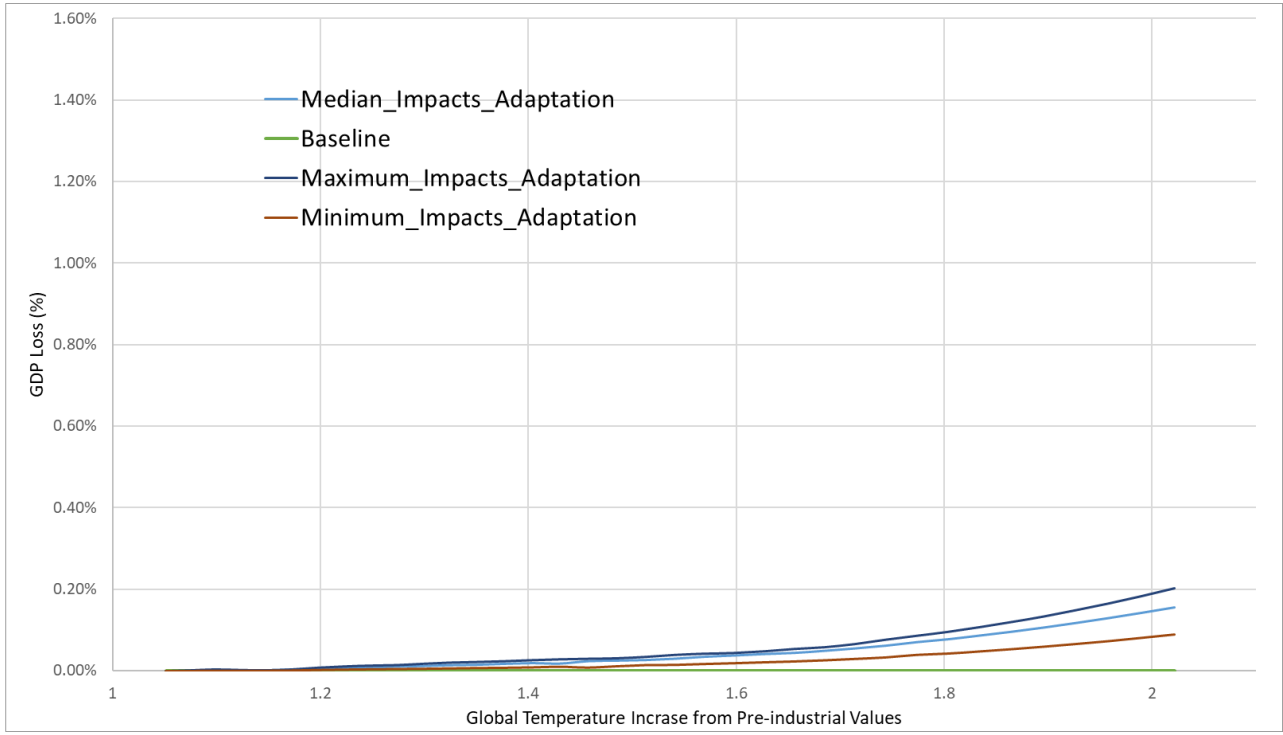
Scenario	Direct Impacts Uncertainty	Adaptation (Recovery)
Scenario 1	Median Impacts	No
Scenario 2	Median Impacts	Yes
Scenario 3	Maximum Impacts	No
Scenario 4	Maximum Impacts	Yes
Scenario 5	Minimum Impacts	No
Scenario 6	Minimum Impacts	Yes

Causal chain of climate change impacts on capital in WILIAM.



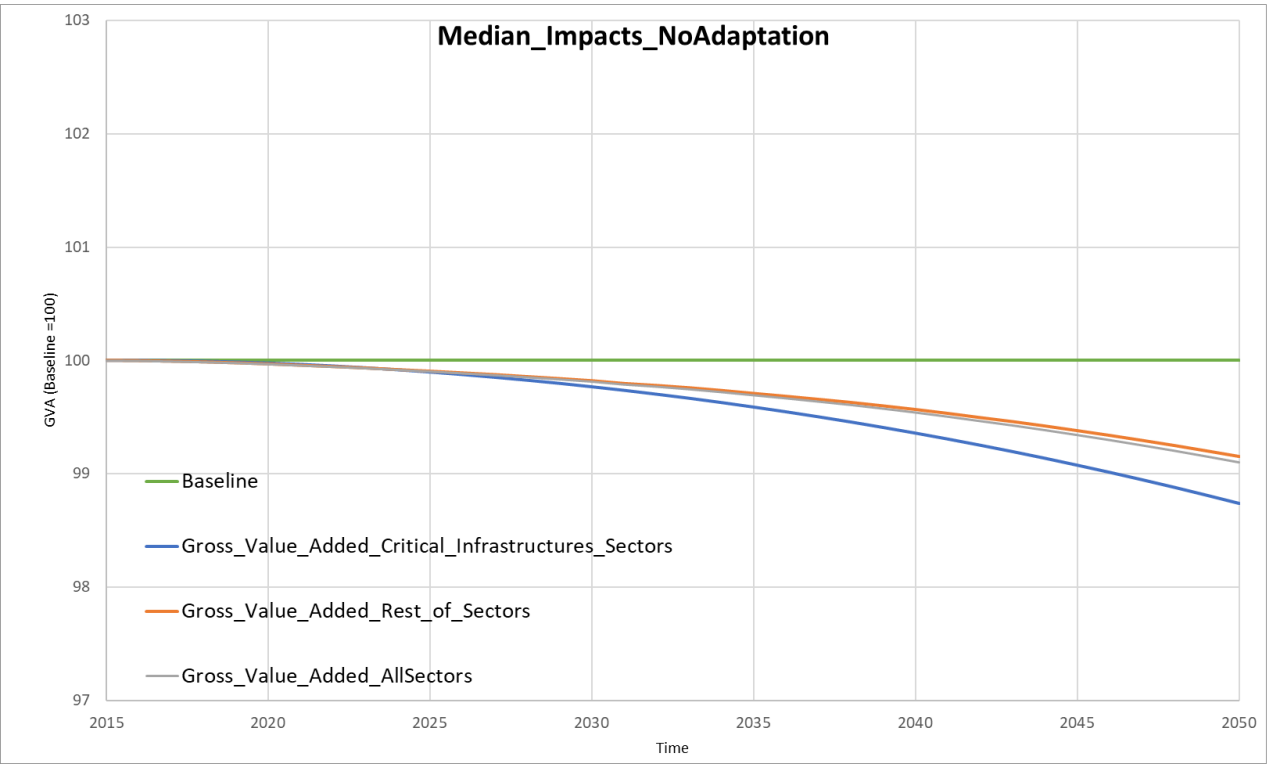
Preliminary results

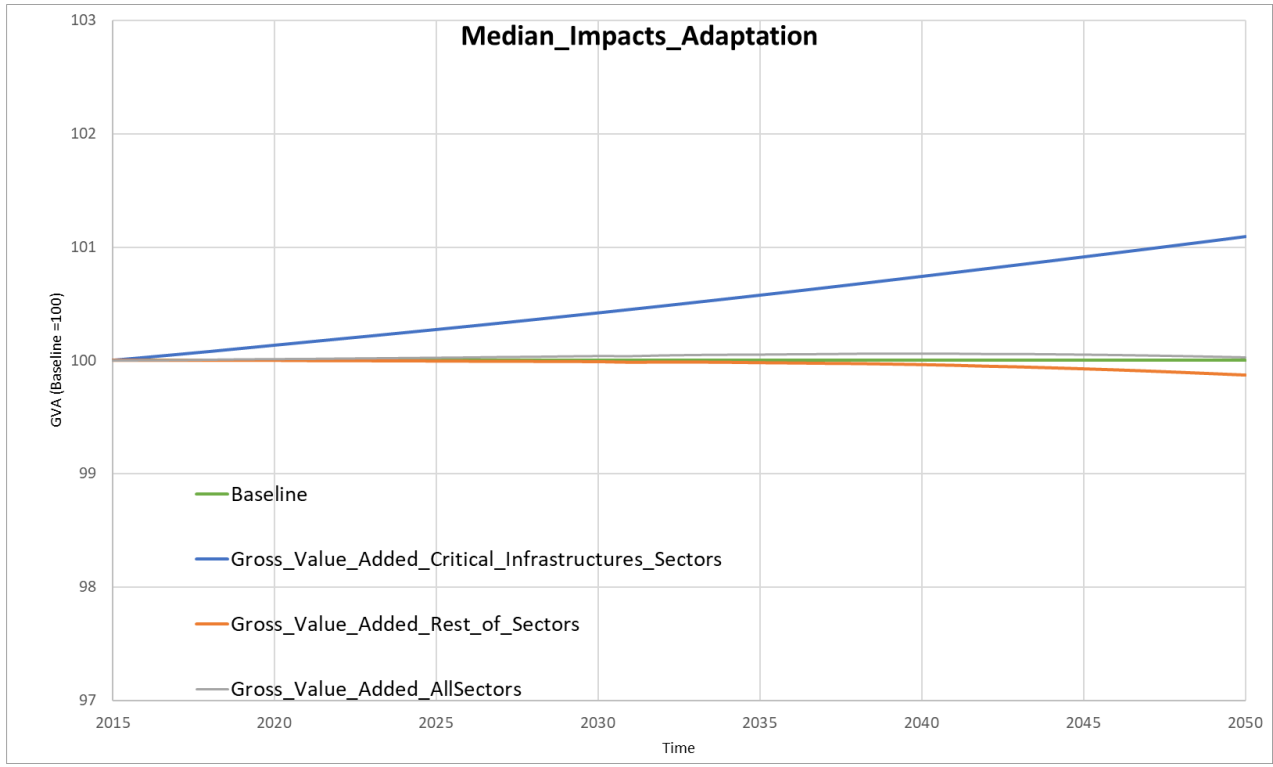




Emerging damage functions representing the EU-27 GDP losses (in real terms) due to heat-related EWEs impacts on critical infrastructures under different scenarios.

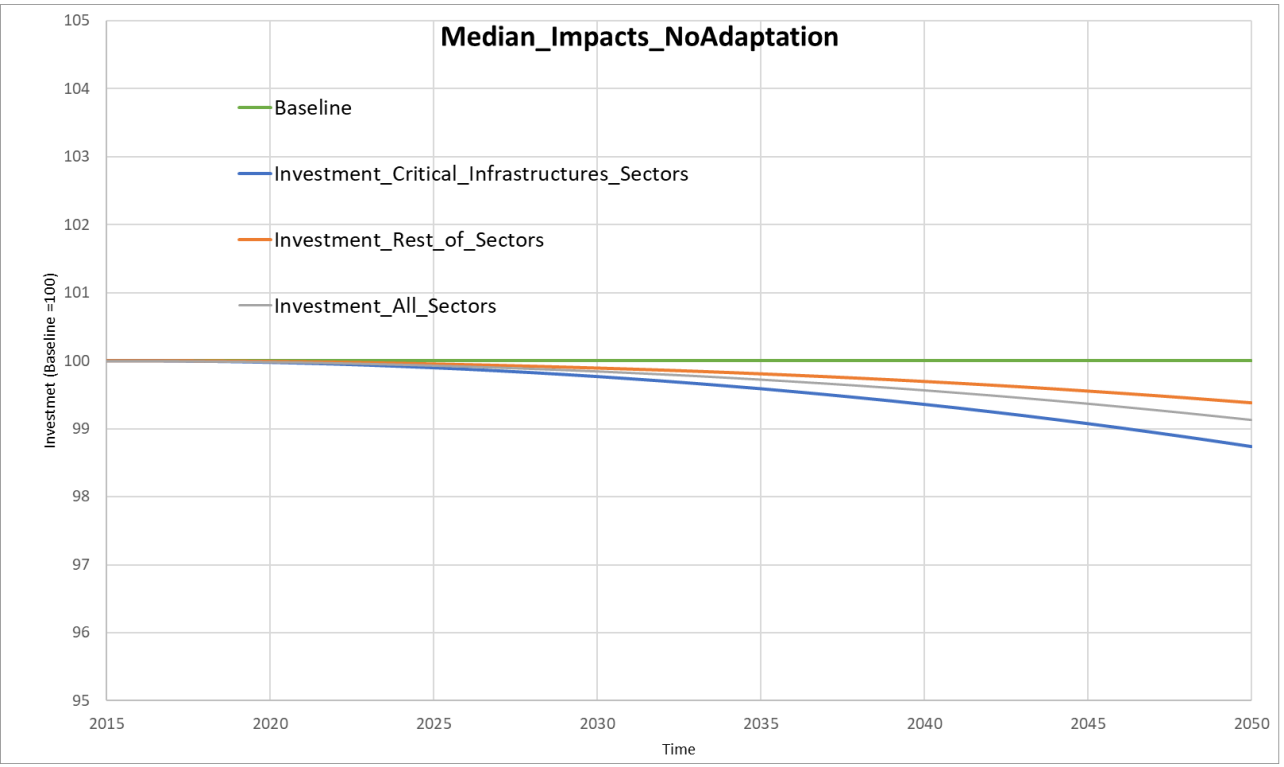
Preliminary results

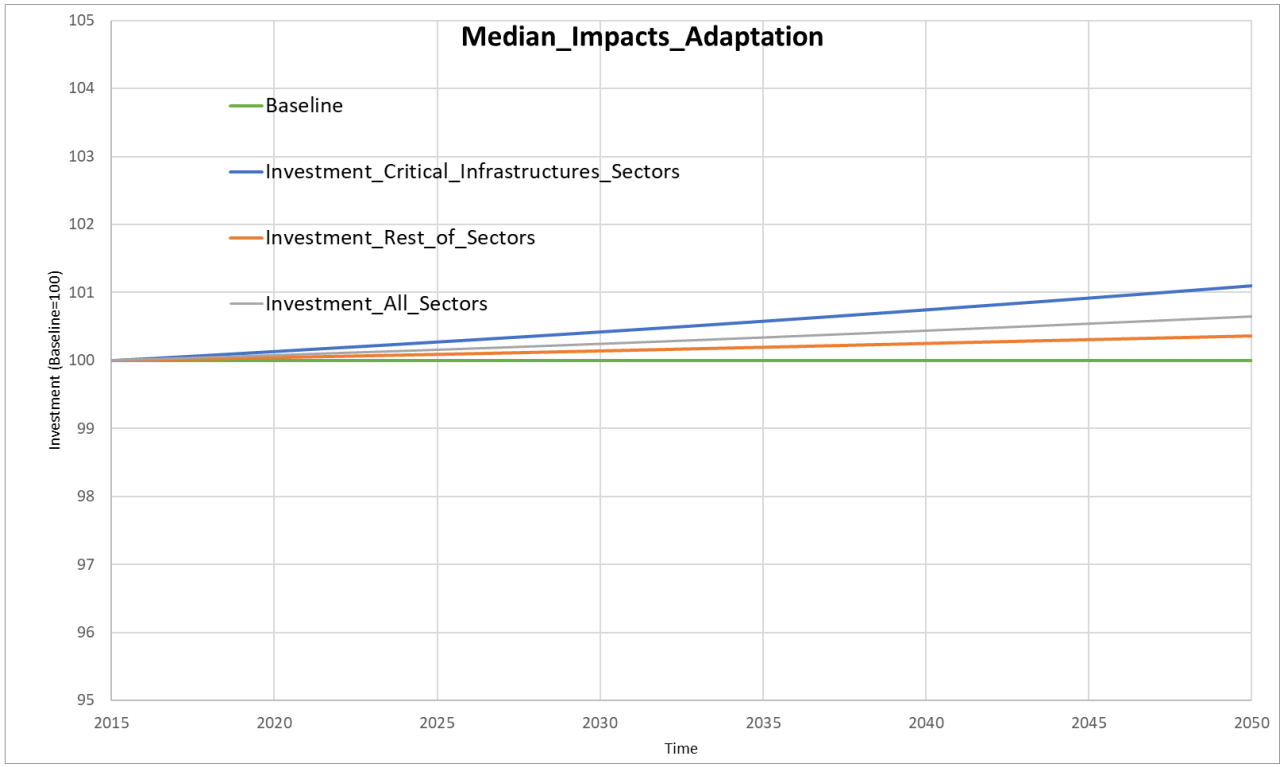




Climate change impacts on Gross Value Added (in real terms and expressed as changes from the baseline in base 100) under different scenarios.

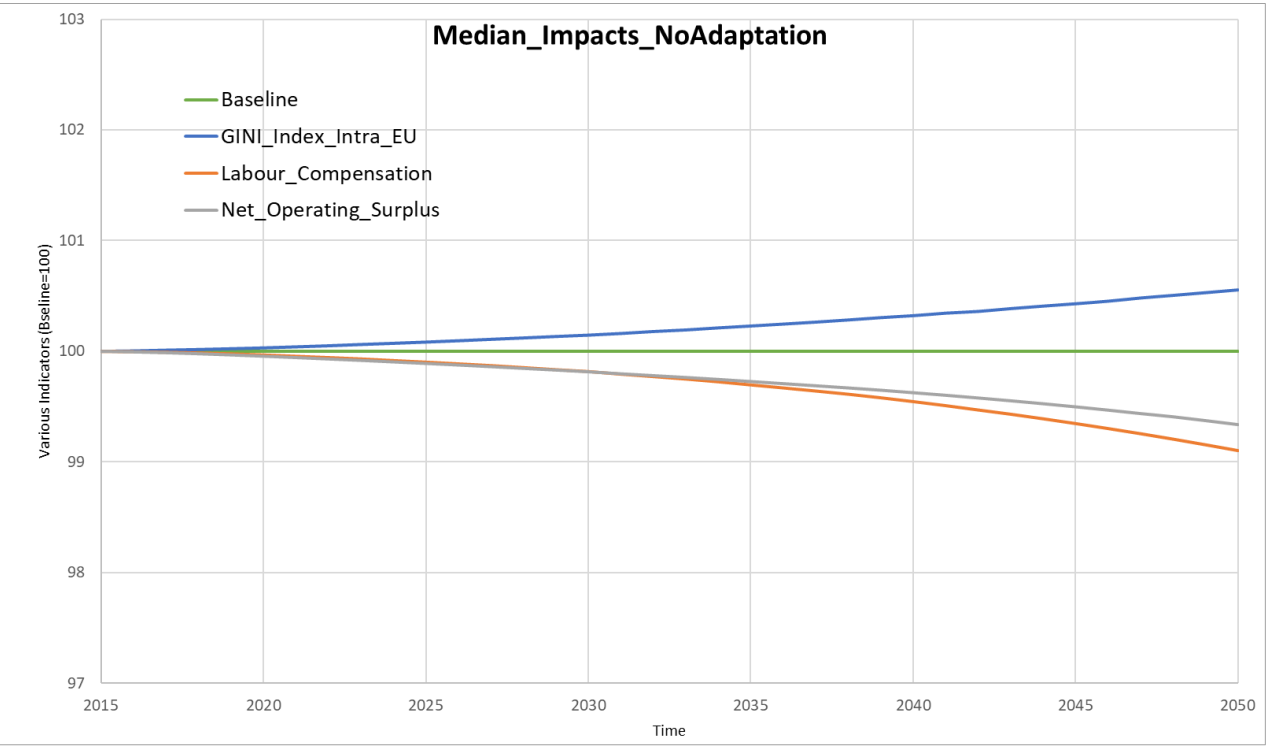
Preliminary results

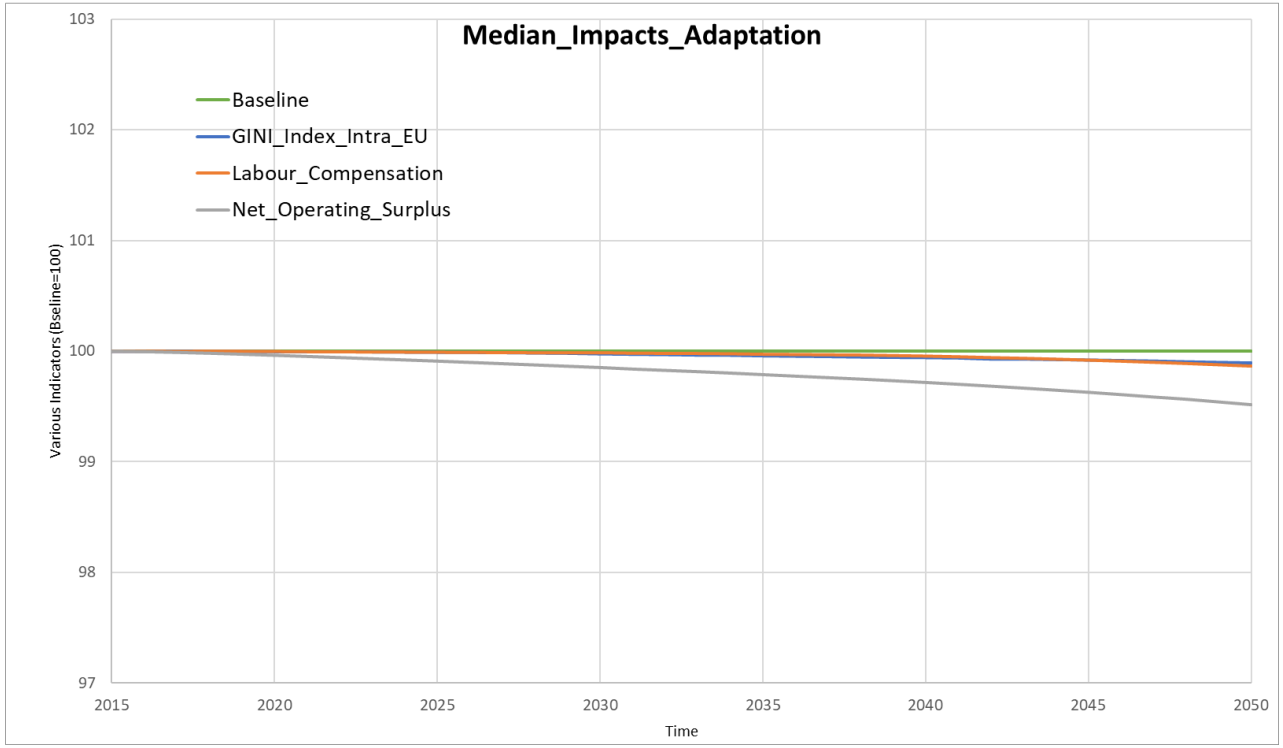




Climate change impacts on Investment (in real terms and expressed as changes from the baseline in base 100) under different scenarios.

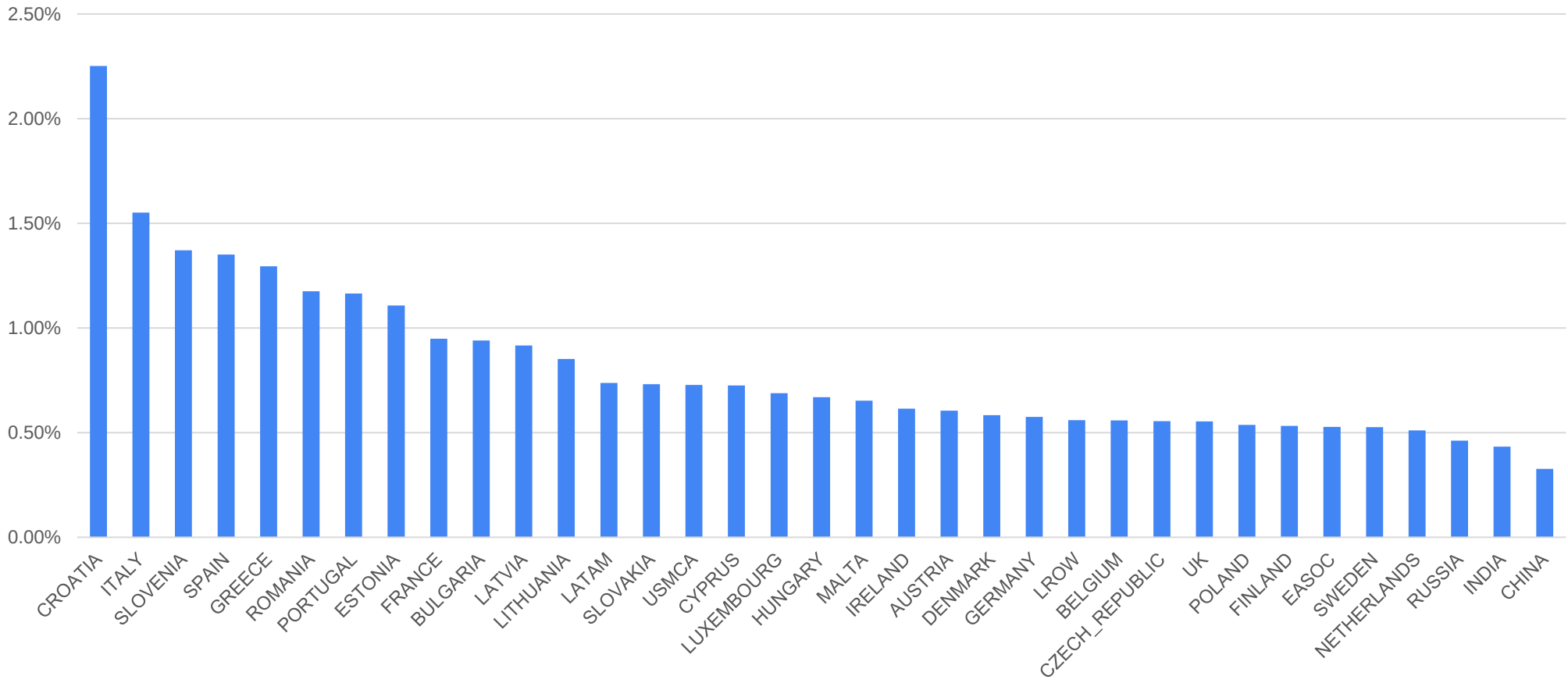
Preliminary results





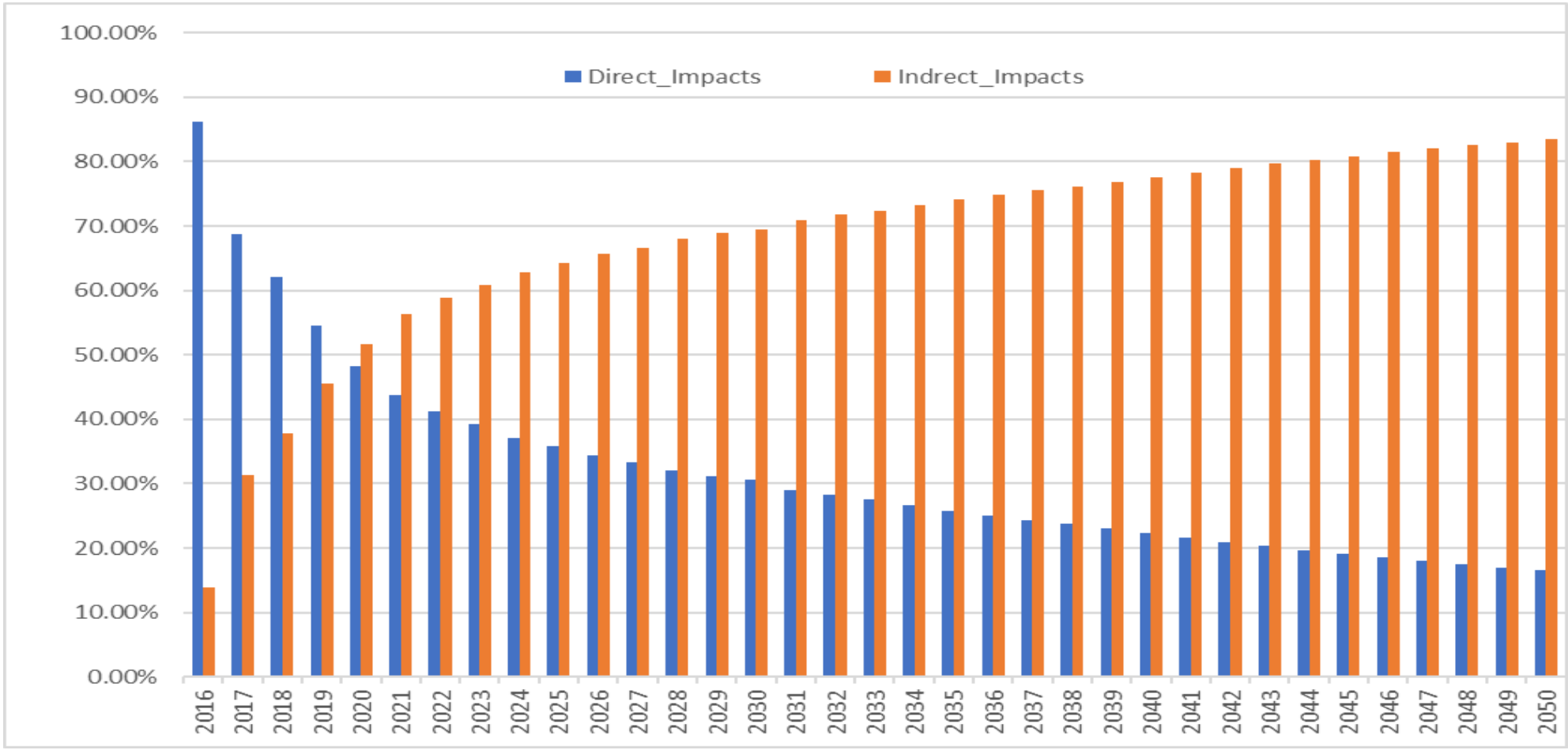
Climate change impacts on Inequality Indicators (in real terms and expressed as changes from the baseline in base 100) under different scenarios.

Preliminary results



Losses in regional GDP when ΔT= 2°C in a Median_Impacts_NoAdaptation scenario.

Preliminary results



Contribution of direct and indirect impacts to total loss of GDP in a Median_Impacts_NoAdaptation scenario.

Final Remarks

- Macroeconomic GDP losses hides very interesting (both positive and negative) effects in regional, sectoral and distributional terms, with high differences regarding the assumptions on recovery or not.
- GDP losses may be higher in areas not directly affected by climate change due to cross-border impacts.
- Limitations: the WILIAM model only captures the indirect effects of capital losses via price increase and smooth climate change damages but we are currently not able to capture other effects such as disruptions in supply chains due to infrastructures failures.
- Further work: including new climate change impacts and analysing this jointly with other changes such as energy scarcity, demographic changes or policy changes to create more holistic scenarios.

Thanks for your attention ☺

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