International Institute for Applied Systems Analysis
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science for global insight

Interactions across impact sectors Energy-Water-Land/Food "Nexus"

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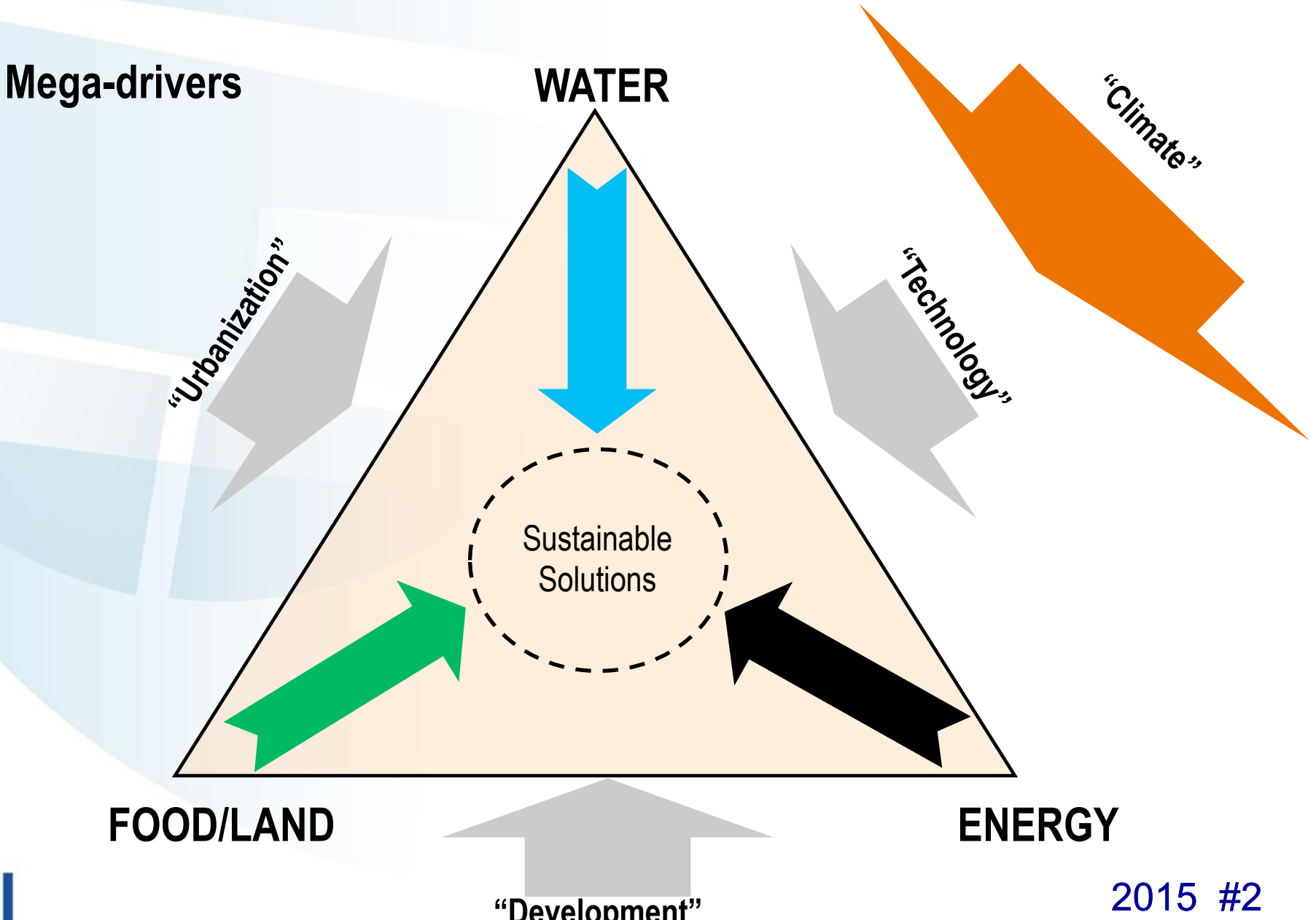
IIASA & TU Graz

EMF Workshop on Climate Change Impacts and Integrated Assessment

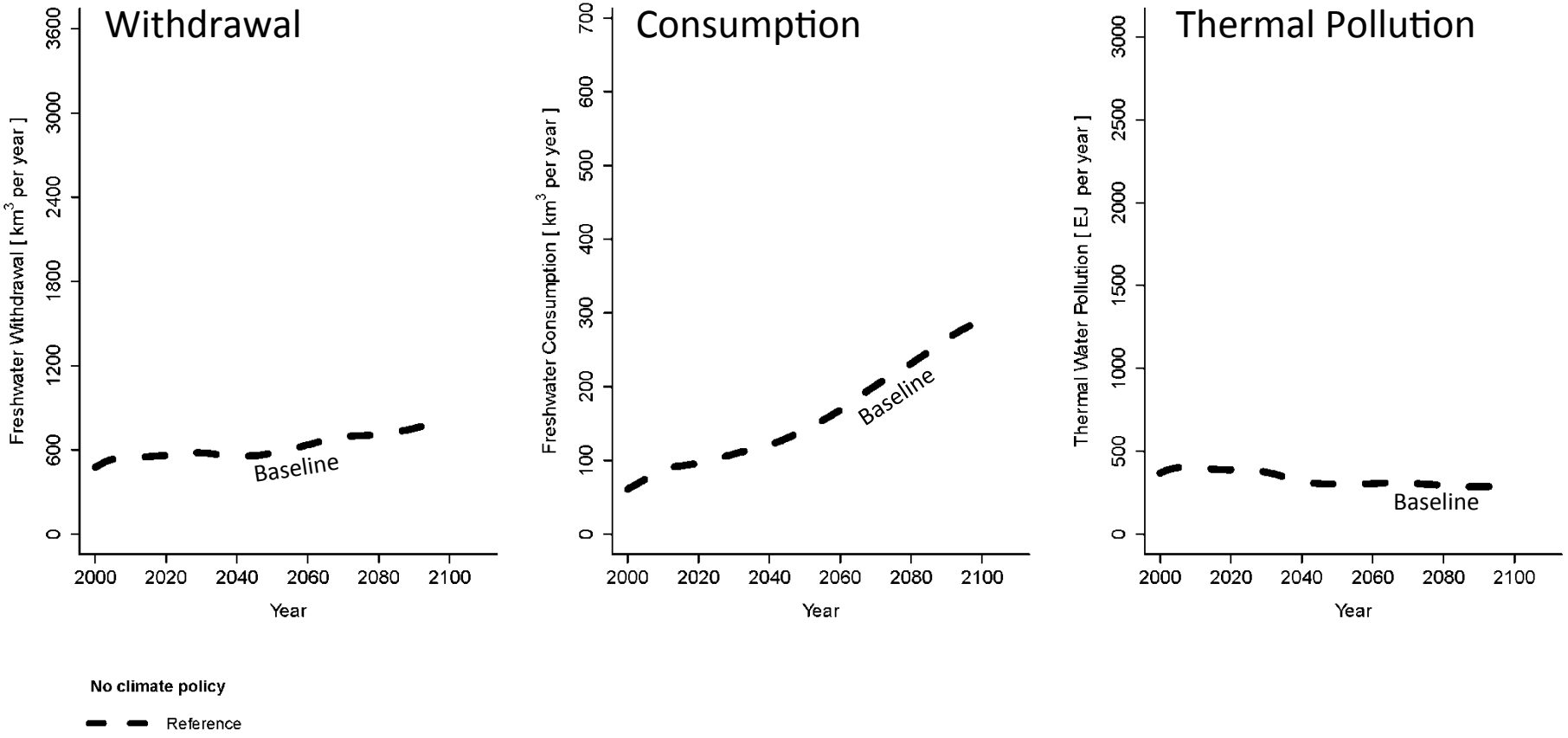
Snowmass, 21-31 July, 2015

Energy-Water-Land Interactions



Impact of Energy Sector on Water

(Fricko, Parkinson et al, forthcoming)



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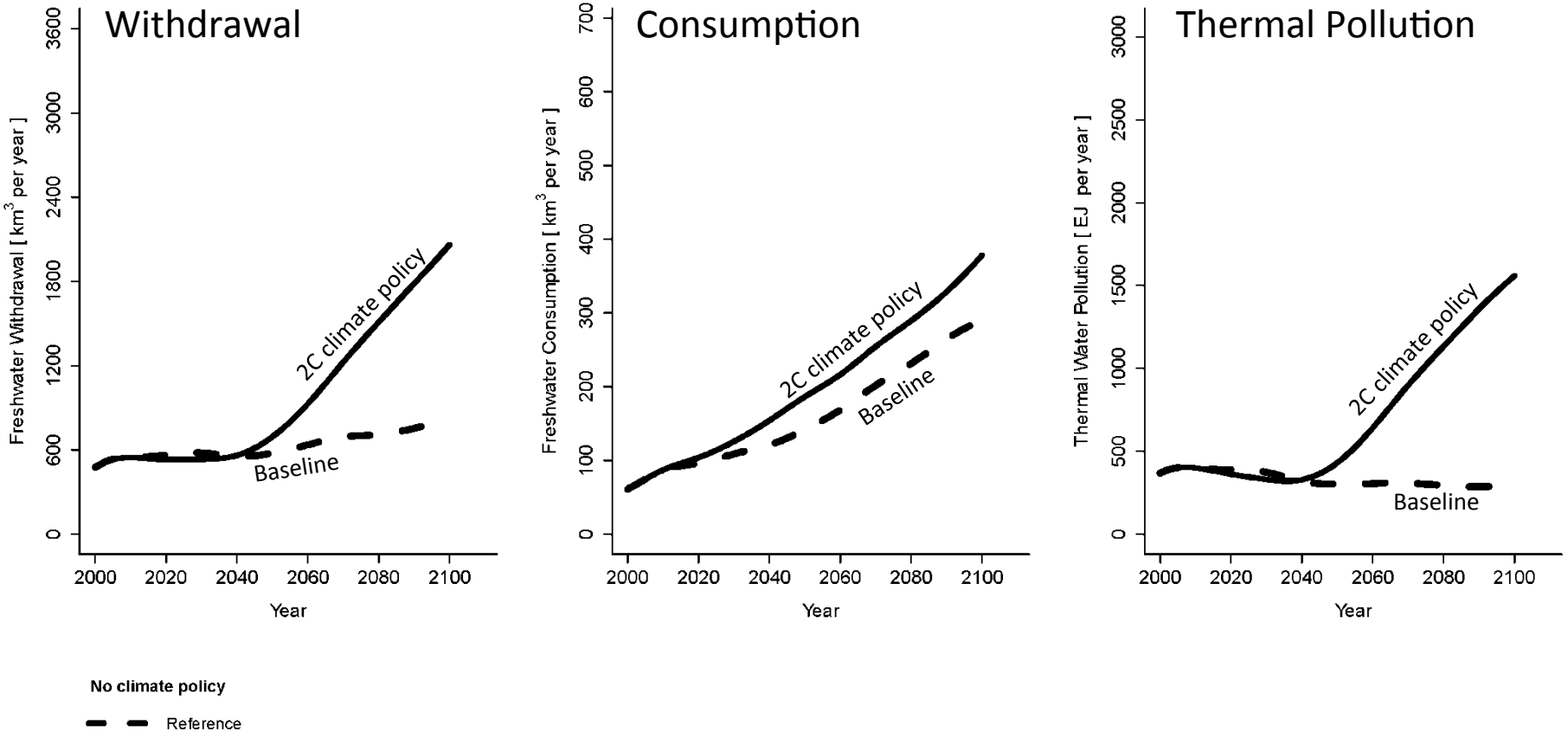

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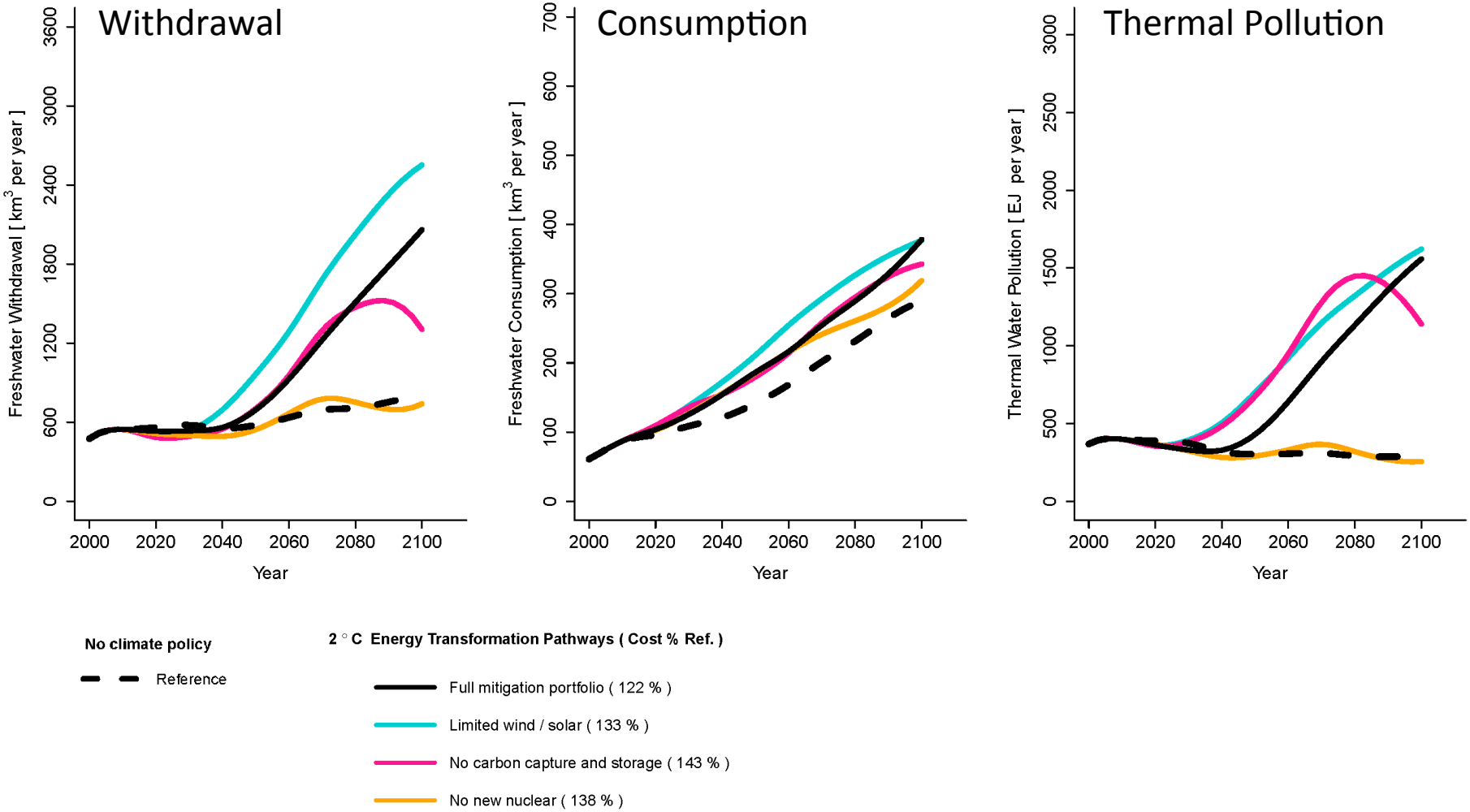
Alternative Technology Choices for 2C



Impact of Energy Sector on Water

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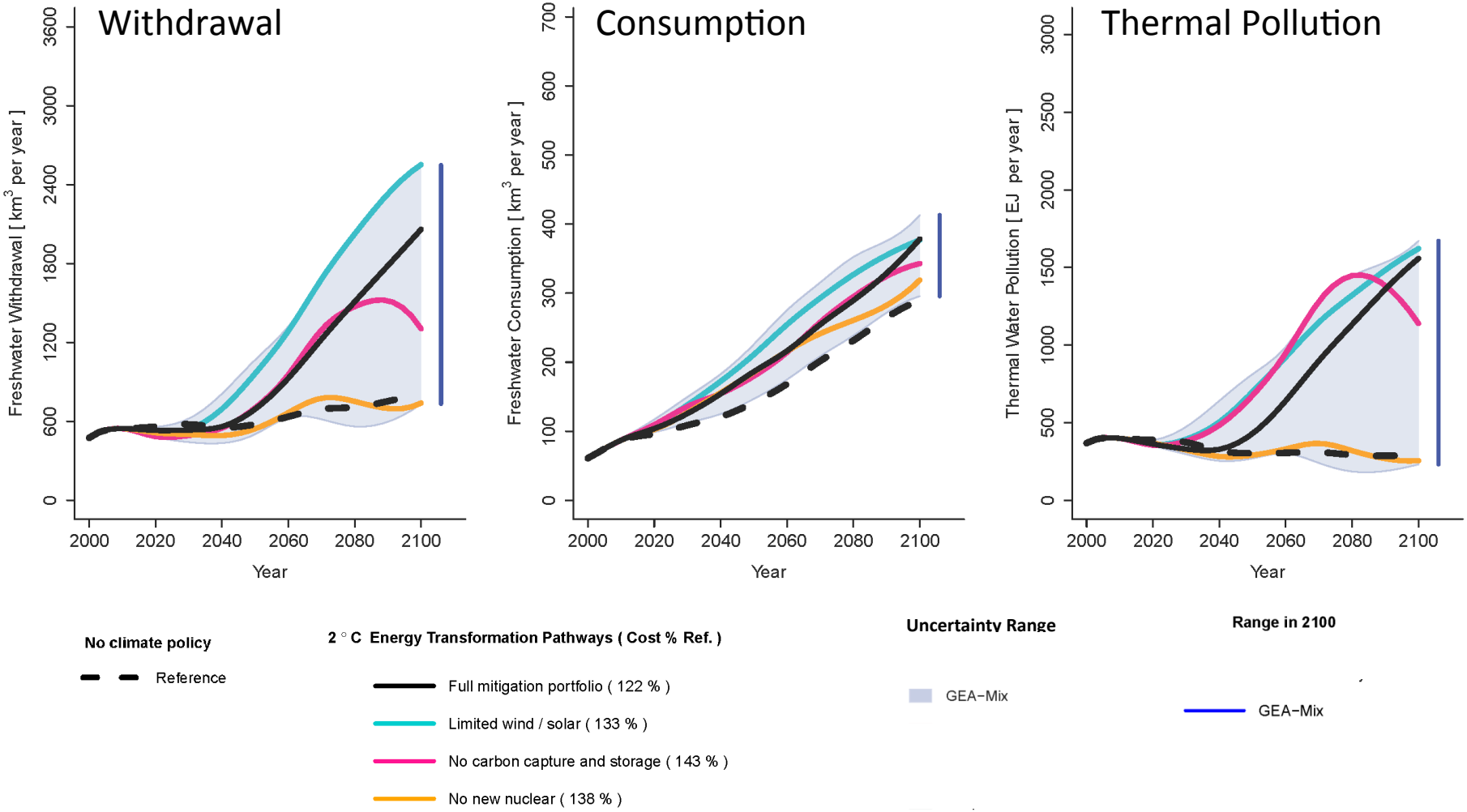
Alternative Technology Choices for 2C (intermediate energy demand range)



Impact of Energy Sector on Water

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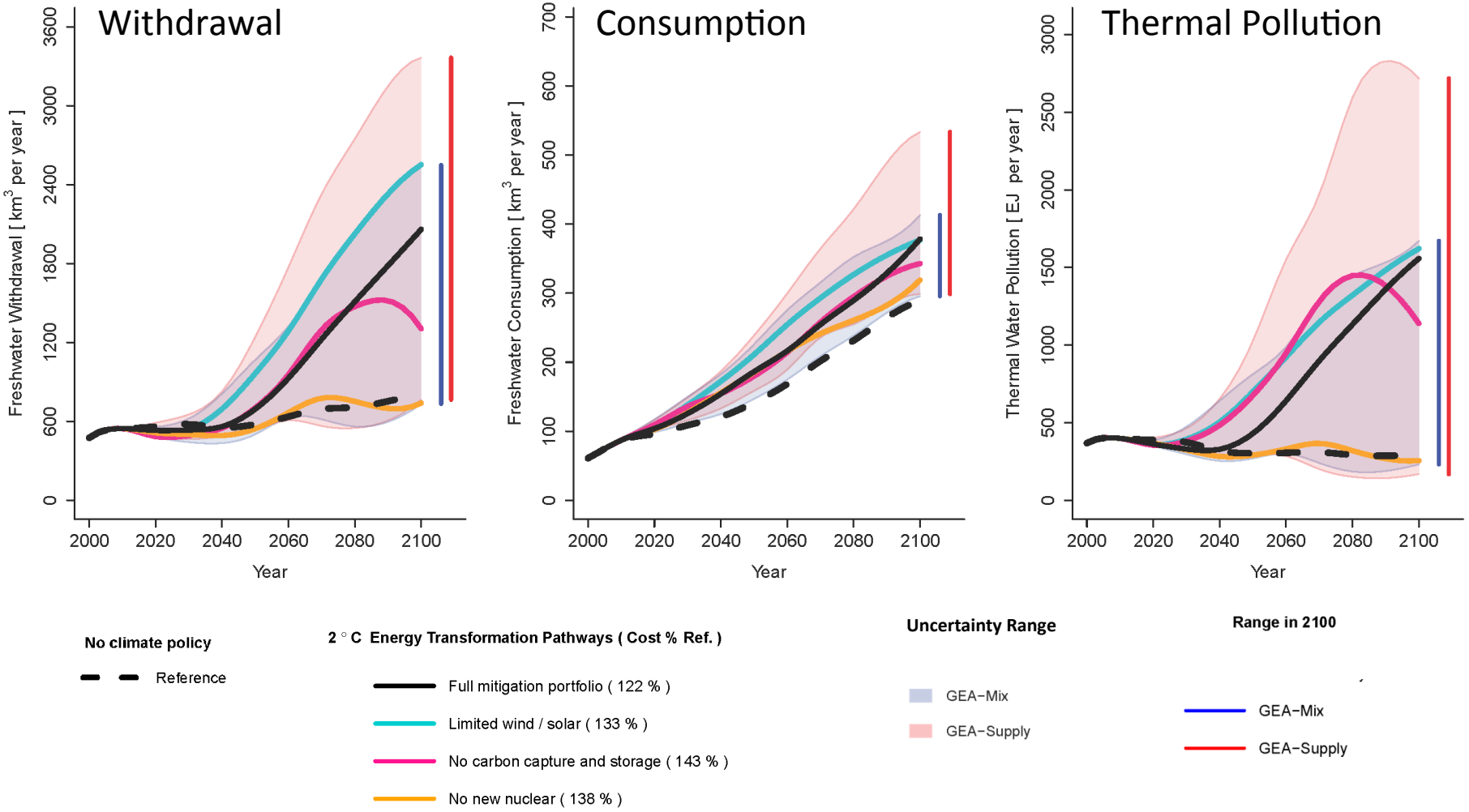
High Energy Demand



Impact of Energy Sector on Water

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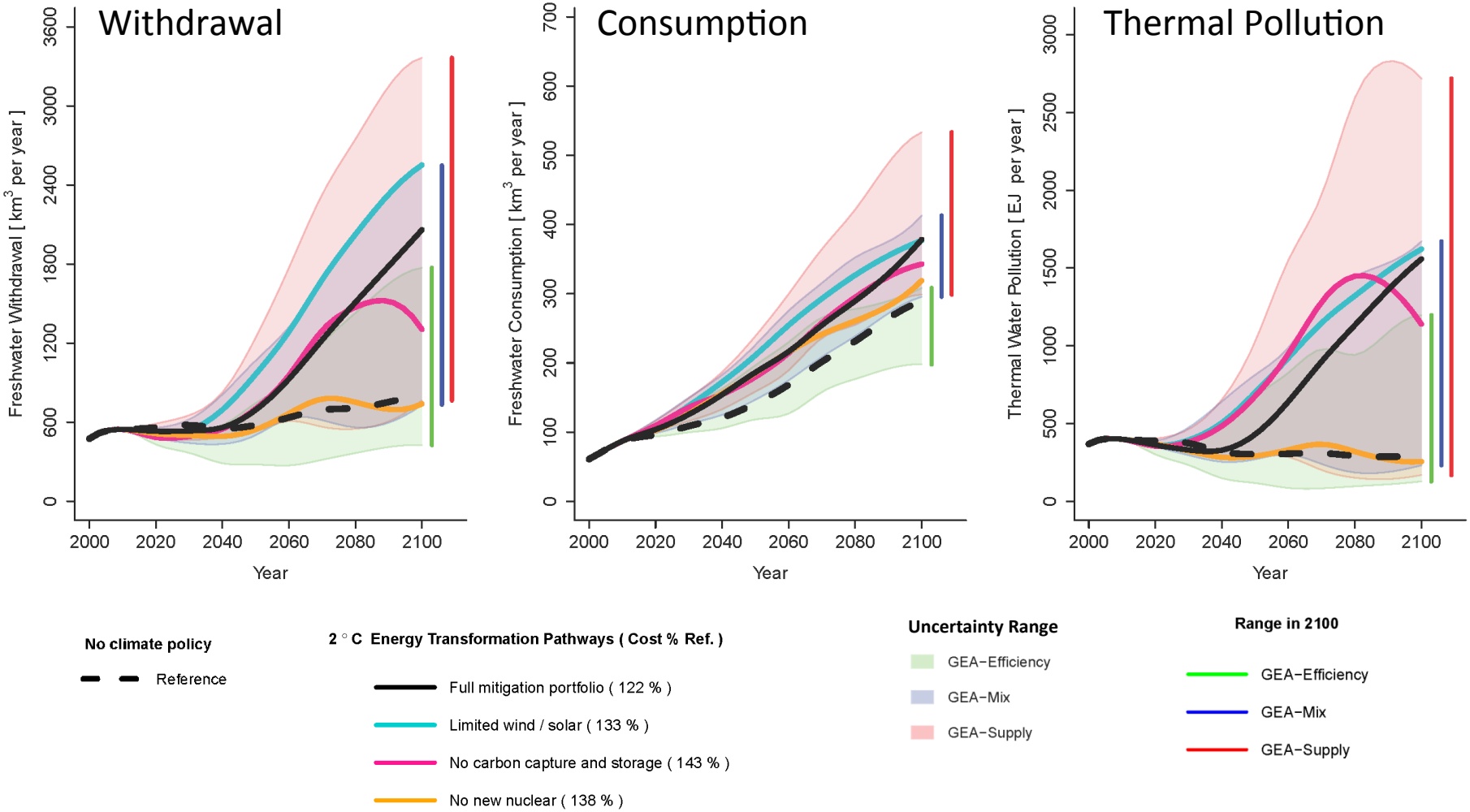
Low Energy Demand (Efficiency!)



Impact of Energy Sector on Water

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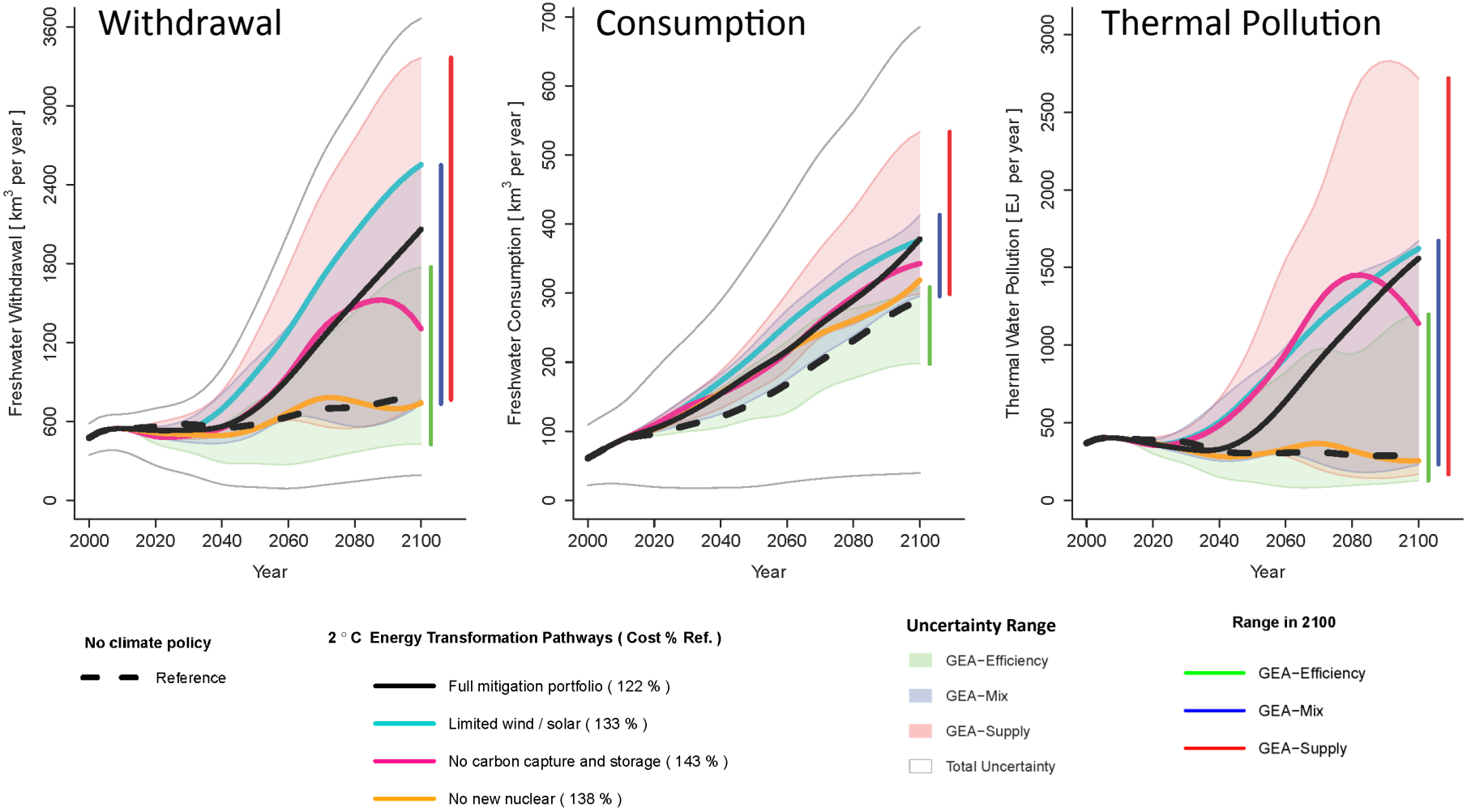
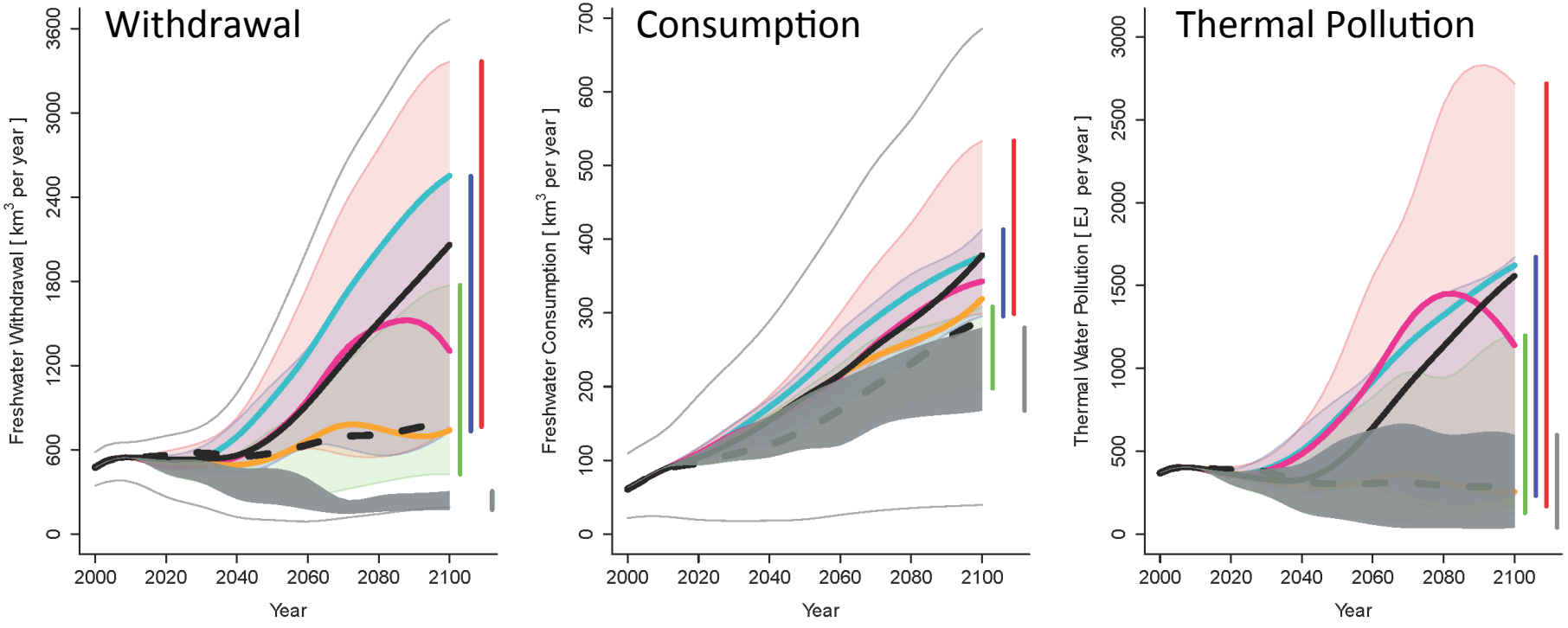


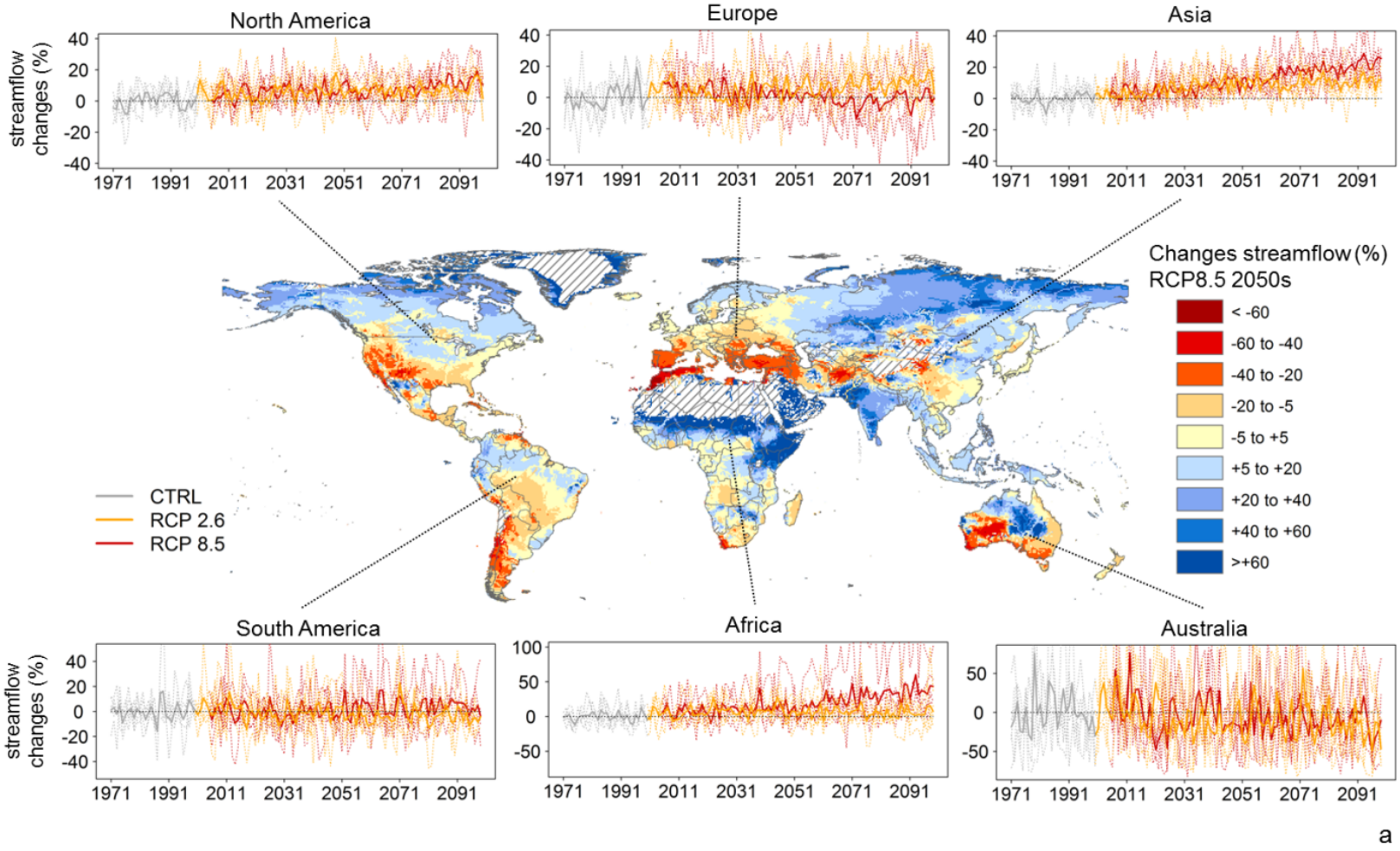
Impact of Energy Sector on Water

(Fricko, Parkinson et al, forthcoming)

Efficiency + Water Adaptation Policies

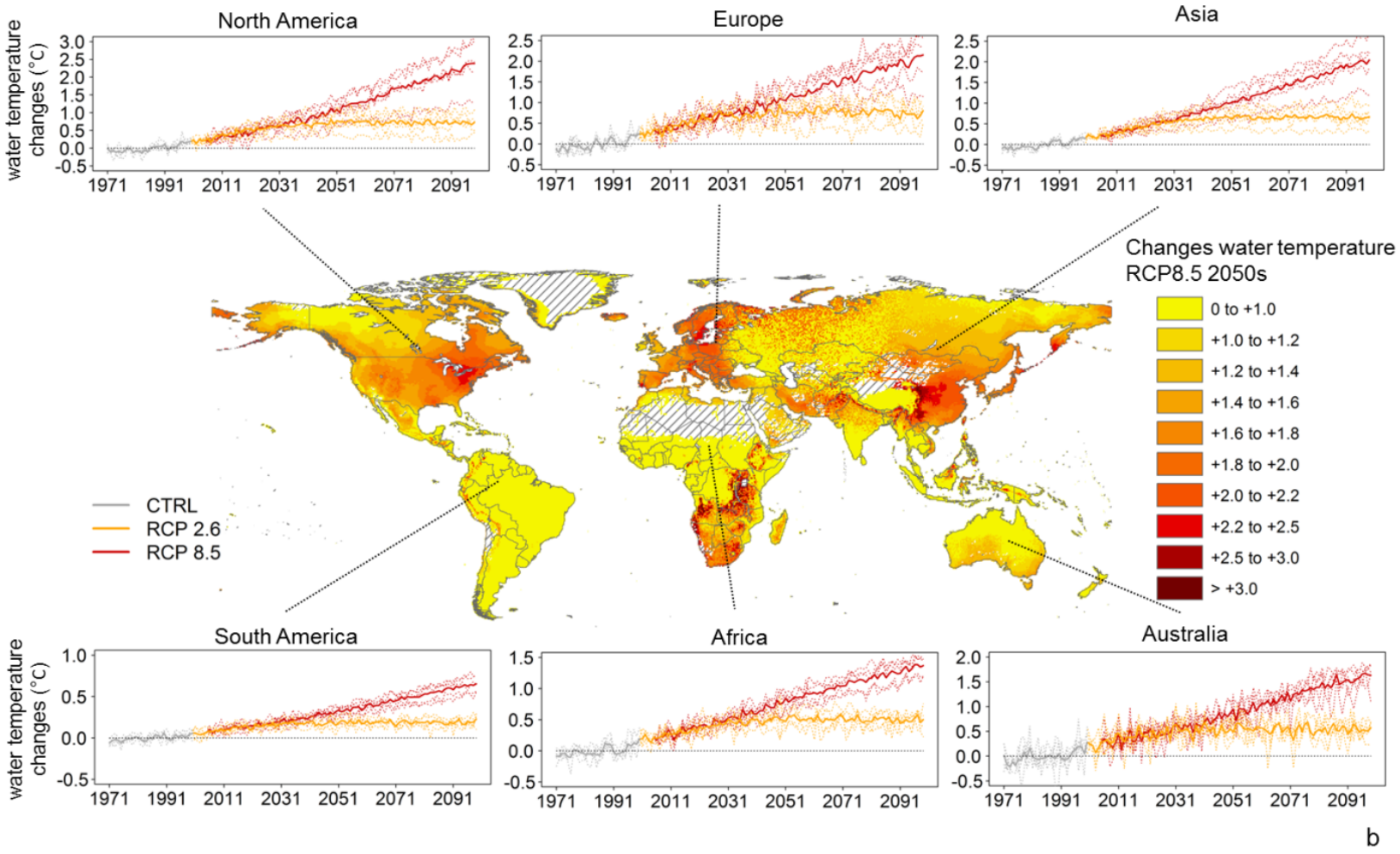


Climate → Water → Energy (1) Streamflow



van Vliet et al., in review (do not cite or quote)

Climate → Water → Energy (2)
Water temperature



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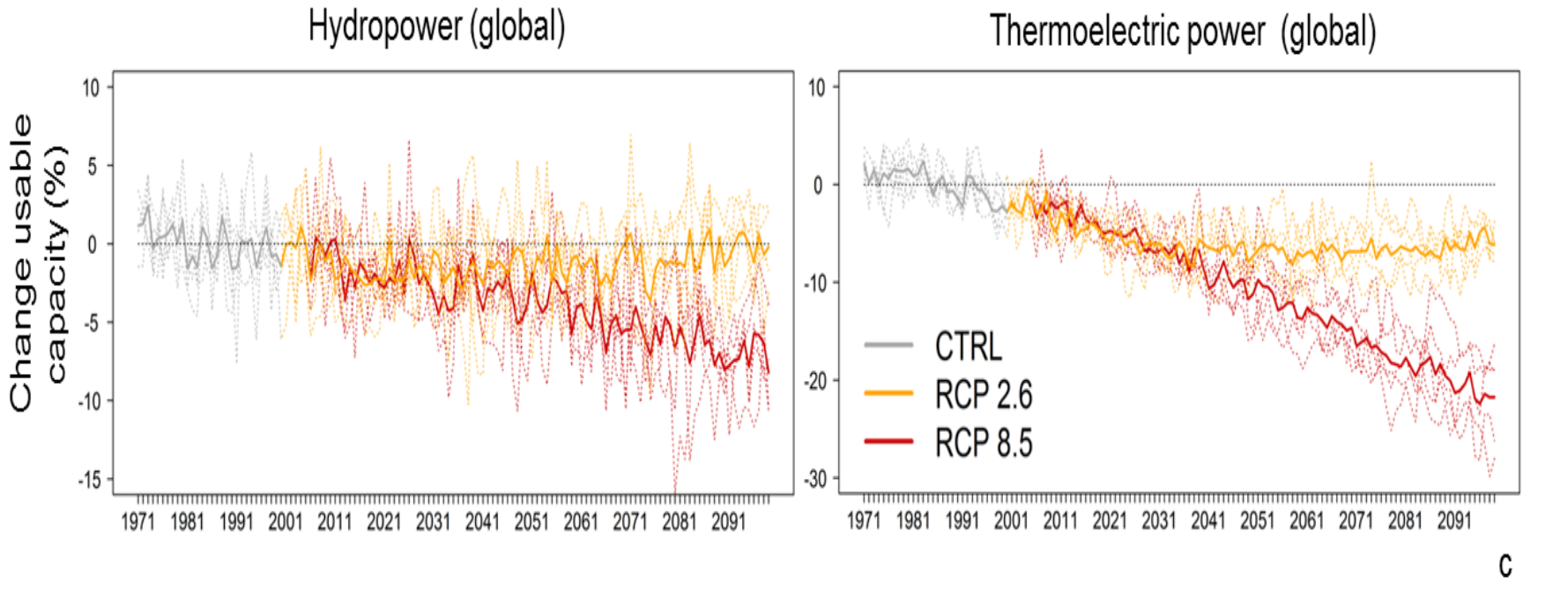
Impact on Global Power Generation Capacity



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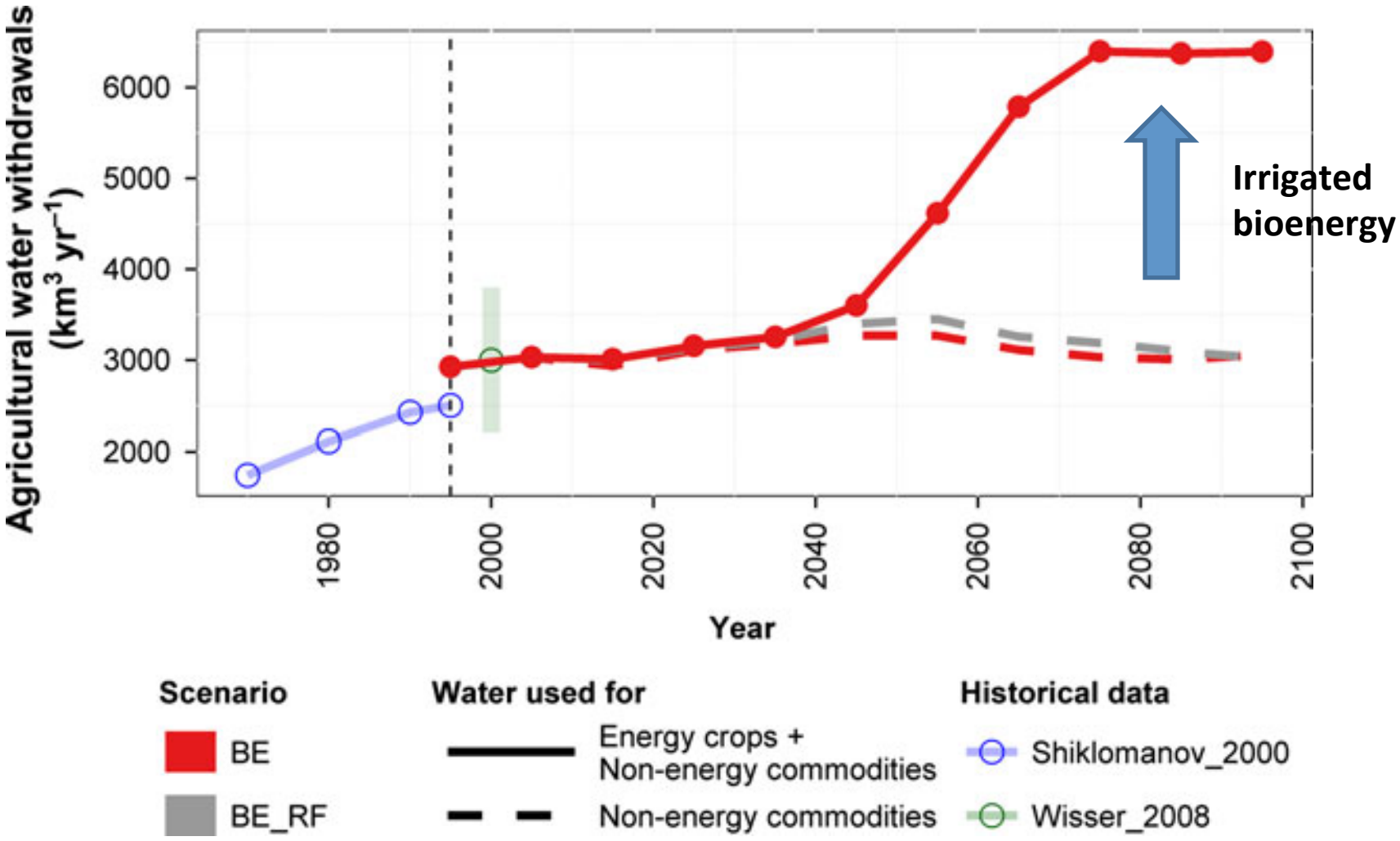
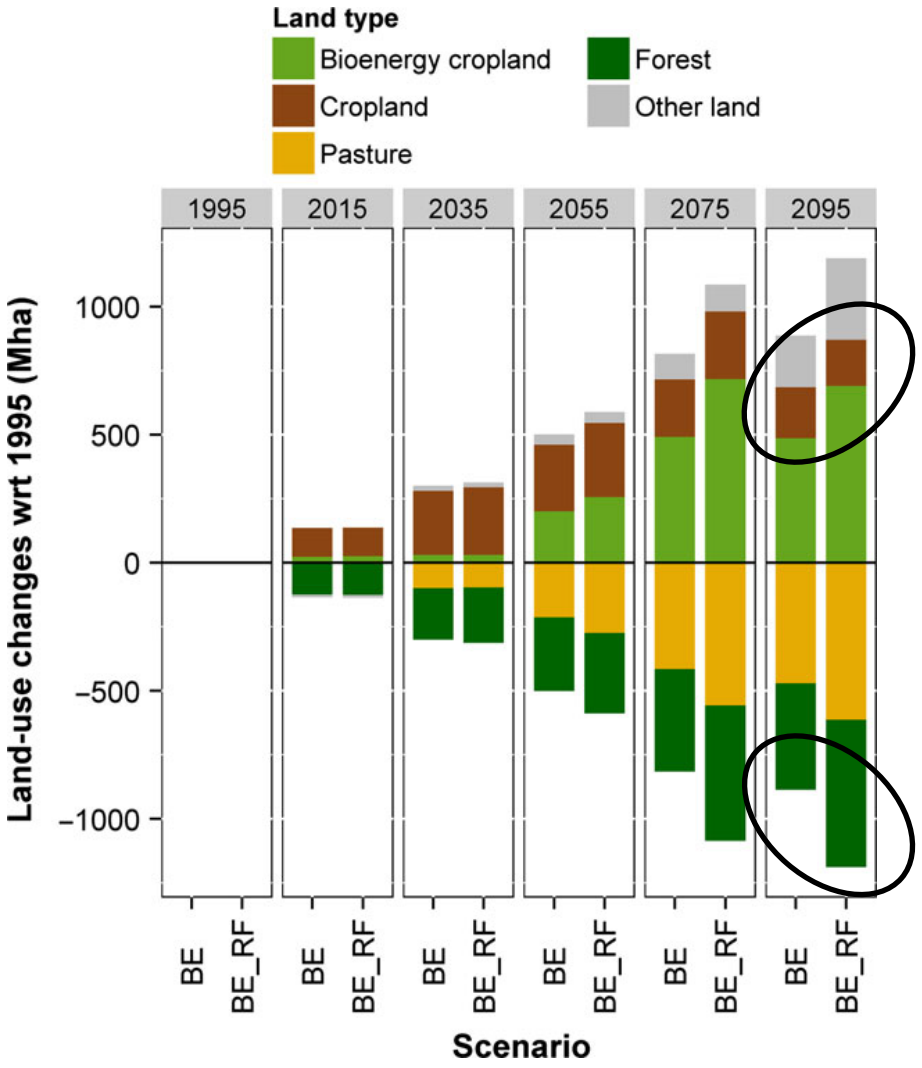
Water-(bio)Energy-Land Tradeoffs



Bonsch et al, 2014

Land implications
rainfed vs irrigated bioenergy

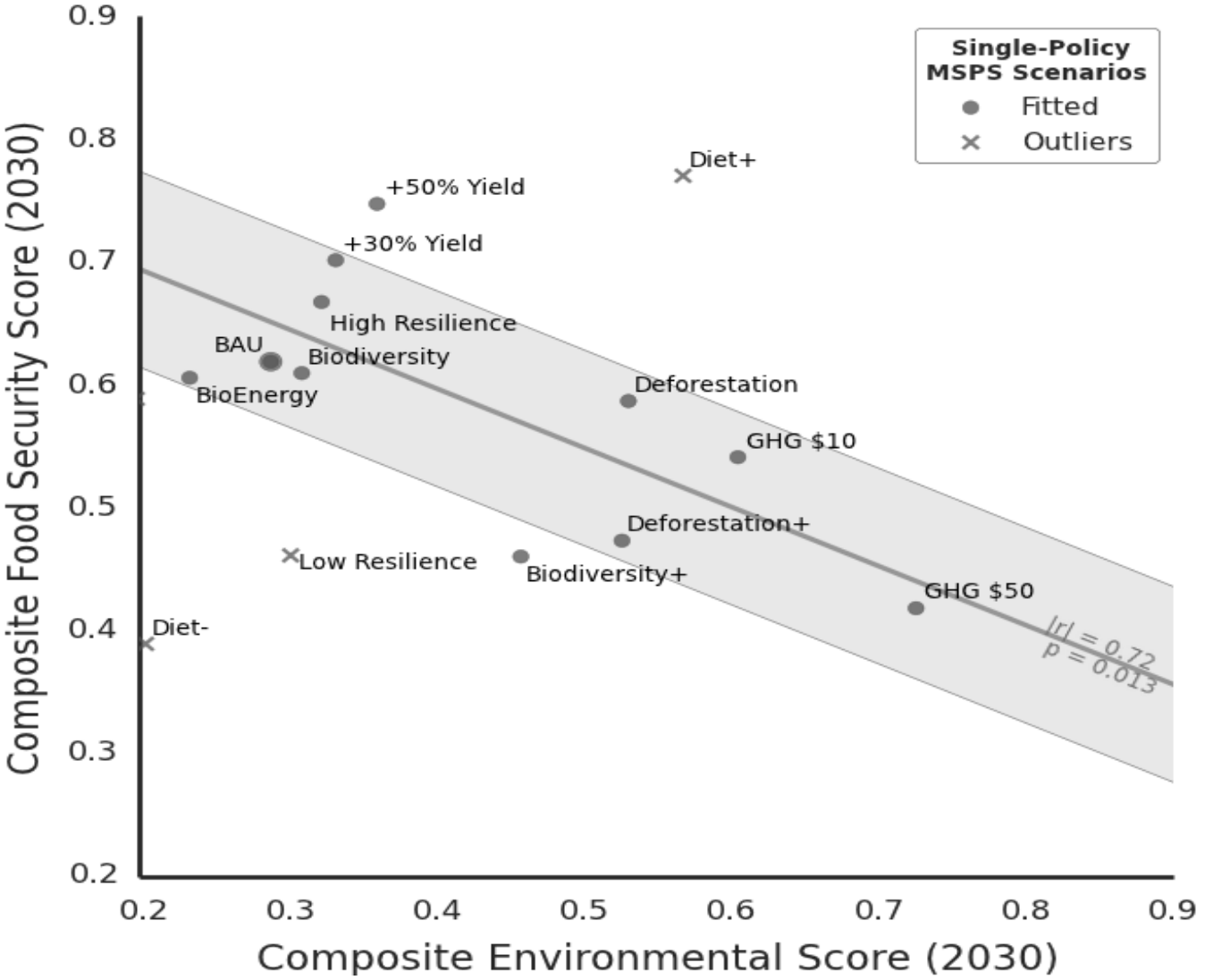


>> pressure on land!

deforestation

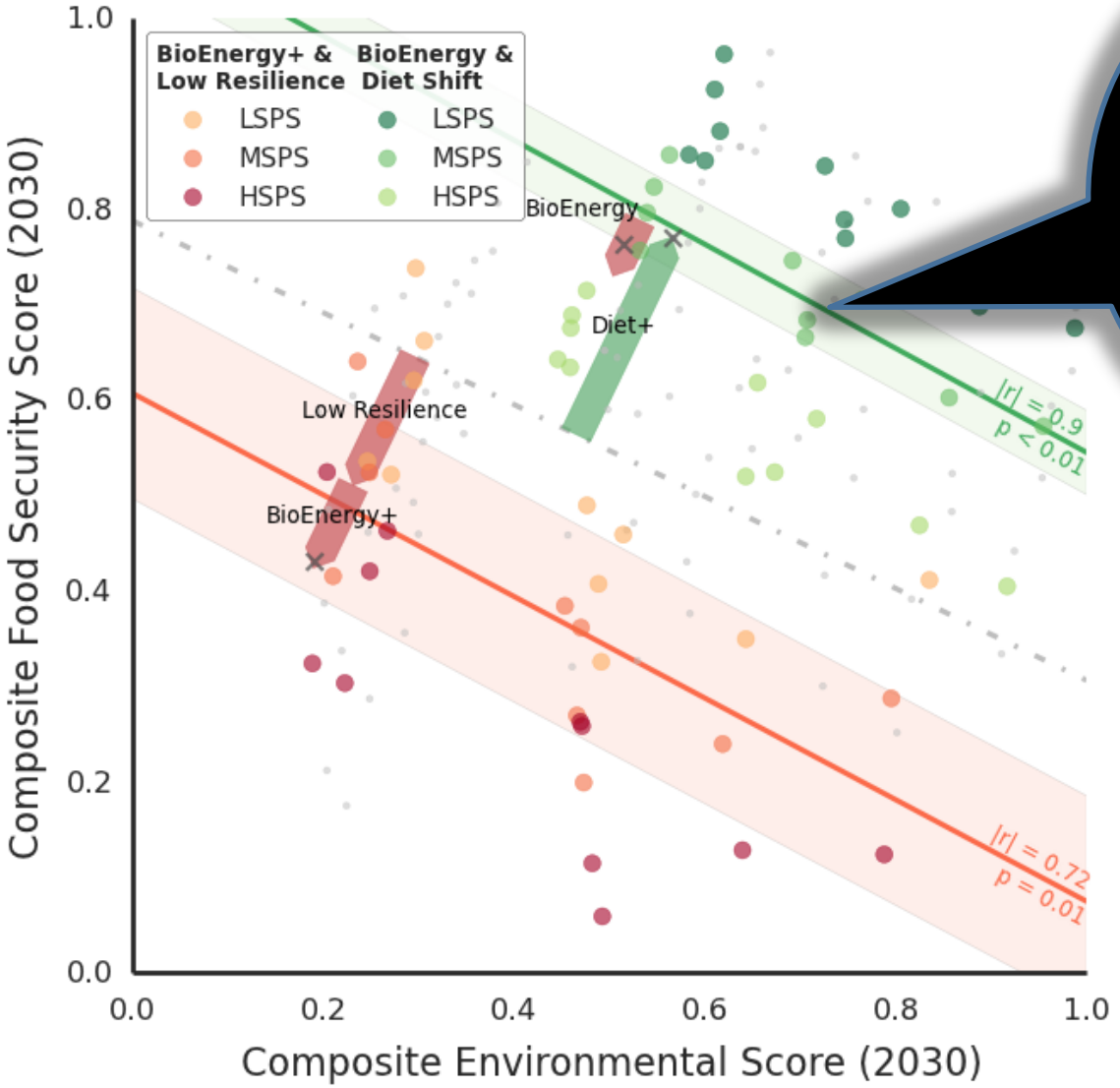
Bonsch et al, 2014

Environment & Food Security Tradeoffs (Land resource nexus)



Source: Obersteiner et al., preliminary – do not cite or quote

Some measures may reduce the overall land pressure



Can't escape the tradeoffs, but can shift the state!

Climate change often acts in a similar way, but opposite direction

Source: Obersteiner et al., preliminary – do not cite or quote

Energy-Water-Land Interactions

Mega-driv

Challenges:

Detailed impact modelling: how to incorporate risks/ opportunities due to cross-sector feedbacks

IAMs:
1) how to bridge/integrate spatial and temporal scales (local infrastr., management options, etc..)
2) Common metric to integrate across sectors

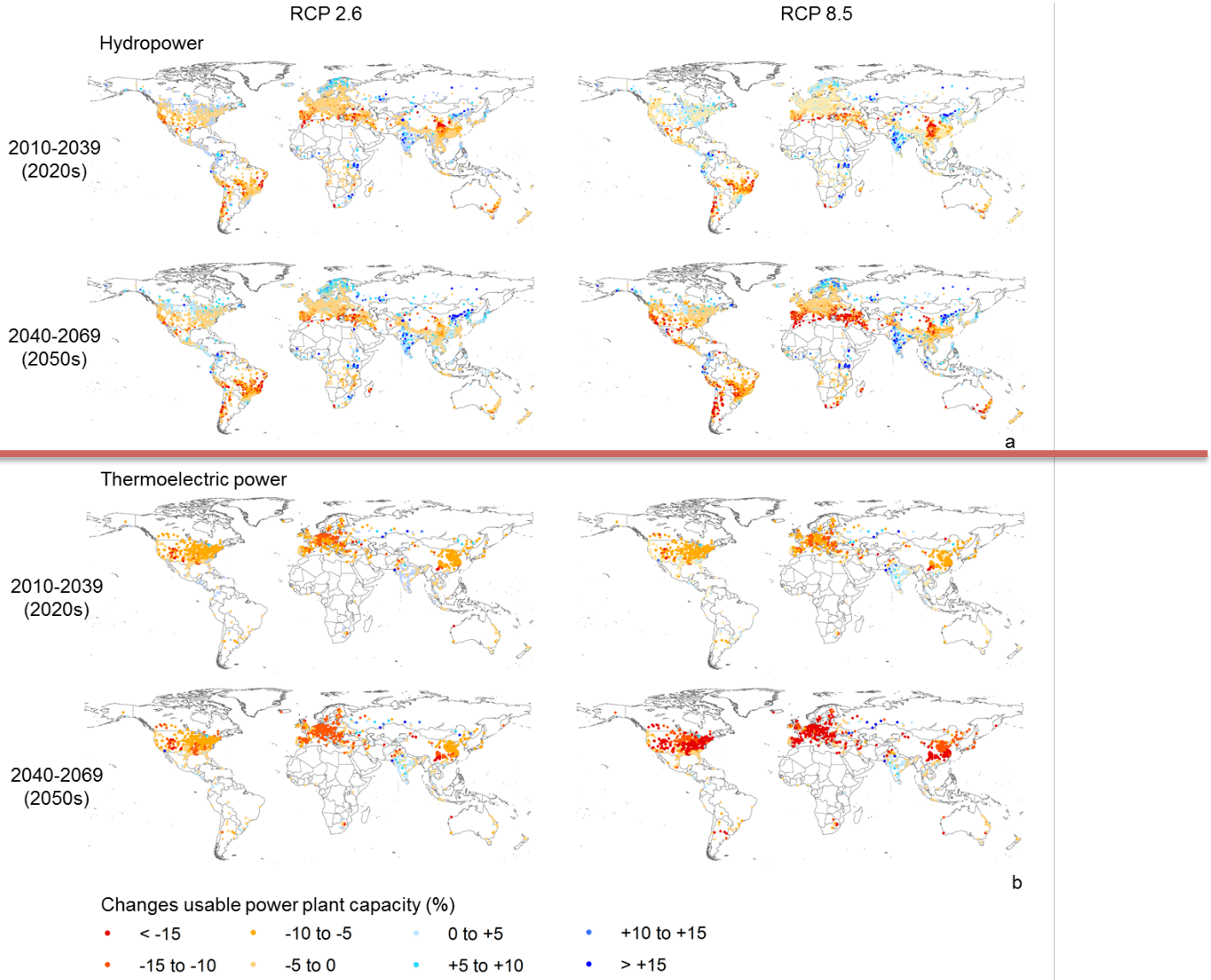
All:
1) Social/distributional impacts (poverty eradication)
2) DATA!! (including extremes, institutional/ governance constraints, etc..)

"Climate"

FOC GY

"Development"

THANK YOU



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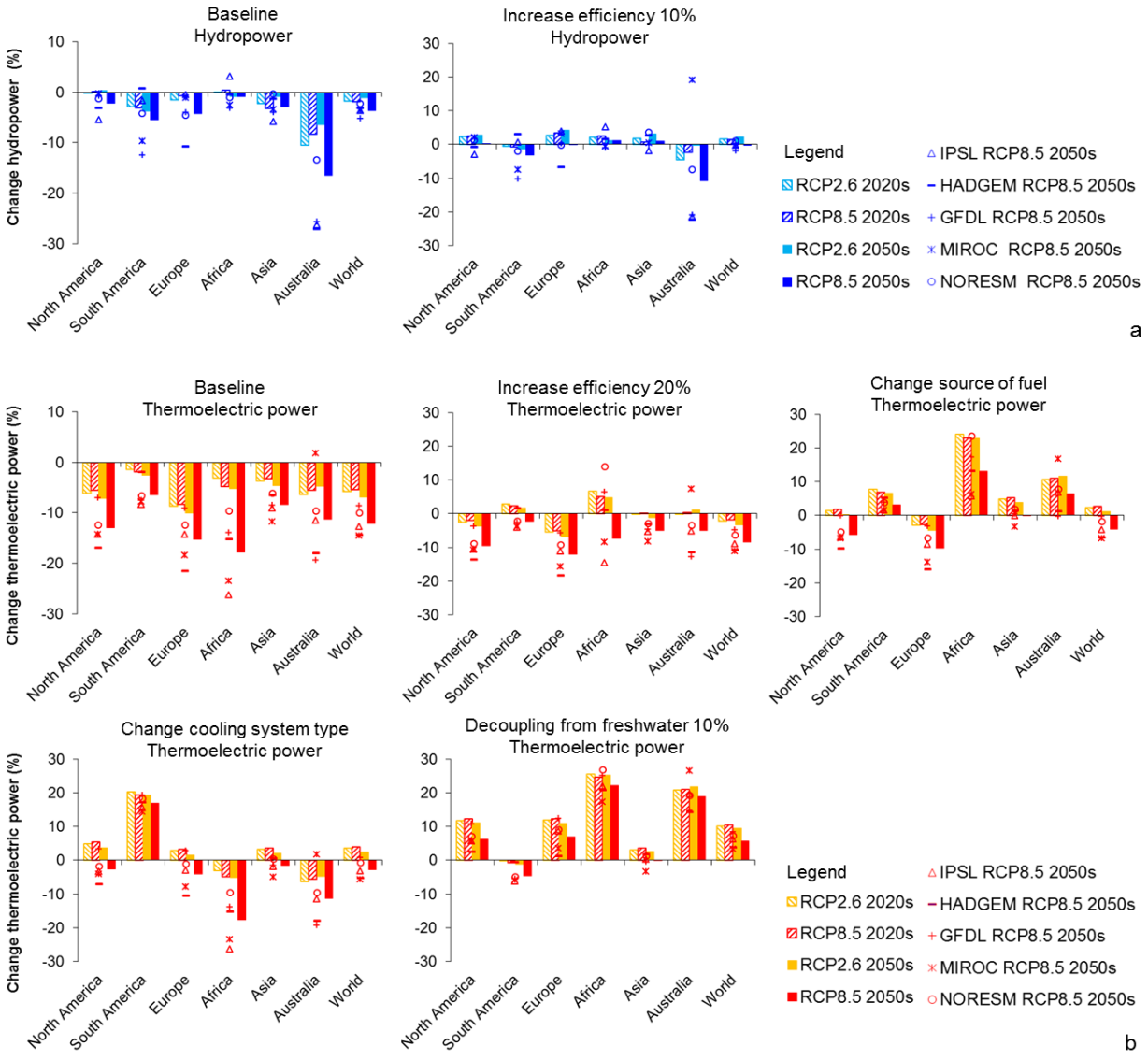

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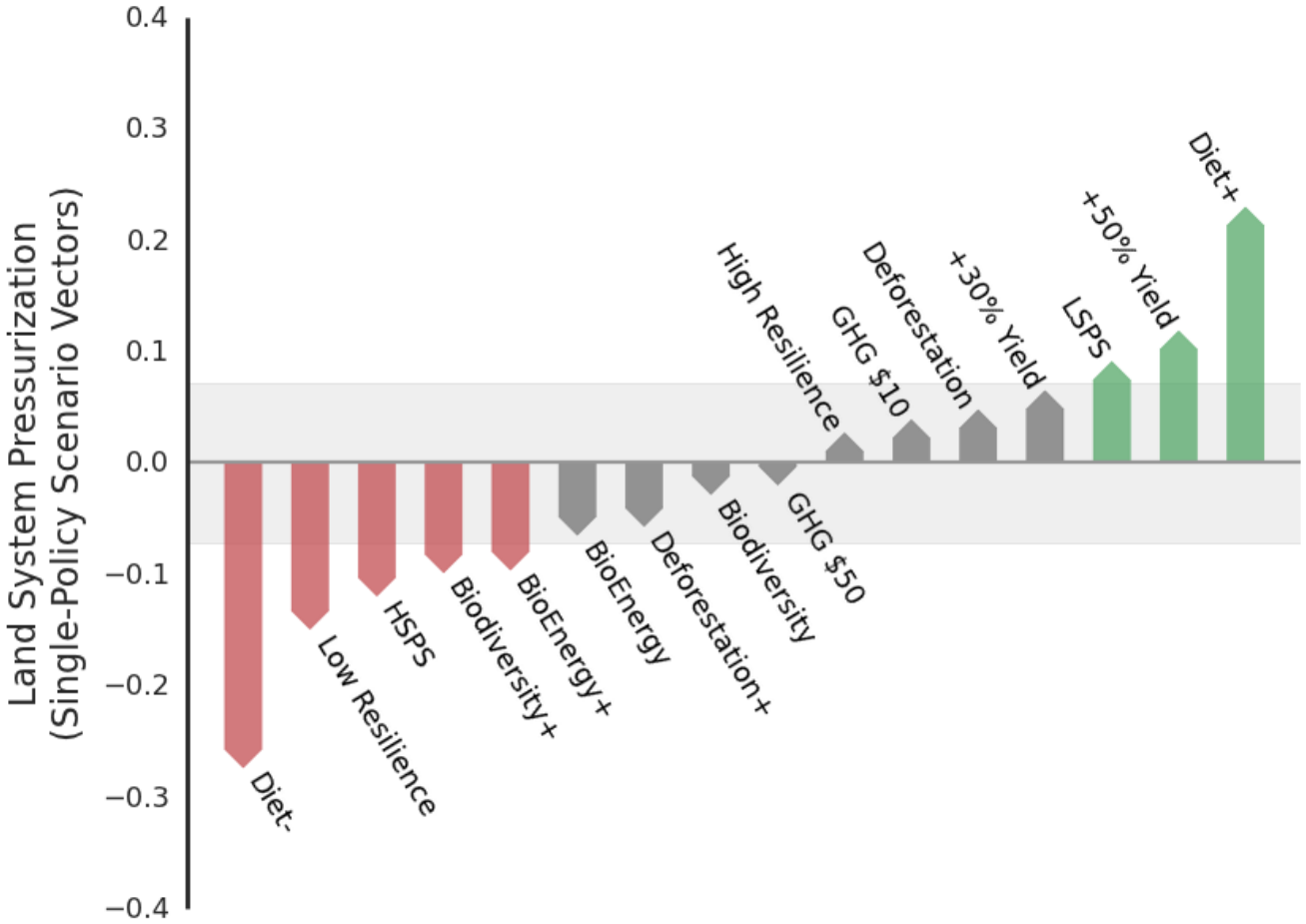

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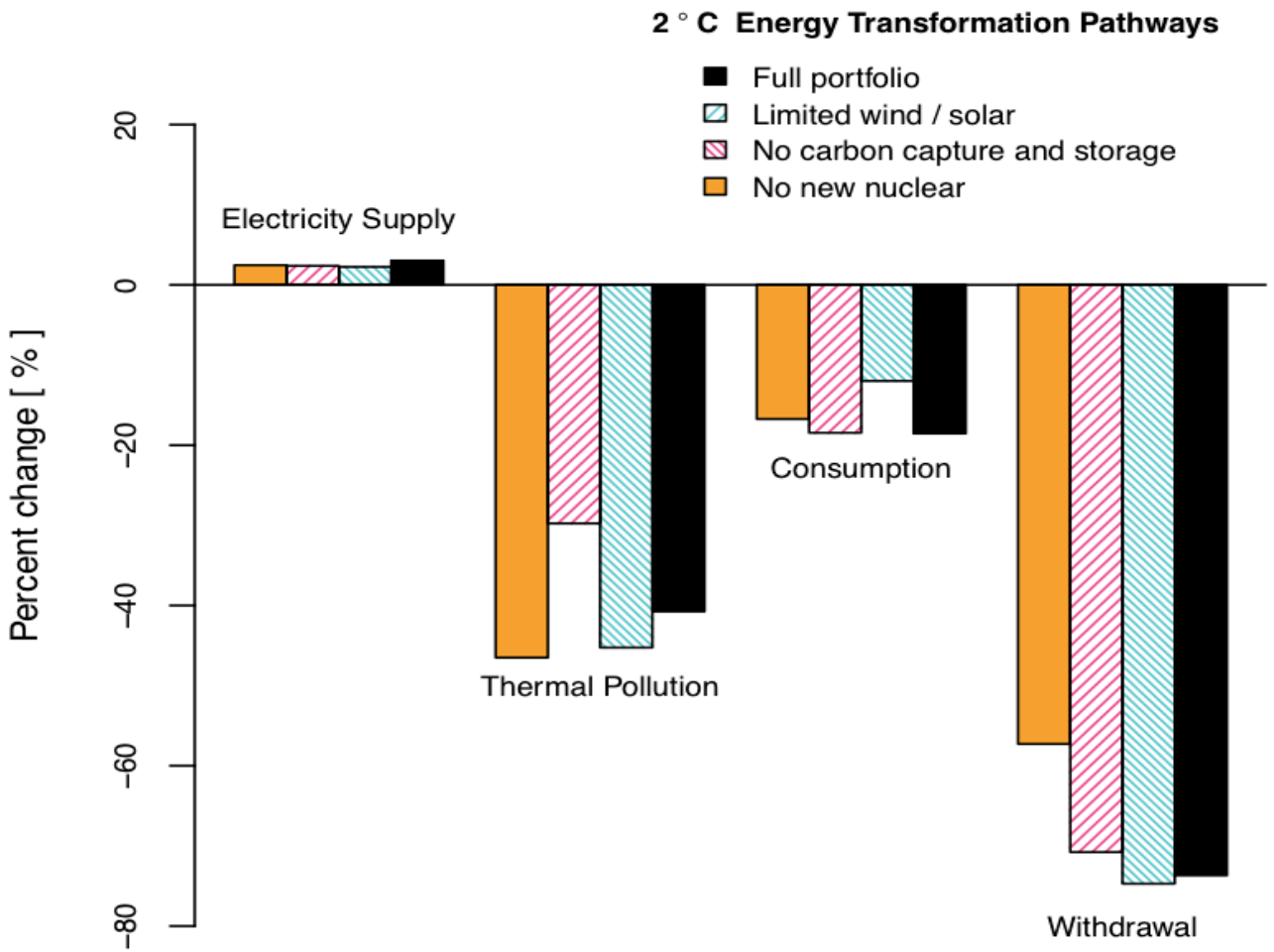
2 ° C Energy Transformation Pathways
Full portfolio
Limited wind / solar
No carbon capture and storage
No new nuclear
Percent change [%]
20
0
-20
-40
-60
-80
Electricity Supply
Thermal Pollution
Consumption
Withdrawal

Food Security and Environmental Score Indicators

Pressure Indicator		SDG Targets	Units	Region
Total Calorie Intake	(CAL)	2,3	$\frac{kCal}{cap \cdot day}$	SSA
Food Price Index	(FPI)	2	—	World
LULUCF Emissions	(GHG)	13	$\frac{MtCO_2eq}{year}$	World
Ag. Water Use	(WAT)	6	km^3	World
Deforestation	(FOR)	6,13,15	$10^3\ ha$	World
Biodiversity Loss	(BIO)	15	$10^3\ ha$	World
Fertilizer Use	(NTR)	2,13	$10^3\ ton$	World

Table 1: Each SDG strategy is scored on five indicators of land system pressure and two of food system pressure in year 2030 of the simulation to quantify progress toward corresponding SDGs, listed above.

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