Accounting for economic disparity in designing net-zero European energy systems

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Introduction (self)

- Meijun (could be pronounced: May + June)
- PhD student on ethically aware energy system modelling
- Supervisors:

Dr. Stefan Pfenninger-Lee

Dr. Francesco Sanvito

Prof. Dr. Jan Kwakkel

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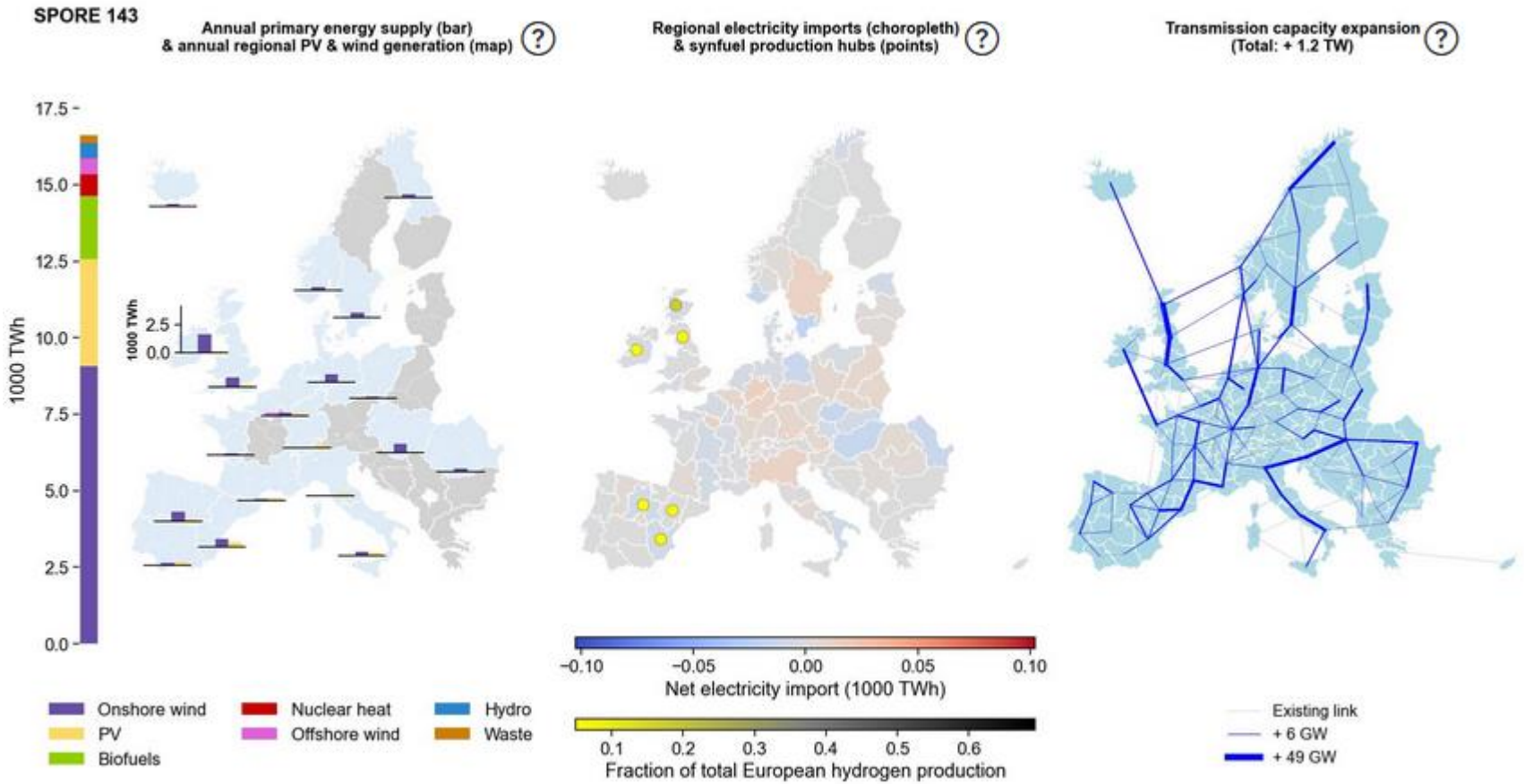
Introduction (topic)

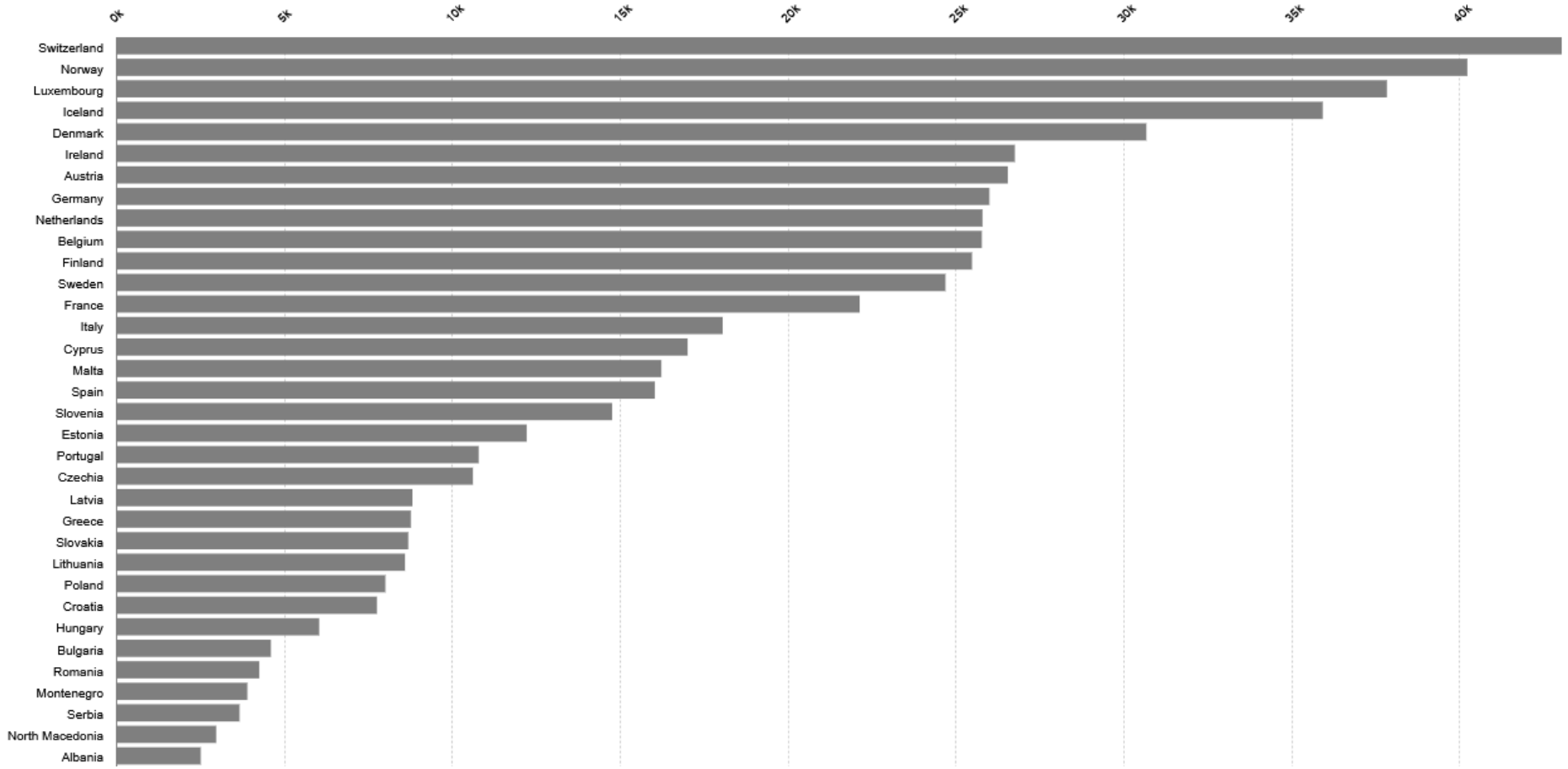


- ✓ Electricity
- ✓ Heat
- ✓ Transport

- Total cost minimisation
- Modelling to generate alternatives

Pickering, B., Lombardi, F., & Pfenninger, S. (2022). Diversity of options to eliminate fossil fuels and reach carbon neutrality across the entire European energy system. *Joule* https://explore.callio.pe

Introduction (topic)

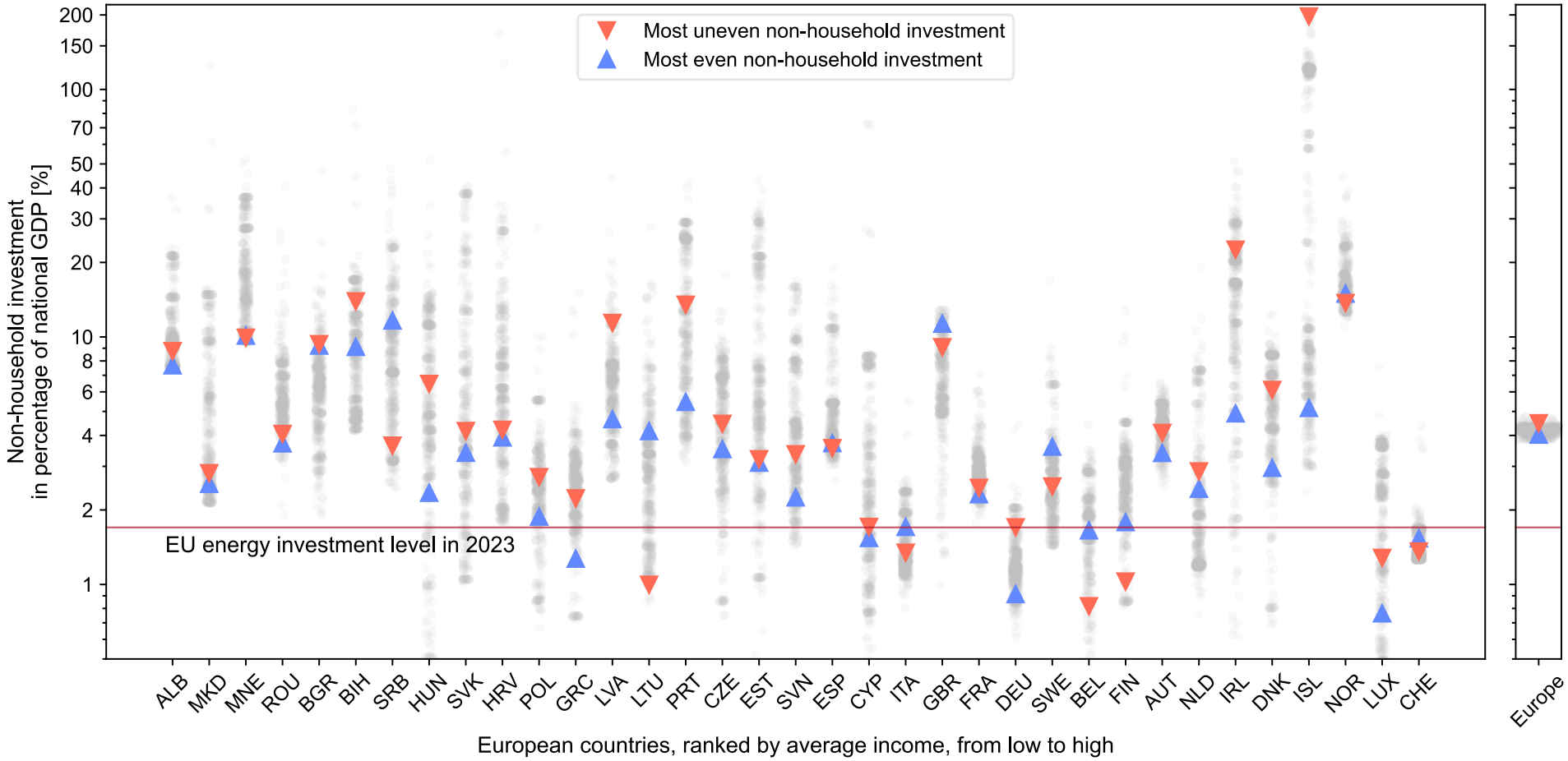


- ✓ Income disparity…

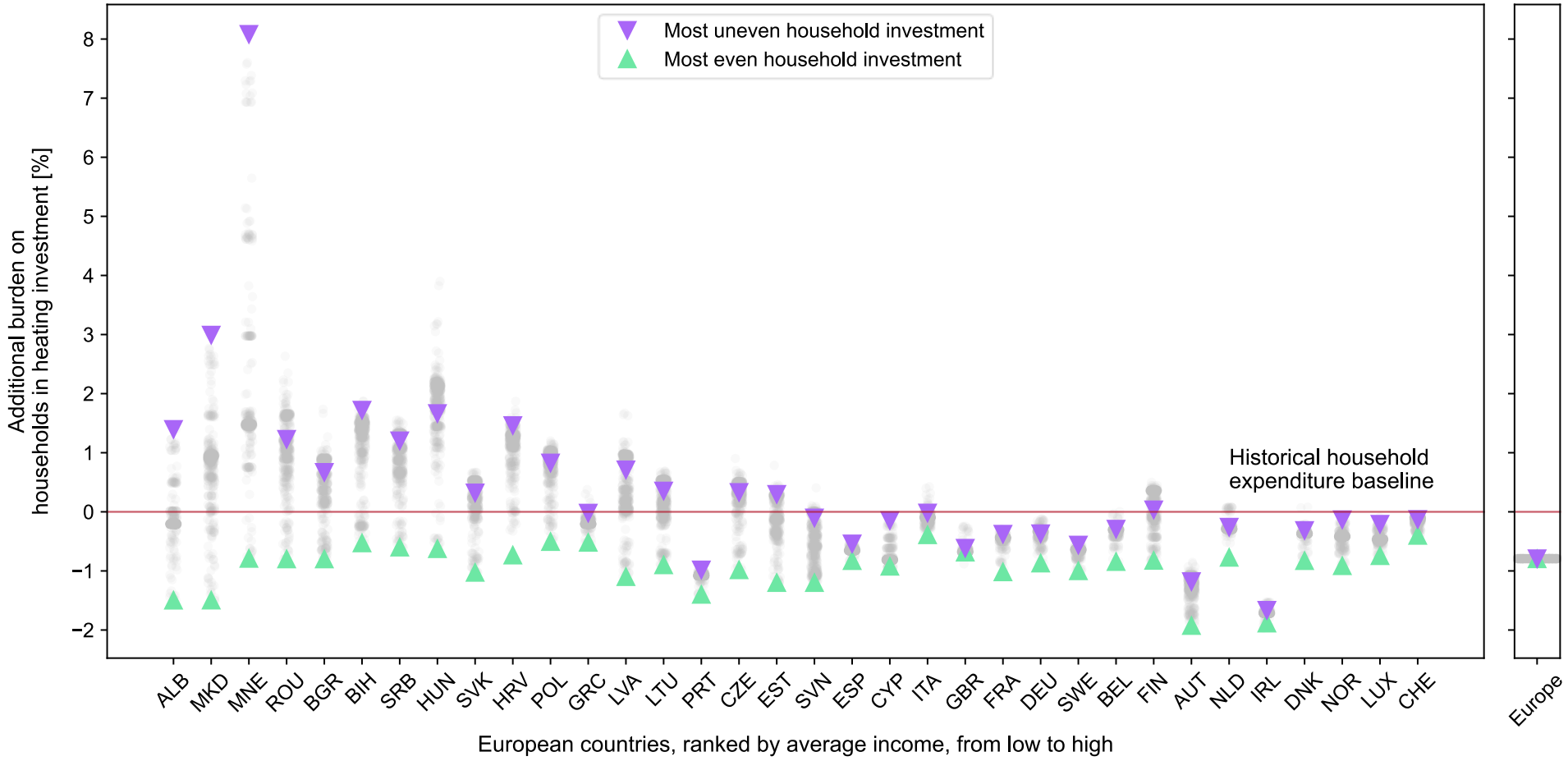
Eurostat. Annual total median equivalised net income, Euro, 2020

Model world vs. real world?

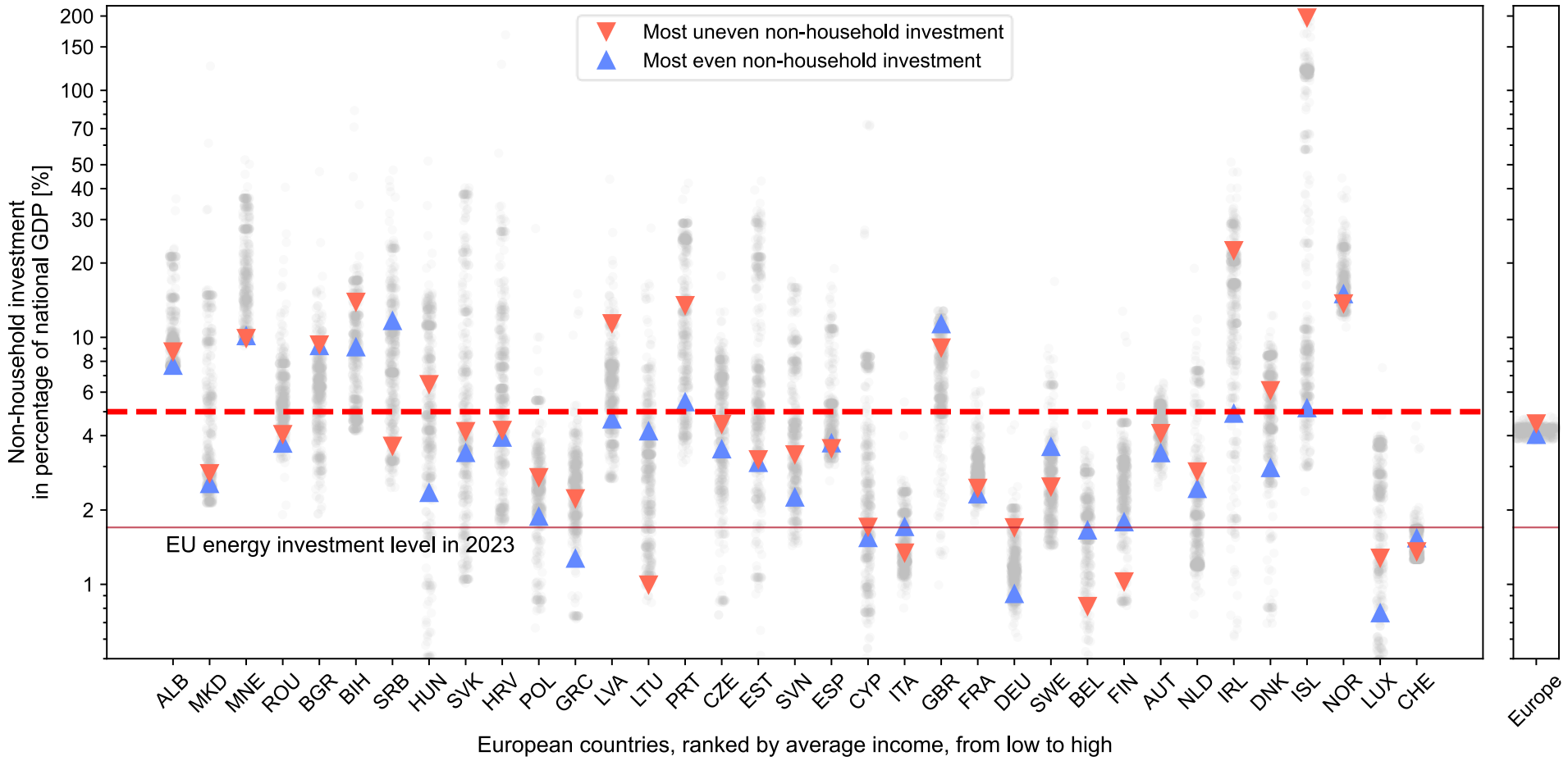
Problem 1 – 1 (National scale)



Problem 1 – 2 (Households)

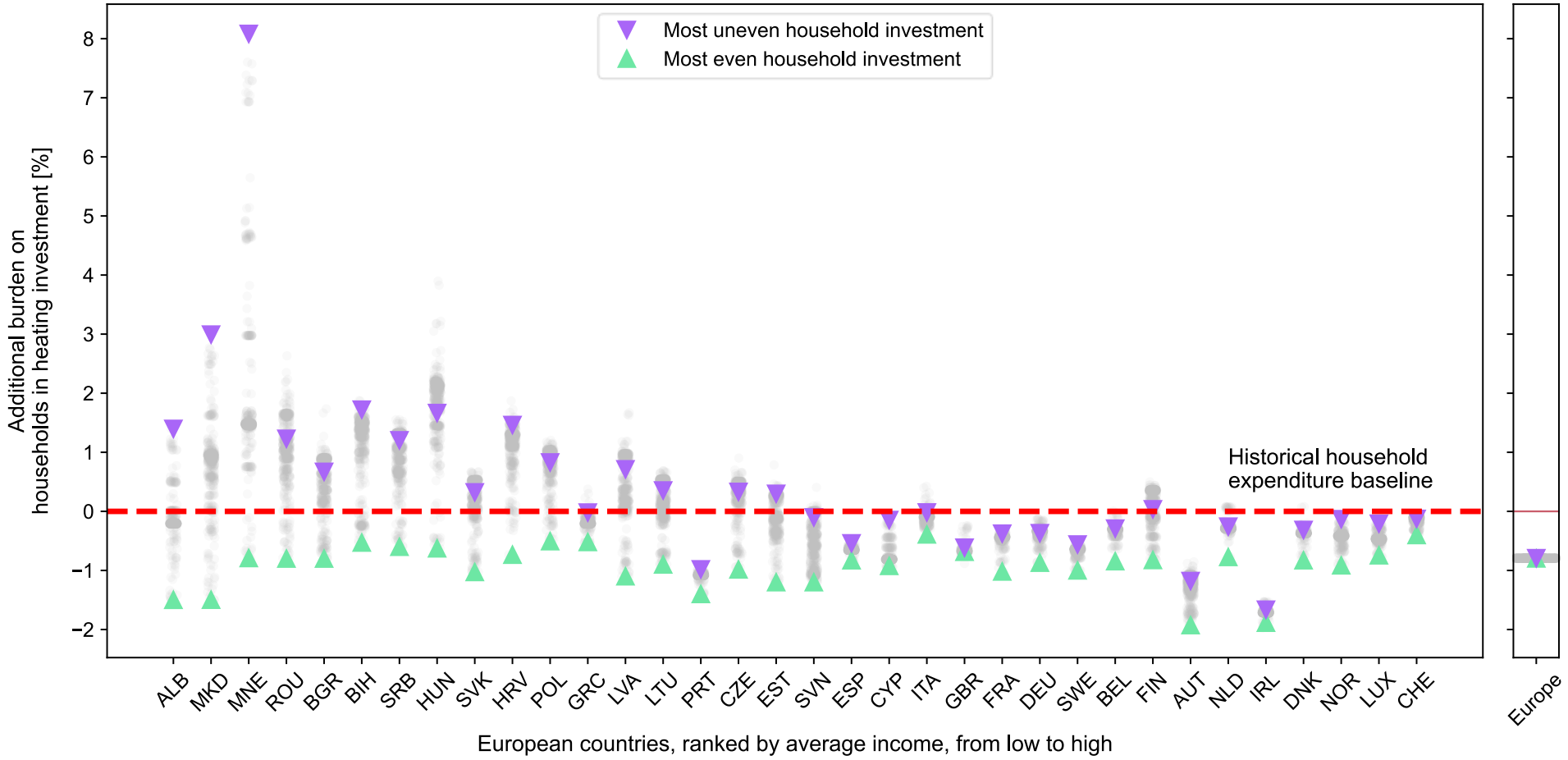


Method (Constraint 1)



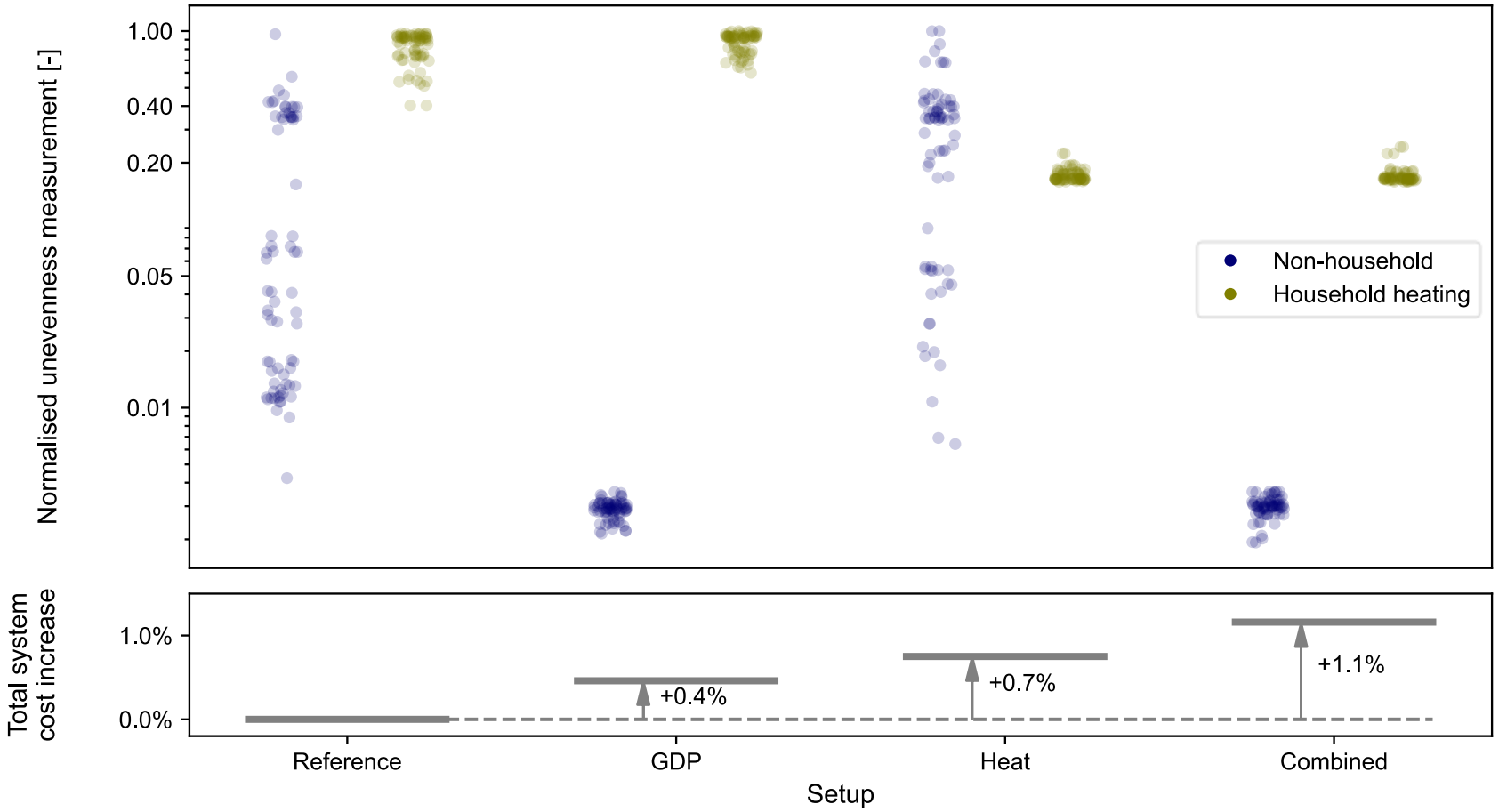
Added as a constraint, not a post-processing tool

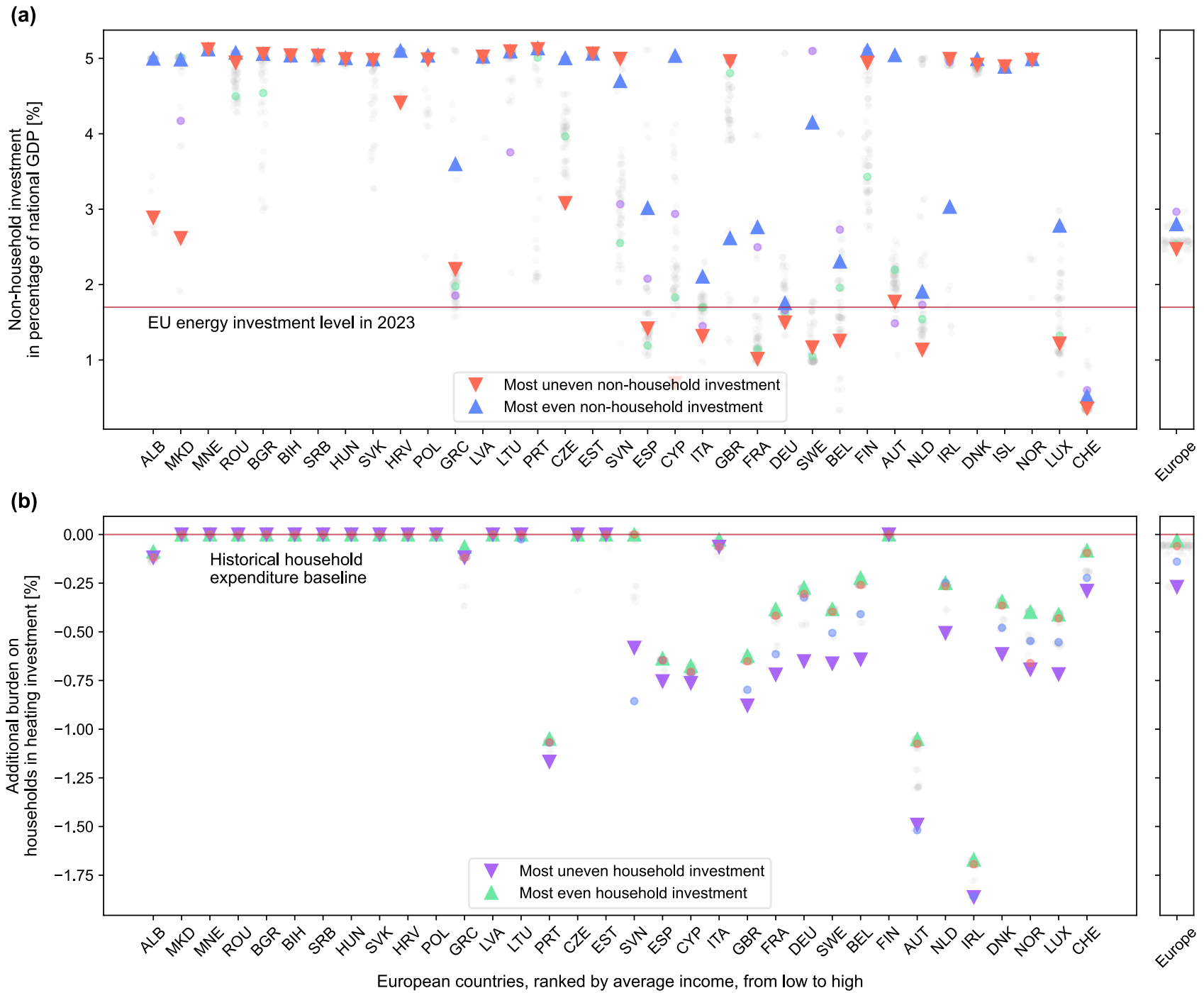
Method (Constraint 2)



But will it be feasible?

Finding 1 – yes, it's feasible




(a)
Non-household investment in percentage of national GDP [%]
EU energy investment level in 2023
Most uneven non-household investment
Most even non-household investment
(b)
Additional burden on households in heating investment [%]
Historical household expenditure baseline
Most uneven household investment
Most even household investment
ALB MKD MNE ROU BGR BIH SRB HUN SVK HRV POL GRC LVA LTU PRT CZE EST SVN ESP CYP ITA GBR FRA DEU SWE BEL FIN AUT NLD IRL DNK ISL NOR LUX CHE Europe
European countries, ranked by average income, from low to high

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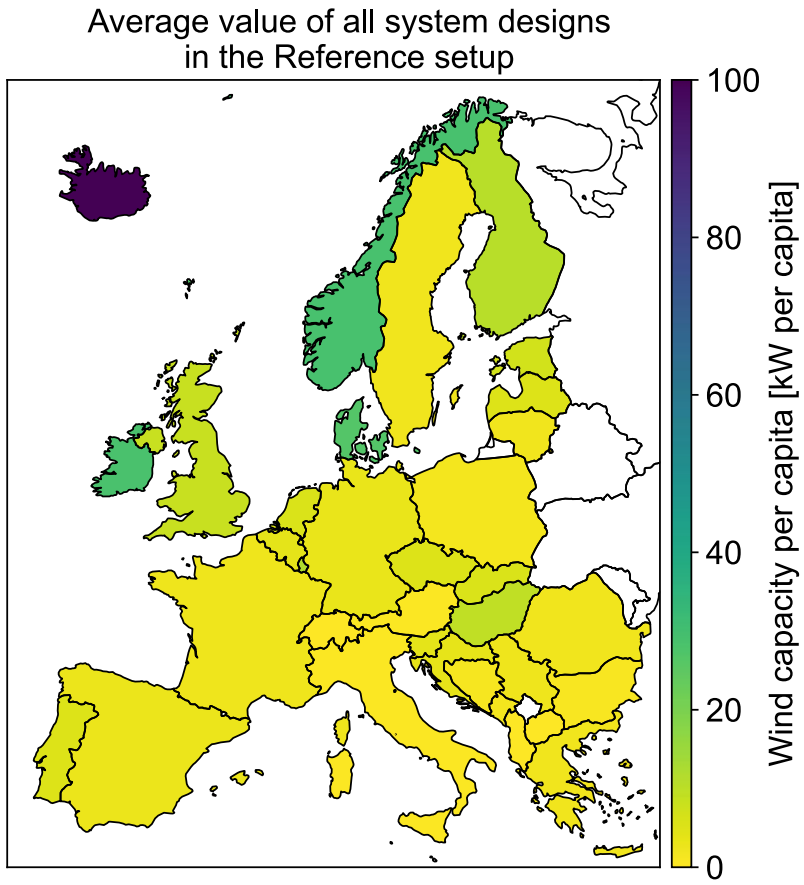
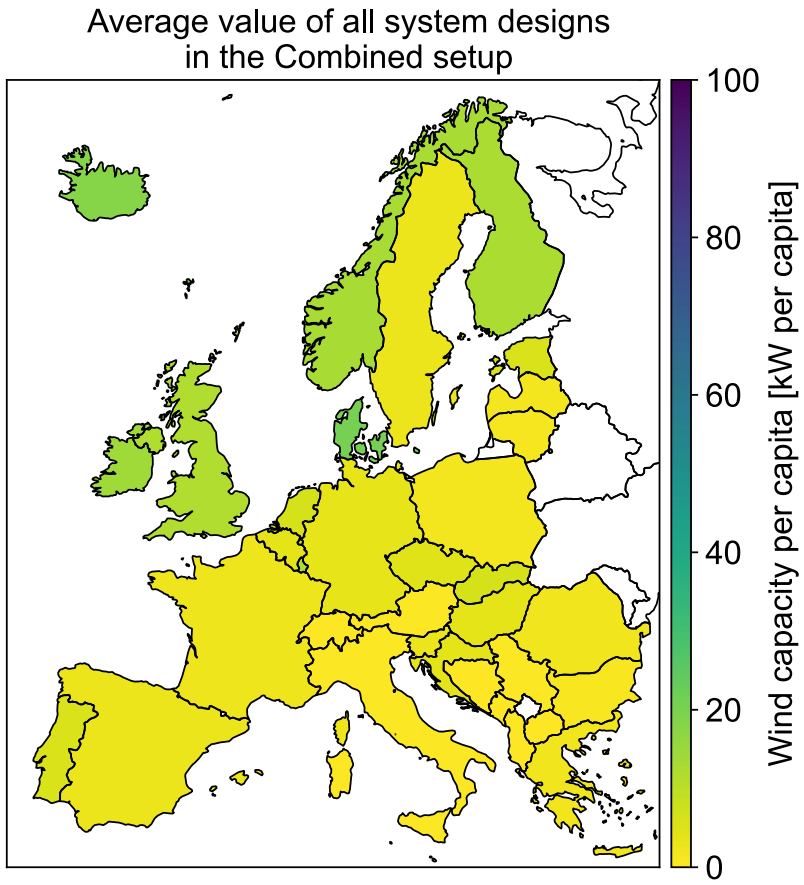
As expected, crazy numbers disappear





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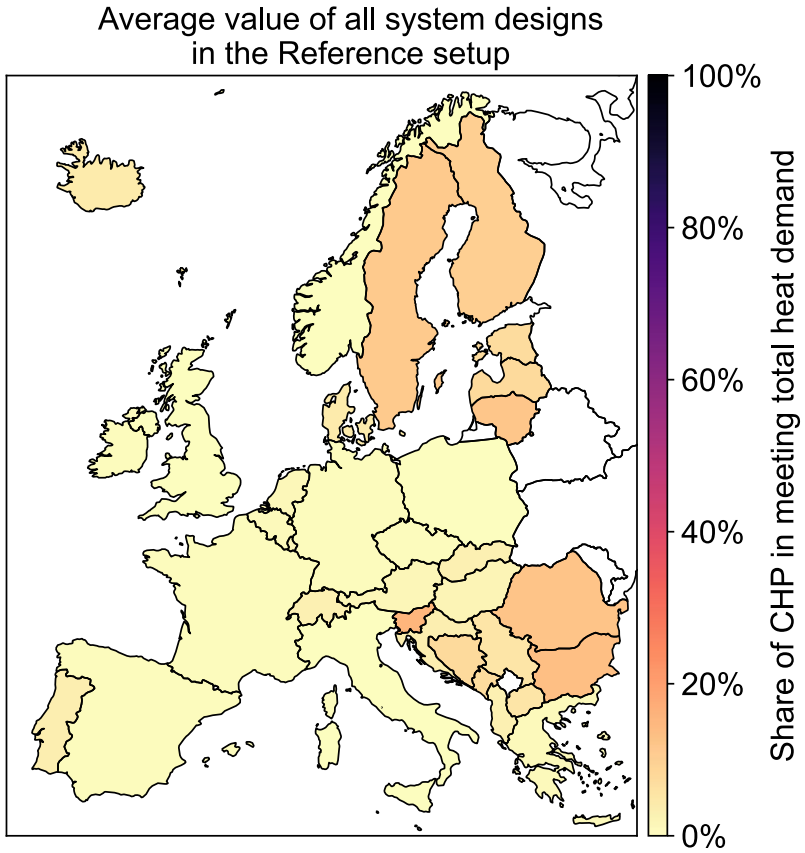
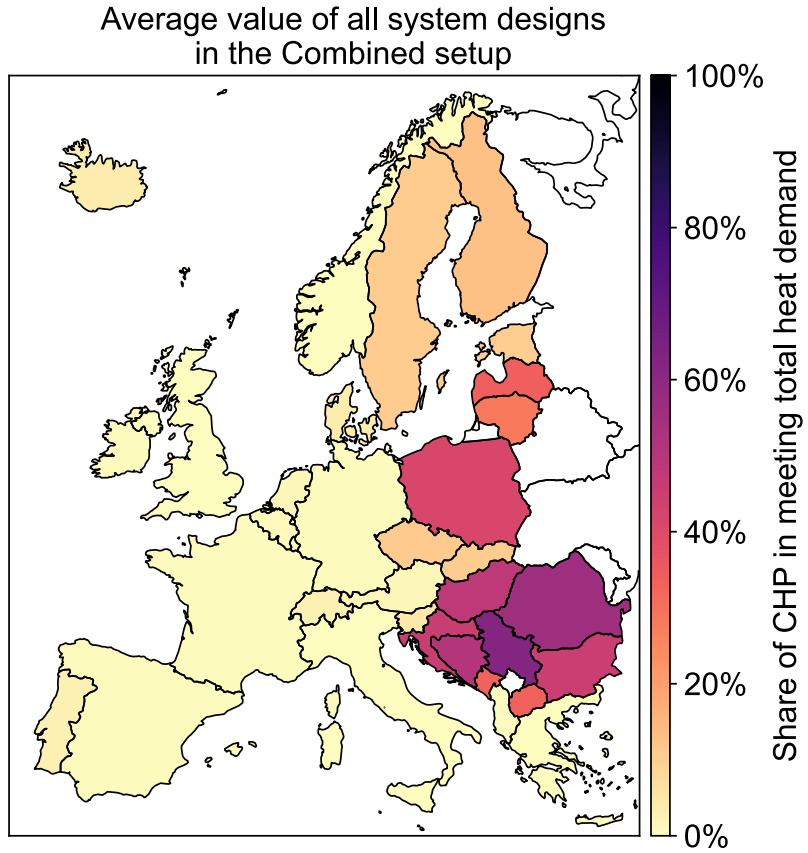
Finding 2 – Less affluence, less diverse choices





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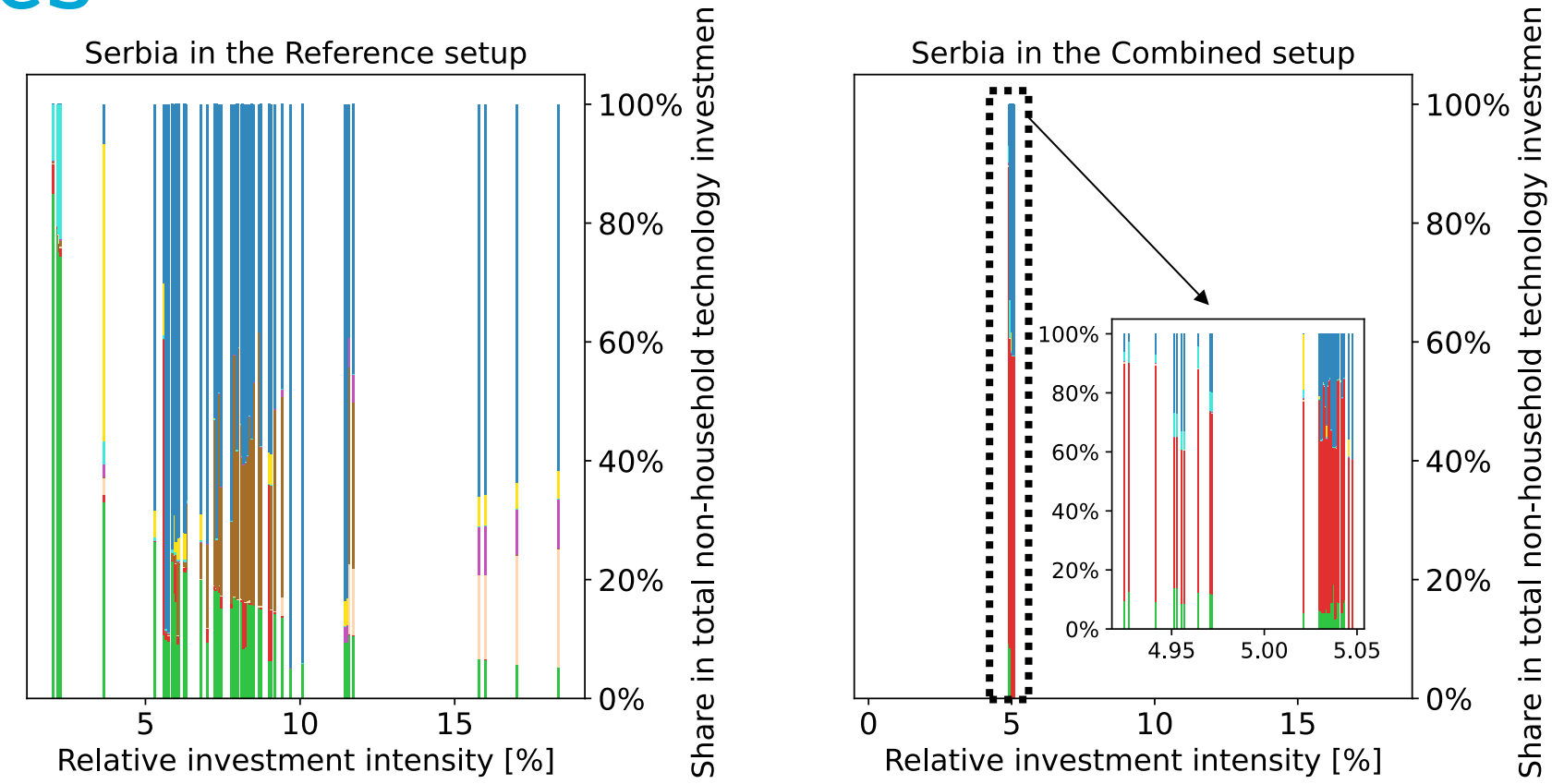

Discussion

- From disparity to justice – what *should* be done?
- How to deal / live with the unrealistic part of optimisation models?
  - Talk about what we don’t know
  - Specify the applicability of the results and conclusions

Take-aways

- May be good to have “safeguarding constraints” in the model that can
  - Prevent outrageous numbers that we cannot always anticipate
  - Tell the model a bit about the real world – multi-actor input
- Economic disparity matters, also to problems at different scales

Thank you for your attention!

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