Impacts of Socio-Economic Uncertainty on Electricity and Emissions in 2°C Stabilization

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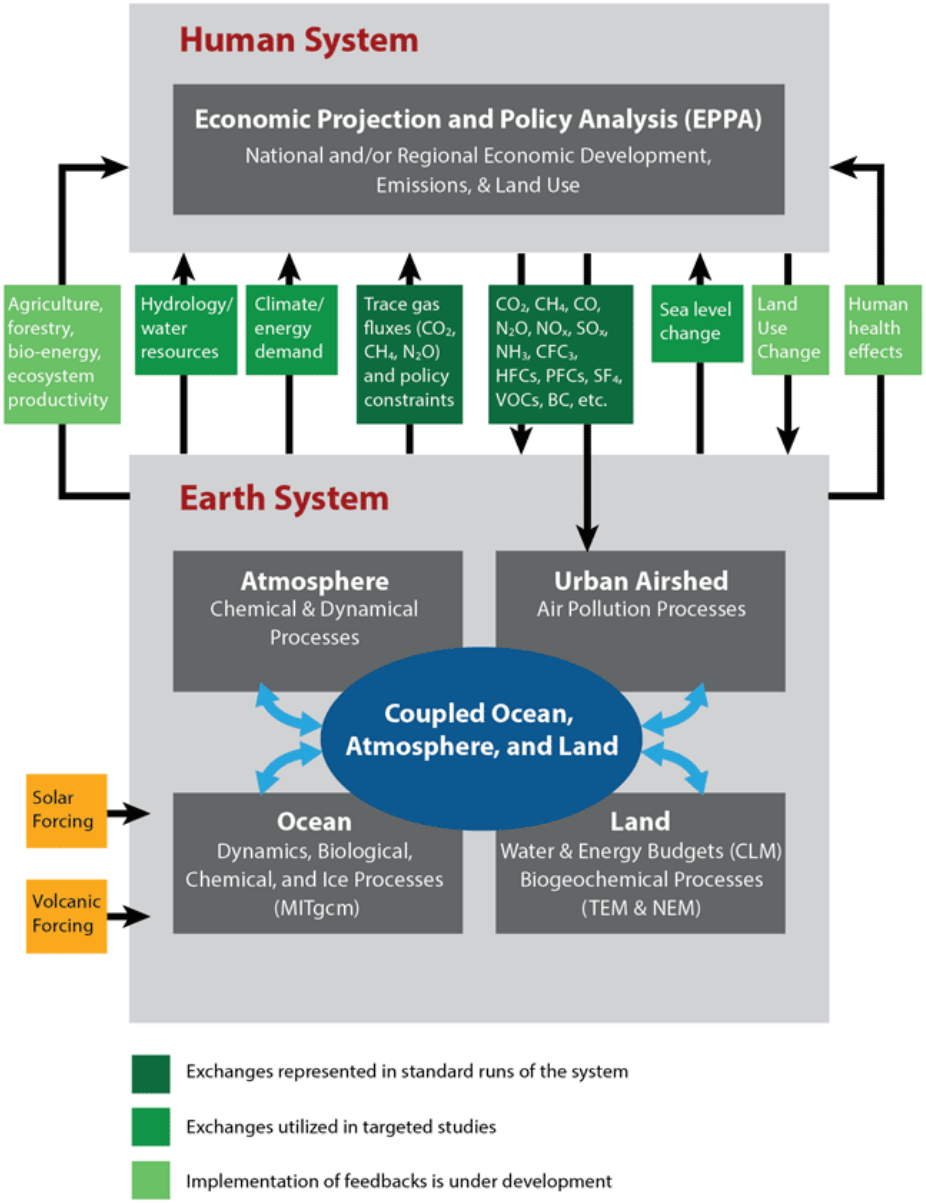
MIT Joint Program on the Science and Policy of Global Change

MIT Global Change Forum

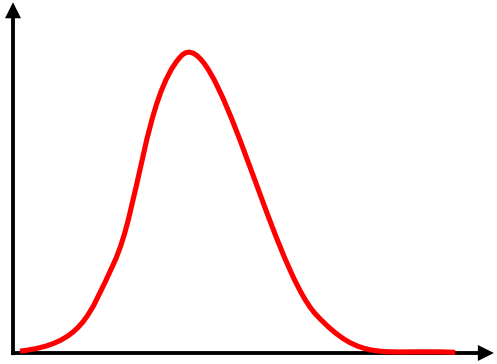
March 28, 2019

MIT Integrated Global System Modeling (IGSM) Framework



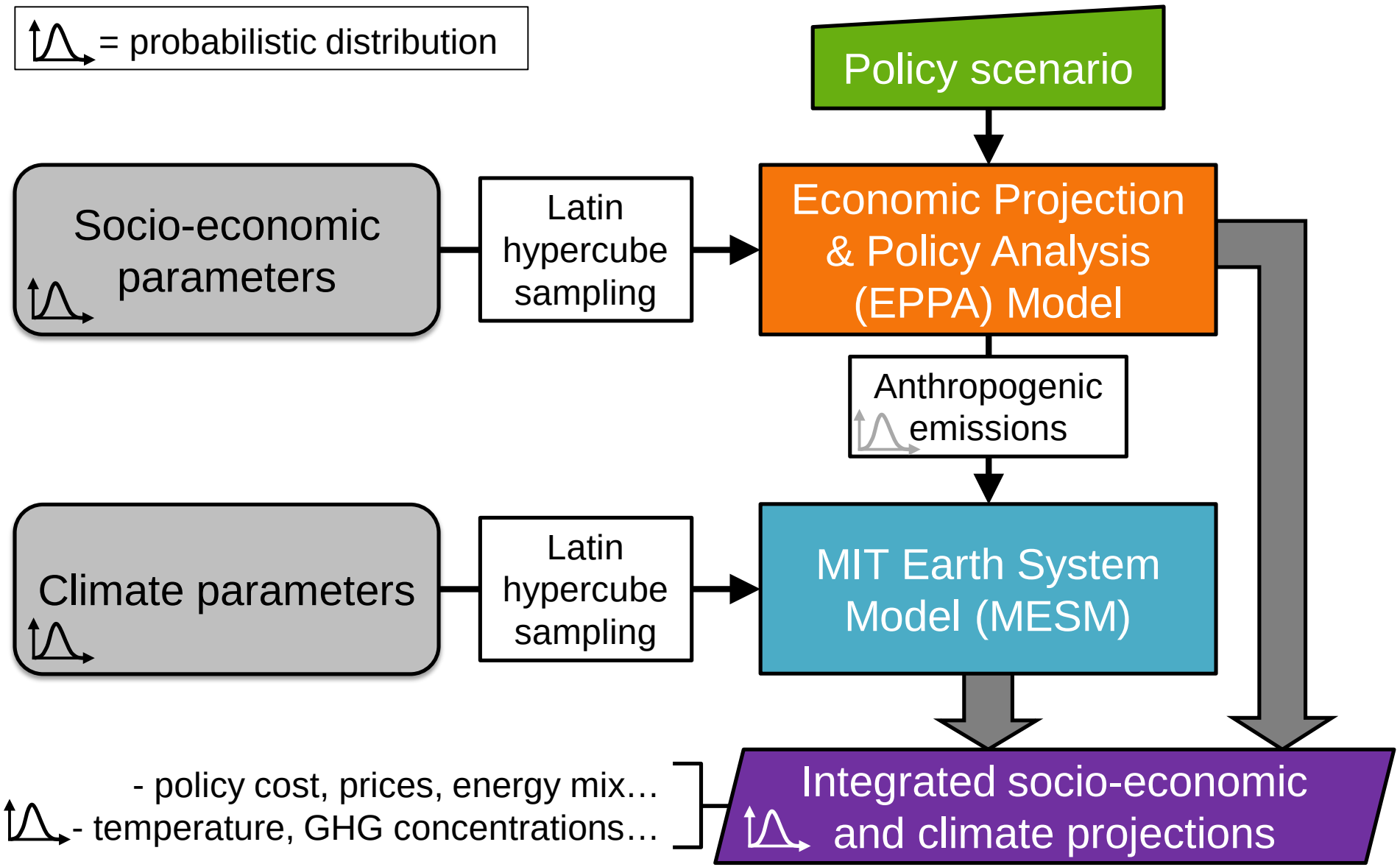
Probabilistic Approach

- Define and sample probability distribution functions (PDFs) of
  - **Population growth**
  - **GDP growth** (total factor productivity)
  - **Technology costs**
  - **Elasticities of substitution** (between capital and labor, between energy and other inputs…)
  - **Energy efficiency trends**
  - **Fossil fuel resource availability**
  - **Urban pollutants initial inventory and trends**
  - **Rate of technology penetration**
  - **Climate parameters** (climate sensitivity, ocean heat uptake, aerosol forcing)



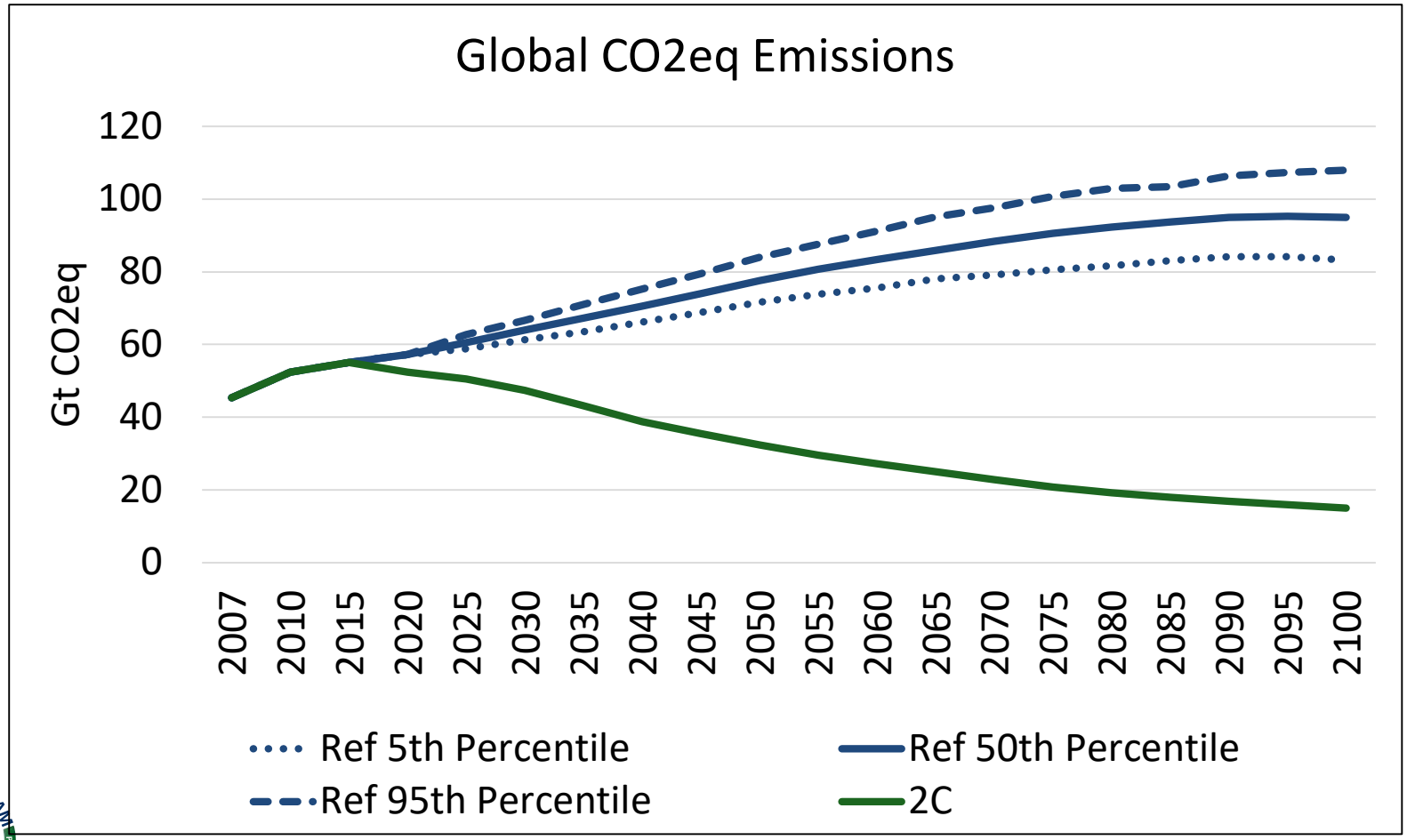
PDFs based on historical data, expert elicitation and scientific modeling

Integrated Socio-Economic and Climate Projections

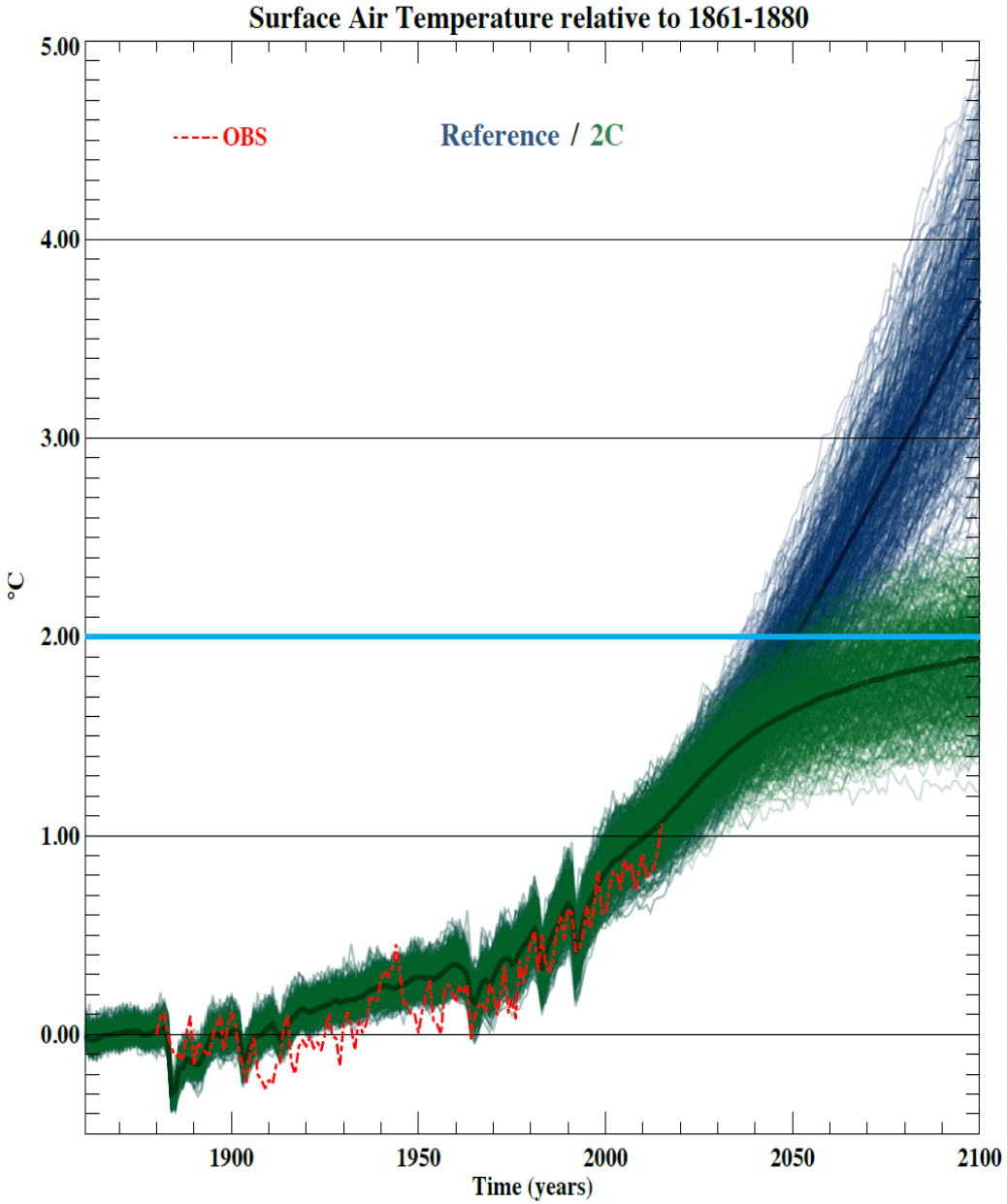


2°C Policy Scenario

Emissions **cap** with a **global carbon price** to ensure that global mean surface air temperature in year 2100 does not exceed **2°C** above pre-industrial levels with a **66% probability**

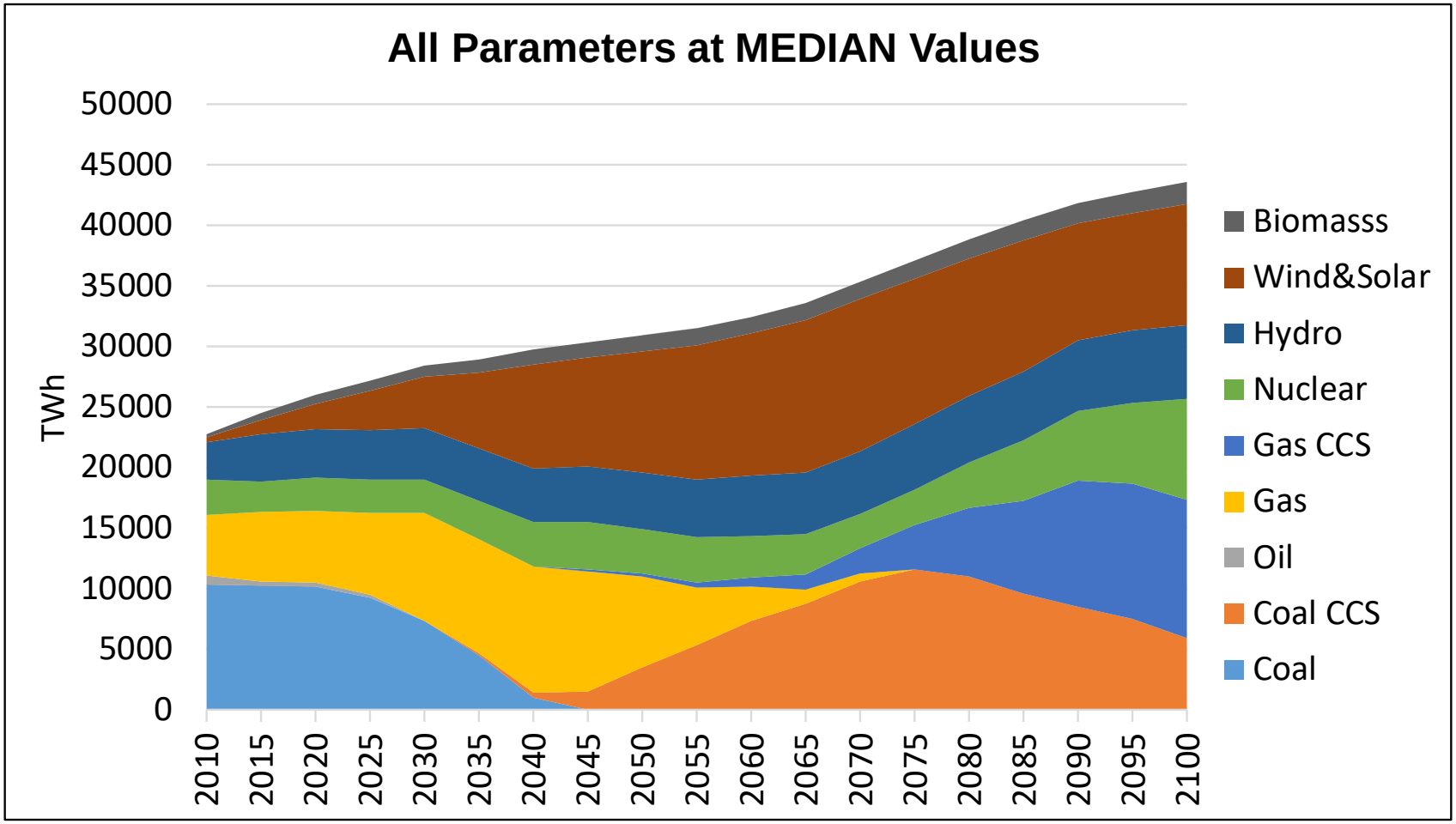


Temperature Results

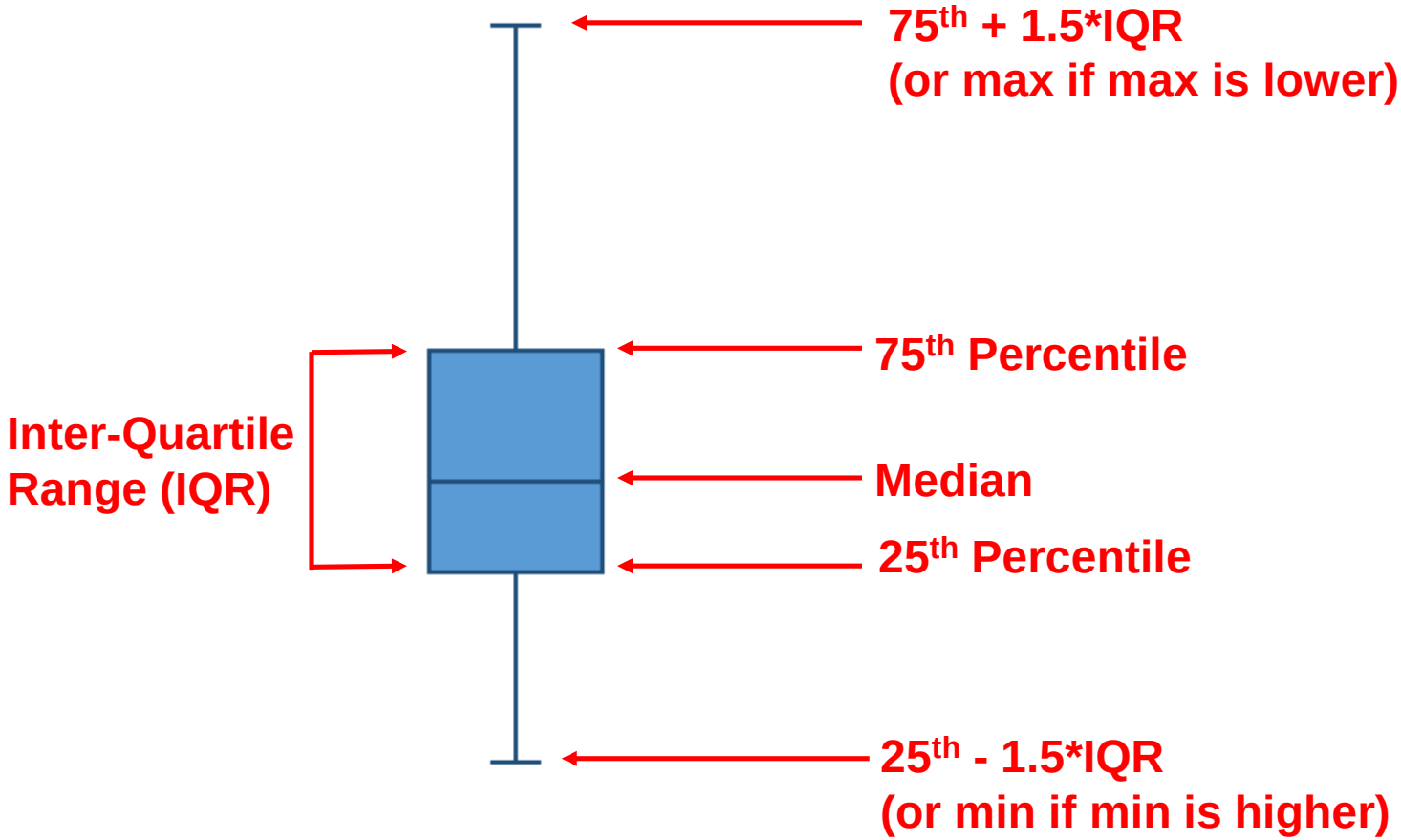


Electricity and Emissions Results

Global Electricity Mix



Box and Whisker Plots



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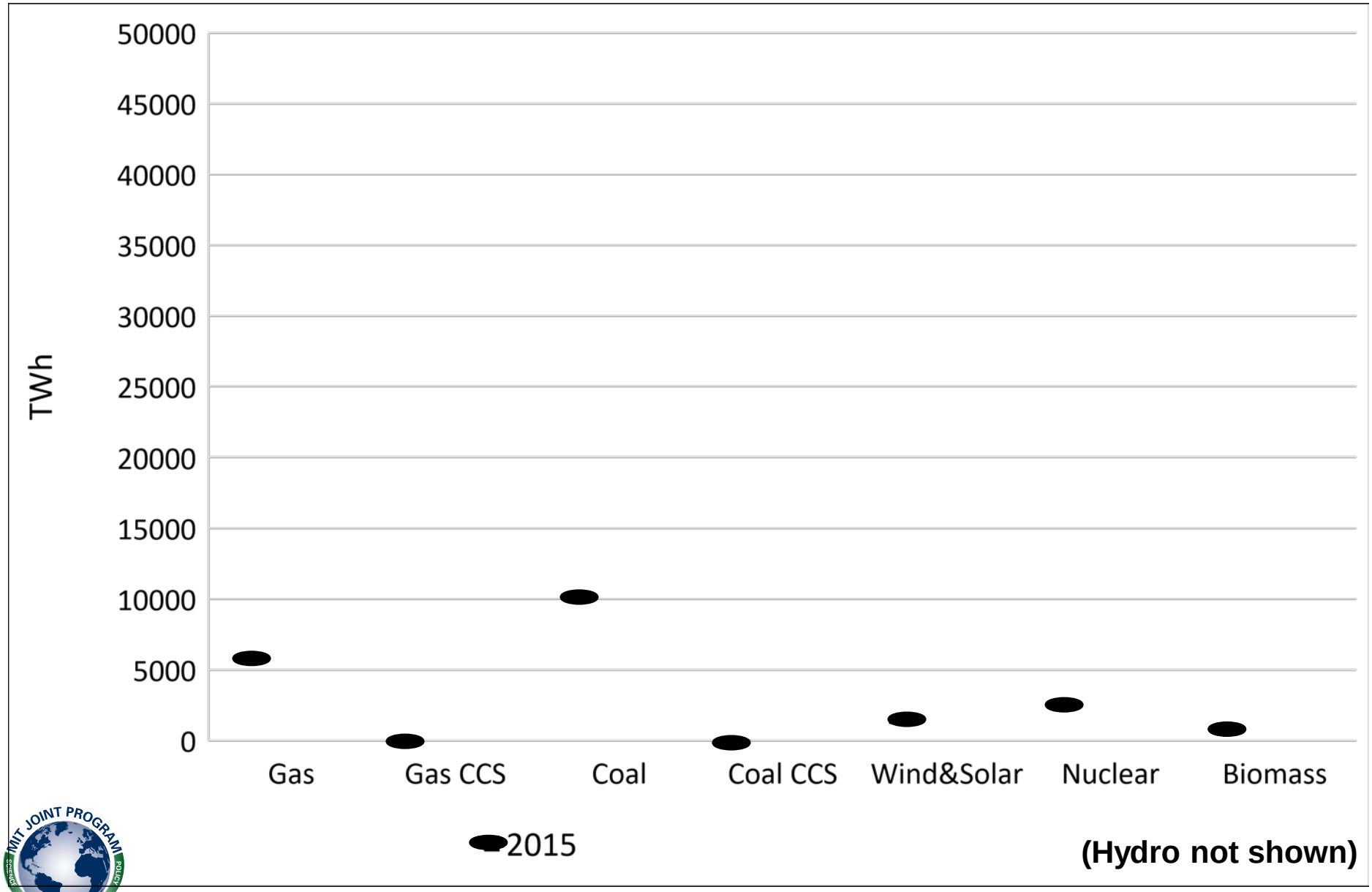

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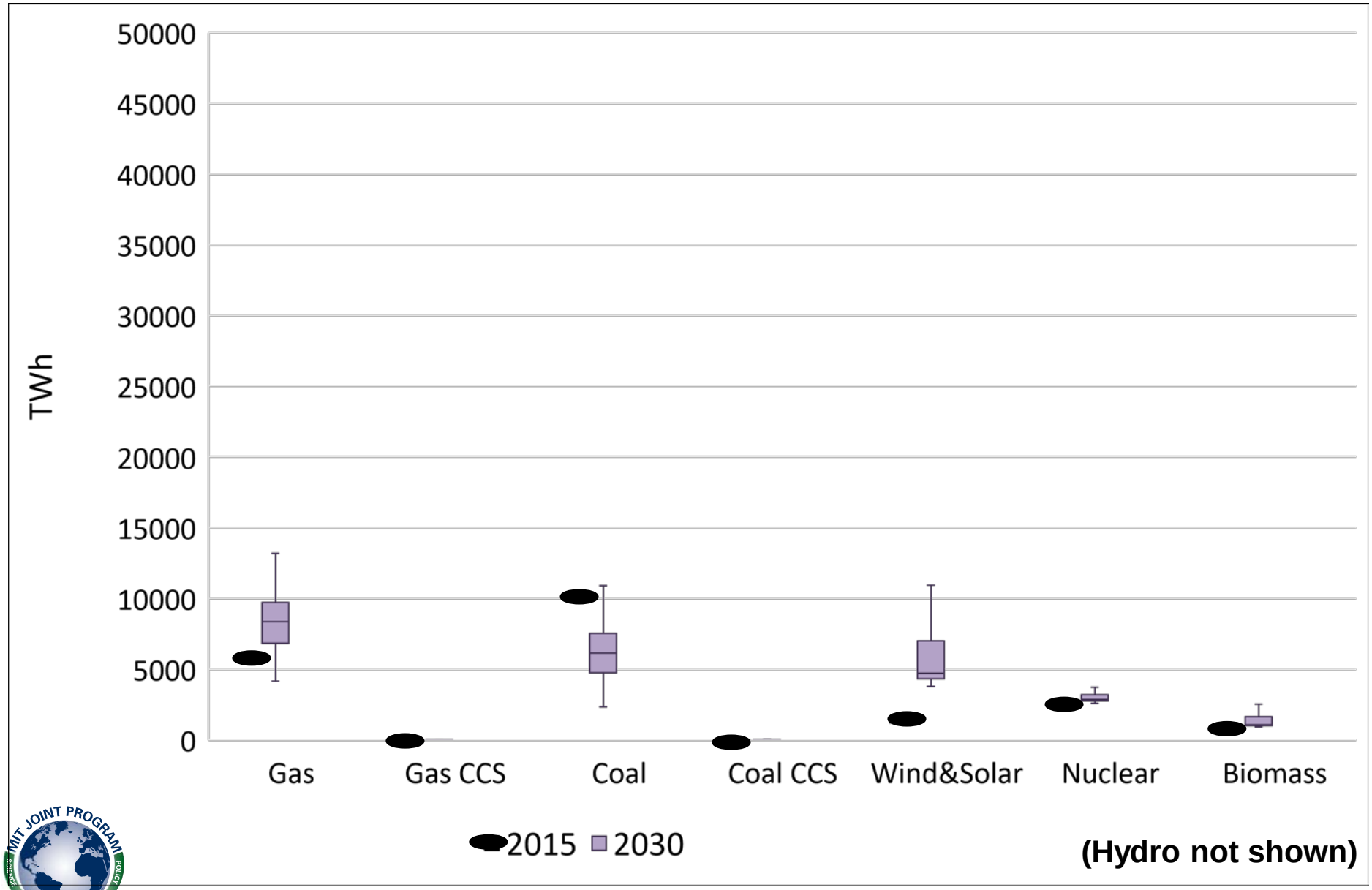

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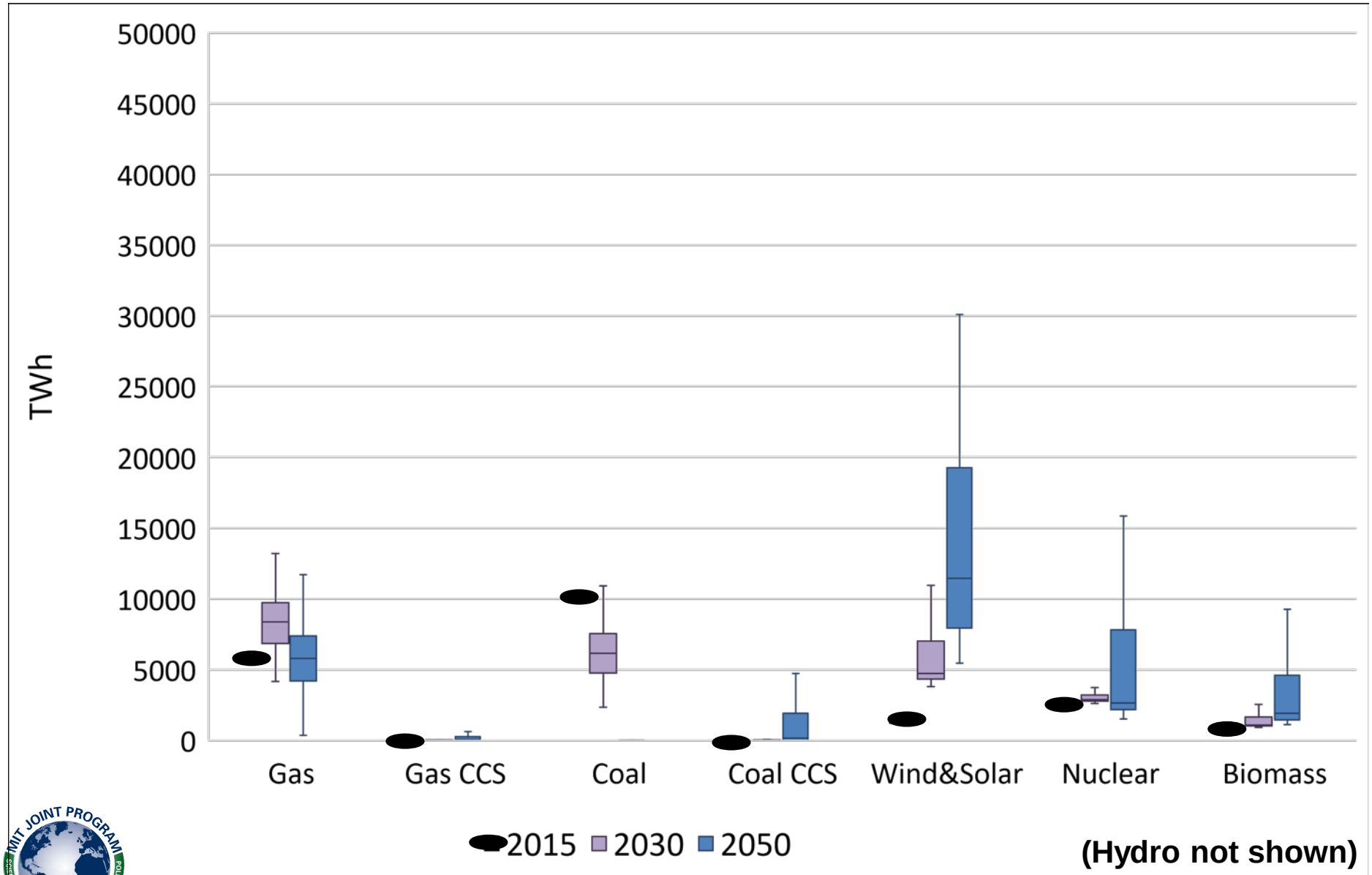

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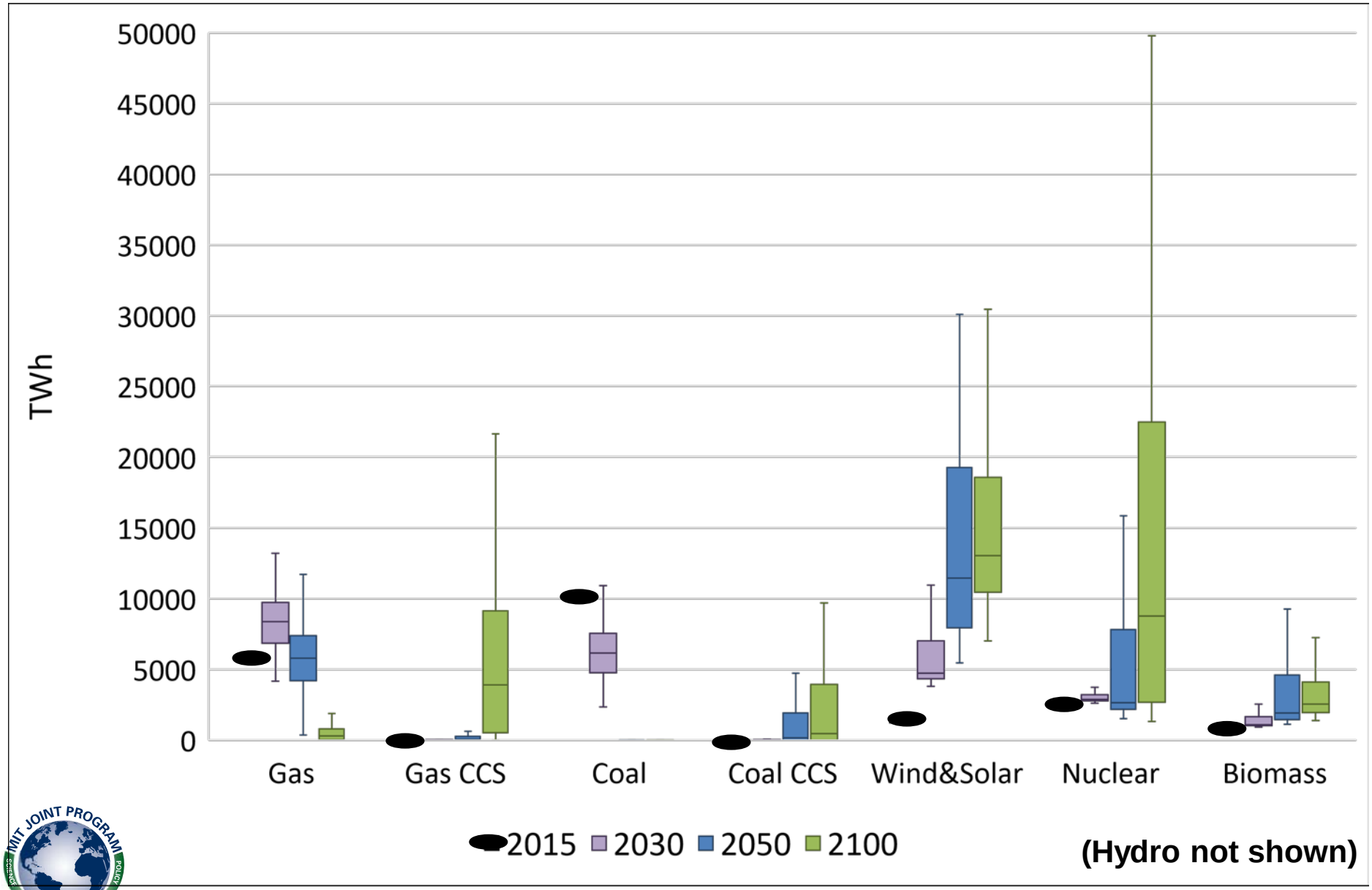
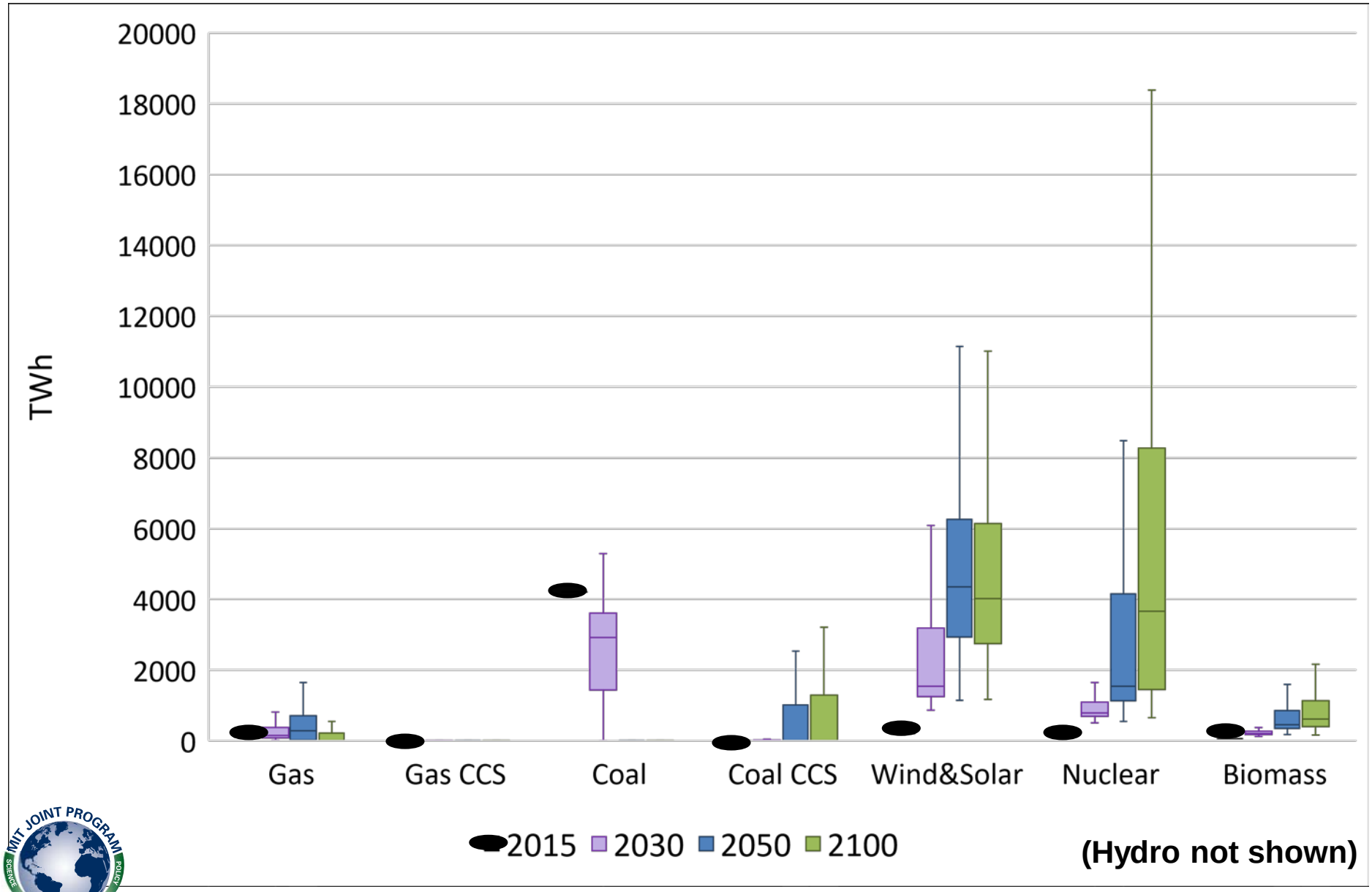
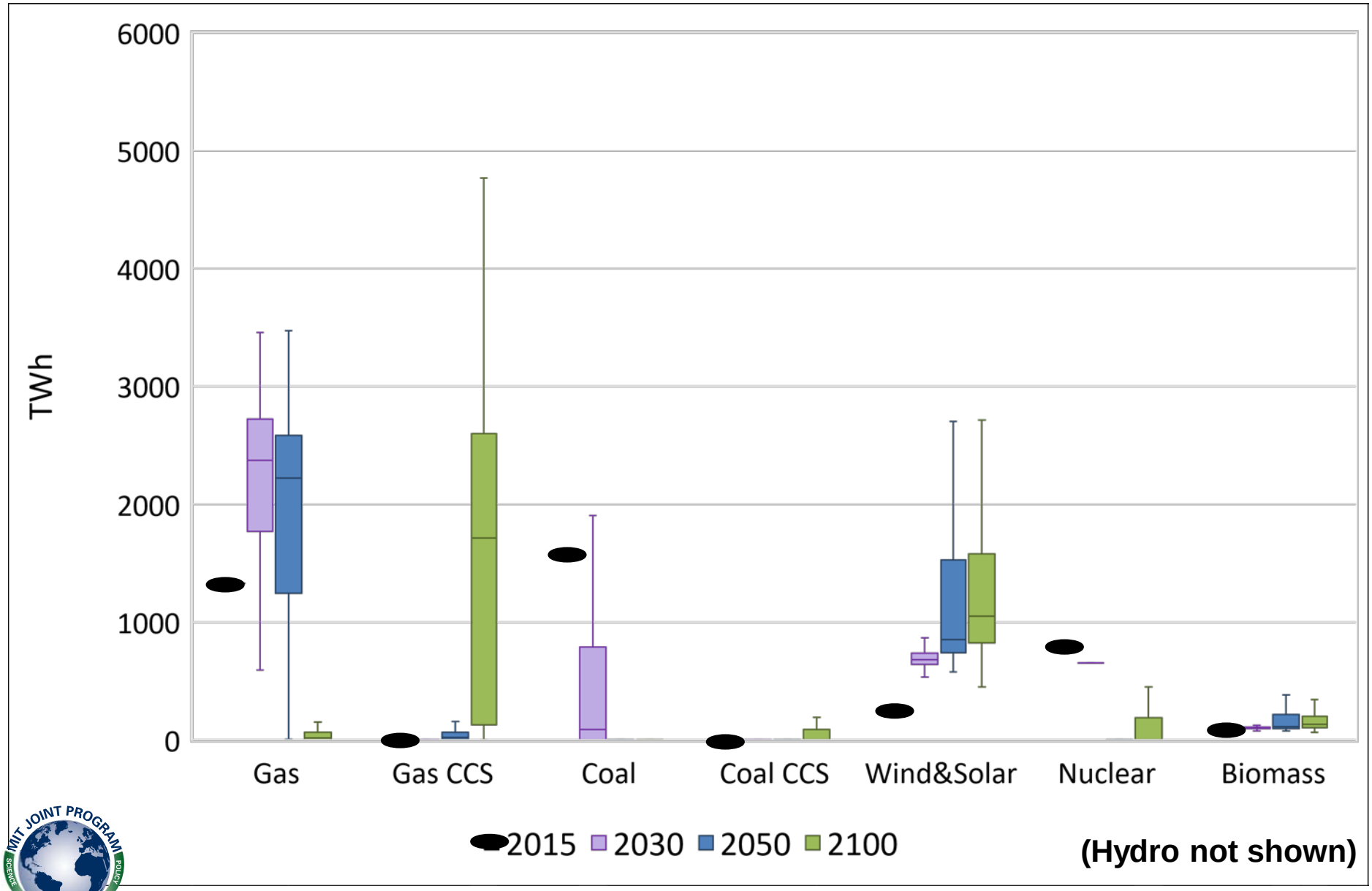


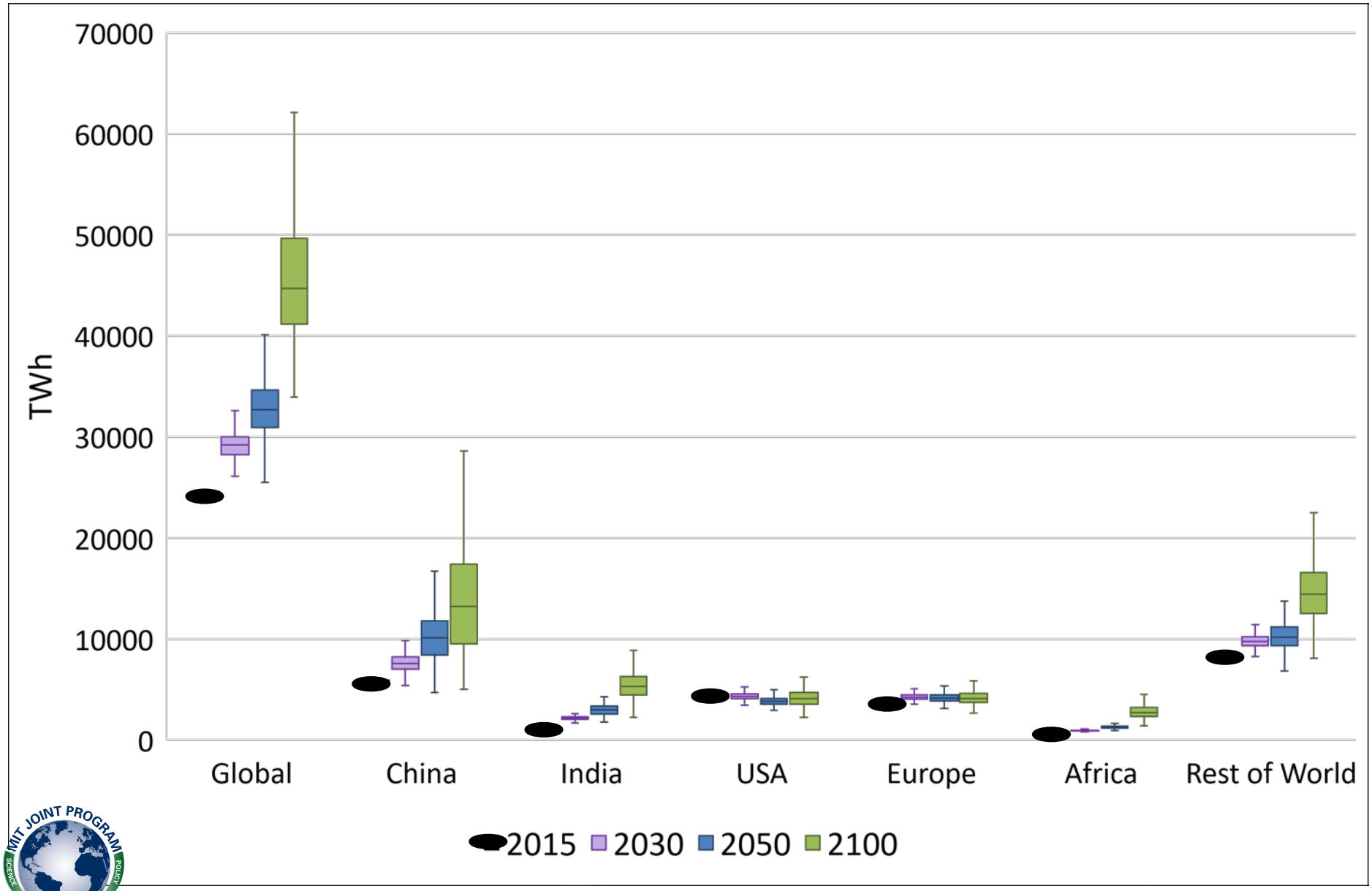
China Electricity Mix



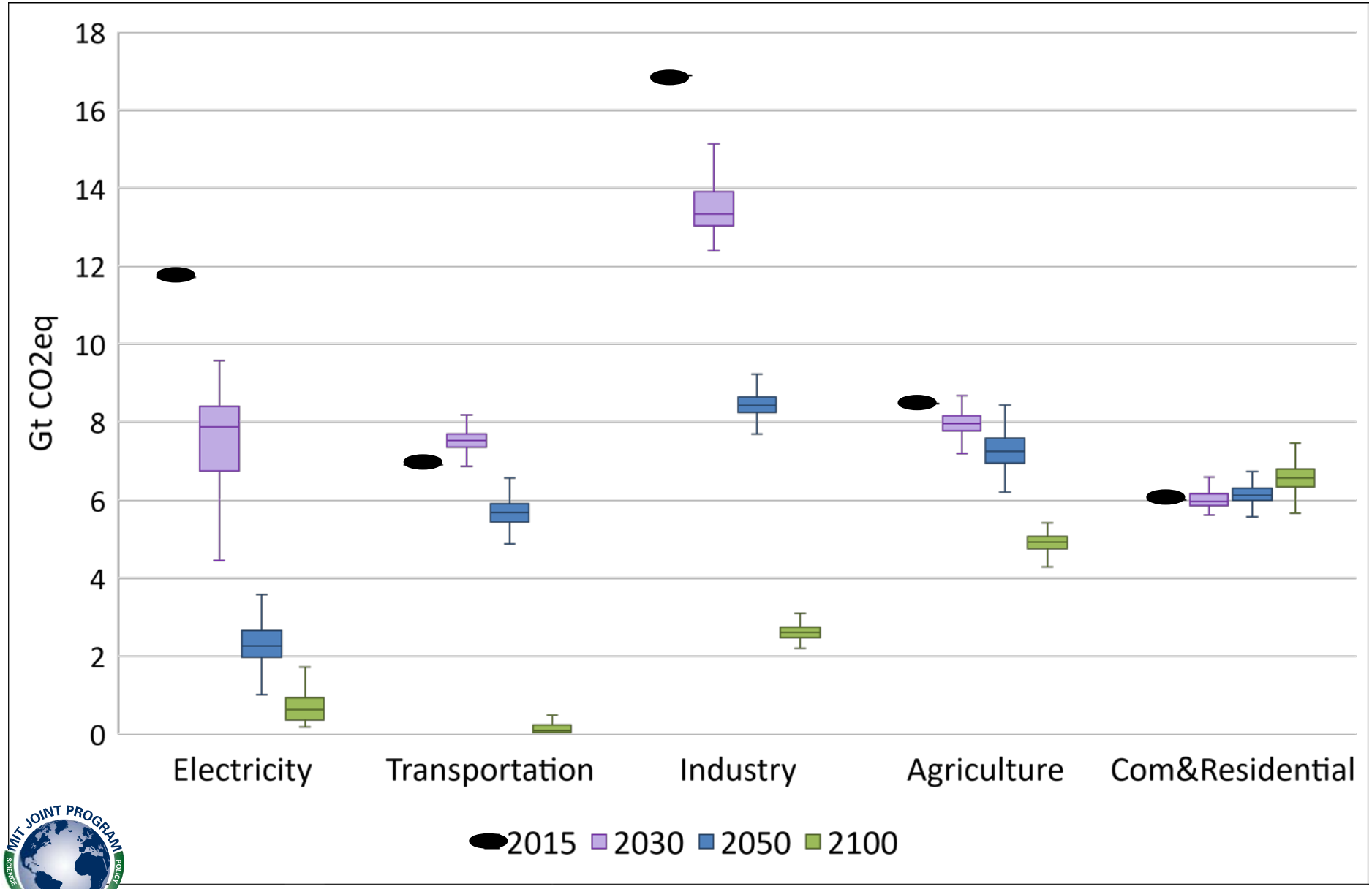
USA Electricity Mix



Total Electricity Generation by Region



Global GHG Emissions by Sector



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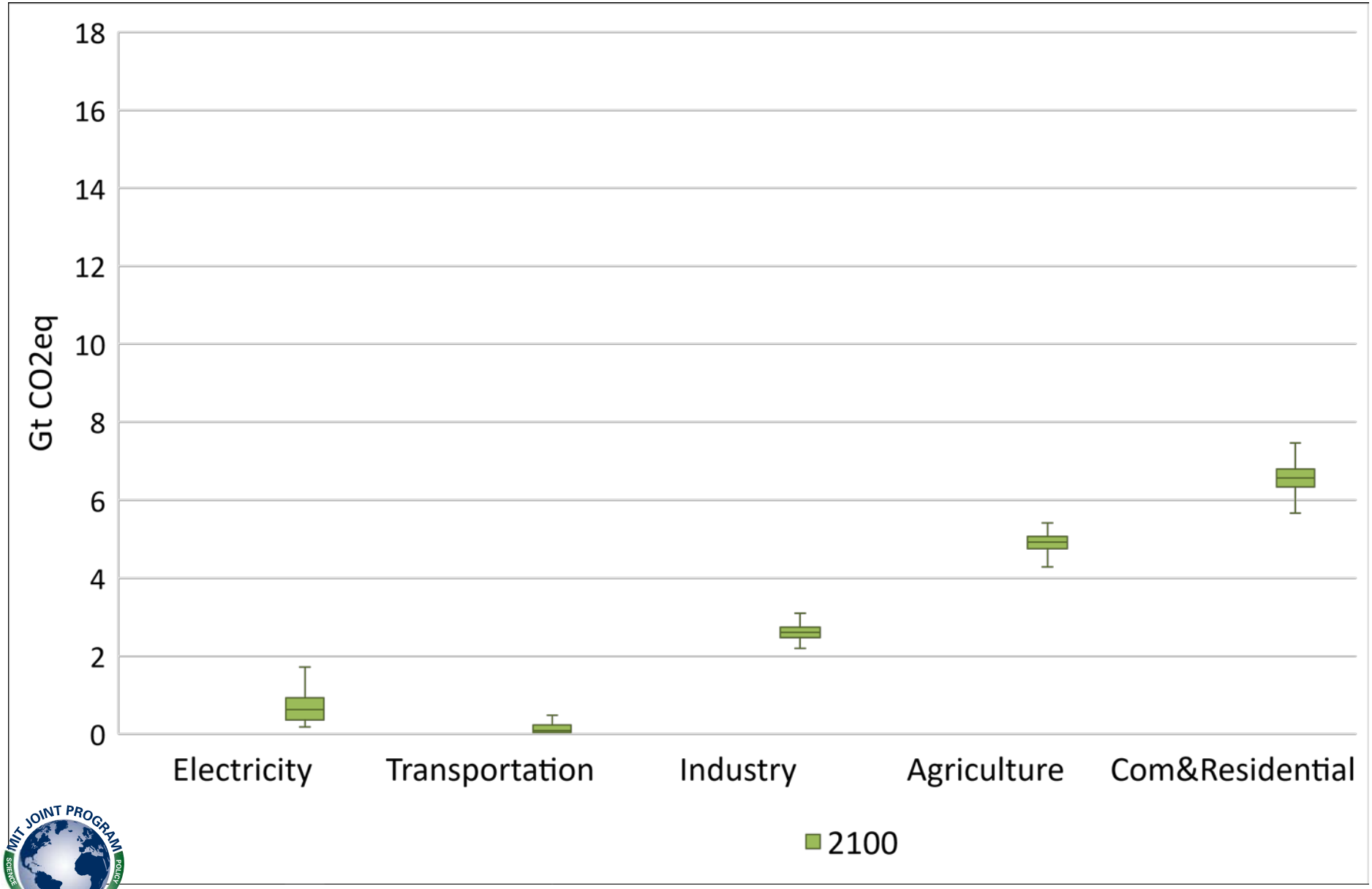

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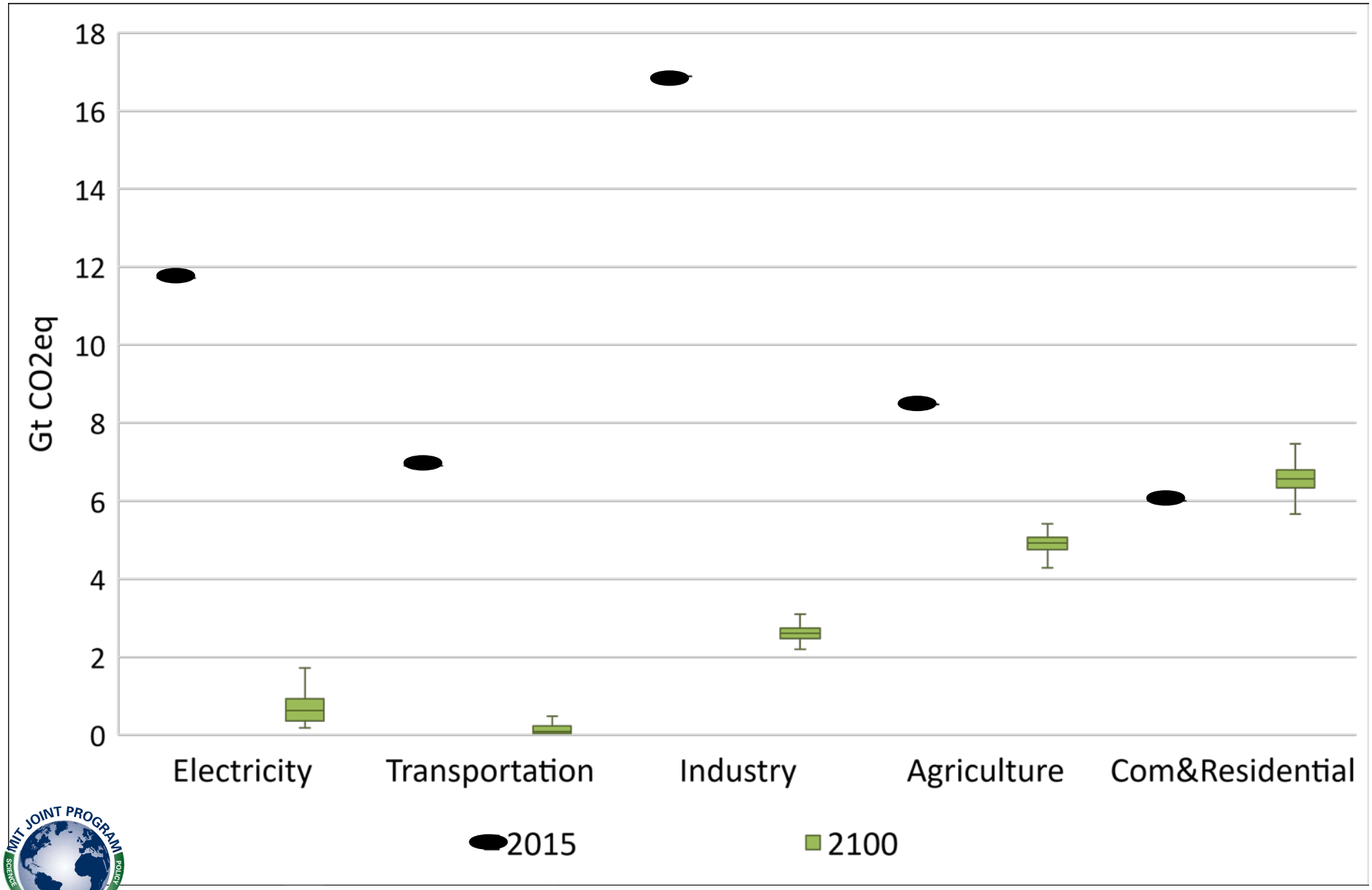

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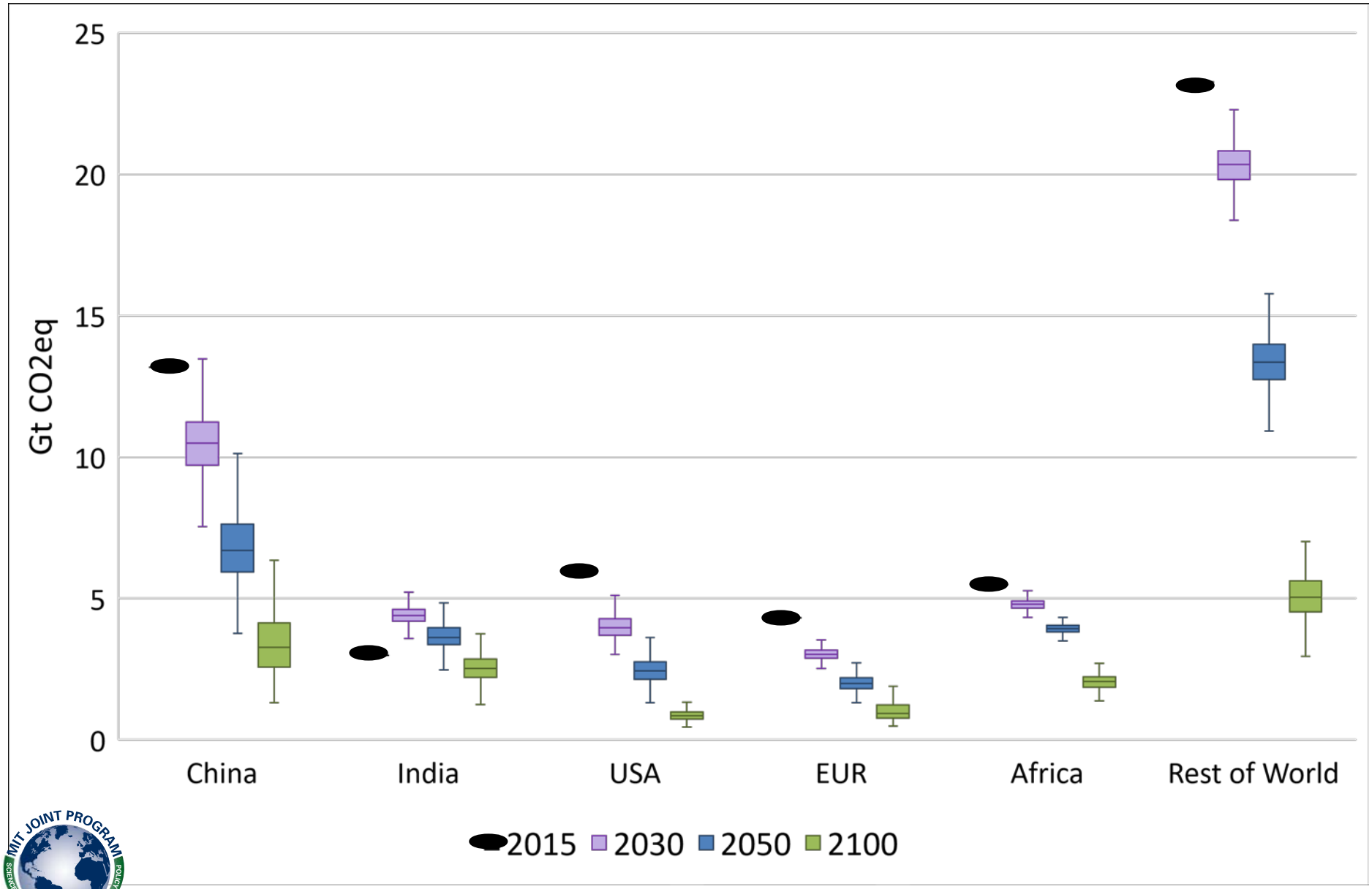
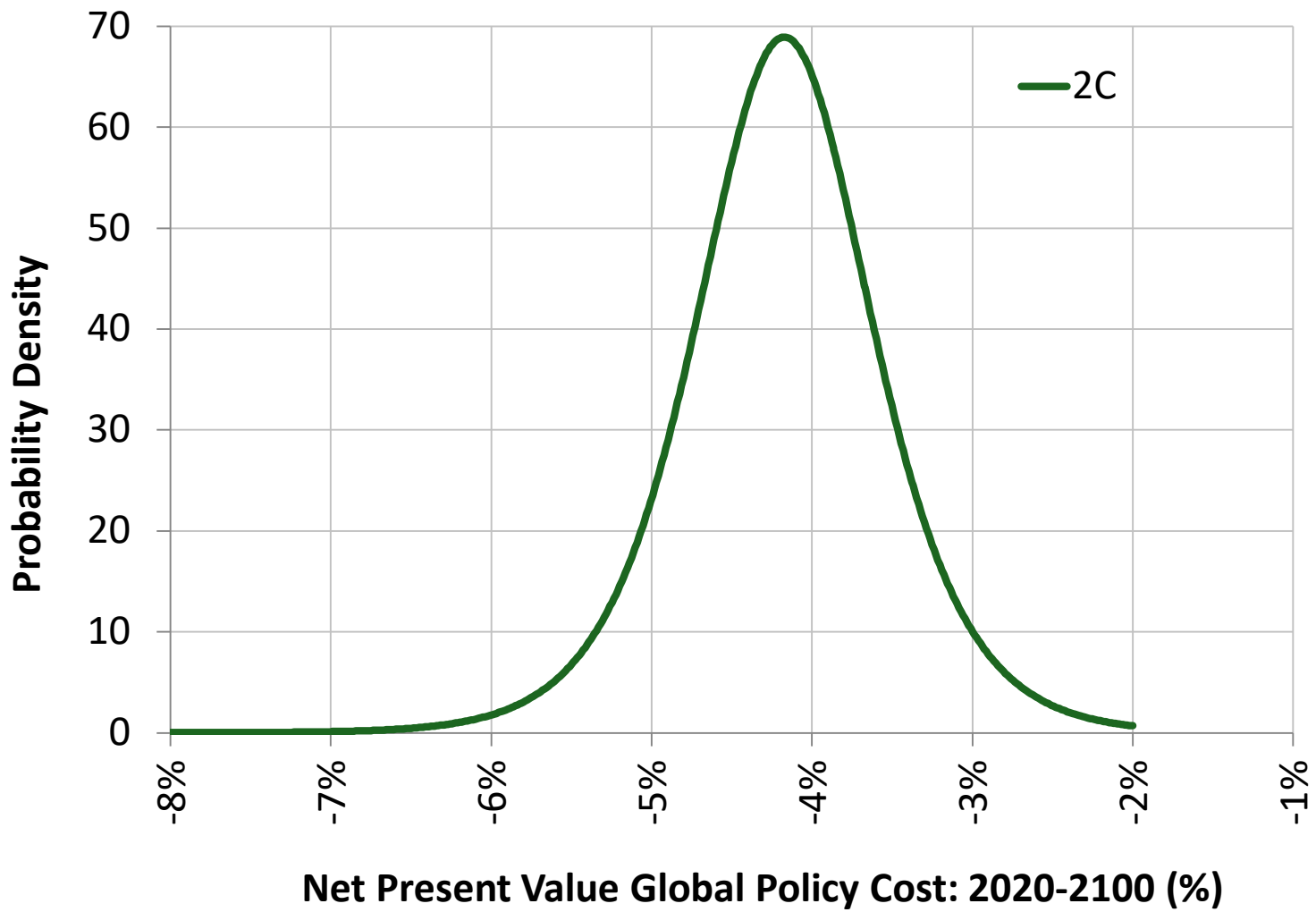
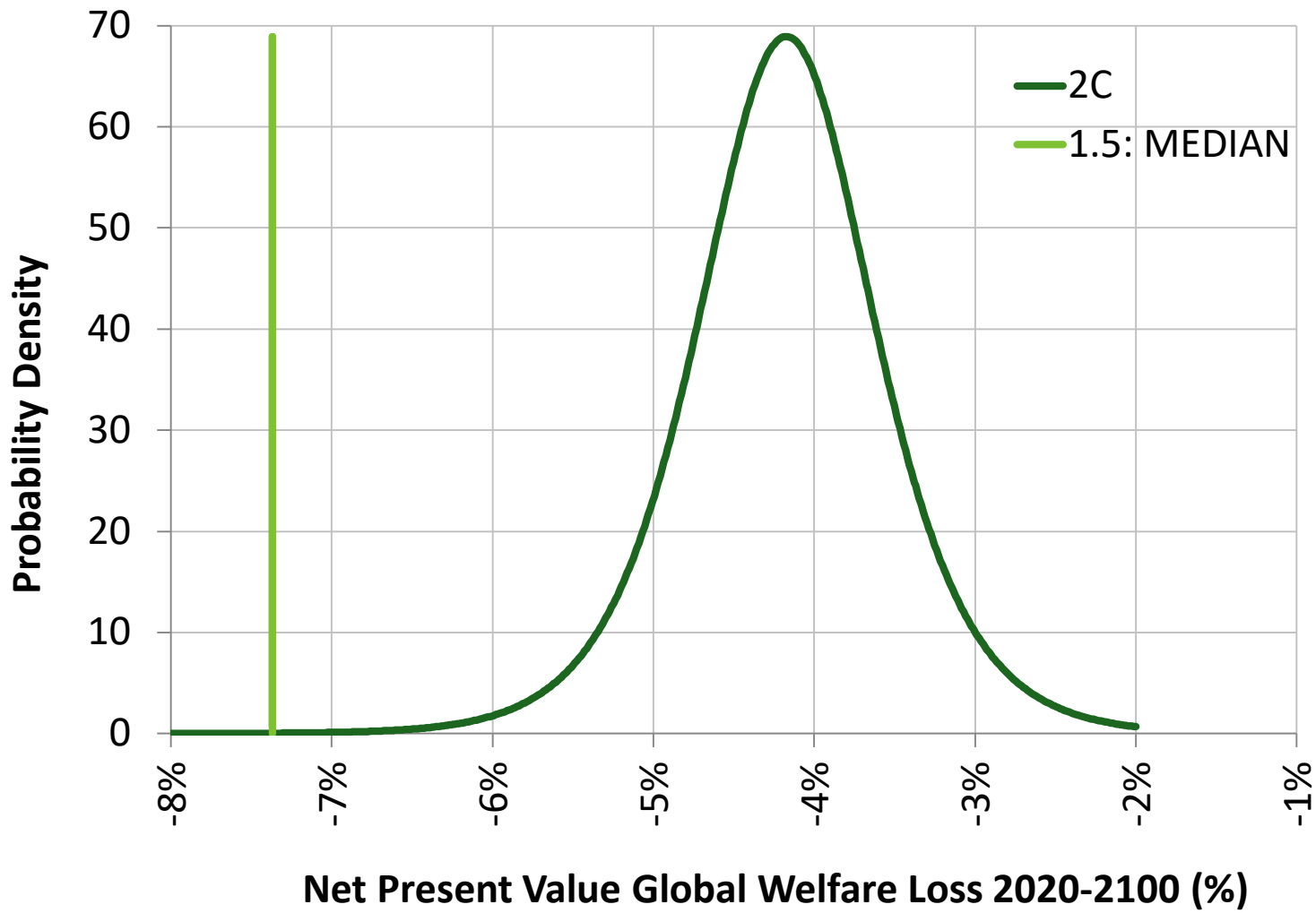


NPV Global Policy Cost



Policy Cost = percentage change in economy-wide consumption **relative to consumption in the reference scenario**

NPV Global Welfare Loss under Policy

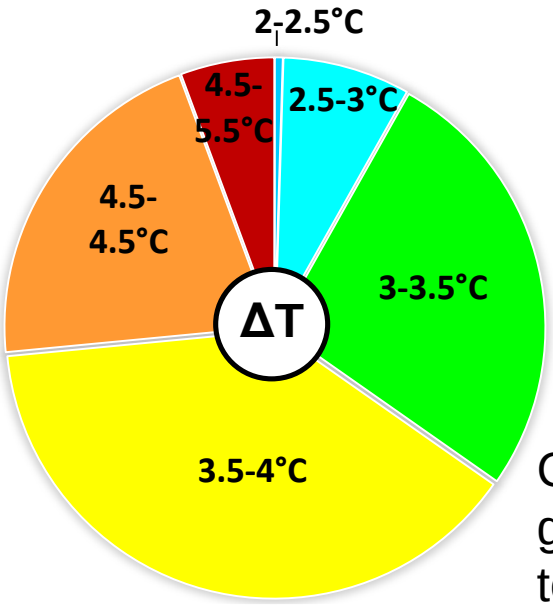


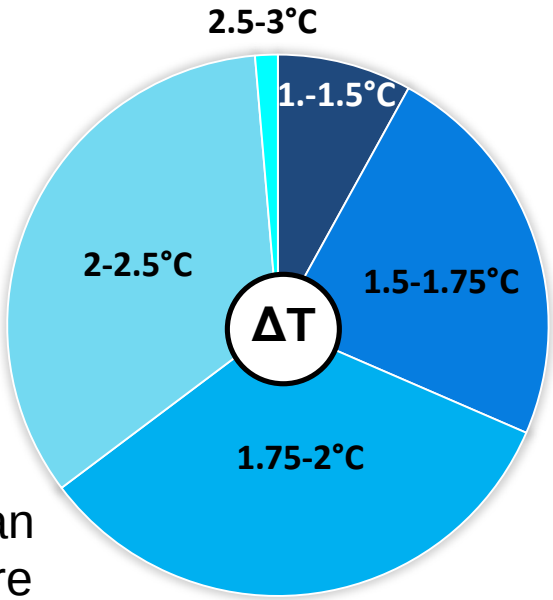
Policy Cost = percentage change in economy-wide consumption **relative to consumption in the reference scenario**

Temperature Impacts

REF | **2ºC**

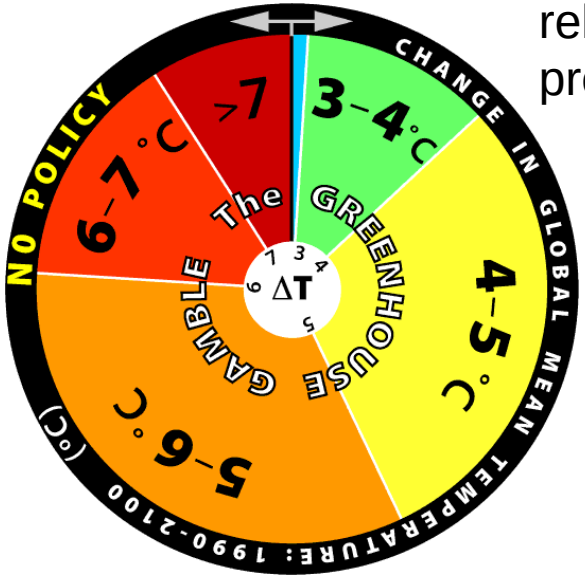
NEW

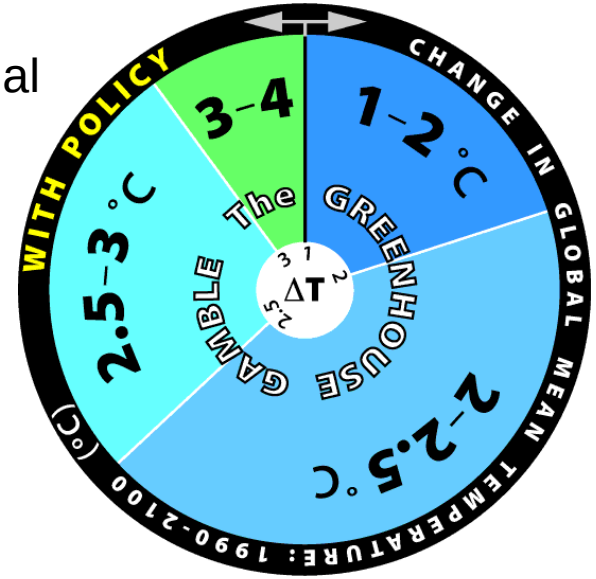




Change in global mean temperature relative to preindustrial

OLD





Thank you

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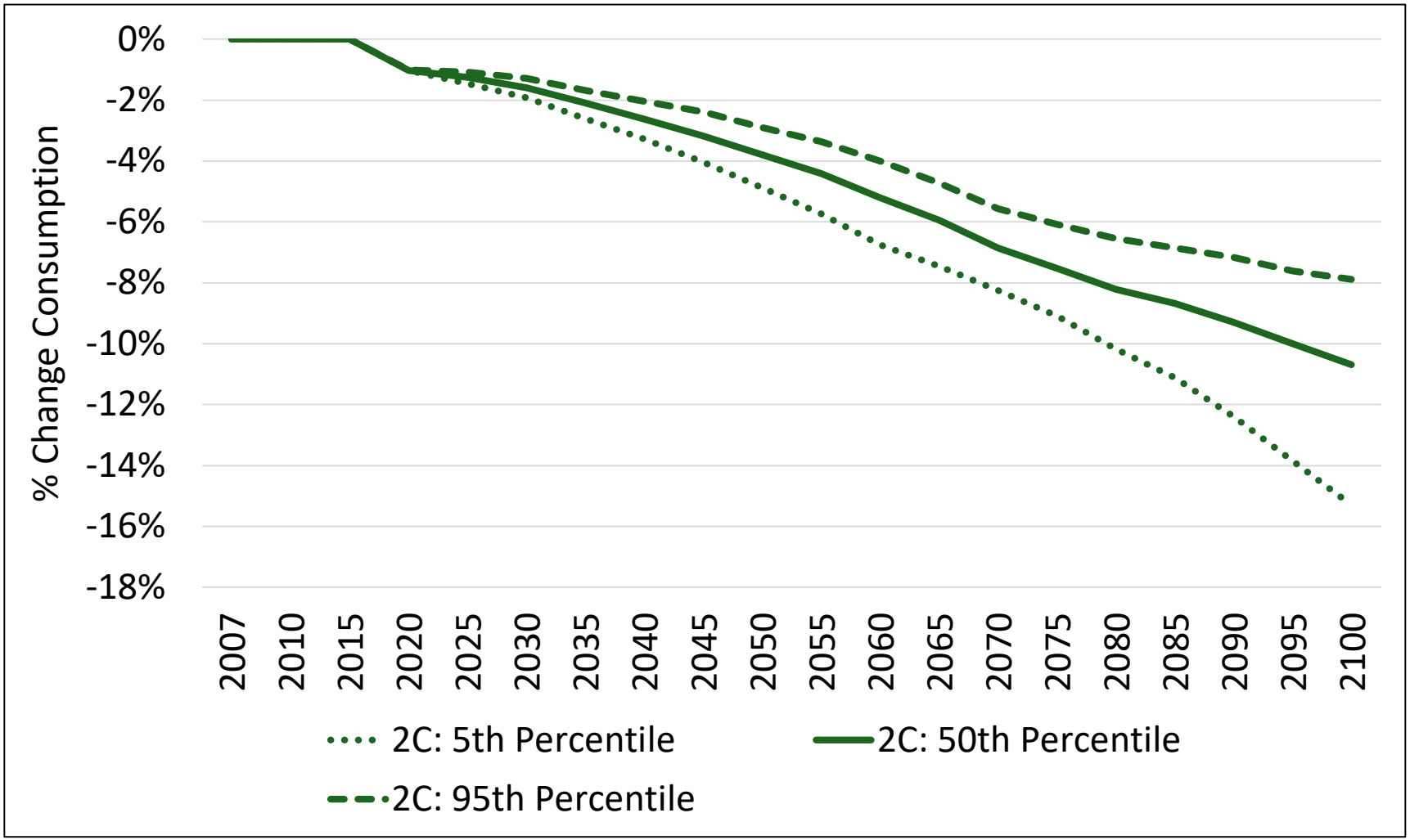
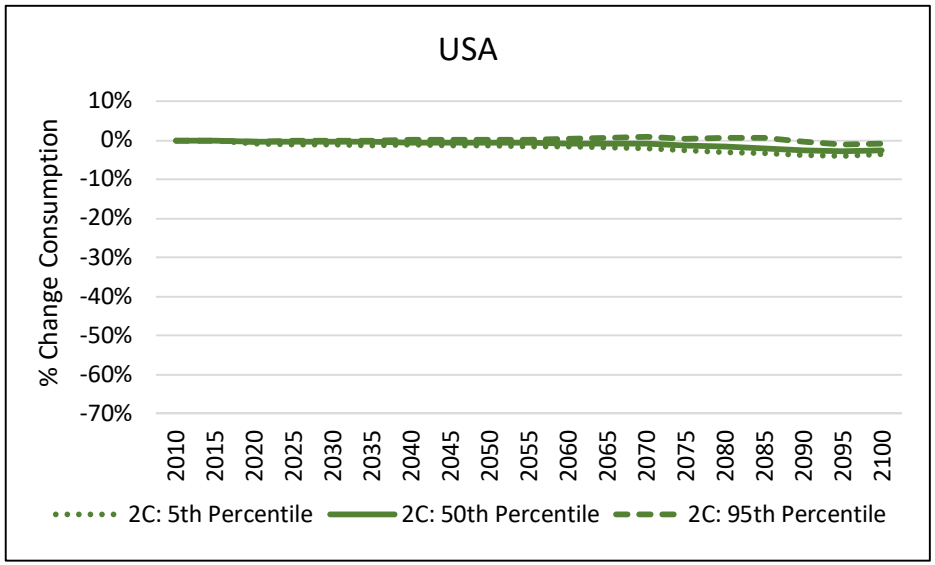
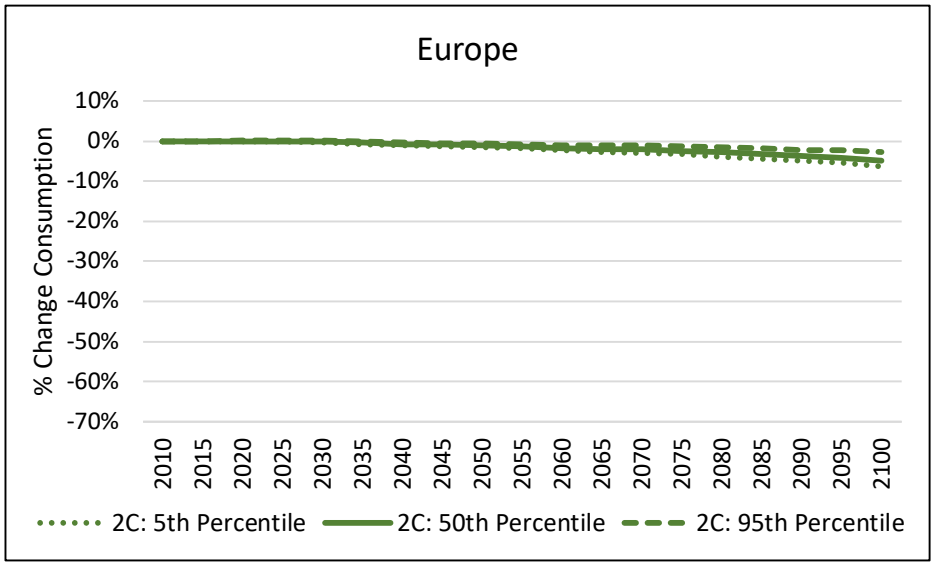
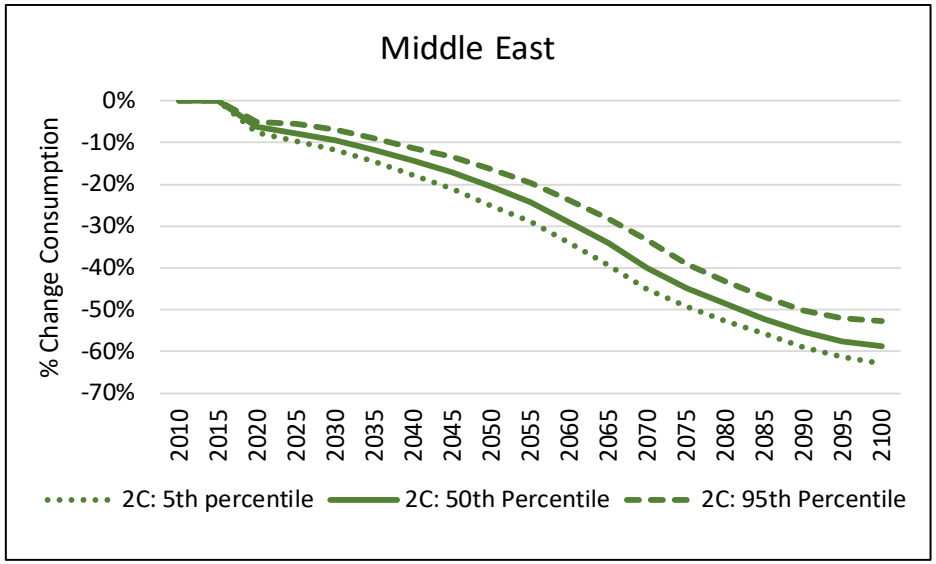
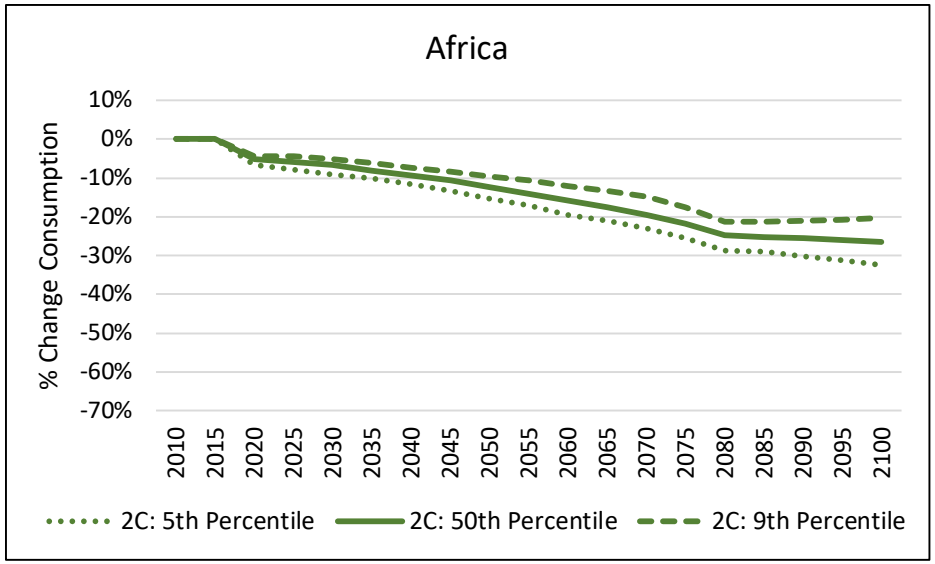
Extras

Global Policy Costs



*Note: Lines show 5th, 50th and 95th percentiles for each year to give an idea of the range. No run would be at the same percentile for all years.

2C Regional Policy Costs