

# Comparing decarbonization scenarios **across the Atlantic**

A MODEL INTER-COMPARISON EXERCISE BETWEEN THE **ENERGY MODELING FORUM 37** AND THE **EUROPEAN CLIMATE AND ENERGY MODELING FORUM**

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CMCC European Institute  
on Economics  
and the Environment



EUROPEAN  
CLIMATE + ENERGY  
MODELLING  
FORUM



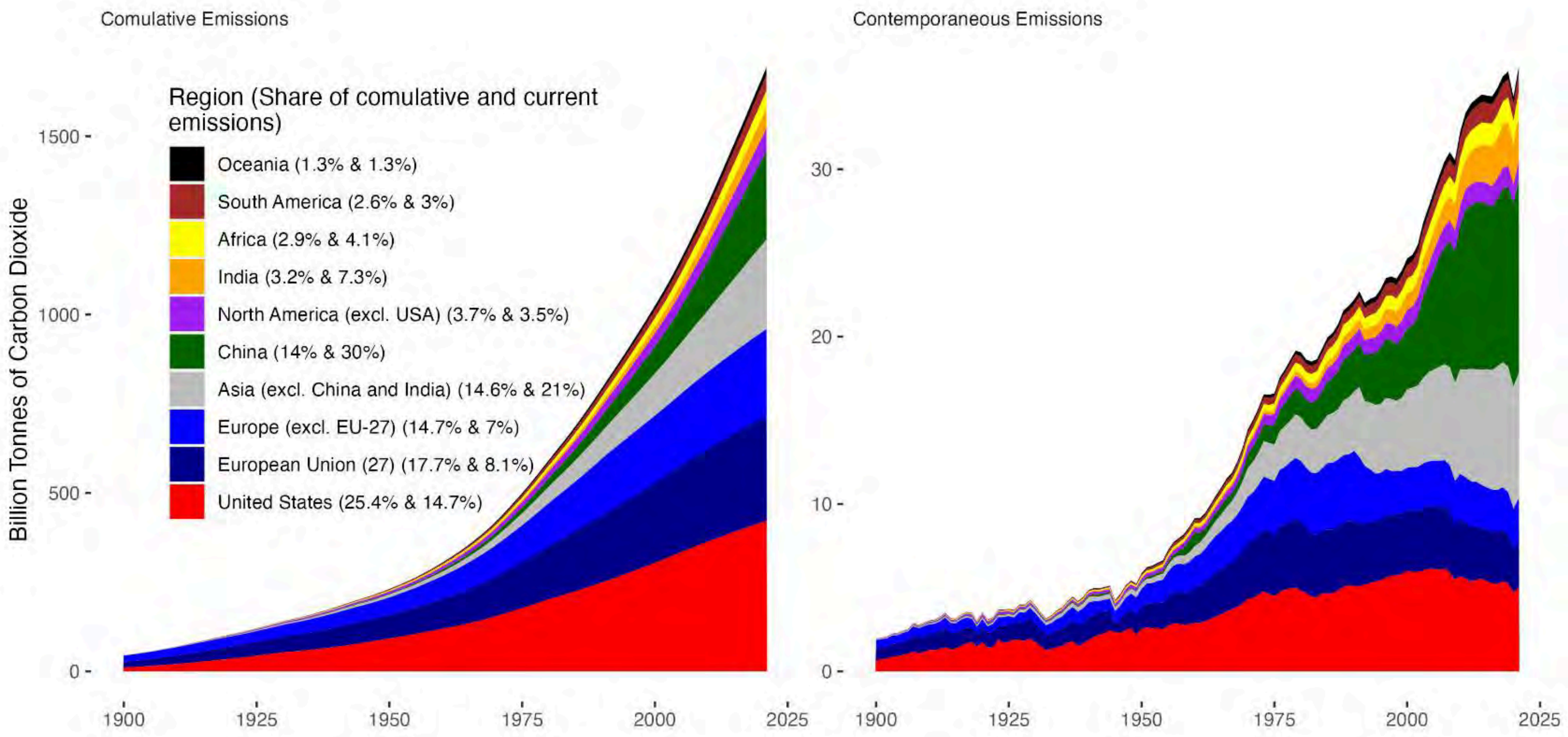


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  - <https://www.luissarmiento.com/>
  - Environmental Economist (CMCC)
  - Research Economist (Bank of Mexico)
- Strengths
  - Applied Econometrics
  - Spatial Econometrics
  - Energy modeling and IAMs

What did we do?



# Some Motivation



## Goal:

Compare the **net zero** pathways

VERY  
interesting



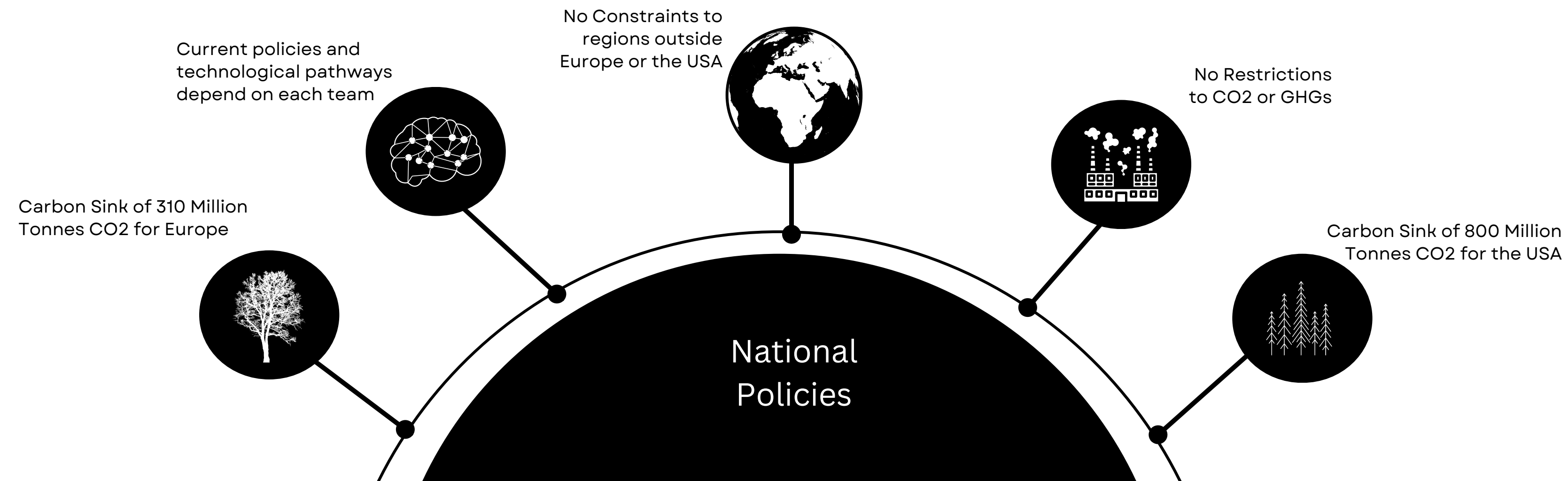
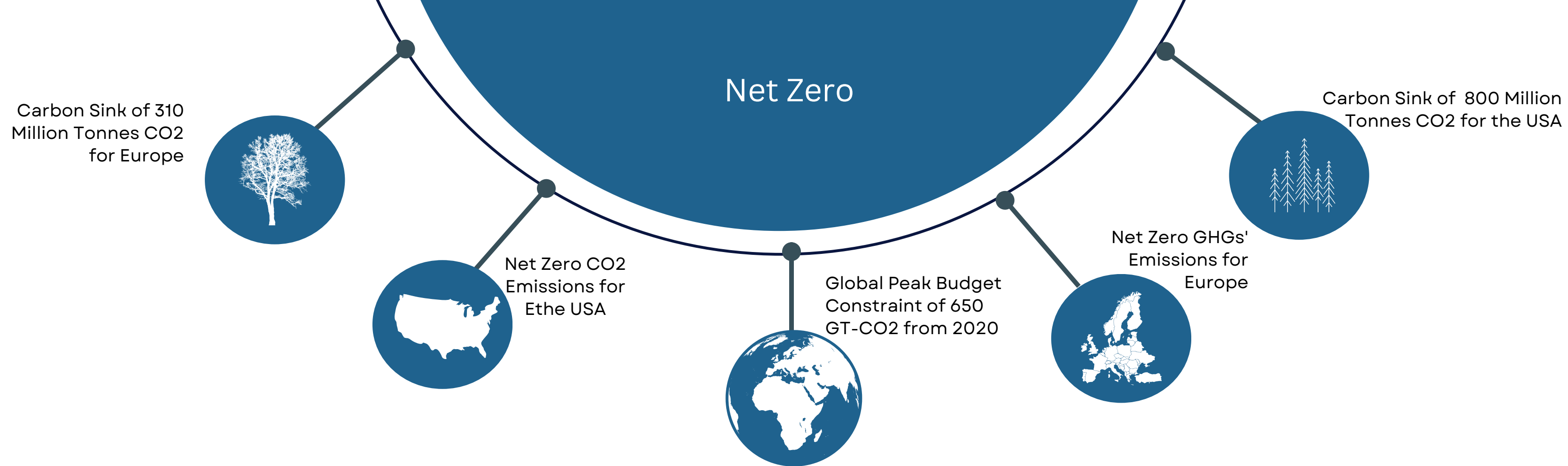
# Ten ECEMF Models



- IMAGE
- WITCH
- PROMETHEUS
- MESSAGEix-GLOBIOM
- REMIND
- TIAM-ECN
- GCAM
- EC-MCMR
- GCAM-USA



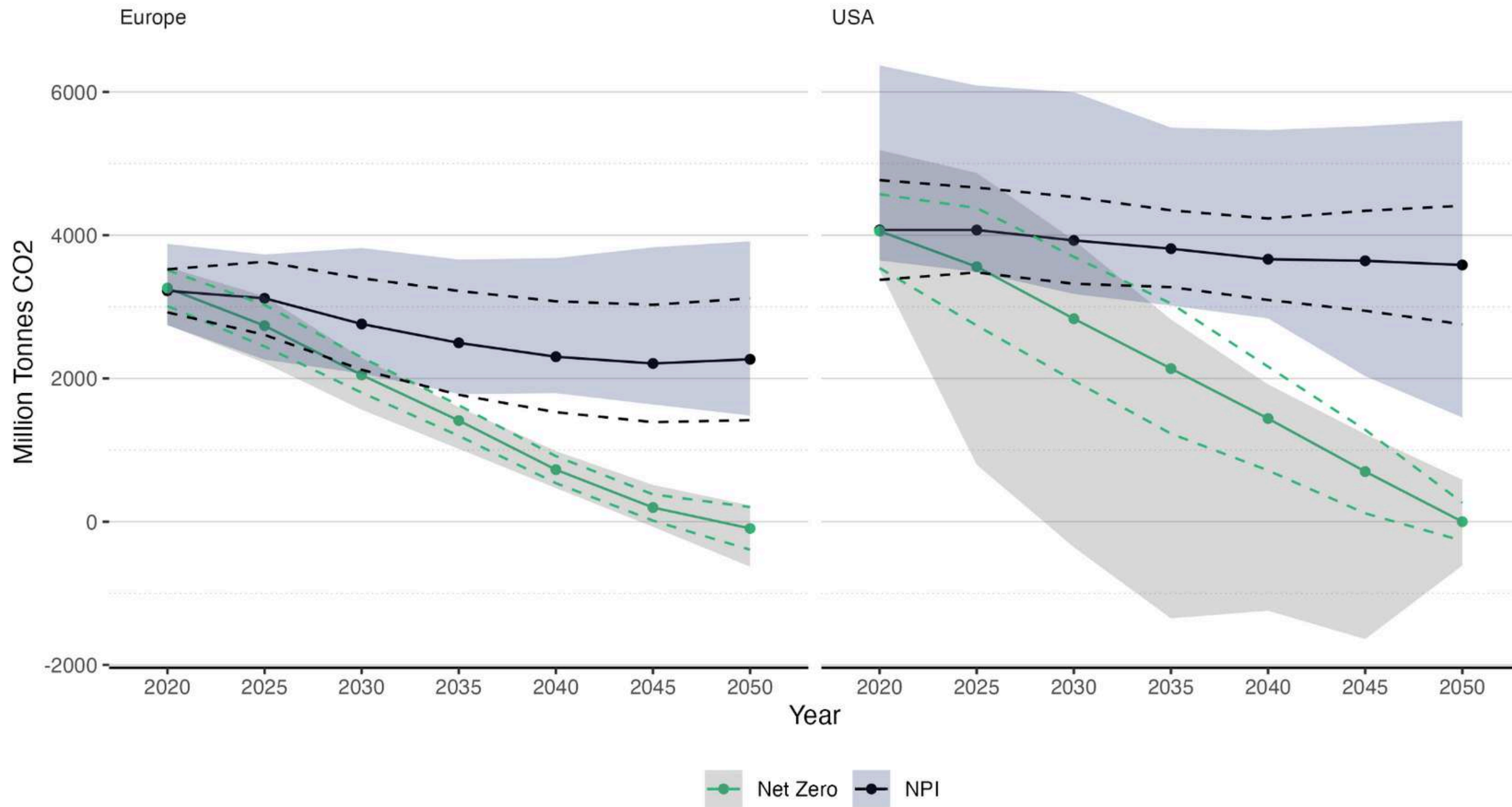
- European Models
- American Models
- Cross-Cut Teams
- EMF 37 and ECEMF Teams







# AVERAGE NET EMISSIONS TIME SERIES



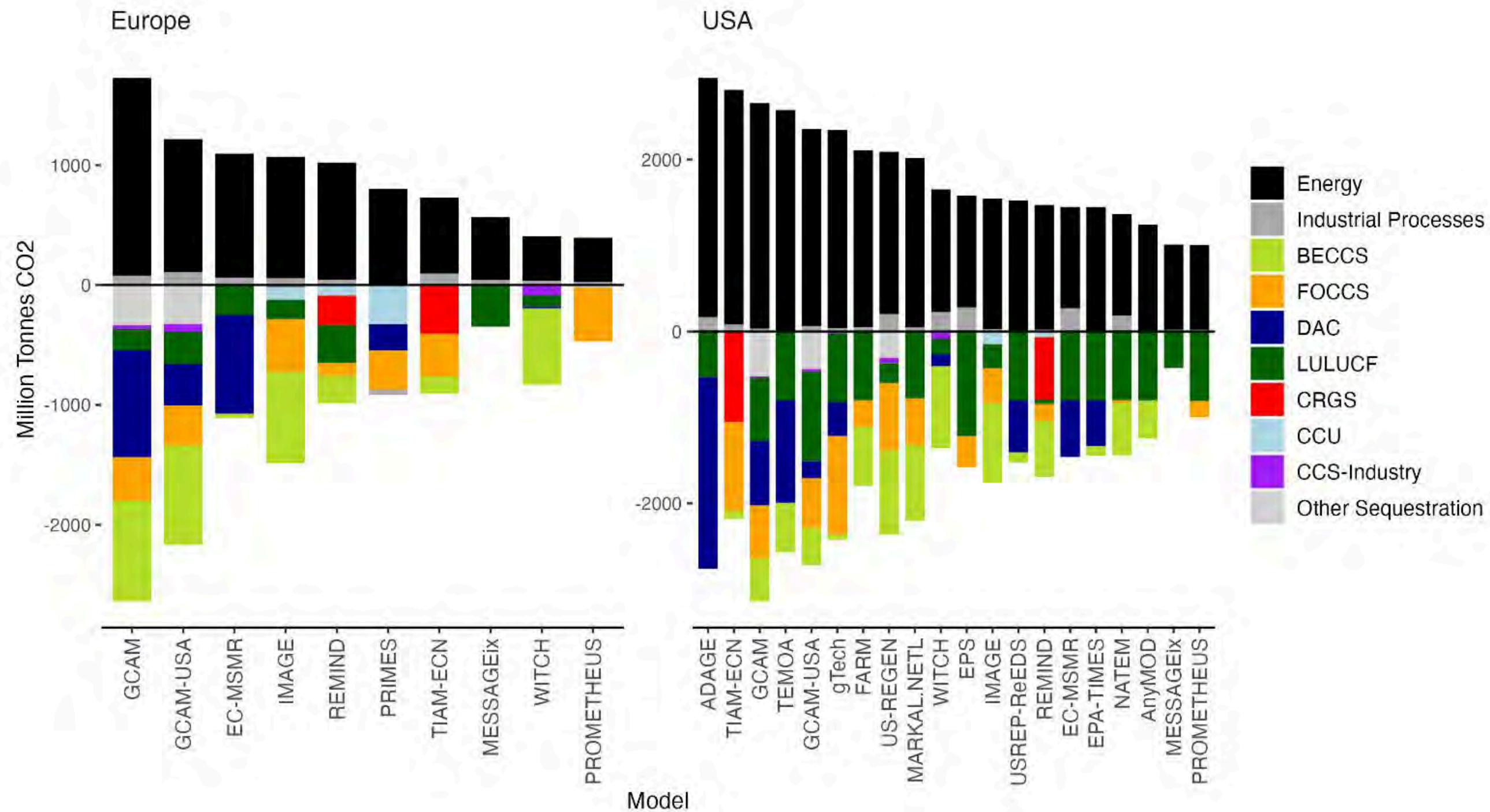
## Main Takes:

- Higher emission levels in 2020 for the US vs. Europe (100 to 80).
- On average, models reach net-zero CO2 by 2050
  - However: steeper decarbonization slope for the US - 22% vs 18% reduction Per annum





# EMISSION DIFFERENCE BETWEEN MODELS



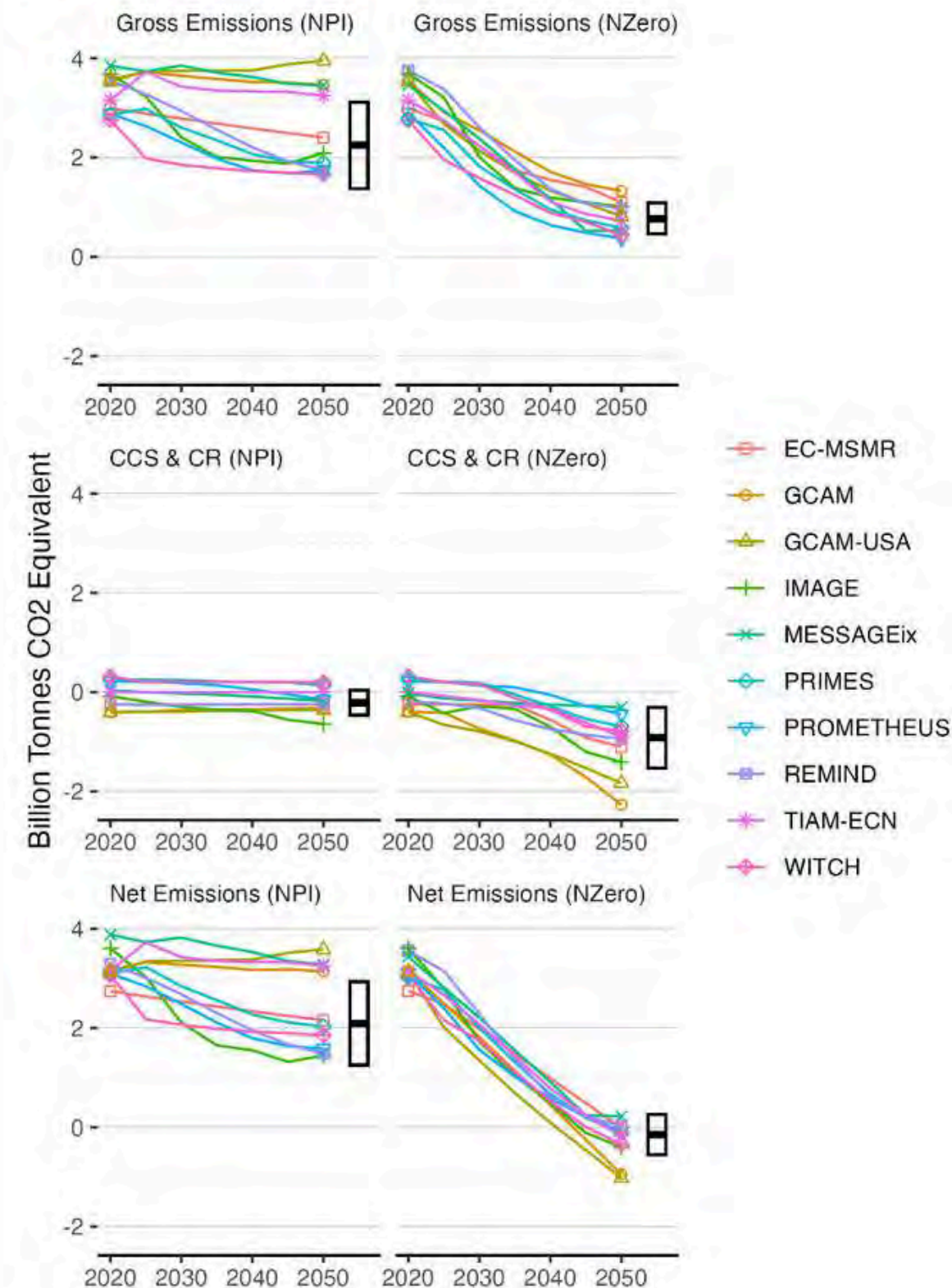
## Main Takes:

- Carbon Sequestration In Europe
  - 1,180 MTCO<sub>2</sub>
  - BECCS - 29.5%
  - FOCCS - 20.1%
  - DAC - 19.5%
  - LULUCF - 13.7%
- Carbon Sequestration In the United States
  - 1,860 MTCO<sub>2</sub>
  - LULUCF - 34.1%
  - BECCS - 21.7%
  - DAC - 19.1%
  - FOCCS - 16.7%

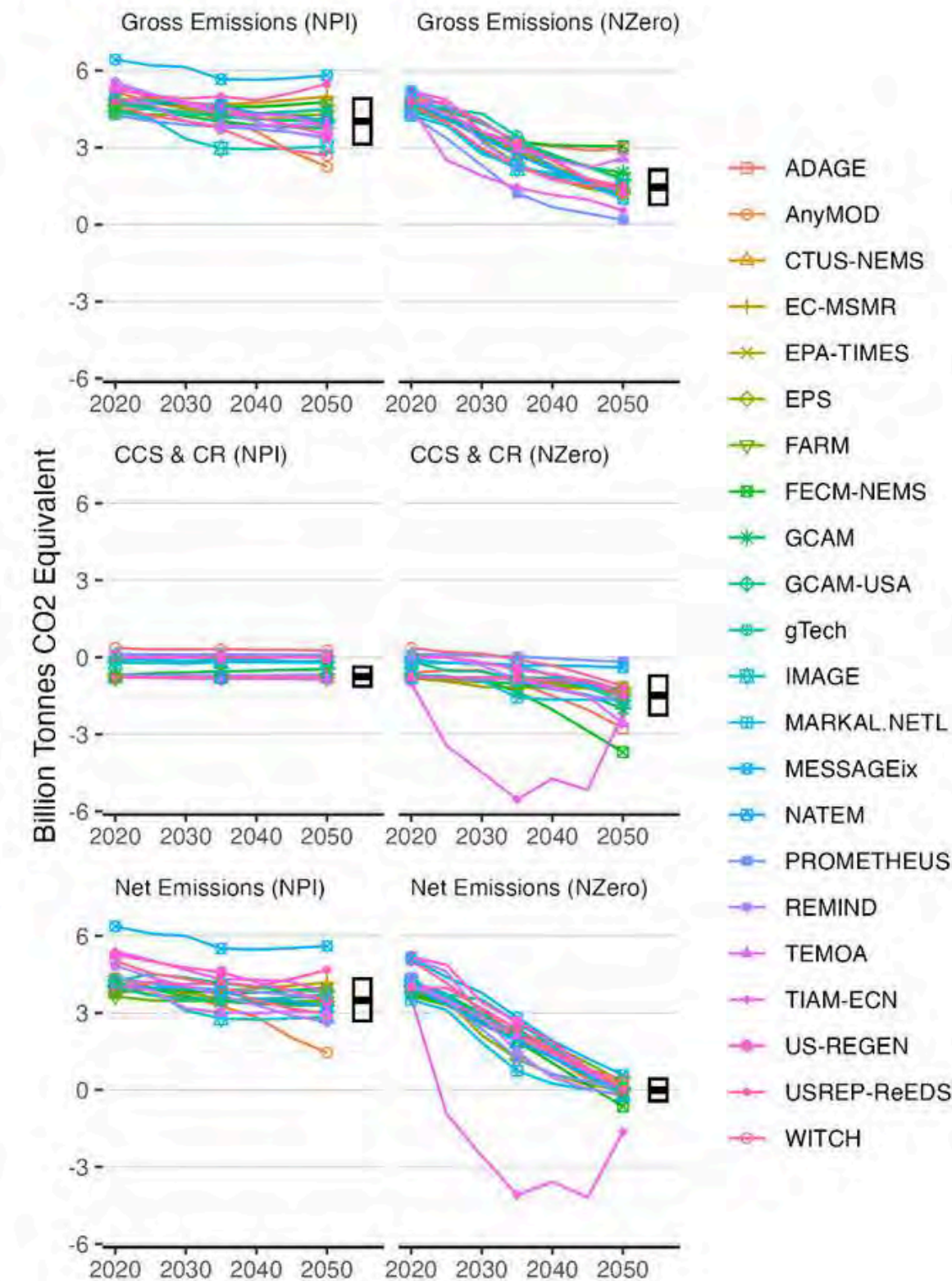


# GROSS, NET, AND CAPTURED EMISSIONS TIME SERIES

(a) Europe



(b) USA



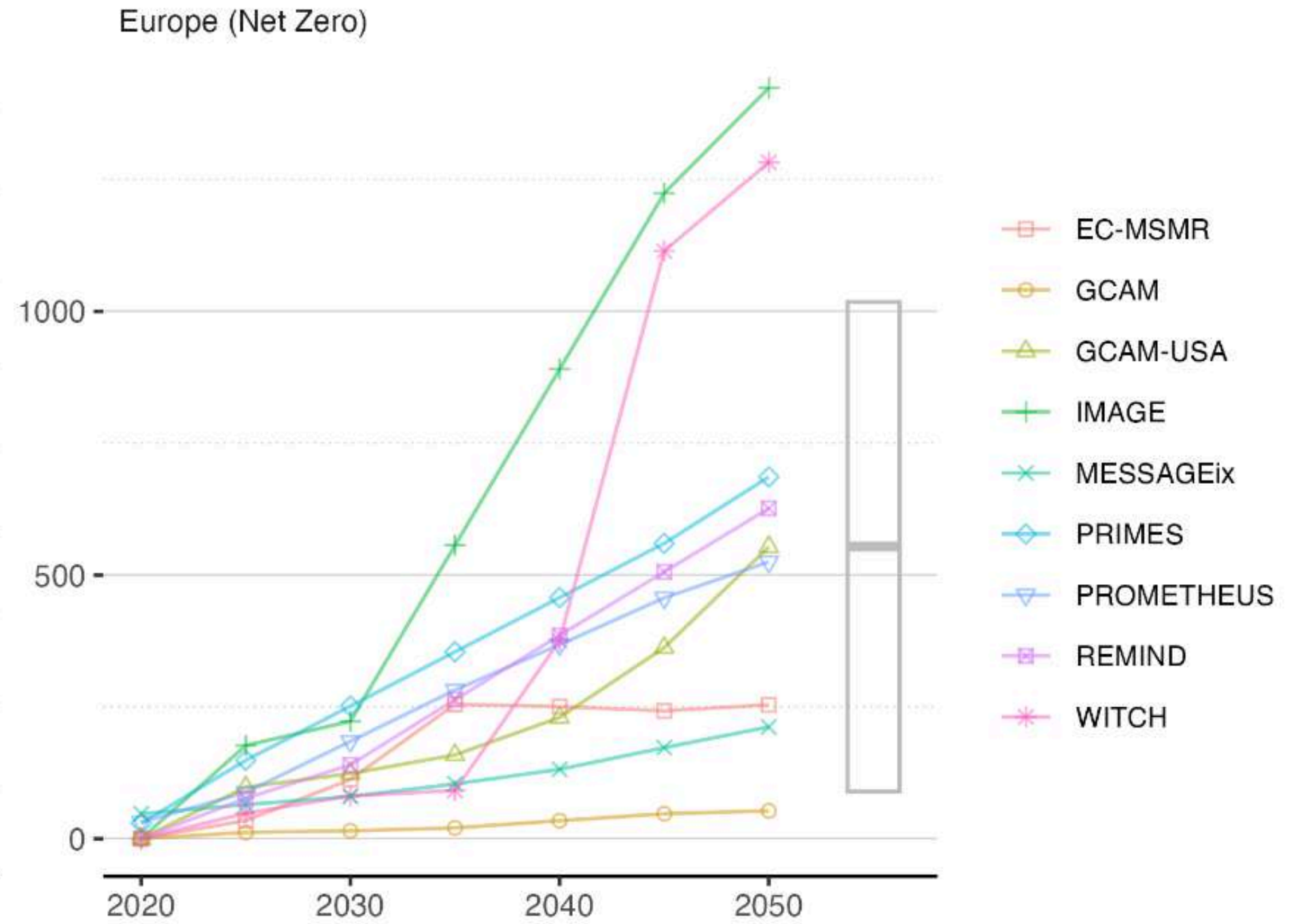
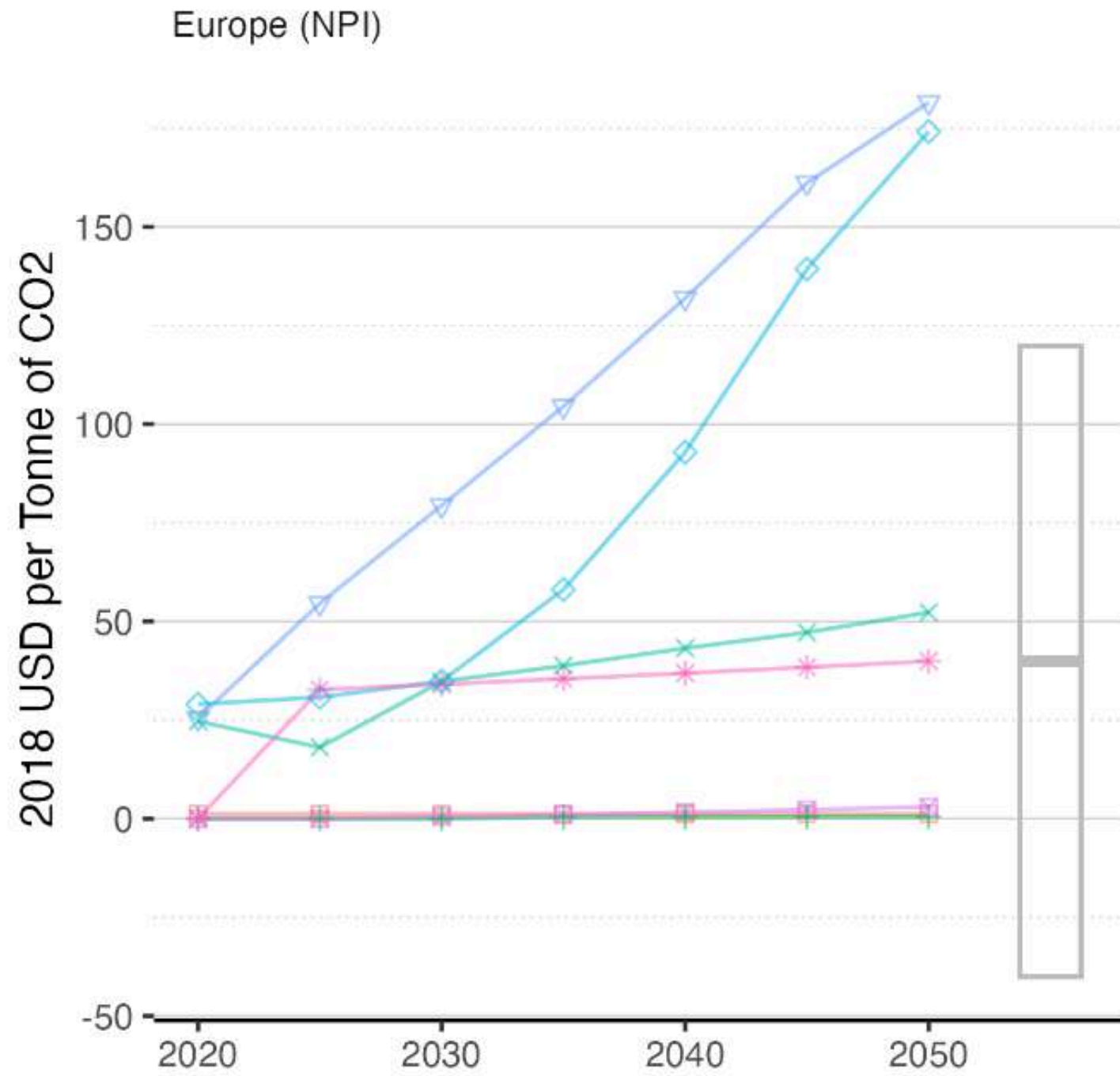
- 2050 Gross median emissions decreased by 68% in Europe and 73% in the US.
- Perhaps some clustering is occurring across models.
- Regarding net emissions, all teams roughly hit the net zero target in both the United States and Europe.





# CARBON PRICES IN EUROPE

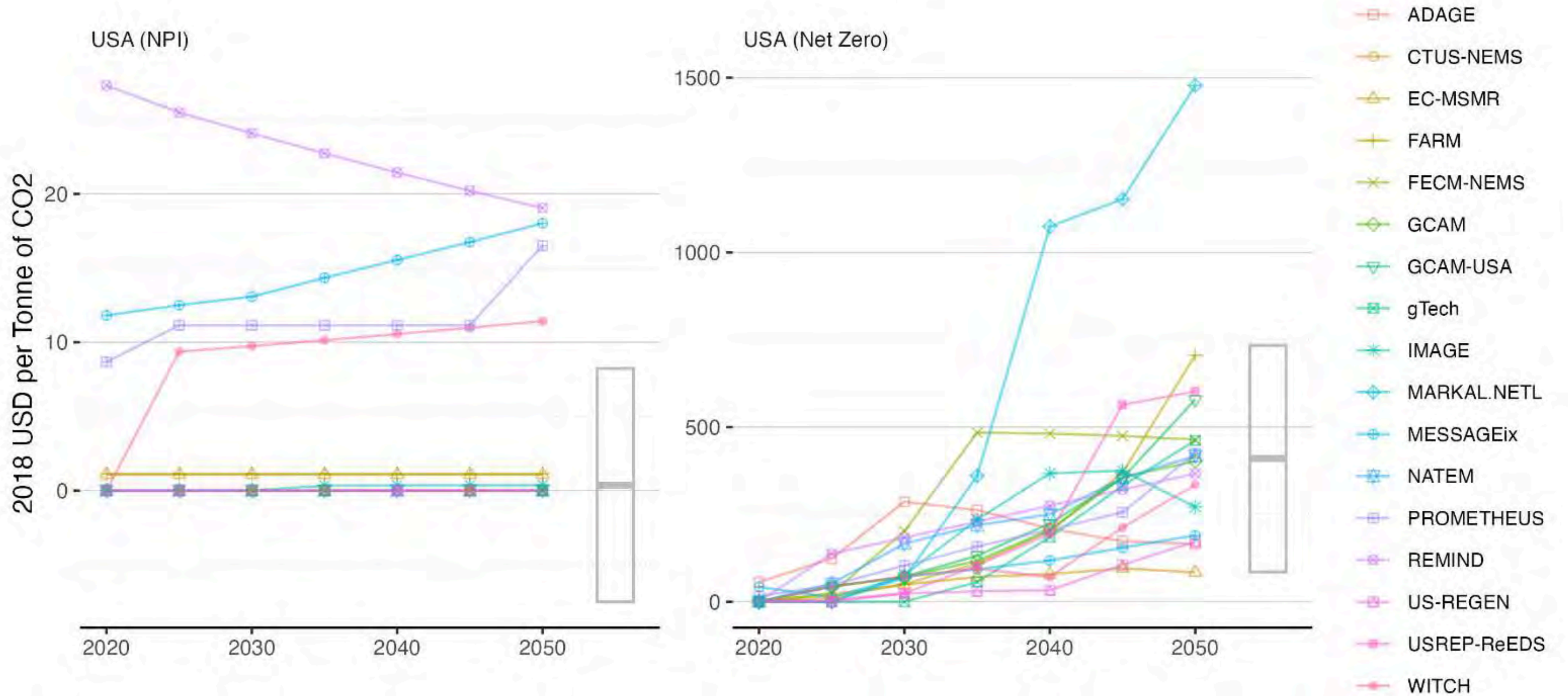
Main Takes:



- EC-MSMR
- GCAM
- GCAM-USA
- IMAGE
- MESSAGEix
- PRIMES
- PROMETHEUS
- REMIND
- WITCH



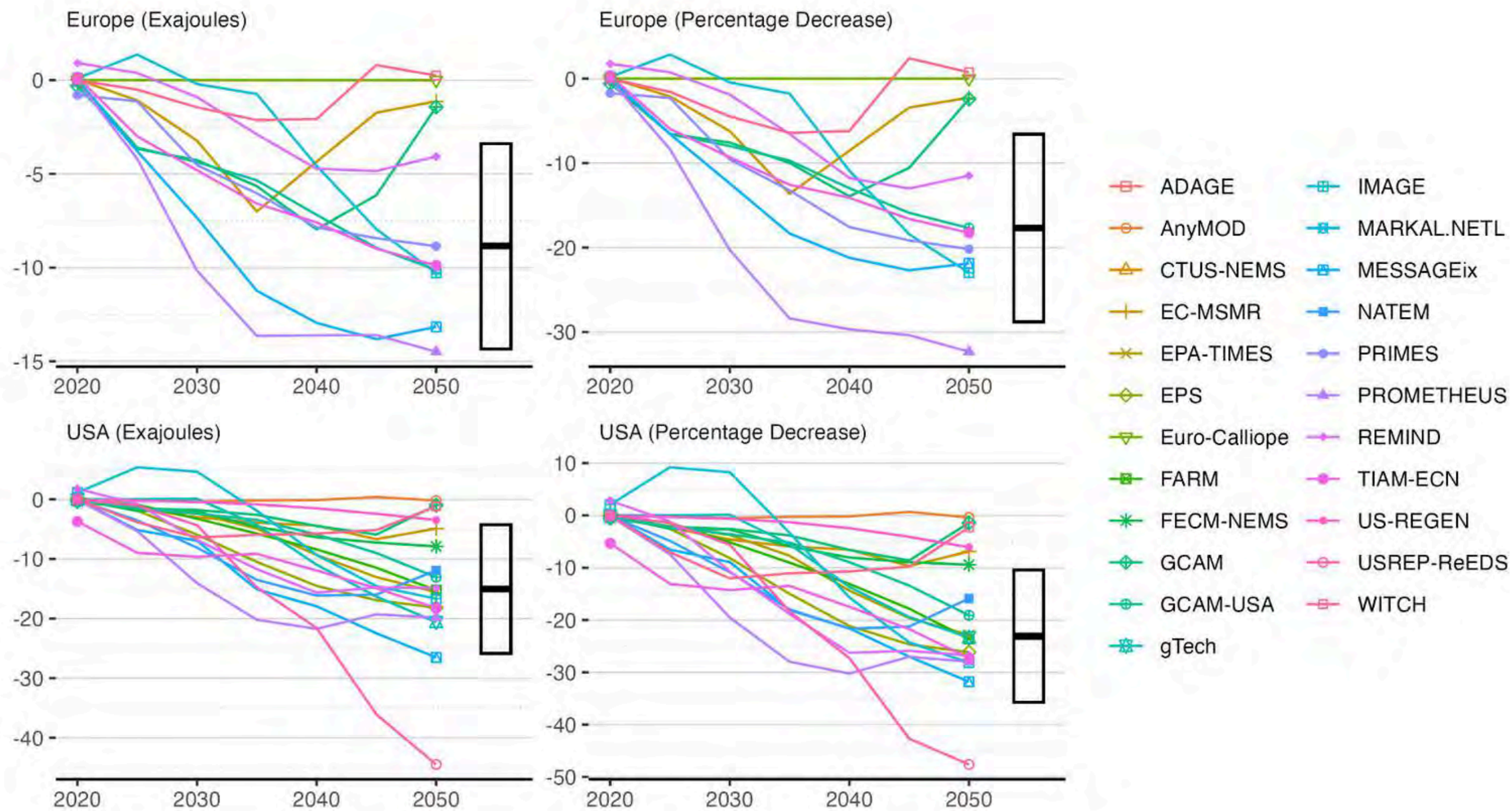
# CARBON PRICES IN THE USA







# CHANGES IN FINAL ENERGY DEMAND



## Main Takes:

- Reduction in final energy demand NPI-Nzero in 2050
  - EU: 9 EJ or 18%
  - USA: 15 EJ or 32%

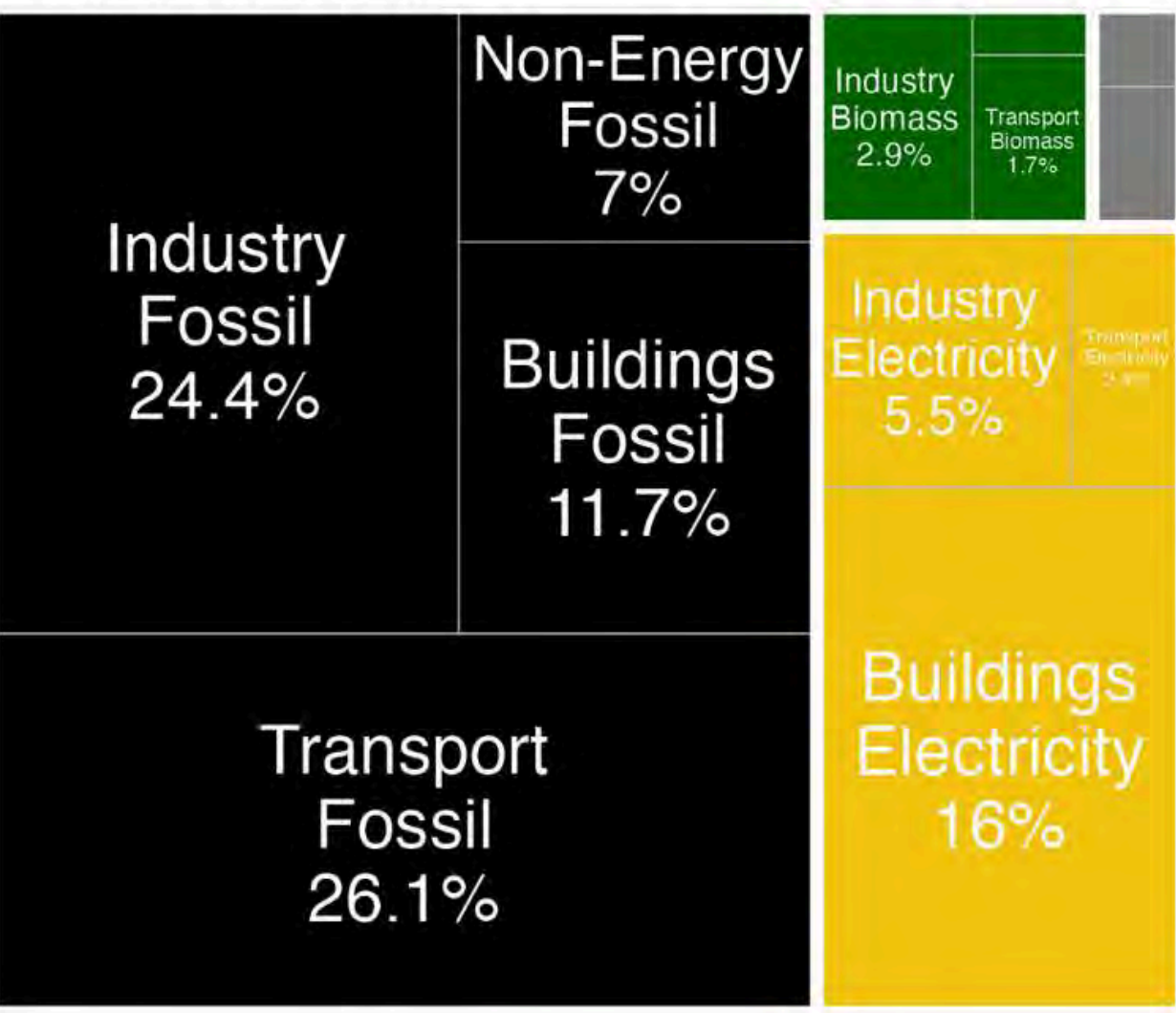
Effects on the GDP

Effects on consumption

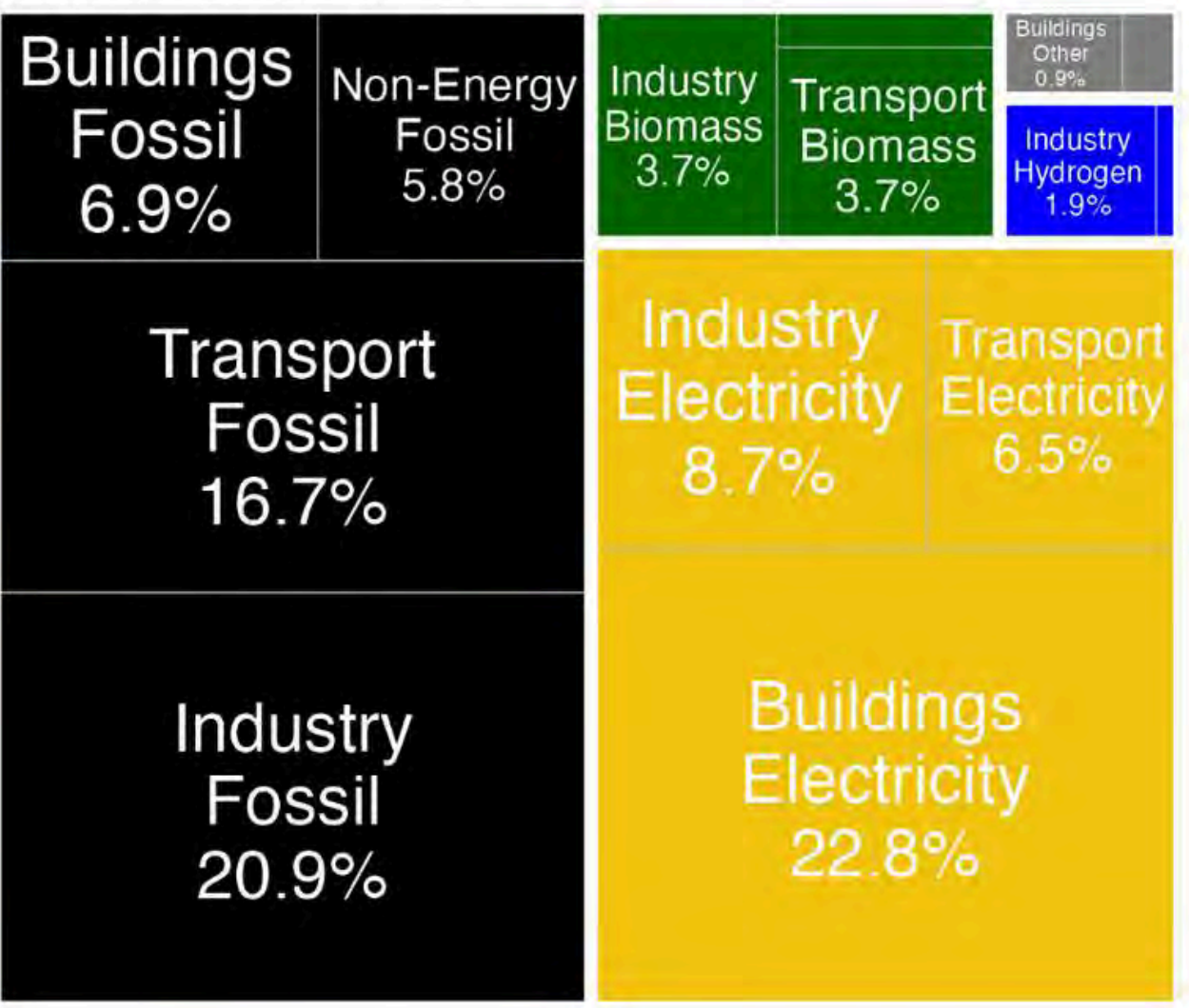


# FINAL ENERGY DEMAND BY SECTOR AND SOURCE IN THE USA

NPI (Demand: 76.9 EJ)



NZero (Demand: 55.5 EJ)



## Main Takes:

- Aggregate demand reduction
- Fossil fuels decrease by 25 EJ.
  - Increase of 2.5EJ in electricity
  - 0.6 EJ in biomass
  - 1.2 EJ in hydrogen and synthetic fuels





# CHANGE IN PRIMARY ENERGY DEMAND

