



International Institute for  
Applied Systems Analysis  
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science for global insight

# Draft results: Modelling Carbon Neutrality - CAS

02 June 2021



IIASA, International Institute for Applied Systems Analysis

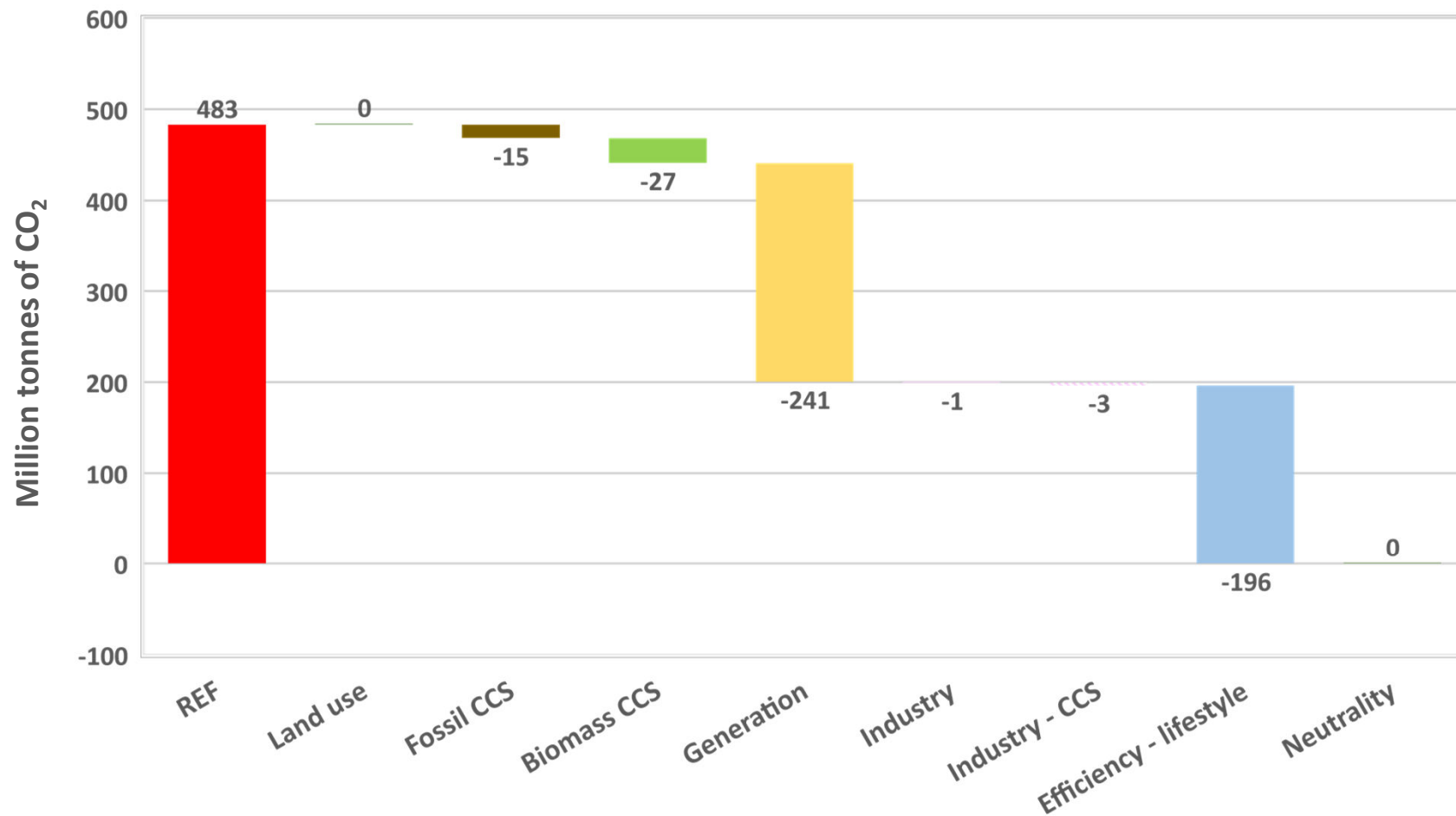
# Modeling Results: CAS

The path to carbon neutrality

ENERGY



Cumulative mitigation steps from REF to CN  
(as seen by an observer in 2050)



# Modeling Results: CAS

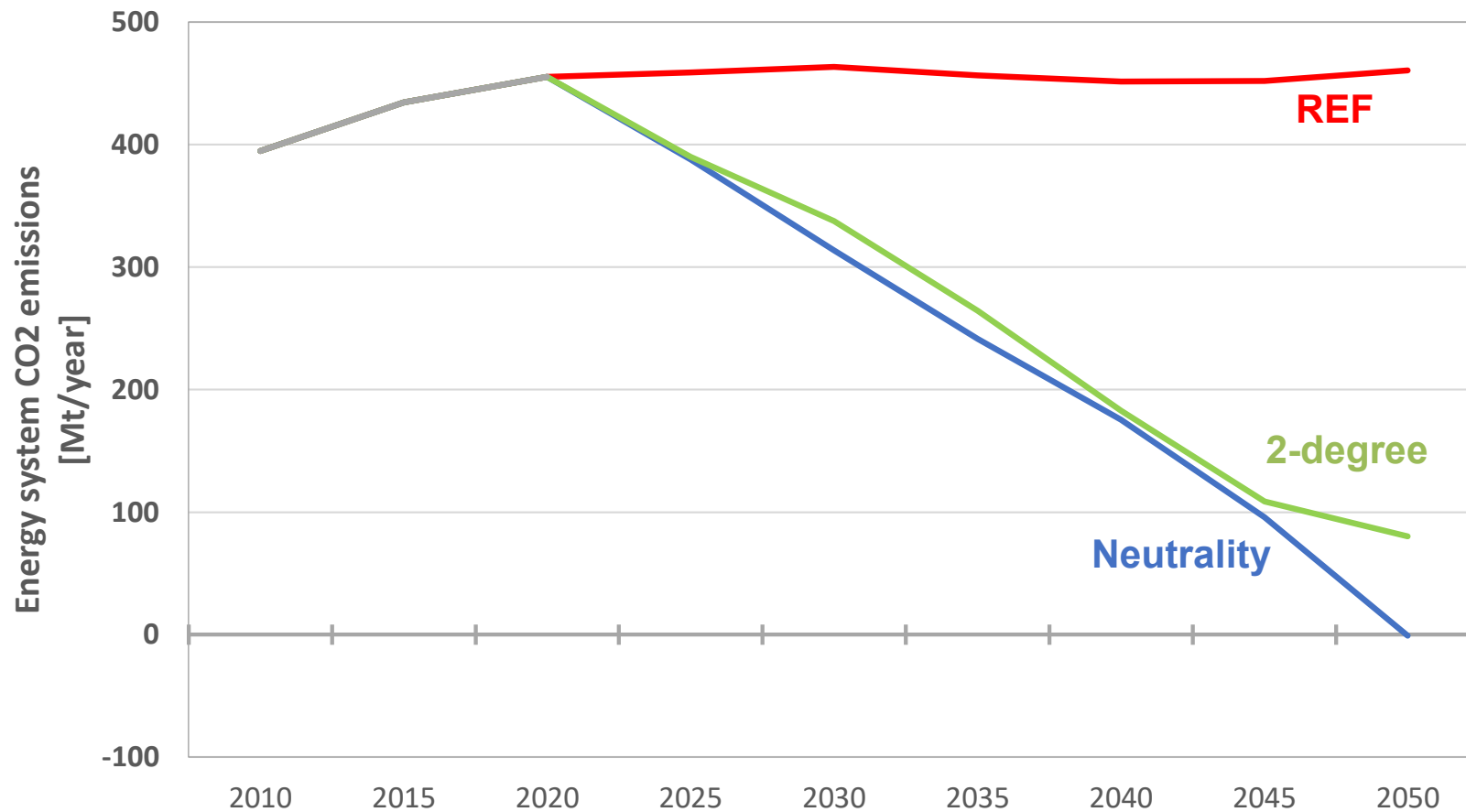
Carbon dioxide emissions

ENERGY



## CO<sub>2</sub> emissions by scenario - CAS

[Million tonnes/year]



# Modeling Results: CAS

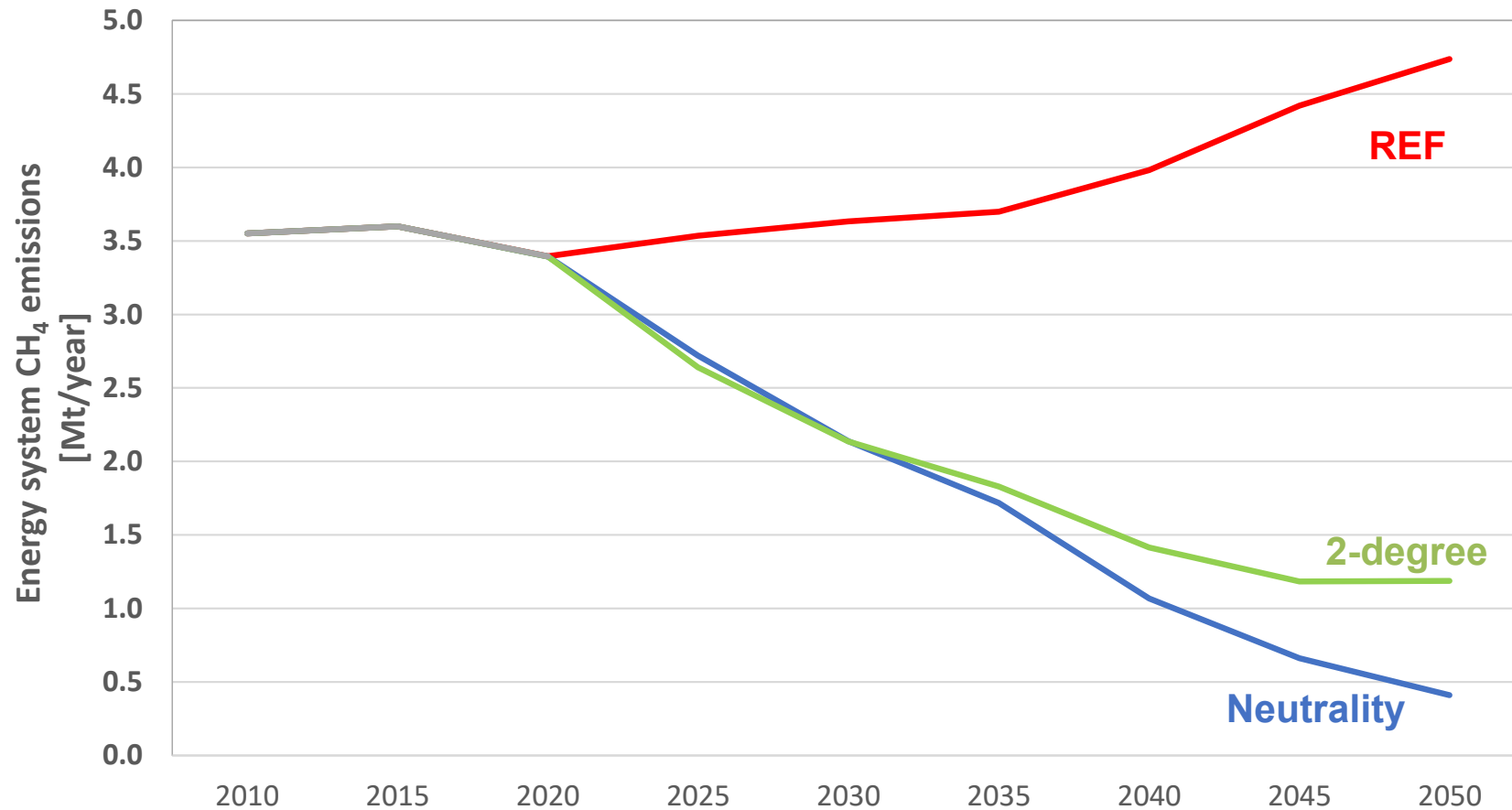
Methane emissions

ENERGY



## CH<sub>4</sub> emissions by scenario - CAS

[Million tonnes/year]



# Modeling Results: CAS

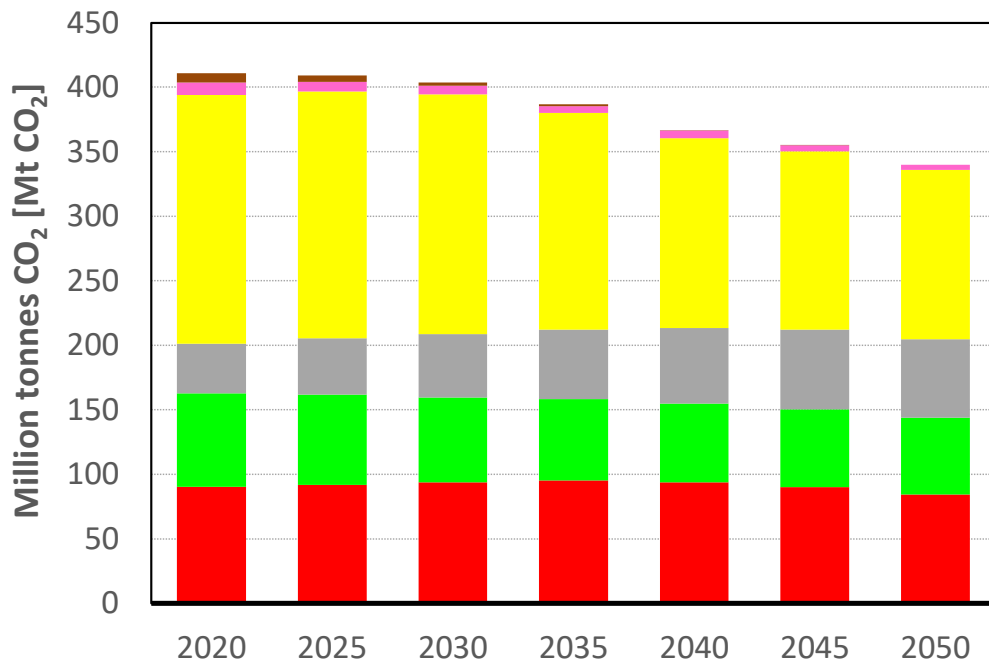
Sector emissions

ENERGY

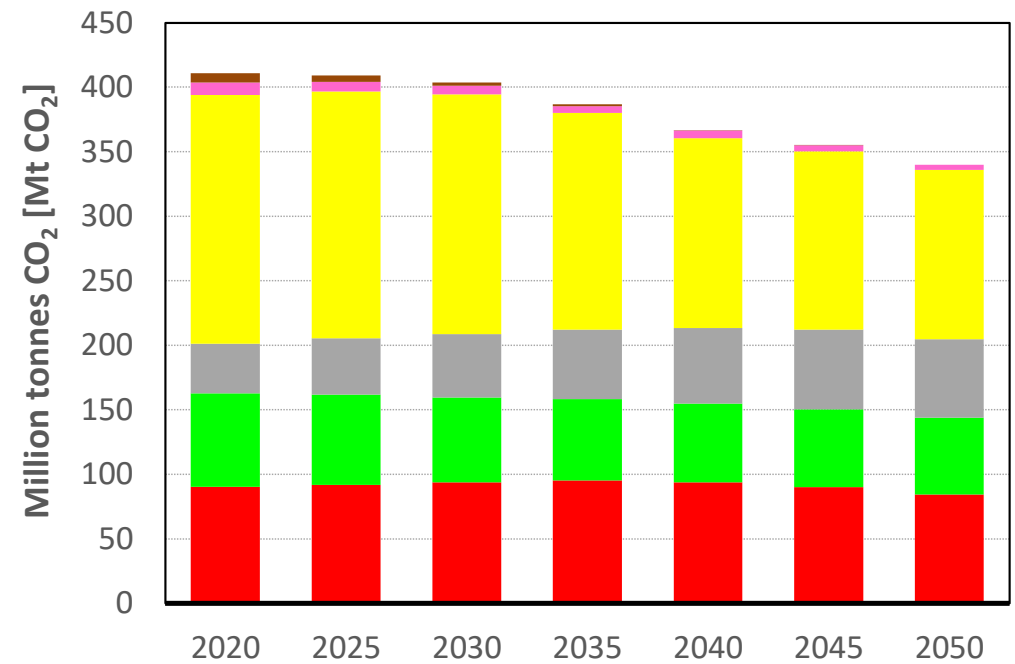


## Carbon emissions by sector

### Reference (REF)



### Neutrality (CN)



- Industry
- Resident/Commercial
- Transportation
- Electricity
- Heat
- Fuel supply

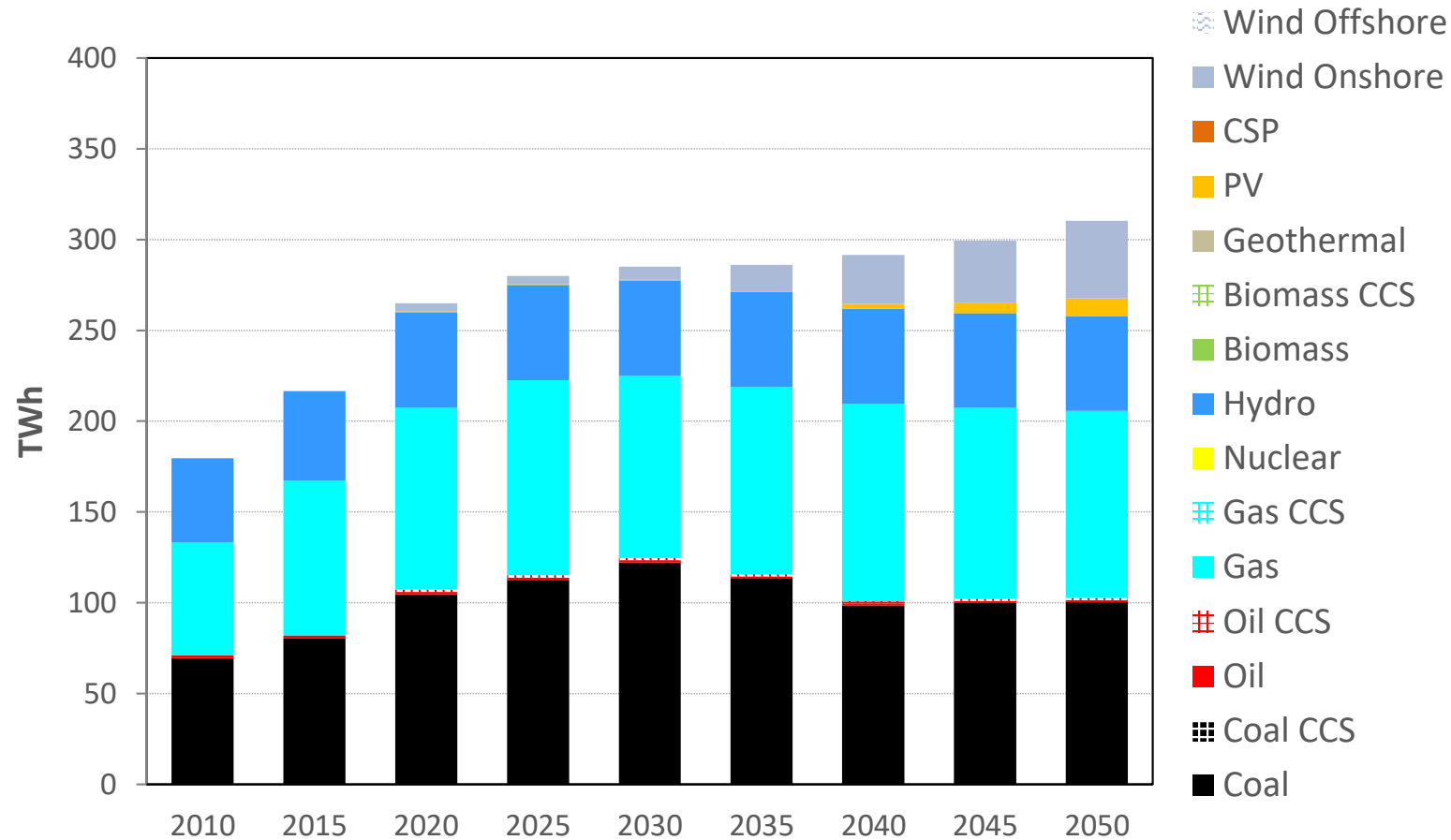
# Modeling Results: CAS

## Electricity Generation

ENERGY



### Electricity generation by technology - CAS REF Scenario



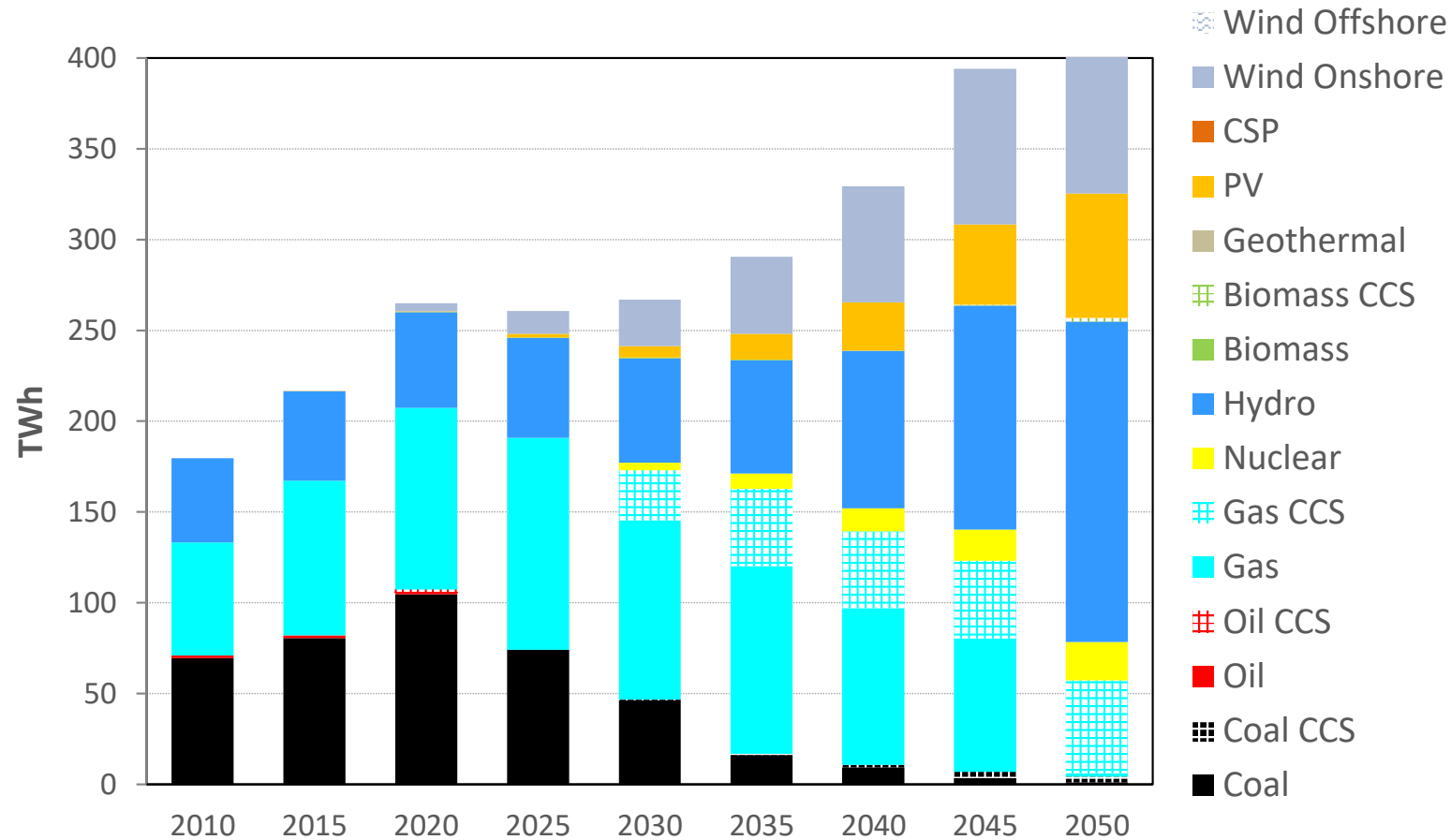
# Modeling Results: CAS

## Electricity Generation

ENERGY



### Electricity generation by technology - CAS CN-UNECE







# Modeling Results: CAS

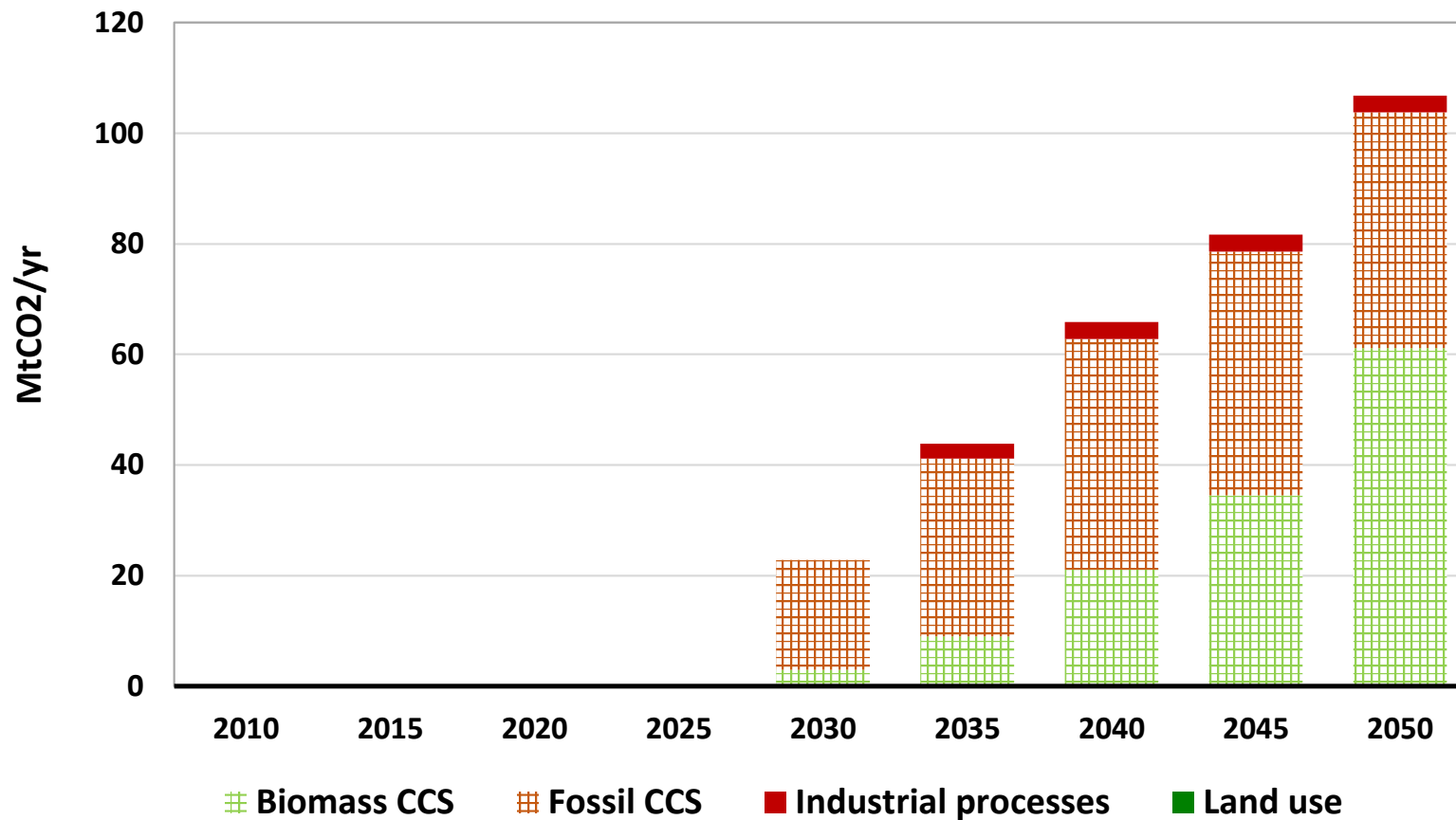
The path to carbon neutrality

ENERGY



## Carbon capture, utilization and storage (sequestration)

A mixed set of measures



# Modeling Results: CAS

Final Energy Mix

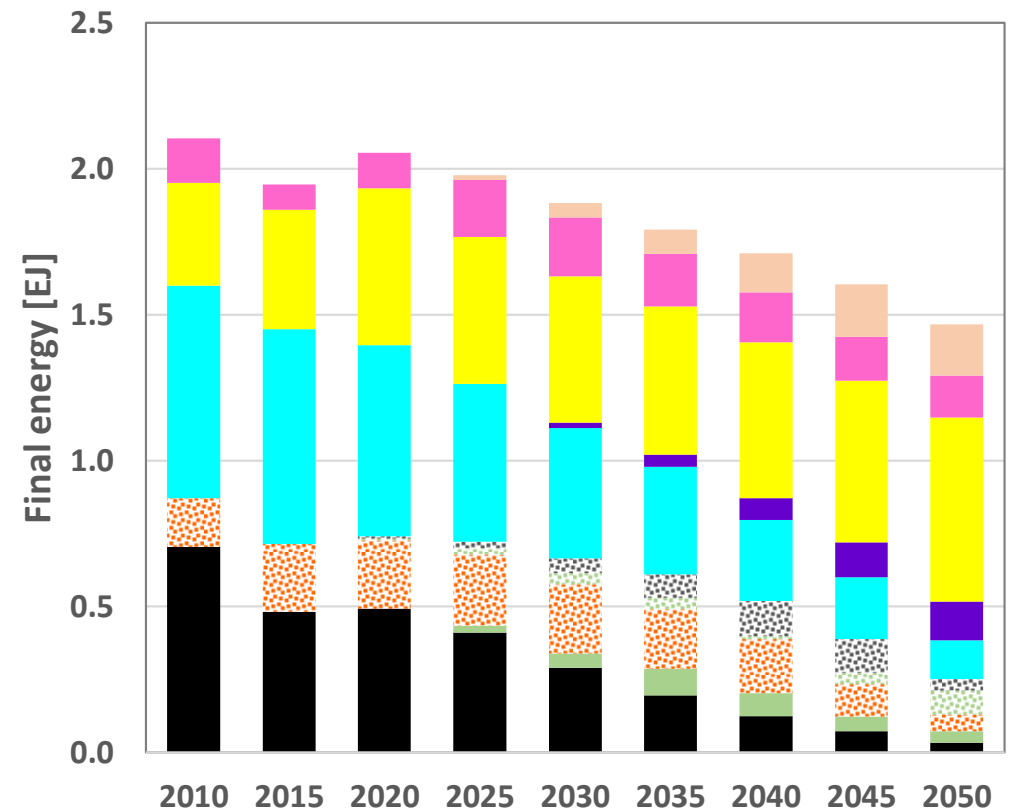
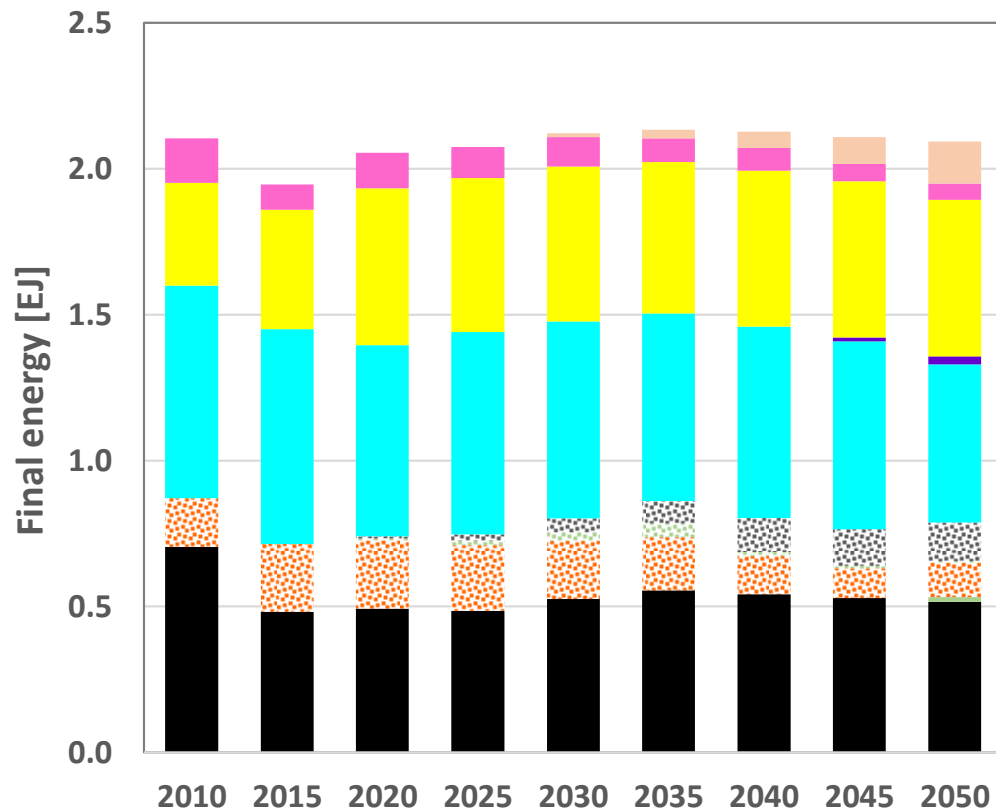
ENERGY



## Final energy mix - Industry

Reference (REF)

Neutrality (CN)



- Coal
- Biomass
- Oil-liquids
- Bio-liquids
- Coal-liquids
- Gas-liquids
- Gas
- Hydrogen
- Elec
- Heat
- Sol (el)
- Other

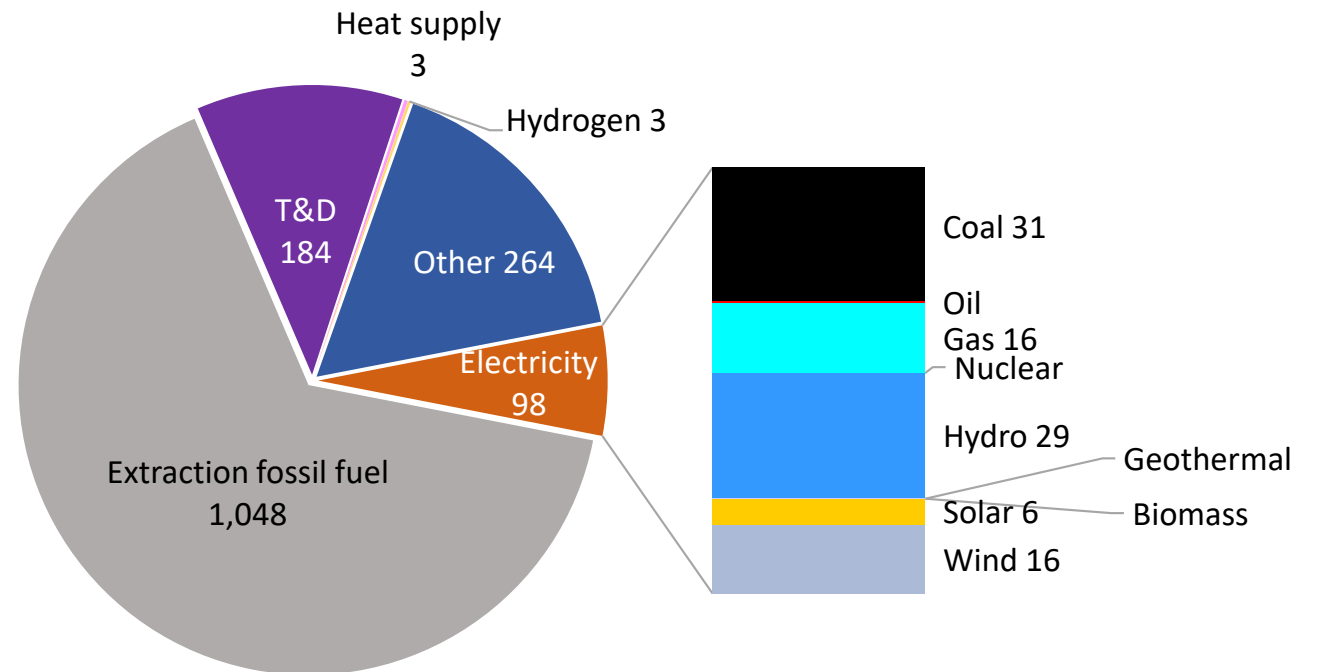
# Modeling Results: CAS

Investment needs

ENERGY



Cumulative investments 2020-2050: *1 600 billion US\$<sub>2020</sub>*  
Reference (REF)



- Extraction fossil fuel
- Coal
- ▤ Coal CCS
- Oil
- ▤ Oil CCS
- Gas
- ▤ Gas CCS
- Nuclear
- Hydro
- Biomass
- ▤ Biomass CCS
- Geothermal
- Solar
- Wind
- T&D
- Energy efficiency
- Heat supply
- Hydrogen
- Other

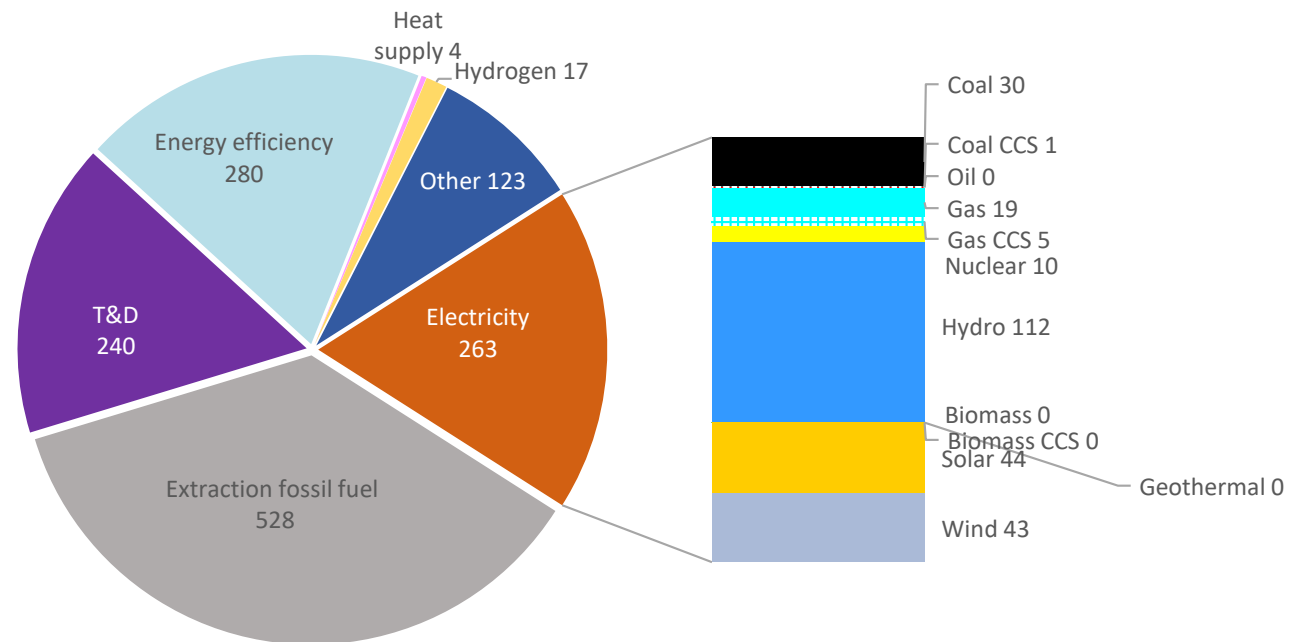
# Modeling Results: CAS

## Investment needs

ENERGY



Cumulative investments 2020-2050: *1 456 billion US\$<sub>2020</sub>*  
Neutrality (CN)



- Extraction fossil fuel
- Coal
- ▨ Coal CCS
- Oil
- ▨ Oil CCS
- Gas
- ▨ Gas CCS
- Nuclear
- Hydro
- Biomass
- ▨ Biomass CCS
- Geothermal
- Solar
- Wind
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- Energy efficiency
- Heat supply
- Hydrogen
- Other

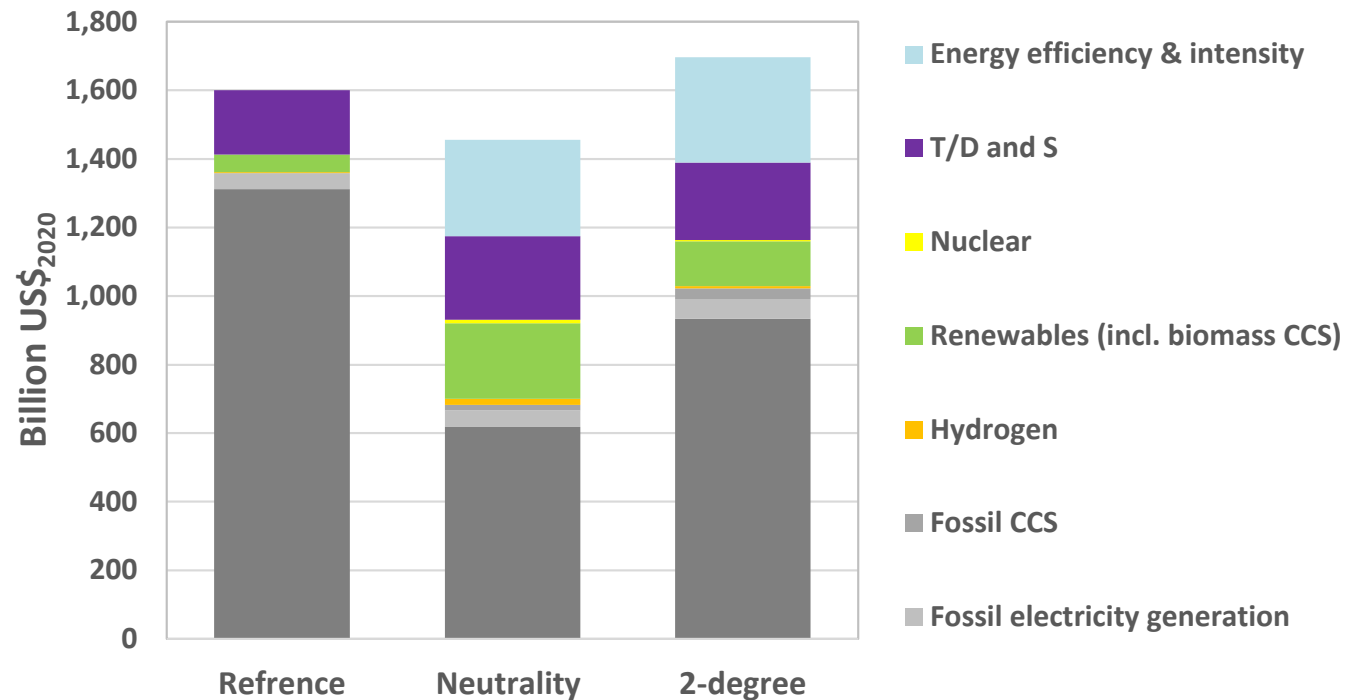
# Modeling Results: CAS

## Investment needs

ENERGY



### Cumulative investment requirements REF, CN and 2-degree



- T/D & S: transmission, distribution and storage of electricity and district heat
- CCS: carbon capture and storage
- BAT: Best available technology

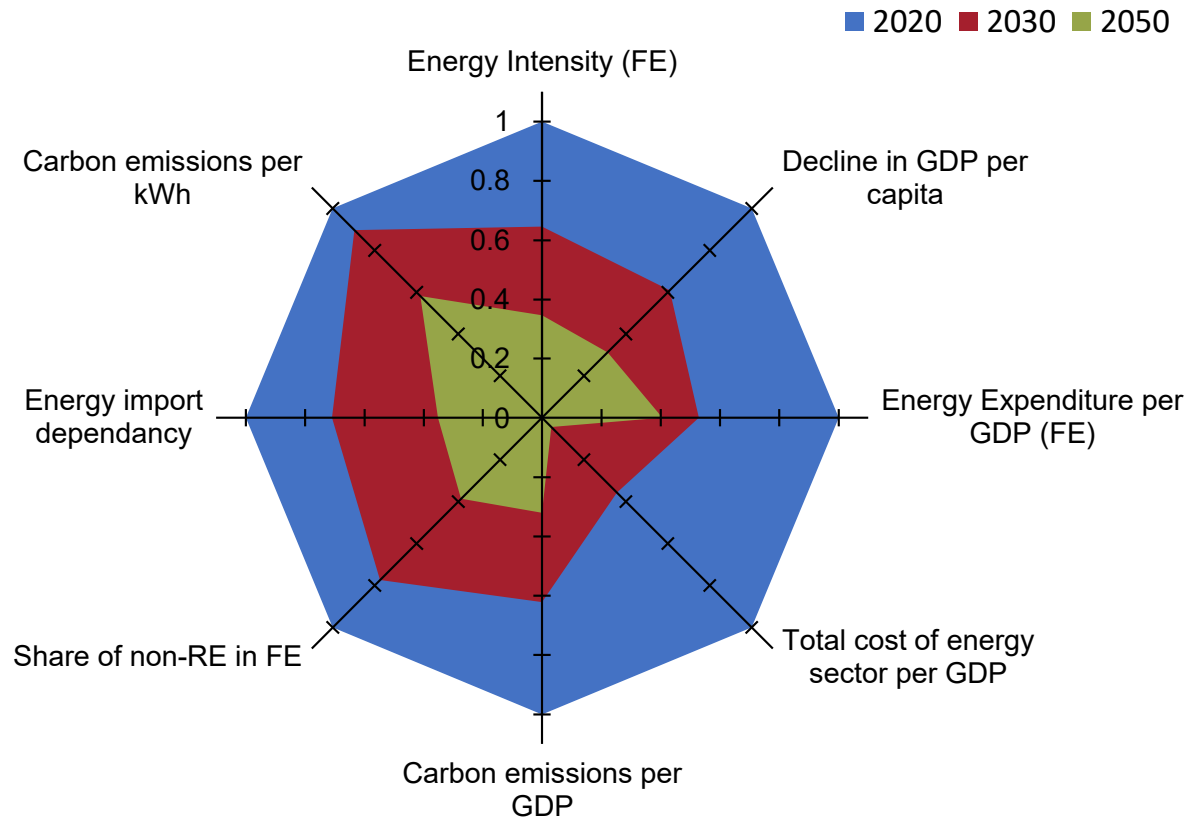
# Modeling Results: CAS

## Indicators

ENERGY



### Reference (REF)



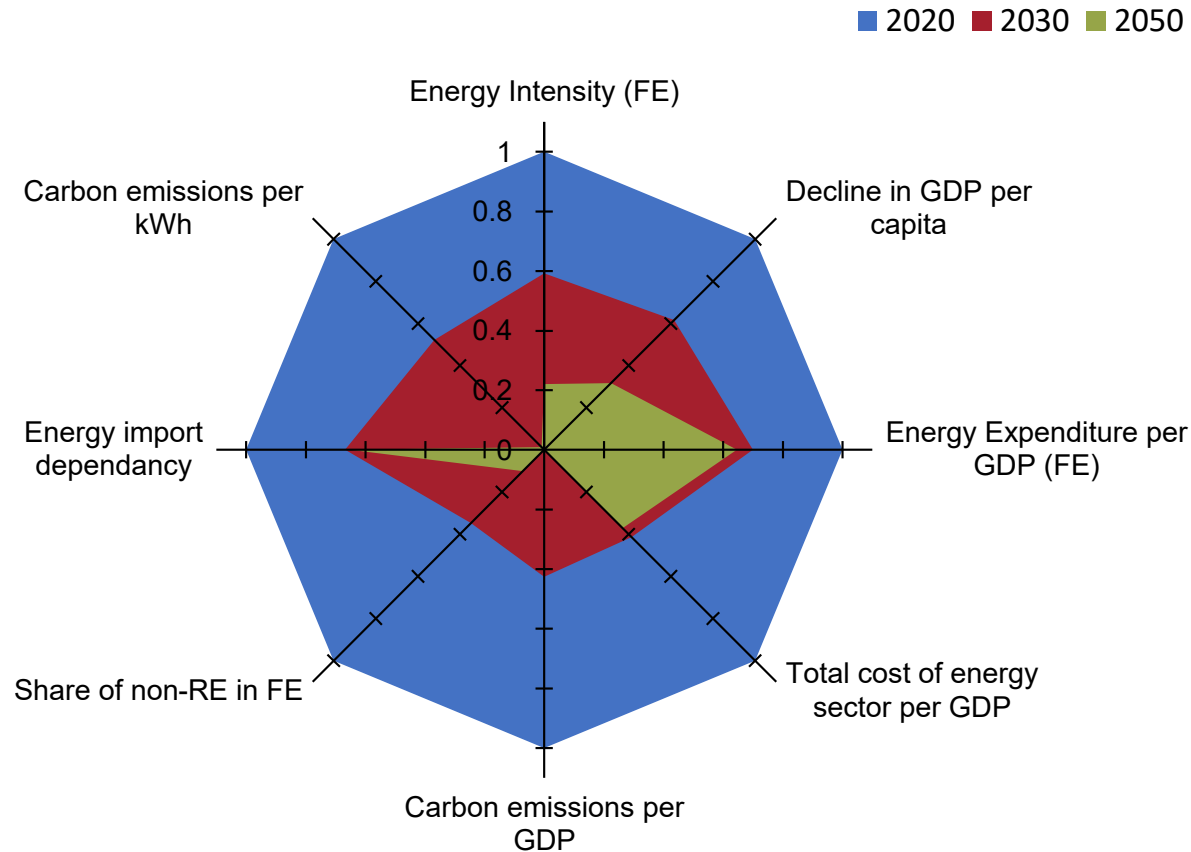
# Modeling Results: CAS

## Indicators

ENERGY



### Neutrality (CN)



# Modeling Results: CAS

Impact of different futures

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## Indicators across scenarios (averages between 2020 and 2050)

