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science for global insight



Which clean energy pathway?

The power sector under different mitigation strategies.

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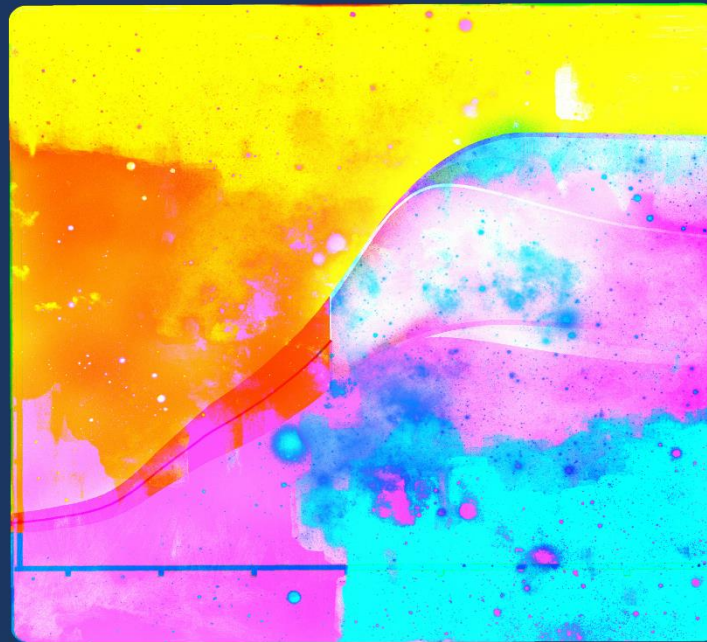
Vienna Energy Transition Forum, 6 June 2019



IIASA, International Institute for Applied Systems Analysis

Global Warming of 1.5°C

An IPCC special report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty.





Systems transitions

- Limiting warming to 1.5°C would require rapid, far-reaching changes on an unprecedented scale:

- Deep emissions cuts in all sectors
- A range of technologies
- Behavioural changes
- Increase investment in low carbon options

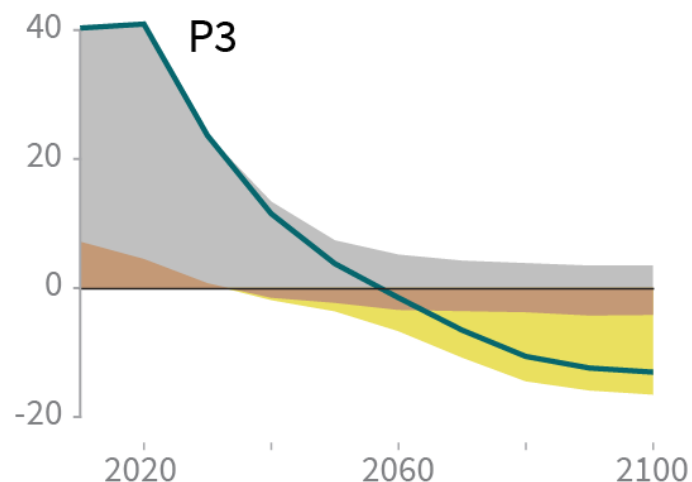


Systems transitions - general trends

- I. **Improve energy efficiency**
Limiting final energy demand in 2050
to +20 to -10% rel. to 2010 levels
 - II. **Decarbonize the power sector**
(carbon-intensity of electricity about 0 or negative in 2050)
 - III. **Electrify energy end use**
(mobility, buildings, industry)
 - IV. **Replace residual fossil fuels with low-carbon options**
(e.g. gas for heating, petrol for driving with bio-based fuels)
- Different roles for different type of fuels

SPM3b | Characteristics of four illustrative model pathways: EXAMPLE

Billion tonnes CO₂ per year (GtCO₂/yr)



- Fossil fuel and industry
- AFOLU
- BECCS

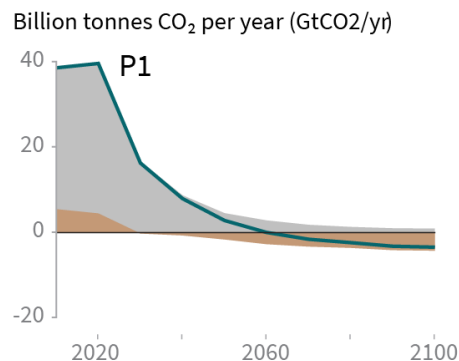
P3: A middle-of-the-road scenario in which societal as well as technological development follows historical patterns. Emissions reductions are mainly achieved by changing the way in which energy and products are produced, and to a lesser degree by reductions in demand.

(Fricko et al, 2017) **ipcc**
INTERGOVERNMENTAL PANEL ON climate change

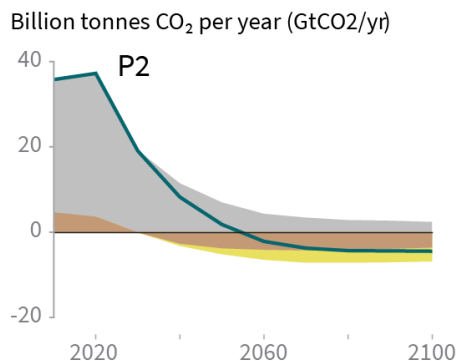


SPM3b | Characteristics of four illustrative model pathways

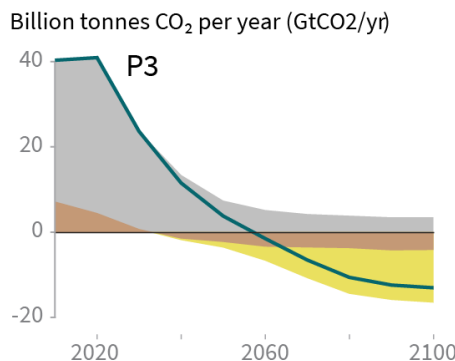
● Fossil fuel and industry ● AFOLU ● BECCS



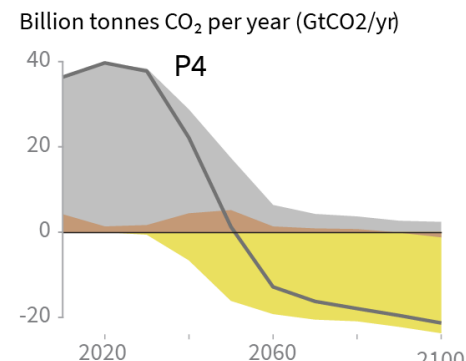
P1: A scenario in which social, business, and technological innovations result in lower energy demand up to 2050 while living standards rise, especially in the global South. A down-sized energy system enables rapid decarbonisation of energy supply. Afforestation is the only CDR option considered; neither fossil fuels with CCS nor BECCS are used.



P2: A scenario with a broad focus on sustainability including energy intensity, human development, economic convergence and international cooperation, as well as shifts towards sustainable and healthy consumption patterns, low-carbon technology innovation, and well-managed land systems with limited societal acceptability for BECCS.



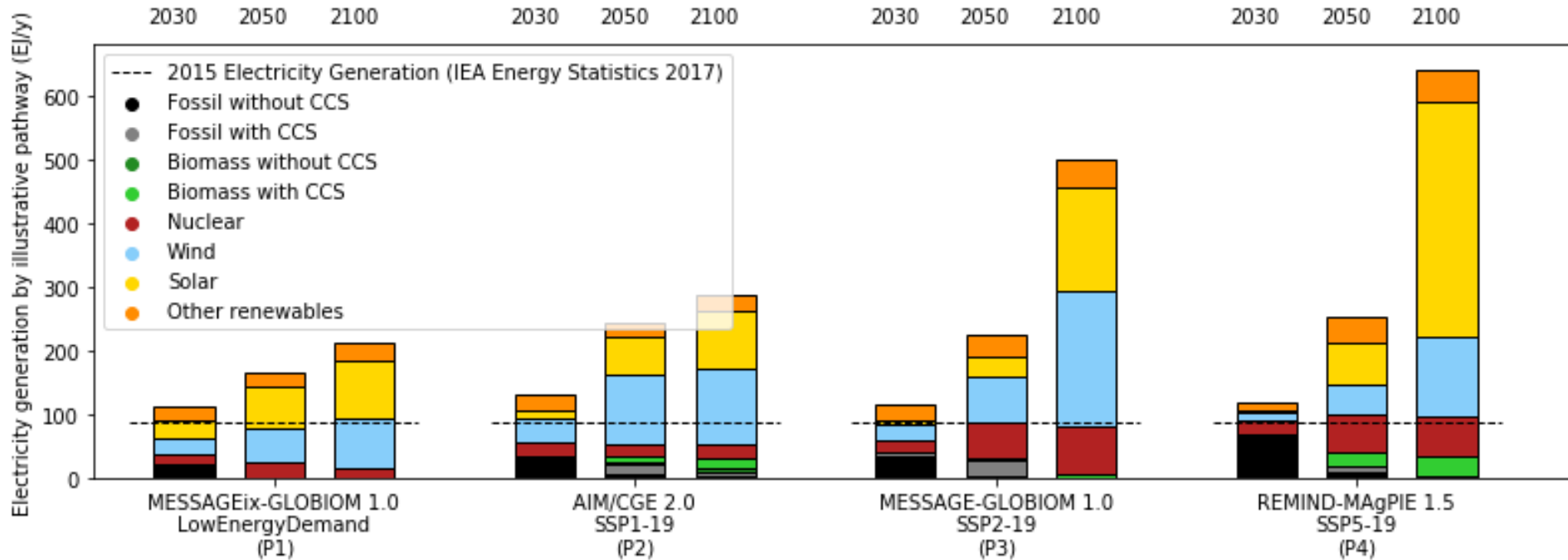
P3: A middle-of-the-road scenario in which societal as well as technological development follows historical patterns. Emissions reductions are mainly achieved by changing the way in which energy and products are produced, and to a lesser degree by reductions in demand.



P4: A resource and energy-intensive scenario in which economic growth and globalization lead to widespread adoption of greenhouse-gas intensive lifestyles, including high demand for transportation fuels and livestock products. Emissions reductions are mainly achieved through technological means, making strong use of CDR through the deployment of BECCS.

Energy system transitions – 1.5C

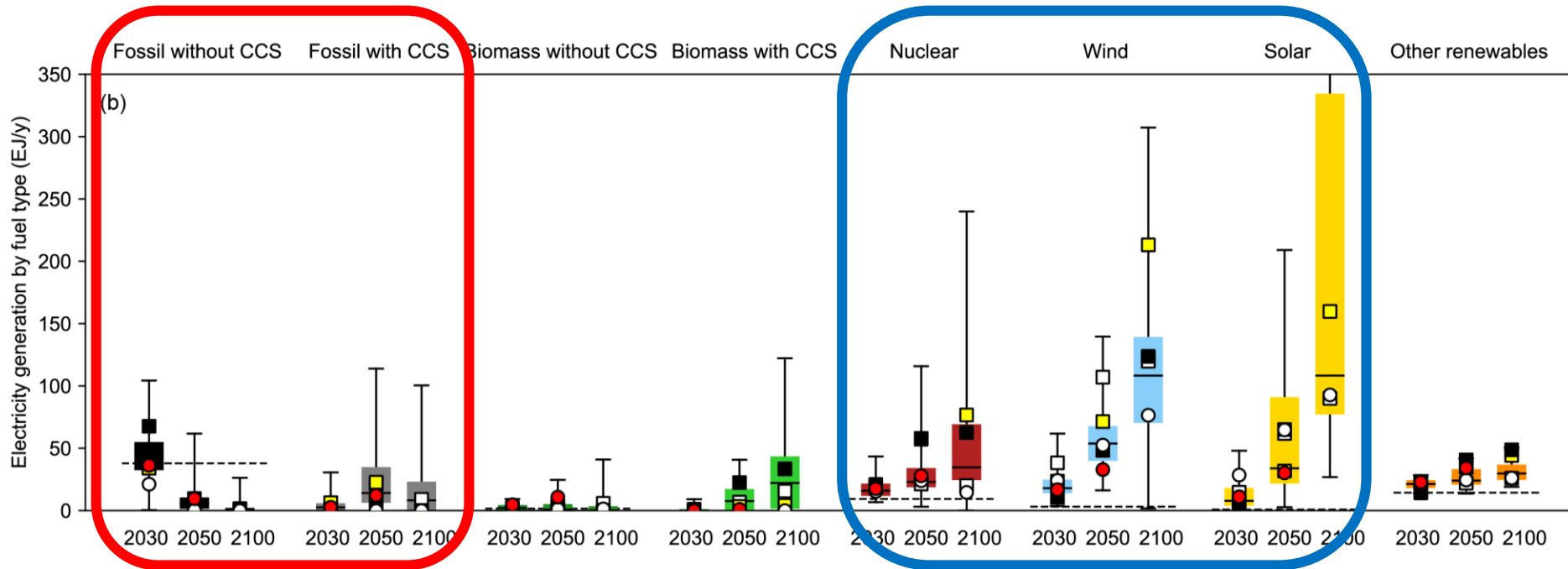
Global electricity generation



- Rapid reductions of fossil fuels: coal the most, gas the least
- Limited amount of fossil CCS (predominantly gas)
- Solar, wind gain the most

Electricity system transitions 1.5C

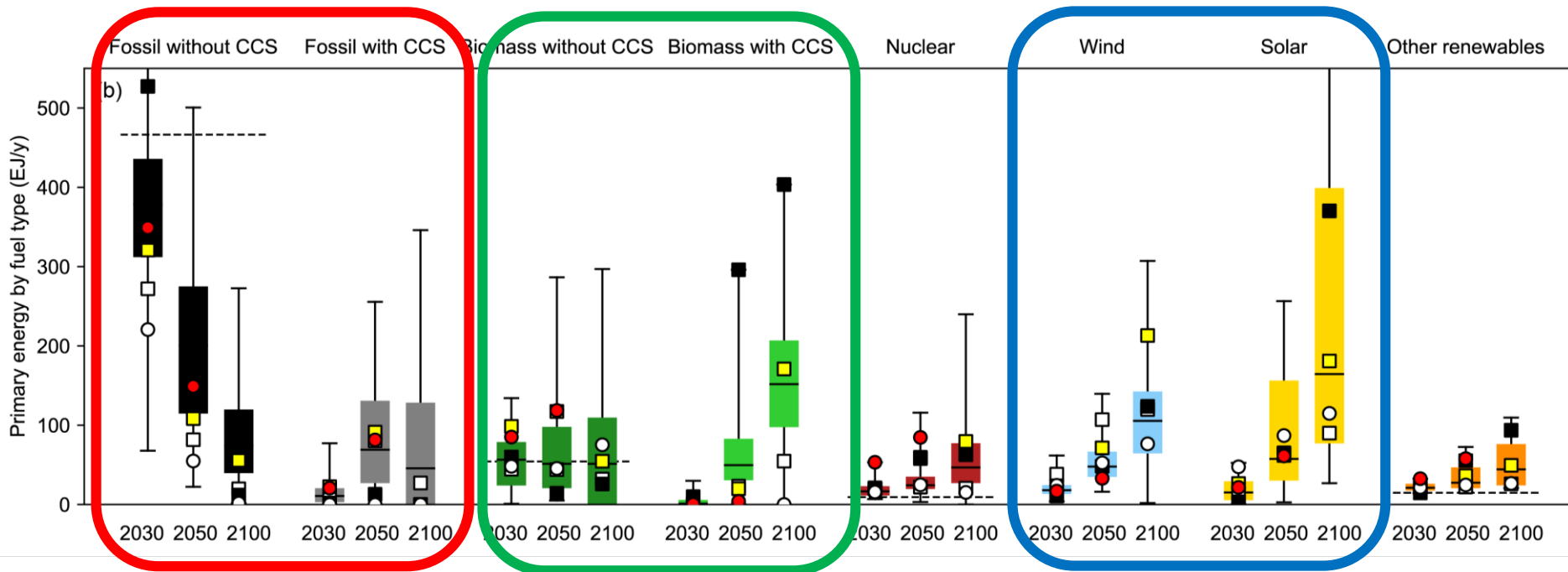
Full decarbonisation by mid-century



- Gas supplies 3-11% of electricity (depend. CCS)
- Coal is phased out as source for electricity (0-2%)
- Renewables supply 70-85% of electricity

Energy system transitions – 1.5C

Global primary energy



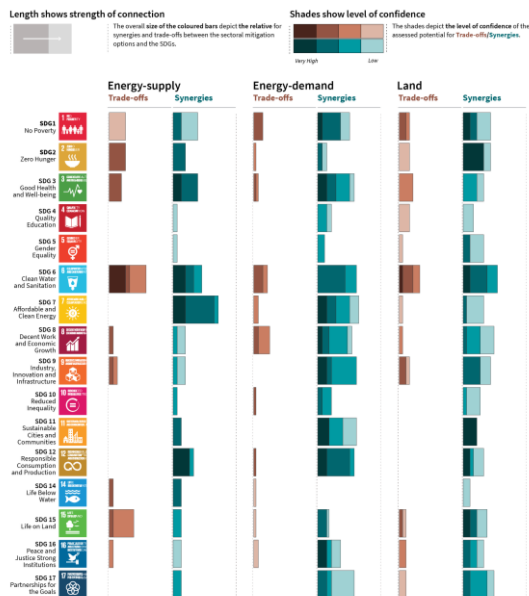
- Rapid reductions of fossil fuels: coal the most, gas the least
- Limited amount of fossil CCS (predominantly gas)
- Solar, wind, bioenergy with CCS gain the most

SPM4

Indicative linkages between mitigation and sustainable development using SDGs (the linkages do not show costs and benefit)

Indicative linkages between mitigation options and sustainable development using SDGs (The linkages do not show costs and benefits)

Mitigation options deployed in each sector can be associated with potential positive effects (synergies) or negative effects (trade-offs) with the Sustainable Development Goals (SDGs). The degree to which this potential is realized will depend on the selected portfolio of mitigation options, mitigation policy design, and local circumstances and context. Particularly in the energy-demand sector, the potential for synergies is larger than for trade-offs. The bars group individually assessed options by level of confidence and take into account the relative strength of the assessed mitigation-SDG connections.



Three aggregated sectors

illustrating different mitigation strategies:

- Energy supply-side measures
- Energy demand-side measures
- Land-based measures

Length shows strength of connection



The overall size of the coloured bars depict the relative for synergies and trade-offs between the sectoral mitigation options and the SDGs.

Shades show level of confidence



The shades depict the level of confidence of the assessed potential for Trade-offs/Synergies.

Very High

Low

SPM4

Indicative linkages between mitigation and sustainable development using SDGs (the linkages do not show costs and benefit)



Climate change mitigation and SDGs

- More potential synergies than trade-offs with the SDGs have been identified
- Particularly strategies focussing on **energy-demand** show many synergies
- Potential trade-offs do not have to materialize and can be resolved with **careful management** and policies
- Choices about the **mitigation portfolio** can have an important effect on the SDGs

1.5°C Scenario Explorer

The underlying data is available online, with “workspaces” to manage figures & data tables, and pre-defined panels replicating SR15 figures



INTERGOVERNMENTAL PANEL ON climate change

Welcome to the IAMC 1.5°C Scenario Explorer hosted by IIASA

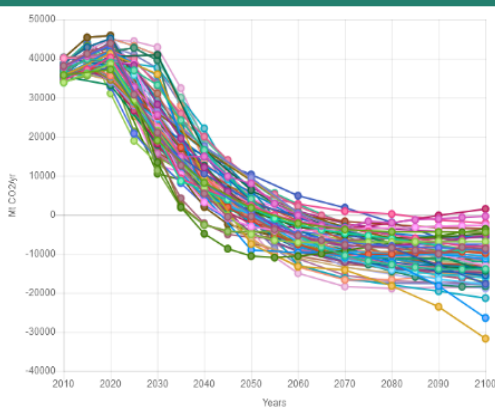
Select an existing workspace or create a new one...

Create new workspace Import Showing all workspaces Ordered by name ↻

Global emissions pathways (SPM Figure 3a)

This workspace shows the panels of Figure 3a in the Summary for Policymakers of the SR15. It displays the net carbon dioxide emissions in all pathways limiting global warming to below 1.5°C pathways at the end of the century, and the methane, black carbon and nitrous oxide.

Open

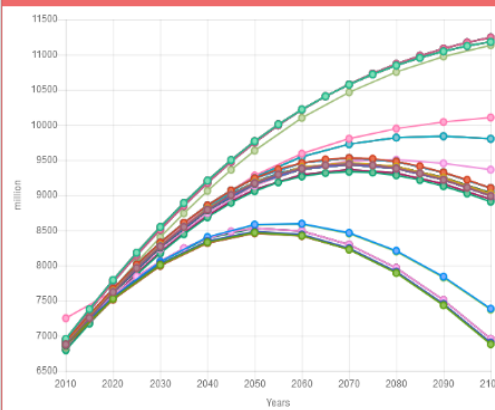


Last updated 2 days ago
Owner huppmann

Socio-economic drivers in 1.5°C pathways

This workspace shows the range of socio-economic assumptions and drivers in pathways limiting global warming to 1.5°C by the end of the century. It is based on Figure 2.4 in Chapter 2 of the SR1.5.

Open

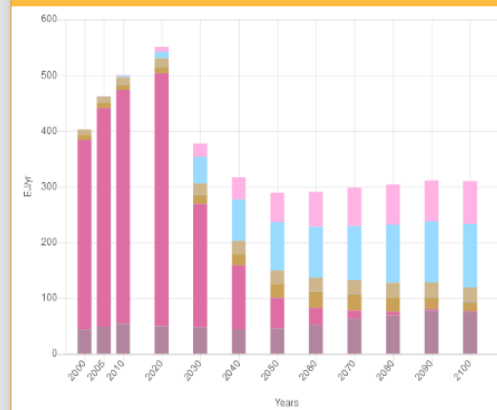


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The energy system in the four illustrative path...

This workspace shows the transformation of the energy system towards no- and low-carbon fuels in the four illustrative pathways. It is based on Figure 2.15 in Chapter 2 of the SR1.5

Open



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Owner huppmann

Visit the Scenario Explorer at <https://data.ene.iiasa.ac.at/iamc-1.5c-explorer>

Huppmann, Kriegler, Krey, Riahi, Rogelj, Rose, Weyant et al, 2018



ENGAGE project

- **Exploring National and Global Actions to reduce Greenhouse gas Emissions**
- H2020 project, 28 global partners
- Develop new emission pathways
 - Reflect Paris Agreement
 - Multidimensional feasibility
- Stakeholder process
 - First stakeholder meeting in Vienna on 19 Sept 2019

Thank you!

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