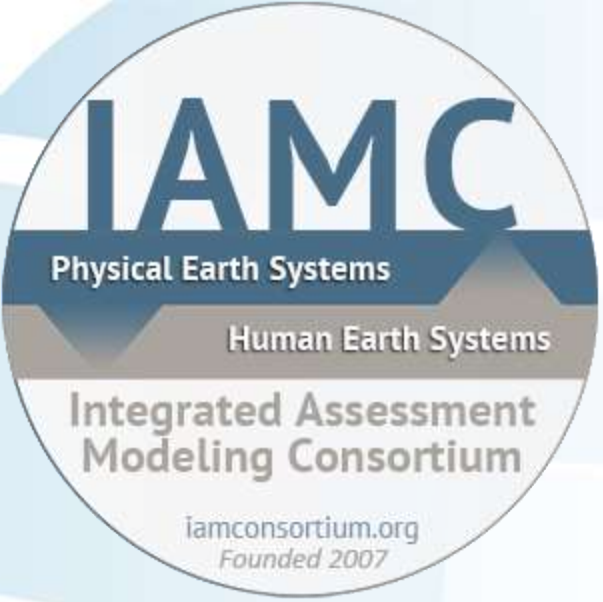
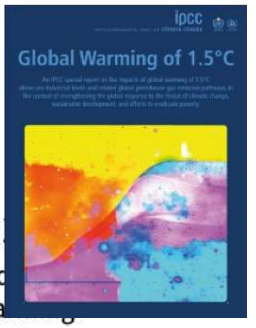


IAMC 1.5°C Scenario Explorer hosted by IIASA

Daniel Huppmann, Nikolay Kushin, Peter Kolp, Valentina Bosetti, Elmar Kriegler, Steven Rose, John Weyant, Volker Krey, Keywan Riahi and many others…

COP24 side event, Katowice, 10 December 2018

Scenarios in IPCC SR1.5



Global total net CO_2 emissions

Billion tonnes of CO_2/yr

*In pathways limiting global warming to 1.5°C with **no or limited overshoot** as well as in pathways with a **high overshoot**, CO2 emissions are reduced to net zero globally around 2050.*

Four illustrative model pathways

P1
P2
P3
P4

Timing of net zero CO_2
Line widths depict the 5-95th percentile and the 25-75th percentile of scenarios

Pathways limiting global warming to 1.5°C with no or low overshoot

Pathways with high overshoot

Pathways limiting global warming below 2°C (Not shown above)

Non-CO_2 emissions relative to

Emissions of non-CO_2 forcers are also rec
or limited in pathways limiting global wa
to 1.5°C with **no or limited overshoot**, but they do not reach zero globally.

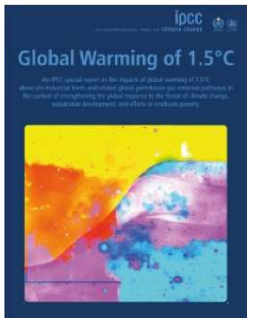
Methane emissions

Black carbon emissions

Nitrous oxide emissions

Source: IPCC SR1.5, Figure SPM.3a

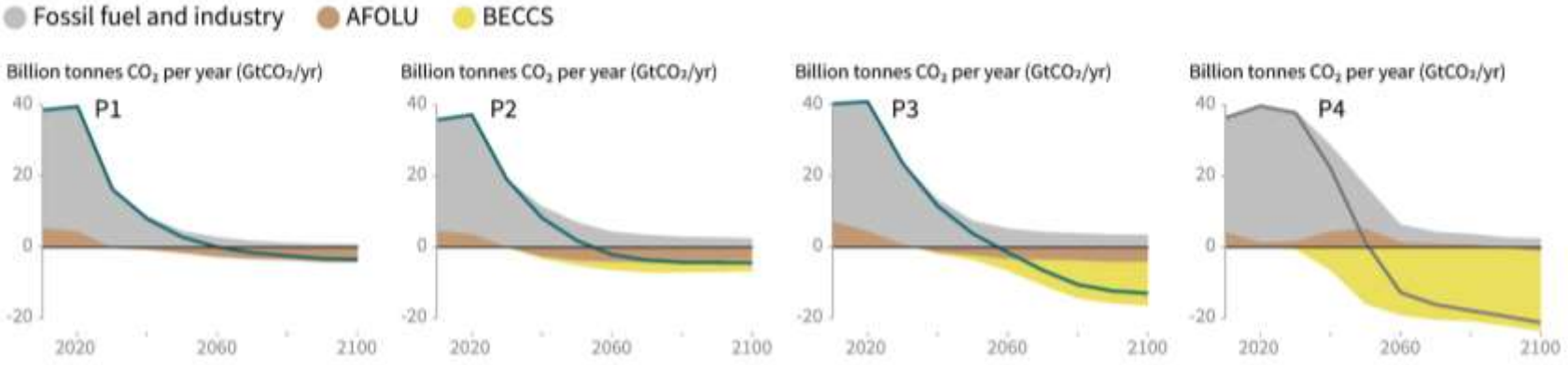
Scenarios in IPCC SR1.5



Characteristics of four illustrative model pathways

Different mitigation strategies can achieve the net emissions reductions that would be required to follow a pathway that limits global warming to 1.5°C with no or limited overshoot. All pathways use Carbon Dioxide Removal (CDR), but the amount varies across pathways, as do the relative contributions of Bioenergy with Carbon Capture and Storage (BECCS) and removals in the Agriculture, Forestry and Other Land Use (AFOLU) sector. This has implications for emissions and several other pathway characteristics.

Breakdown of contributions to global net CO_2 emissions in four illustrative model pathways



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 downsized energy system enables rapid decarbonization 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.

Source: IPCC SR1.5, Figure SPM.3b

Objectives

- Openness
- Transparency
  (of IPCC assessment and related literature)
- Reproducibility
  (of results, tables and figures)
- Reusability
  (of scenario ensemble by other researchers and analysts)

Collaboration between institutions

IPCC Working Group III TSU

Assessment reports
SR1.5 and AR6

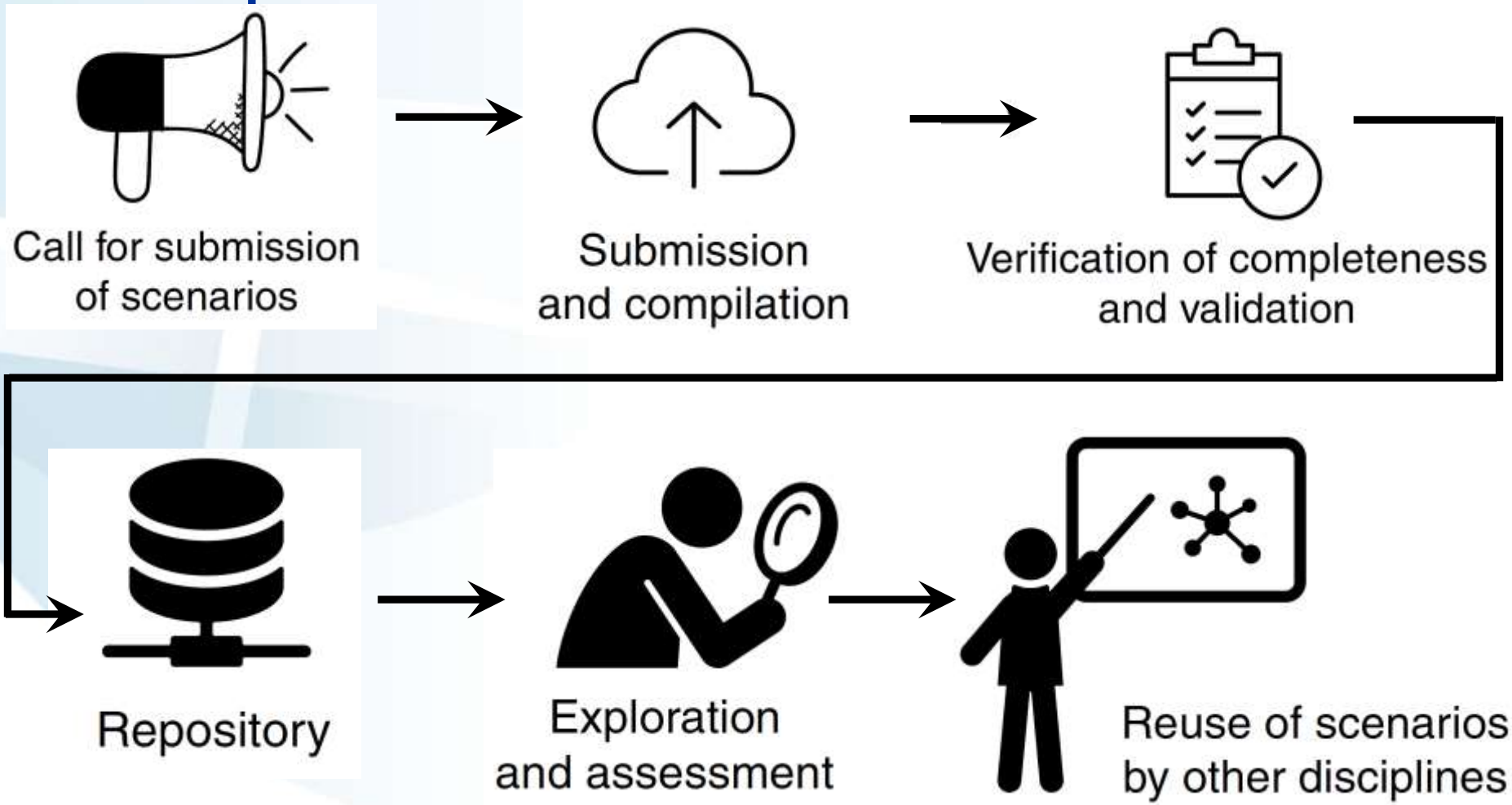
Integrated Assessment Modeling Consortium (IAMC)

research community organization

International Institute for Applied Systems Analysis (IIASA)

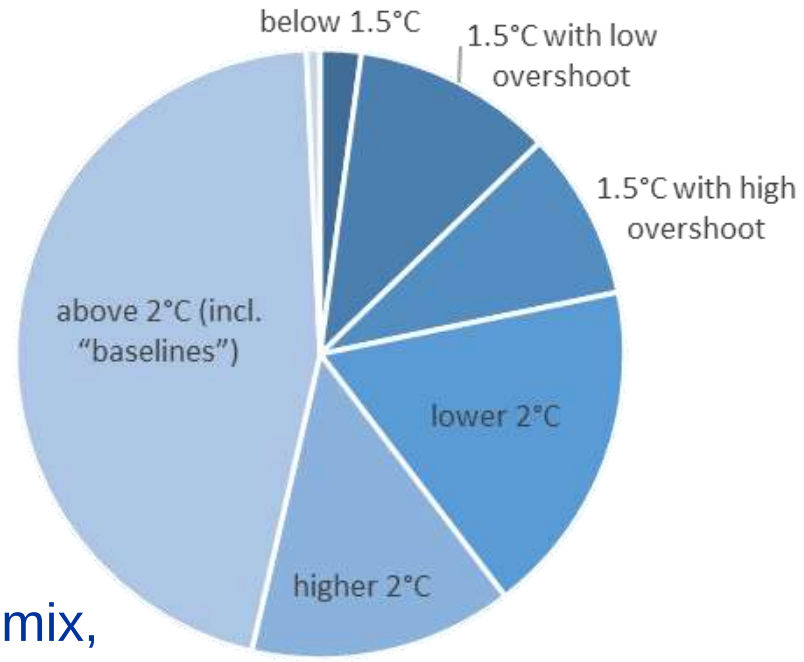
hosting infrastructure for scenario data collection and dissemination

Process of the scenario ensemble compilation



Data Set Features

- 414 Scenarios



- Variables

  Energy system configuration and fuel mix, Emissions by species and sectors, CCS, CDR, Investment expenditure, Socio-economic indicators (population, GDP development, prices), Land use and agricultural production, Indicators for sustainable development

- 13 Modeling frameworks

  AIM/CGE, C-ROADS, GENeSYS-MOD, GCAM, IEA ETP Model, IEA World Energy Model, IMAGE, MERGE, MESSAGEix-GLOBIOM, POLES, REMIND-MAgPIE, Shell World Energy Model, WITCH

Scenario Explorer Features

- Audience: *scientific users* and *policy analysts*
- Workspace philosophy
  - Personalized workspace configurations
  - Analysis can be shared with others (e.g., workspace sharing, figure/data export)
  - SR1.5 Scenario Explorer includes predefined workspaces with figures from report
  - Integrated documentation (models, scenarios, variables, regions)
- Toolkit for data visualization and analysis (Python-based)

Scenario Explorer: Entry page

IAMC 1.5°C Scenario Explorer hosted by IIASA release 1.0 License About

International Institute for Applied Systems Analysis
IIASA www.iiasa.ac.at

IAMC

IAMC 1.5°C Scenario Explorer hosted by IIASA

This Scenario Explorer presents an ensemble of quantitative, model-based climate change mitigation pathways underpinning the *Special Report on Global Warming of 1.5°C* (SR1.5) by the Intergovernmental Panel on Climate Change's (IPCC) 2018.

Copyright and License

The scenario ensemble is made publicly available to ensure reproducibility and transparency with respect to the scenario set that has been assessed in SR15. The Scenario Explorer allows for the re-use of scenario data by other research communities, under a derivative of the Creative Commons Attribution 4.0 License. Please read the guidance note and the license terms on the License page before downloading data or figures.

Login

Username

Password

Login

Register Forgot password?

Guest login

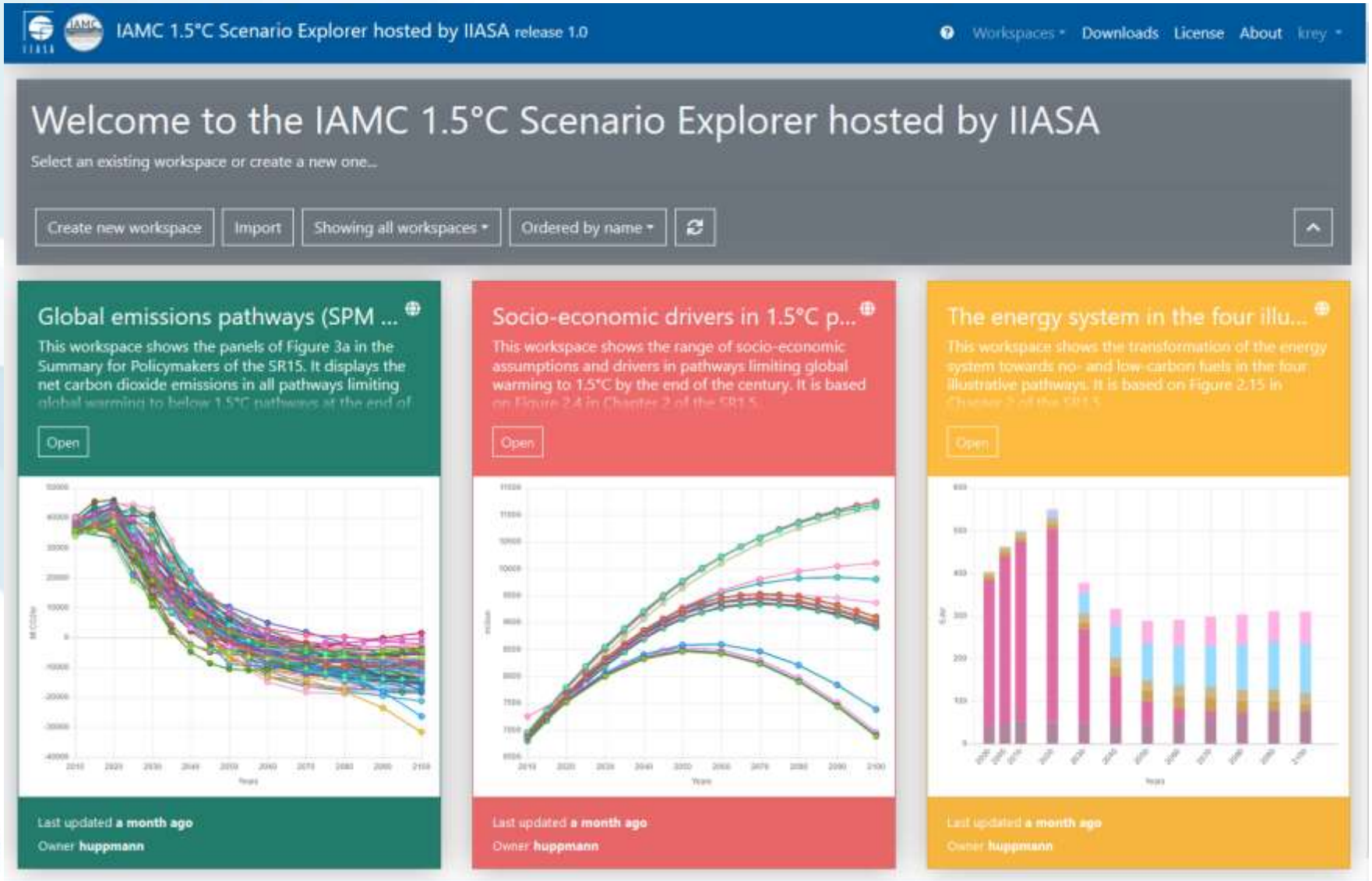
Terms of use

Background of the Scenario Explorer

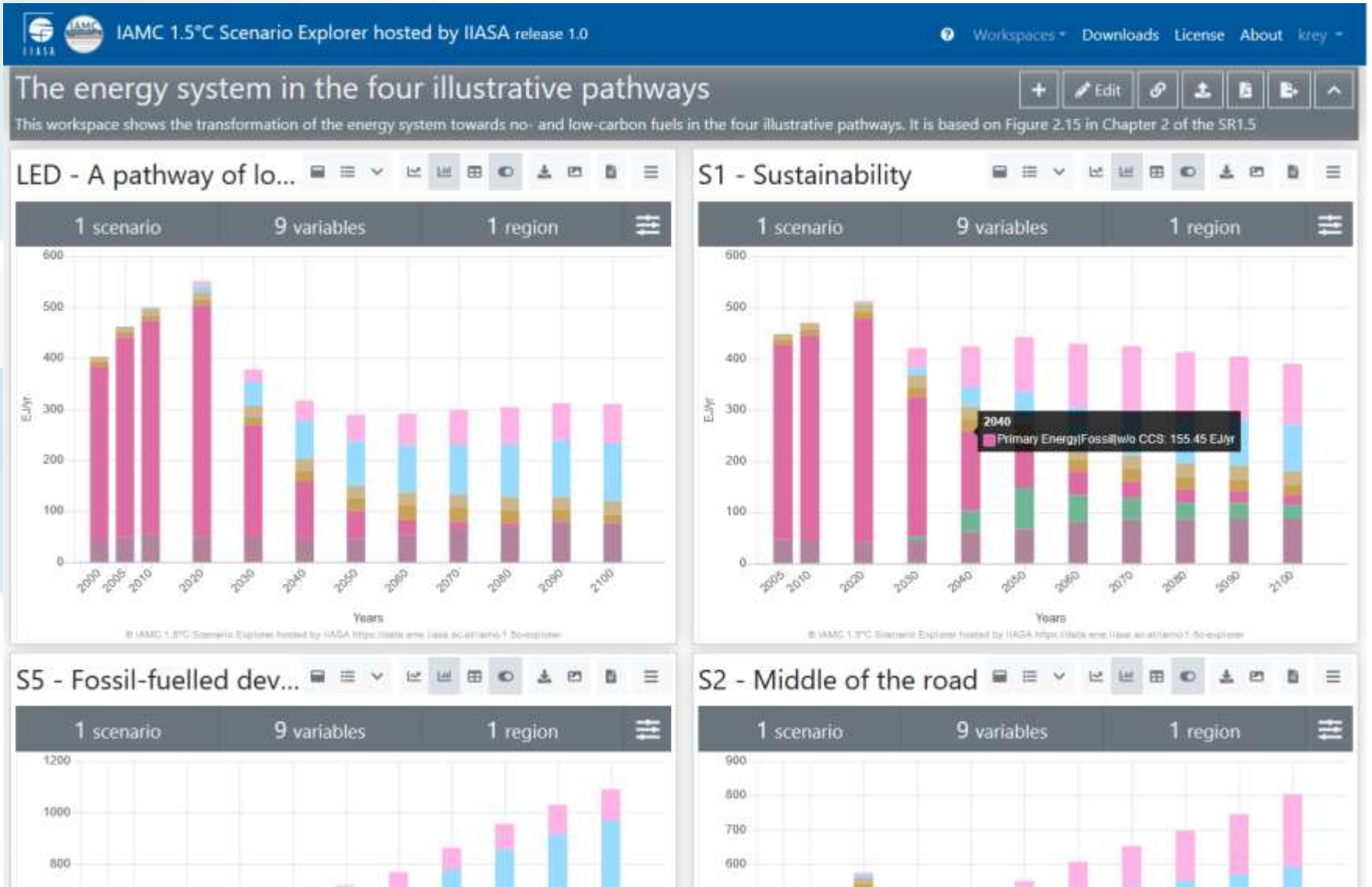
As part of the IPCC's *Special Report on Global Warming of 1.5°C* (SR15), an assessment of quantitative, model-based climate change mitigation pathways was conducted. To support the assessment, the Integrated Assessment Modeling Consortium (IAMC) facilitated a coordinated and systematic community effort by inviting modelling teams to submit their available 1.5°C and related scenarios to a curated database. The compilation and assessment of the scenario ensemble was conducted by authors of the IPCC SR15, and the resource is hosted by the International Institute for Applied Systems Analysis (IIASA) as part of a cooperation agreement with Working Group III of the IPCC.

The scenario ensemble contains more than 400 emissions pathways with underlying socio-economic development, energy system transformations and land use change until the end of the century, submitted by over a dozen research teams from around the world. The criteria for submission included that the scenario is presented in a peer-reviewed

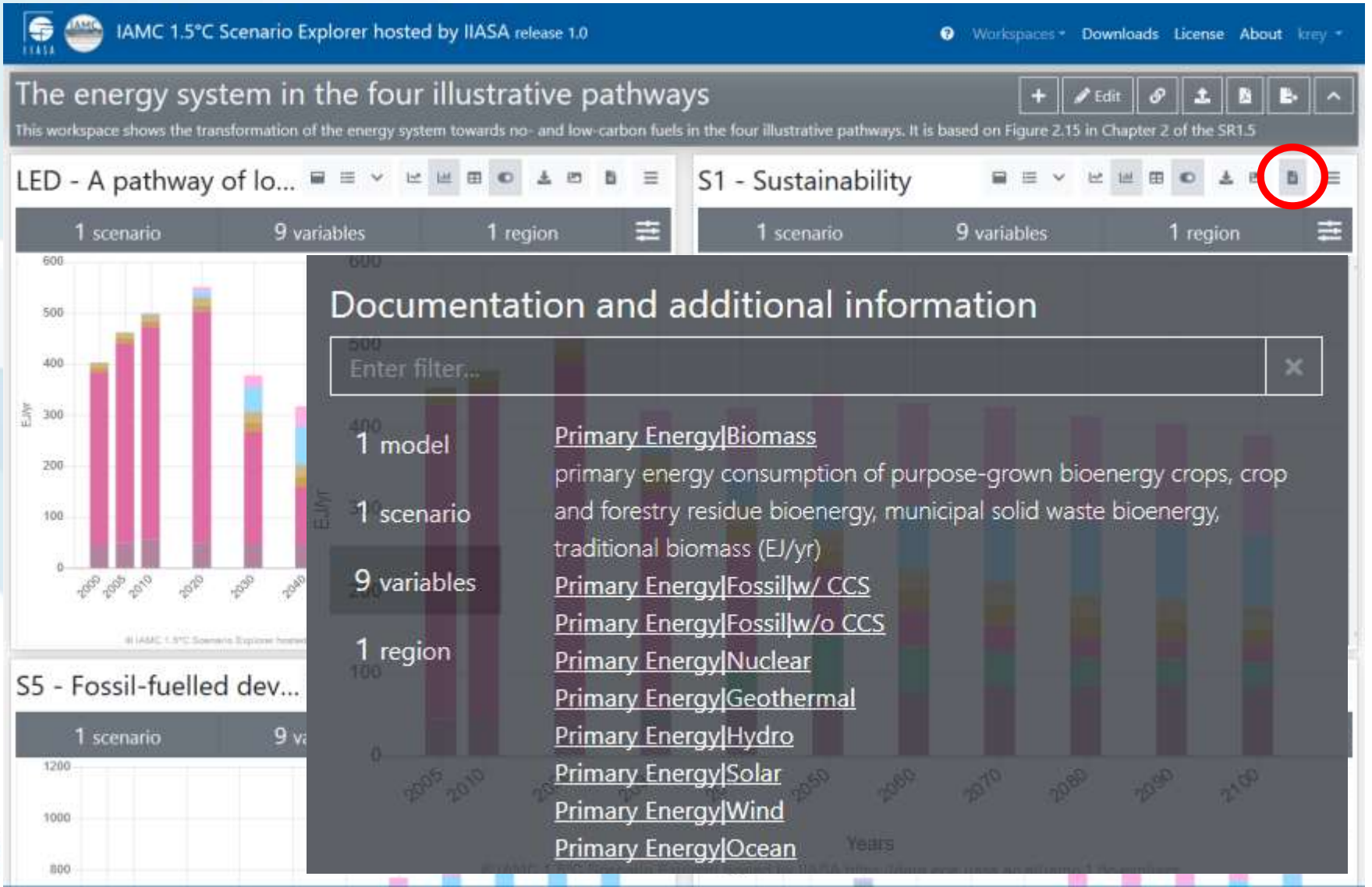
Scenario Explorer: Workspaces



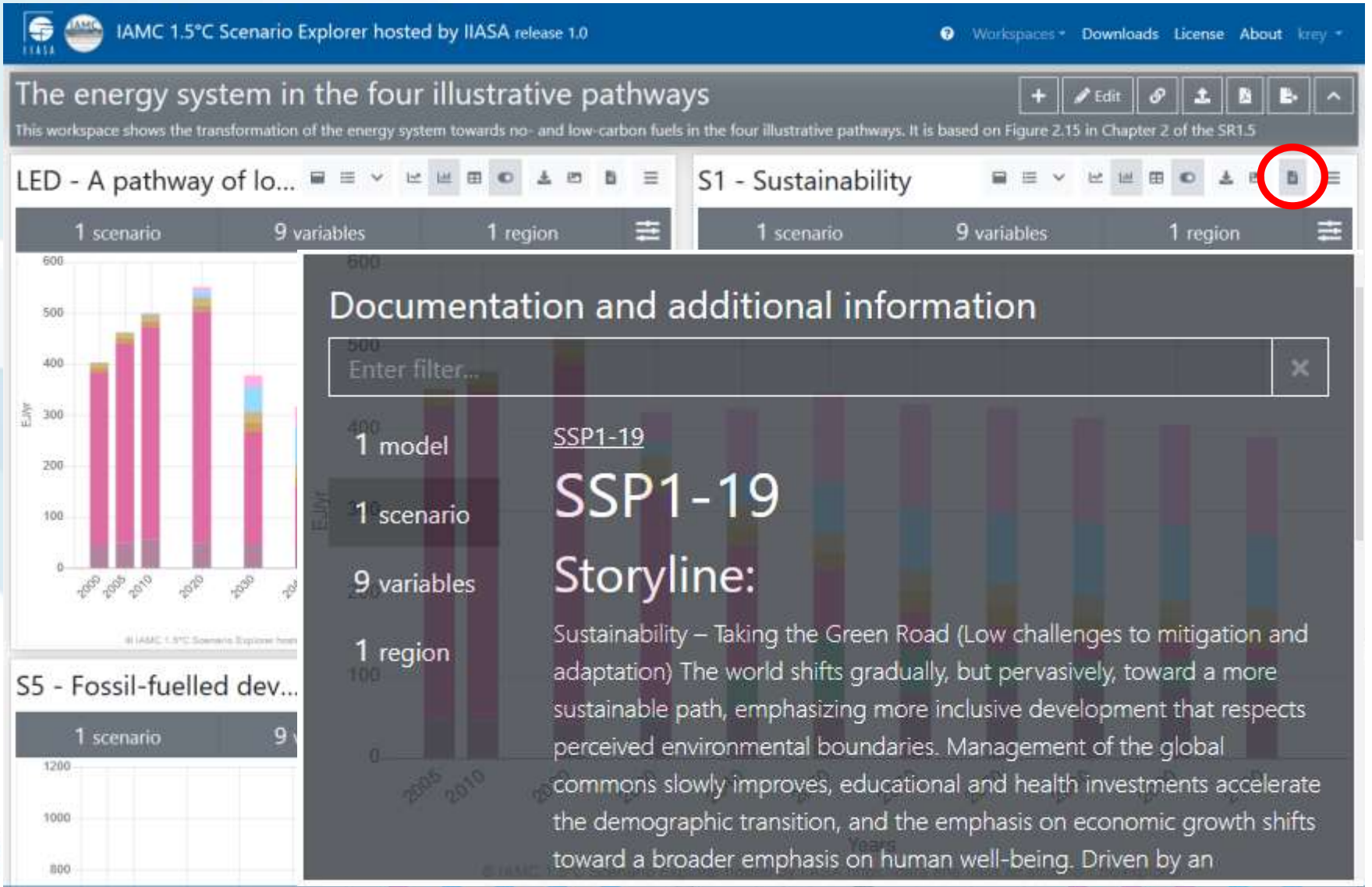
Scenario Explorer: Multiple panels



Scenario Explorer: Documentation



Scenario Explorer: Documentation



Jupyter Notebooks (e.g. Figure 2.4)

IPCC SR15 scenario assessment

Assessment of underlying drivers and assumptions

International Institute for Applied Systems Analysis

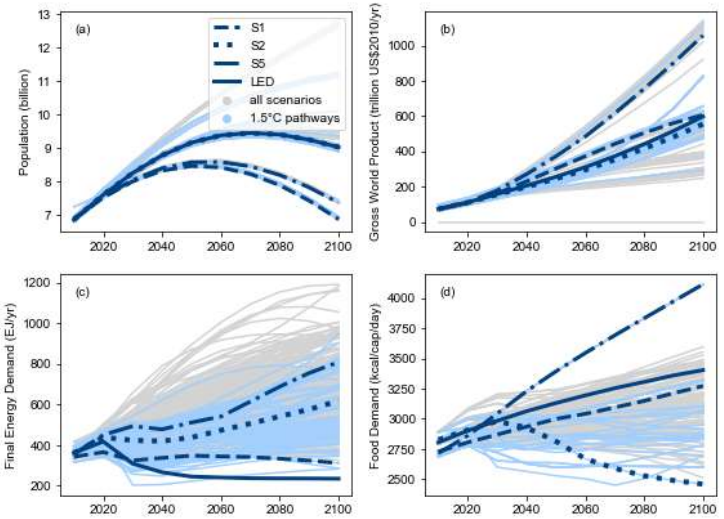
This notebook contains the assessment of underlying drivers and assumptions of the scenario ensemble in **Section 2.3.1** and **Figure 2.4** for the IPCC's *"Special Report on Global Warming of 1.5°C"*.

The scenario data used in this analysis can be accessed and downloaded at https://data.ene.iiasa.ac.at/iamc-1.5c-explorer

Load pyam package and other dependencies

```
In [1]: import pandas as pd
        import numpy as np
        import io
        import yaml
        import math
        import matplotlib.pyplot as plt
        plt.style.use('style_sr15.mplstyle')
        %matplotlib inline
        import pyam

        from utils import boxplot_by_cat
```



Import scenario data, categorization and specifications files

The metadata file must have been generated from the notebook `sr15_2.0_categories_indicators` included in this repository. If the snapshot file has been updated, make sure that you rerun the categorization notebook.

The last cell of this section loads and assigns a number of auxiliary lists as defined in the categorization notebook.

```
In [2]: sr1p5 = pyam.IamDataFrame(data='../data/iamc15_scenario_data_world_r1.xlsx')
        INFO:root:Reading `../data/iamc15_scenario_data_world_r1.xlsx`

In [3]: sr1p5.load_metadata('sr15_metadata_indicators.xlsx')
        INFO:root:Importing metadata for 416 scenarios (for total of 416)

In [4]: with open("sr15_specs.yaml", 'r') as stream:
            specs = yaml.load(stream)
```

https://data.ene.iiasa.ac.at/sr15_scenario_analysis/

Introduction to the SR1.5 scenarios

comment

A new scenario resource for integrated 1.5 °C research

Scenarios have supported assessments of the IPCC for decades. A new scenario ensemble and a suite of visualization and analysis tools is now made available alongside the IPCC 1.5 °C Special Report to improve transparency and re-use of scenario data across research communities.

Daniel Huppmann, Joeri Rogelj, Elmar Kriegler, Volker Krey and Keywan Riahi

Over the past two years, the IPCC has been preparing a Special Report on the impacts of global warming of 1.5 °C above pre-industrial levels and related global GHG emission pathways[1] (SR1.5). This process was initiated at the explicit invitation of the 193 governments of the United Nations Framework Convention on Climate Change (UNFCCC) as part of the decisions taken in Paris in 2015[2]. During the first week of October in 2018 the resulting report, comprising more than 200 pages, was presented for approval by the IPCC plenary in Incheon, South Korea. The report

sense that they are used to the fullest extent. To this end, the Integrated Assessment Modeling Consortium (IAMC) — the umbrella organization of modelling teams conducting global climate change mitigation analyses — facilitated a coordinated and systematic community effort implemented by the International Institute for Applied Systems Analysis (IIASA) and authors of IPCC SR1.5. The consolidated scenario data supporting the IPCC SR1.5 assessment has been published online as part of the 'IAMC 1.5 °C Scenario Explorer hosted by IIASA' (https://data.ene.iiasa.ac.at/iamc-1.5c-

and resources to contribute their scenario data to the database can be found in Table 1. Scenarios were submitted from a diverse set of recent publications including multi-model comparison projects[7,8] and single-model scenario studies[9,10].

However, developing a useable scenario database requires more than simply porting diverse data from various sources into one large container. The literature on 1.5 °C and 2 °C pathways varies significantly in the amount and type of data that was published in figures and digital form, which severely limits comparability of pathway

https://doi.org/10.1038/s41558-018-0317-4

Good practice guidelines

Box 1 | Good practice for analysing ensembles of opportunity of IAM scenarios. A user's guide to the analysis and interpretation of scenario ensembles

In this context, an ensemble of opportunity refers to a serendipitous collection of scenario data from a variety of sources and studies. Here, we provide a list of good practice for analysing such ensembles, as well as some examples.

Don't interpret the scenario ensemble as a statistical sample or in terms of likelihood/agreement in the literature. A number of scenarios show that limiting global warming to 1.5 °C can be achieved without the deployment of BECCS, while the majority of scenarios use it (Fig. 1c). This information by itself does not imply that reaching ambitious climate goals is less likely without BECCS — instead, it shows that pathways with and without BECCS exist for implementing the goals of the Paris Agreement, highlighting that different societal preferences and strategies can result in vastly different outcomes.

Don't focus only on the medians, but consider the full range over the scenario set. Although it is often easier to communicate single numbers rather than ranges, the full breadth of indicators or trajectories within a scenario set carries important information about the available options (Fig. 1b–e).

Don't cherry-pick individual scenarios to make general conclusions. Select an appropriate subset of scenarios instead, in such a way that differences or alternative developments between scenarios within one category can be highlighted (Fig. 1d).

Don't over-interpret scenario results and don't venture too far from the original research focus. All scenarios in this compilation analyse the emission pathways and the energy system transformation in mitigation pathways; comparing emissions and similar indicators is therefore a valid meta-analysis. In contrast, most scenario designs implicitly look for the least-cost solution with respect to mitigation efforts and are not designed to consider interregional fairness or burden-sharing methods. Regional GDP changes under mitigation policies from these scenarios thus provide little information about who will ultimately win or lose from climate action and is taking the meta-analysis outside of the application domain of these scenarios.

Don't conclude that the absence of a particular scenario (necessarily) means that this scenario is not feasible or possible. The solution space in an ensemble of opportunity is not comprehensive. Scenarios might be 'missing' because no study asked a research question that would require such a scenario to be developed, or, even more banal, because such a scenario was published in the literature but not included in the ensemble for other reasons. Unavailable scenarios do not preclude them from being possible, unless a study specifically indicates that a particular scenario was attempted but could not be produced by a modelling framework (for example, limiting radiative forcing in 2100 to 1.9W m^2 under SSP3 socioeconomic assumptions[1,13]).

Good practice guidelines

- *Don’t interpret the scenario ensemble as a statistical sample or in terms of likelihood/ agreement in the literature.*
- *Don’t focus only on the medians, but consider the full range over the scenario set.*
- *Don’t cherry-pick individual scenarios to make general conclusions.*
- *Don’t over-interpret scenario results and don’t venture too far from the original research focus.*
- *Don’t conclude that the absence of a particular scenario (necessarily) means that this scenario is not feasible or possible.*

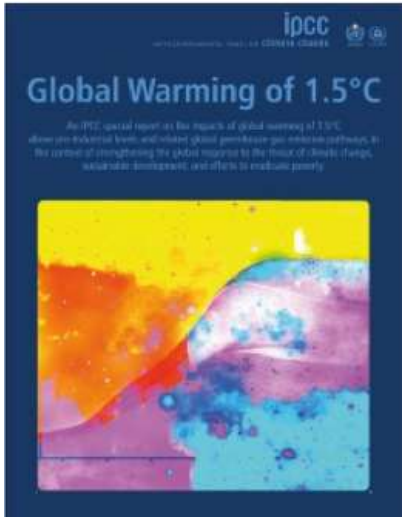
More information

- Public website: data.ene.iiasa.ac.at/iamc-1.5c-explorer
- Recommended citation of the scenario explorer and data

  Daniel Huppmann, Elmar Kriegler, Volker Krey, Keywan Riahi, Joeri Rogelj, Steven K. Rose, John Weyant, et al. *IAMC 1.5°C Scenario Explorer and Data hosted by IIASA*. Integrated Assessment Modeling Consortium & International Institute for Applied Systems Analysis, 2018. doi: 10.22022/SR15/08-2018.15429
- High-level description of the scenario ensemble

  A new scenario resource for integrated 1.5 °C research. *Nature Climate Change*, 2018. doi: 10.1038/s41558-018-0317-4
- Open-source assessment notebooks for the SR15

  github.com/iiasa/ipcc_sr15_scenario_analysis/



The scenario ensemble was compiled for the assessment of quantitative climate change mitigation pathways in the IPCC Special Report on Global Warming of 1.5° C (SR15, http://www.ipcc.ch/report/sr15/)

Thank you!

Volker Krey
krey@iiasa.ac.at

Funding Projects

Backup Slides

Different roles for visualization tools

From research insights to communication

(Bosetti, Riahi, Kriegler, Huppmann, et al…)

Simple & intuitive "points of entry"

General public

Policymakers

Researchers

Modeling experts

Infographics

Focus on communicating key messages in an accessible way

Scenario Portal

Focus on selected insights form small set of scenarios

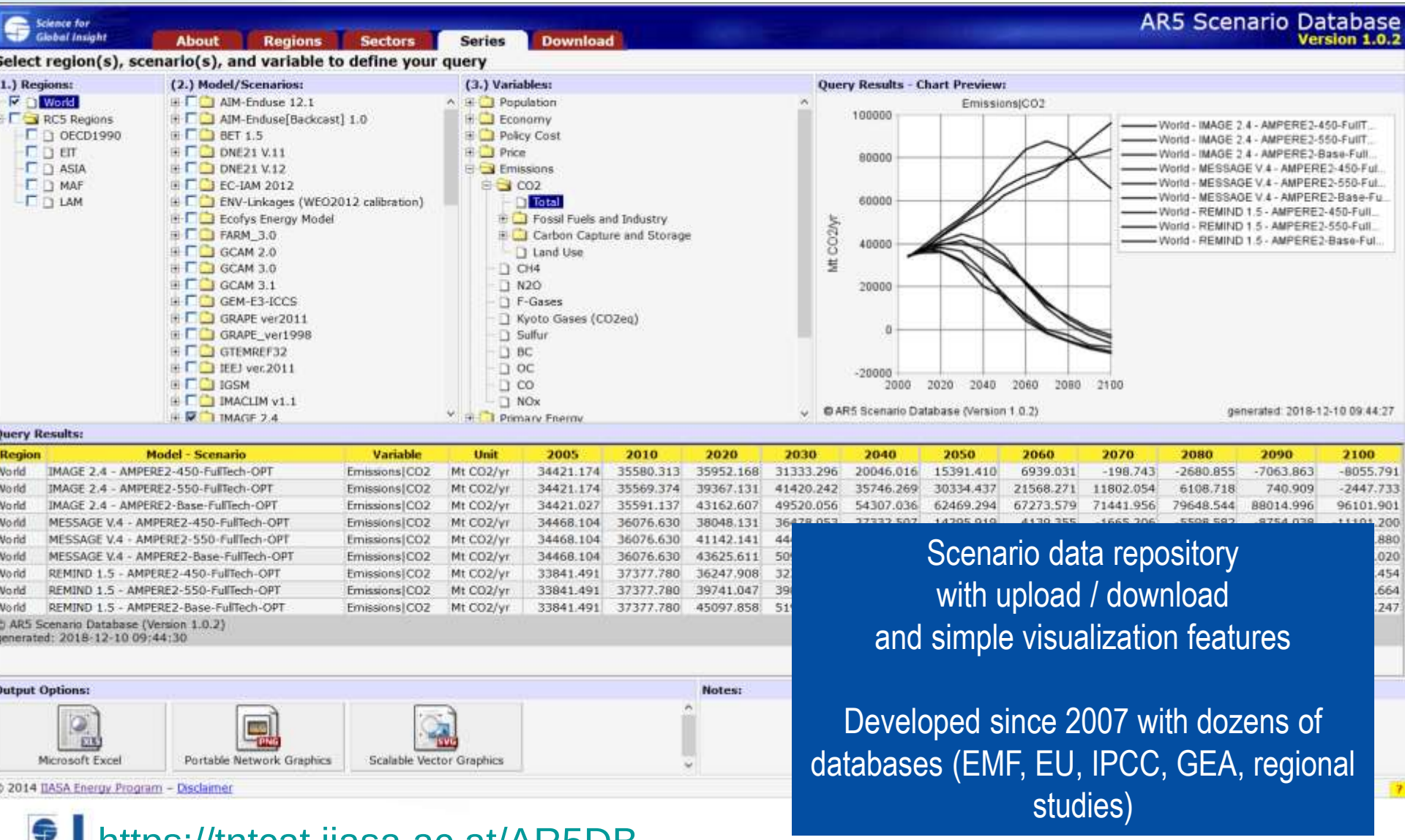
Scenario Explorer

Comprehensive access to data, results and assumptions

Increasing level of complexity guiding users towards better understanding of findings

Flexible tools for visualization & analysis to assist researchers/modelers "finding the story" in the haystack

Scenario Explorer replaces the current database infrastructure (e.g., AR5)



Scenario data repository
with upload / download
and simple visualization features

Developed since 2007 with dozens of databases (EMF, EU, IPCC, GEA, regional studies)

https://tntcat.iiasa.ac.at/AR5DB