

PARIS
REINFORCE



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IISA2021

**The Twelfth International Conference on Information,
Intelligence, Systems and Applications (IISA 2021)**

12-14 July 2021, Athens, Greece

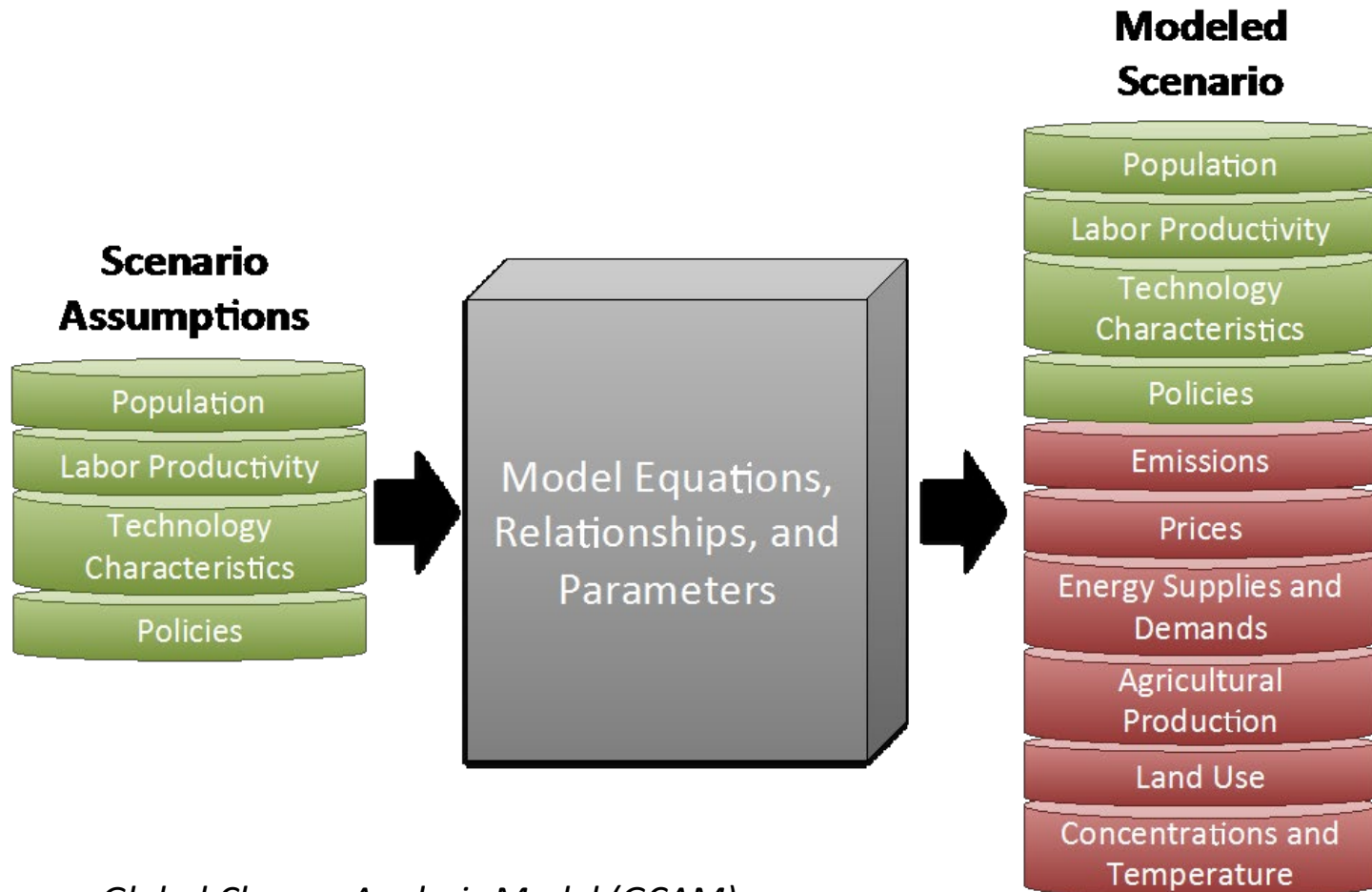
Big Data Analytics in the Energy Sector

**Integrating Integrated Assessment Modelling in Support
of the Paris Agreement: The I2AM PARIS Platform**

Dr. Alexandros Nikas (*National Technical University of Athens*)



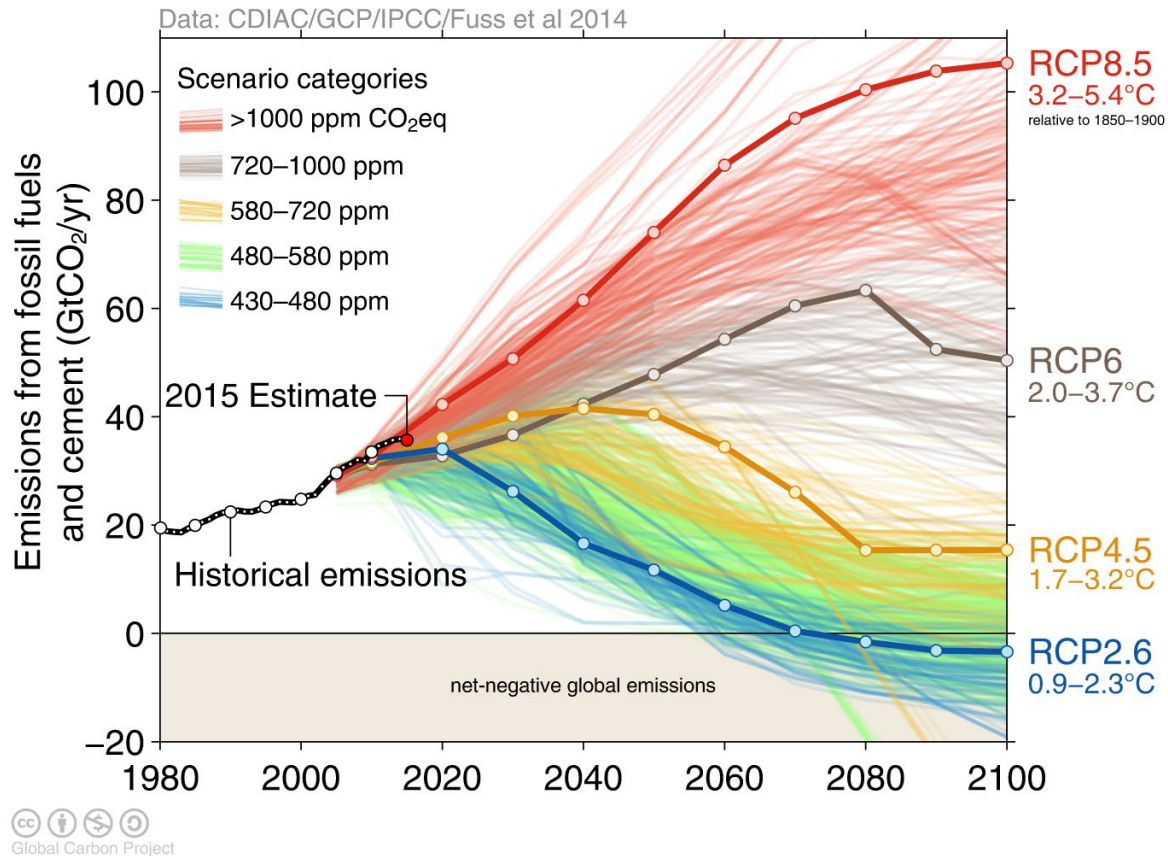
www.paris-reinforce.eu



Source: *Global Change Analysis Model (GCAM)*



What happens when you have more runs?

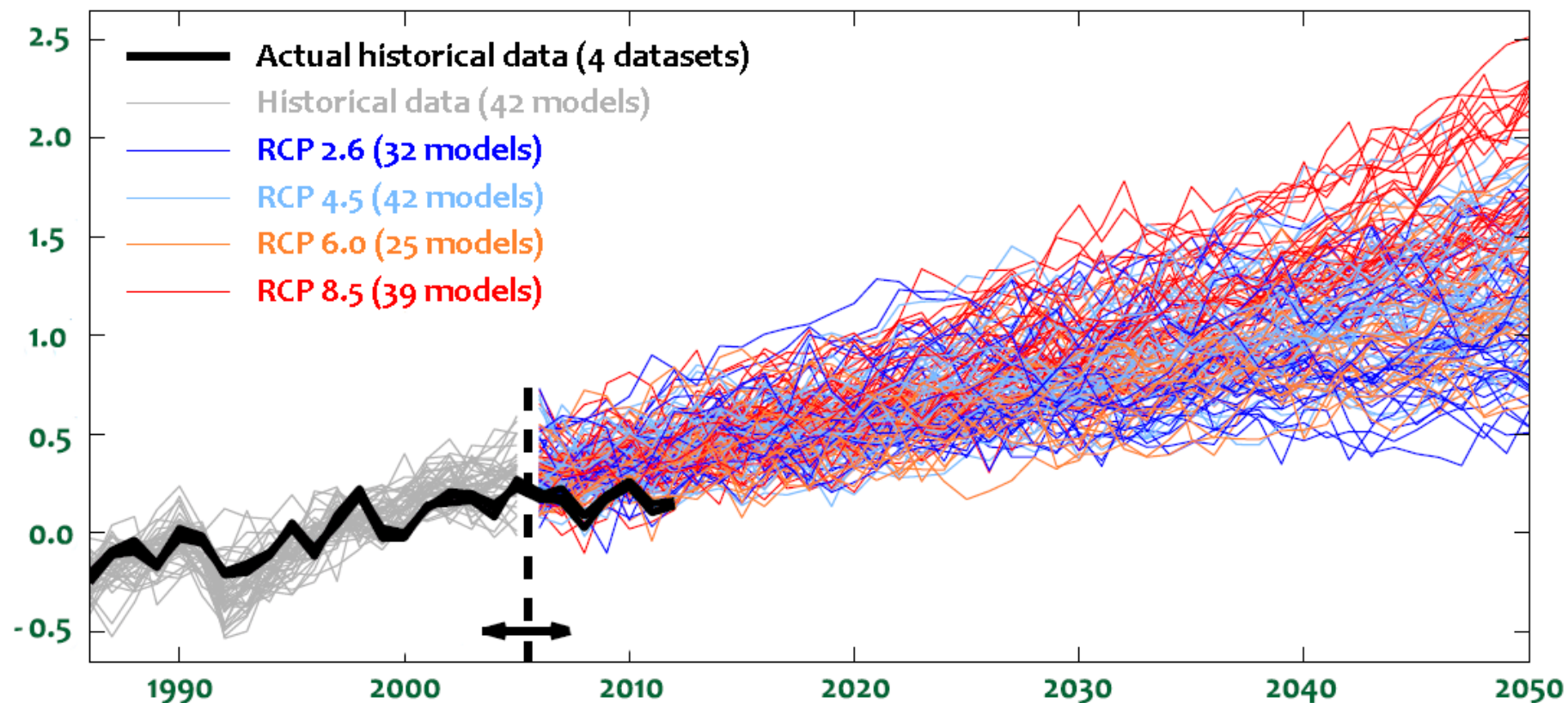


Source: The Global Carbon Project



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Global mean temperature projections based on 1986-2005



Source: IPCC 5th Assessment Report (2014)



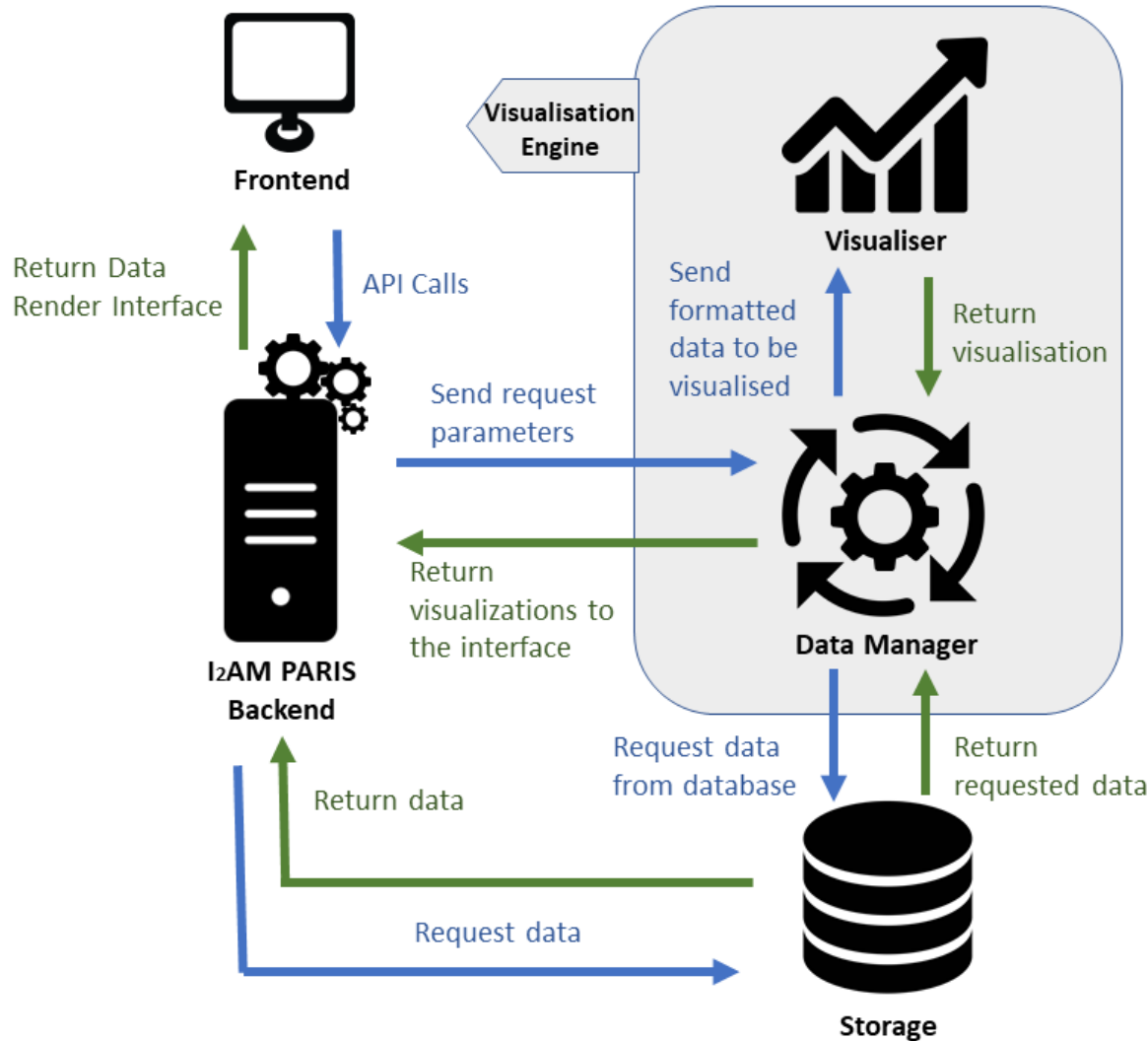
- Integrated assessment models: undoubted contribution to climate policymaking ('best available science')
- However: extent of this support frequently debated
 - Too many, diverse (different) models
 - Too many input assumptions
 - Too many outputs
- How to present, summarise, visualise, and tie policy prescriptions to the modelling mechanisms and assumptions underpinning them?
- Calls "to do science differently" and democratise data and the research process.



Hence, the I²AM PARIS platform

A screenshot of the I²AM PARIS website homepage. The background is a dark green with a pattern of light green wavy lines. At the top left is the I²AM PARIS logo. At the top right, a small text line reads "PARIS REINFORCE is an EU-funded research project aimed at effectively supporting the design of climate policies." Below the logo is a dark navigation bar with white text for "HOME", "DOCUMENTATION", "RESULTS", "THE PROJECT", "OPEN CALL", "CONTACT", and "★ EVALUATE US". On the far right of the navigation bar is a white icon of a hand pointing to the right, followed by the text "MODEL DYNAMIC DOCUMENTATION". The main content area features the title "I²AM PARIS" in large white font, followed by the subtitle "Integrating Integrated Assessment Models" in a slightly smaller white font. Below the subtitle are two light green rectangular boxes containing white text. The first box says "An open-access, data exchange platform to host the detailed documentation, and analyses carried out by means of the PARIS REINFORCE integrated assessment and energy system models". The second box says "Bridging the gap between scientists and stakeholders". On the left and right sides of the main content area, there are circular green buttons with white arrows pointing left and right respectively.

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- **Parsers:** extracting data from files; processing and storing info in Database
- **Backend:** mediator that orchestrates all operations executed for all end-to-end scenarios; and facilitates integration (interfaces/APIs)
- **Data Manager:** create, store and execute queries; process data returned and convert in visualisable form
- **Visualiser:** chart and map visualisation generator





Model Dynamic Documentation

An interactive library of the models, in the form of a responsive "infographic", for all models, with regard to their features.



Overview and Comparative Assessment

- Global Models
- National/ Regional Models for Europe
- National/ Regional Models for countries outside Europe



Detailed Model Documentation

A detailed documentation of each one of the global, regional and national models of the PARIS REINFORCE modelling ensemble



Variable Harmonisation Heatmap

This tool creates on-demand heatmaps that indicate how different variables are handled across the different models within the Paris Reinforce consortium.



Layout ▾
Back

Models

42	DICE	E3ME	GCAM	GEMINI-E3
ICES	MUSE	TIAM	CONTO	MAPLE
MARKAL-India	NATEM	SIGGEMA	TIMES-CAC	ALADIN
FORECAST	EU-TIMES	LEAP	MANAGE *	NEMESIS

* Models outside the PARIS REINFORCE project

Geographic Coverage of GCAM

Equirectangular
Mercator
Miller
Eckert 6
Orthographic



Model Dynamic Documentation

An interactive library of the models, in the form of a responsive "infographic", for all models, with regard to their features.

Sectors

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Emissions

CH ₄	CO ₂	F [*]	CO ₂ [*]	N ₂ O	(V)OC	NH ₃	NO _x
PM ₅	SO _x						

Mitigation-Adaptation Measures

Policy

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Socio-Economics

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SDGs

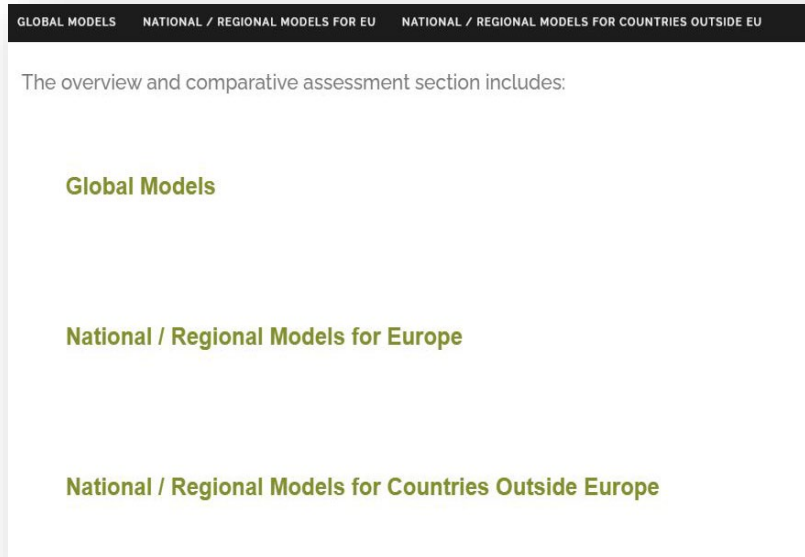


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Overview and Comparative Assessment

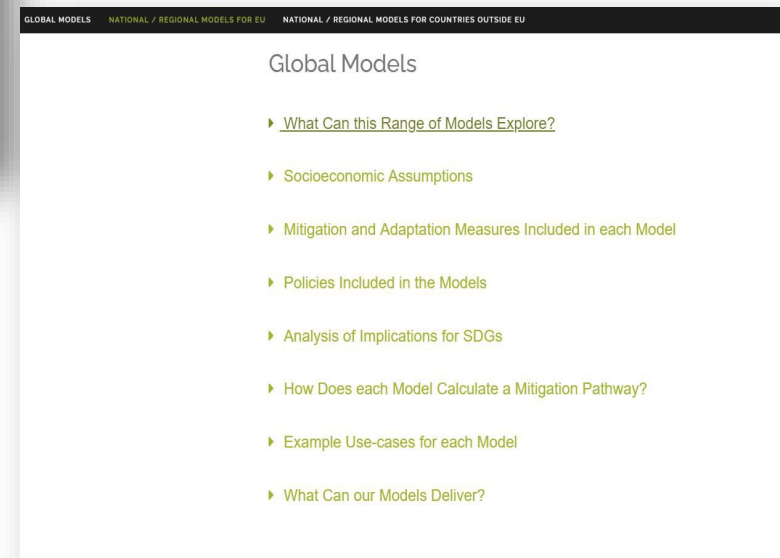
- Global Models
- National/ Regional Models for Europe
- National/ Regional Models for countries outside Europe



The user can select one subsection and more details are displayed (expanding headings)

Models are separated in 3 categories:

- Global Models
- National/Regional Models for Europe
- National/Regional Models for countries outside Europe



The detailed model documentation section includes:



Models are separated in 3 sections:

- Global Models
- National / Regional Models for Europe
- National / Regional Models for Countries Outside Europe

When the user selects a model, a new page is shown that displays more details about the model.

Detailed Model Documentation

A detailed documentation of each one of the global, regional and national models of the PARIS REINFORCE modelling ensemble

Navigation among models

Navigation among documentation sections

OTHER GLOBAL MODELS GEMINI-E3 ICES GCAM TIAM EXIME MUSE 42

Short overview

Key features of the GCAM model

- Climate module & emissions granularity
- Socio-economic dimensions
- Mitigation/adaptation measures and technologies
- Economic rationale and model solution
- Key parameters
- Policy questions and SDGs
- Recent use cases
- GCAM-China
- GCAM-SOUSEI
- GCAM-USA

The Global Change Assessment Model (GCAM)

Short overview

The Global Change Assessment Model (GCAM) is a global integrated assessment model that represents both human and Earth system dynamics. It explores the behaviour and interactions between the energy system, agriculture and land use, the economy and climate. The role of GCAM is to bring multiple human and physical Earth systems together in one place to provide scientific insights that would not be available from the exploration of individual scientific research lines. The model components provide a faithful representation of the best current scientific understanding of underlying behaviour.

GCAM allows users to explore what-if scenarios, quantifying the implications of possible future conditions. These outputs are not predictions of the future; they are a way of analysing the potential impacts of different assumptions about future conditions. GCAM reads in external 'scenario assumptions' about key drivers (e.g. population, economic activity, technology, and policies) and then assesses the implications of these assumptions on key scientific or decision-relevant outcomes (e.g. commodity prices, energy use, land use, water use, emissions, and concentrations).

It is used to explore and map the implications of uncertainty in key input assumptions and parameters into implied distributions of outputs, such as GHG emissions, energy use, energy prices, and trade patterns. Techniques include scenarios analysis, sensitivity analysis, and Monte Carlo simulations.

GCAM has been used to produce scenarios for national and international assessments ranging from the very first IPCC scenarios (Response Strategies Working Group, 1990) through the present Shared Socioeconomic Pathways (SSPs) (Calvin et al., 2017).

Key features of the GCAM model

GCAM takes in a set of assumptions and then processes those assumptions to create a full scenario of prices, energy and other transformations, and commodity and other flows across regions and into the future. The energy, agriculture and land use, economy and climate systems are interconnected and interact with each other (see the figure below). The interactions between these different systems are modelled as one integrated whole.



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On-demand harmonisation heatmap

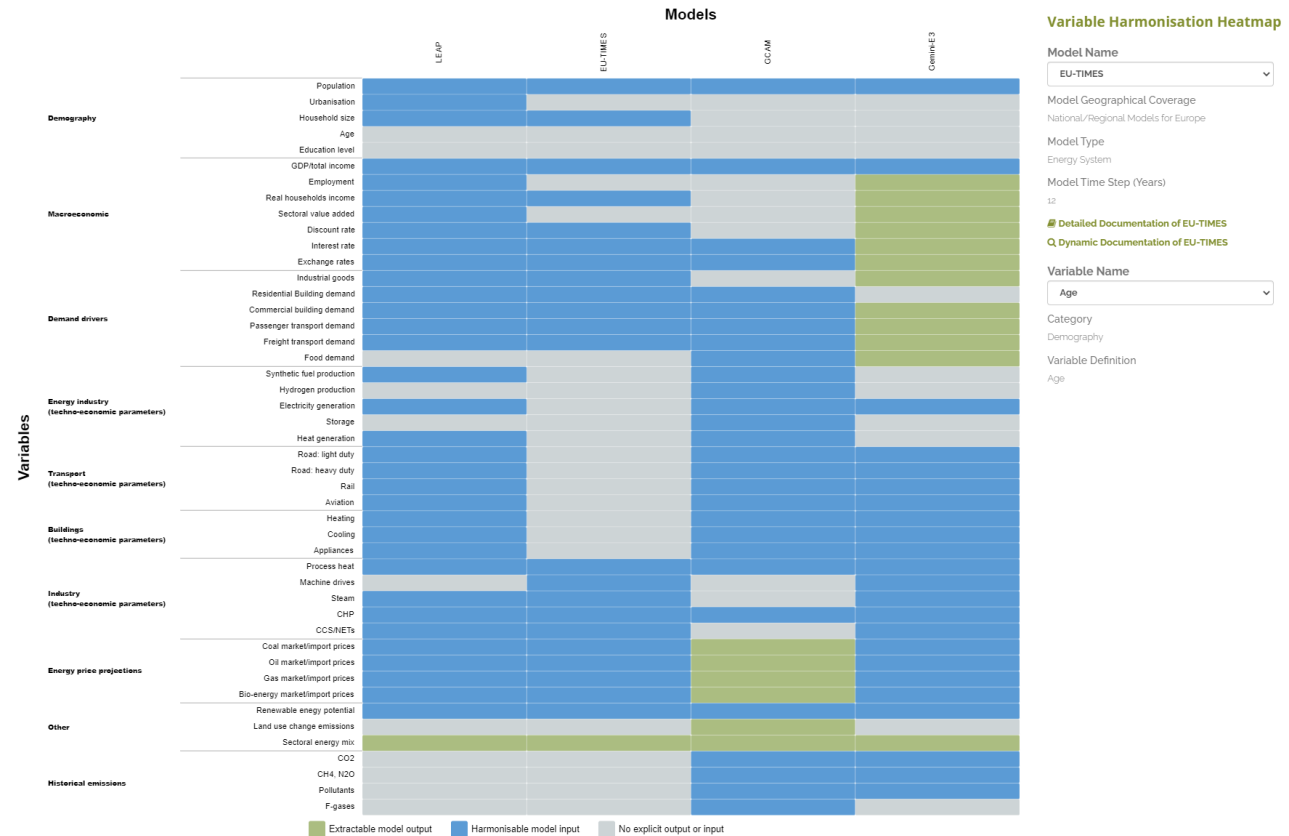
Variable Harmonisation

Please, select up to 15 models from the list below and press the **Run** button. The created heatmap will indicate how different variables are handled across the models available in i²AM PARIS Platform.

42
 E3ME
 GCAM
 GEMINI-E3
 ICES
 MUSE
 TIAM
 CONTO
 MAPLE
 NATEM
 TIMES-CAC
 ALADIN
 FORECAST
 EU-TIMES

LEAP
 NEMESIS

* Models outside the PARIS REINFORCE project



Variable Harmonisation Heatmap

This tool creates on-demand heatmaps that indicate how different variables are handled across the different models within the Paris Reinforce consortium.



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RESULTS

Choose among the following workspaces



Where are we headed?

These are the results produced by the analysis made using the models of the Paris Reinforce project.

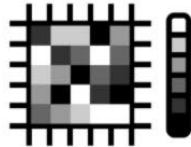


EU Recovery Policy DB

This workspace includes the CINEA Climate Neutrality WGII Shared EU Recovery Policy Database for modelling research.



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Variable Harmonisation Heatmap

A heatmap that indicates how different variables are handled across the models within the Paris Reinforce consortium. The rows present the different socio and techno economic variables. The columns indicate the 16 PR models. Variables are either considered as outputs from models, inputs to models or are not represented by the models as any explicit output or input



Where are we headed? (Advanced Scientific Module)

These are the results produced by the analysis made using the models of the Paris Reinforce project used in scientific research and this service provides tools to explore the available data.



Cool... what does that mean?

This section presents the outcome of the analysis process along with meaningful conclusions about it and other insightful information.



Virtual Library

This section essentially includes scientific publications, policy briefs, databases (probably direct download links, input data sources information i.e. IEA WorldBank EDGAR etc.) relevant to Paris Reinforce workspace run.



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Fossil Energy CO₂ emissions

The chart on the right will present the Fossil Energy CO₂ Emissions to 2100 for all selected models, scenarios and region. Only three of our models (TIAM, GCAM, MUSE) run to 2100, 42 runs to 2045, ICES, GEMINI-E3 and E3ME run to 2050.

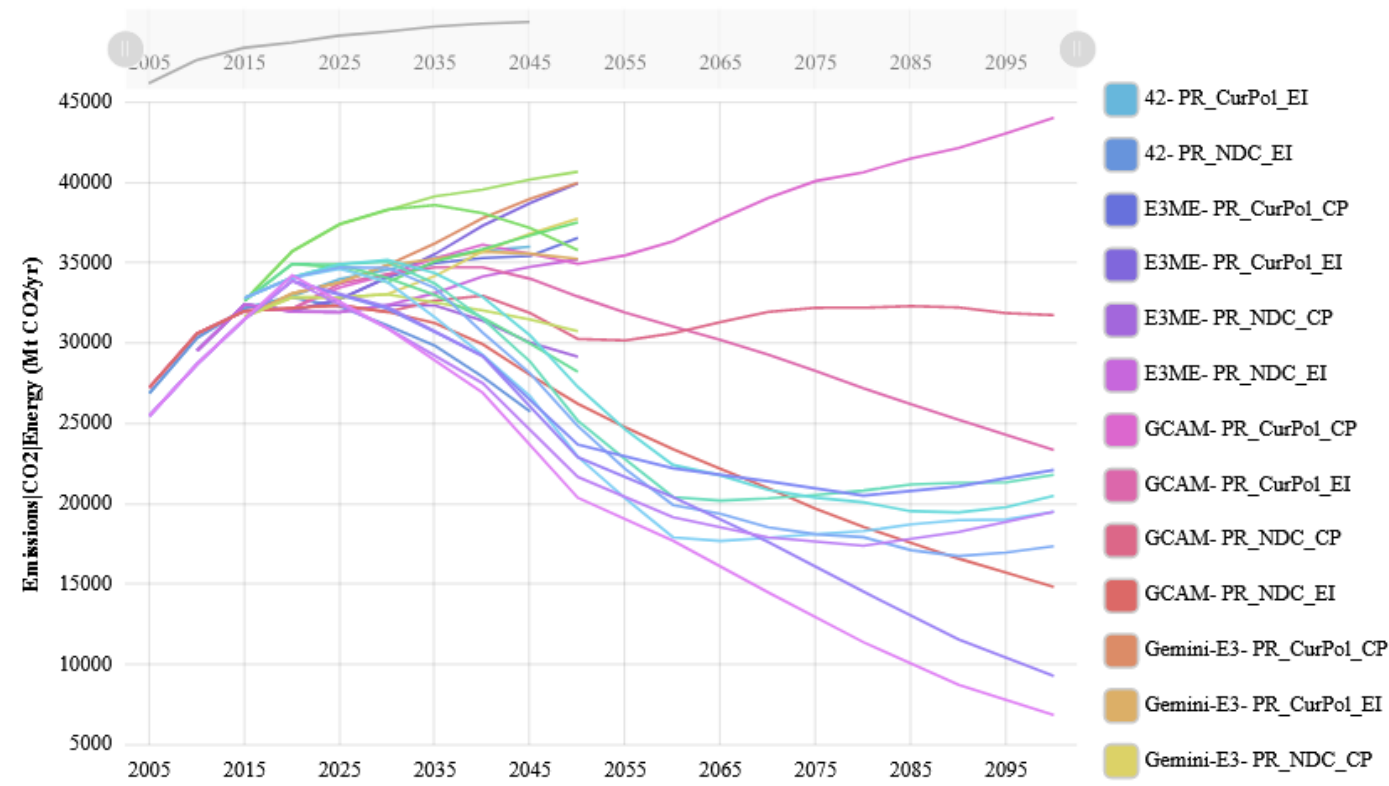
Models

Scenario

Region

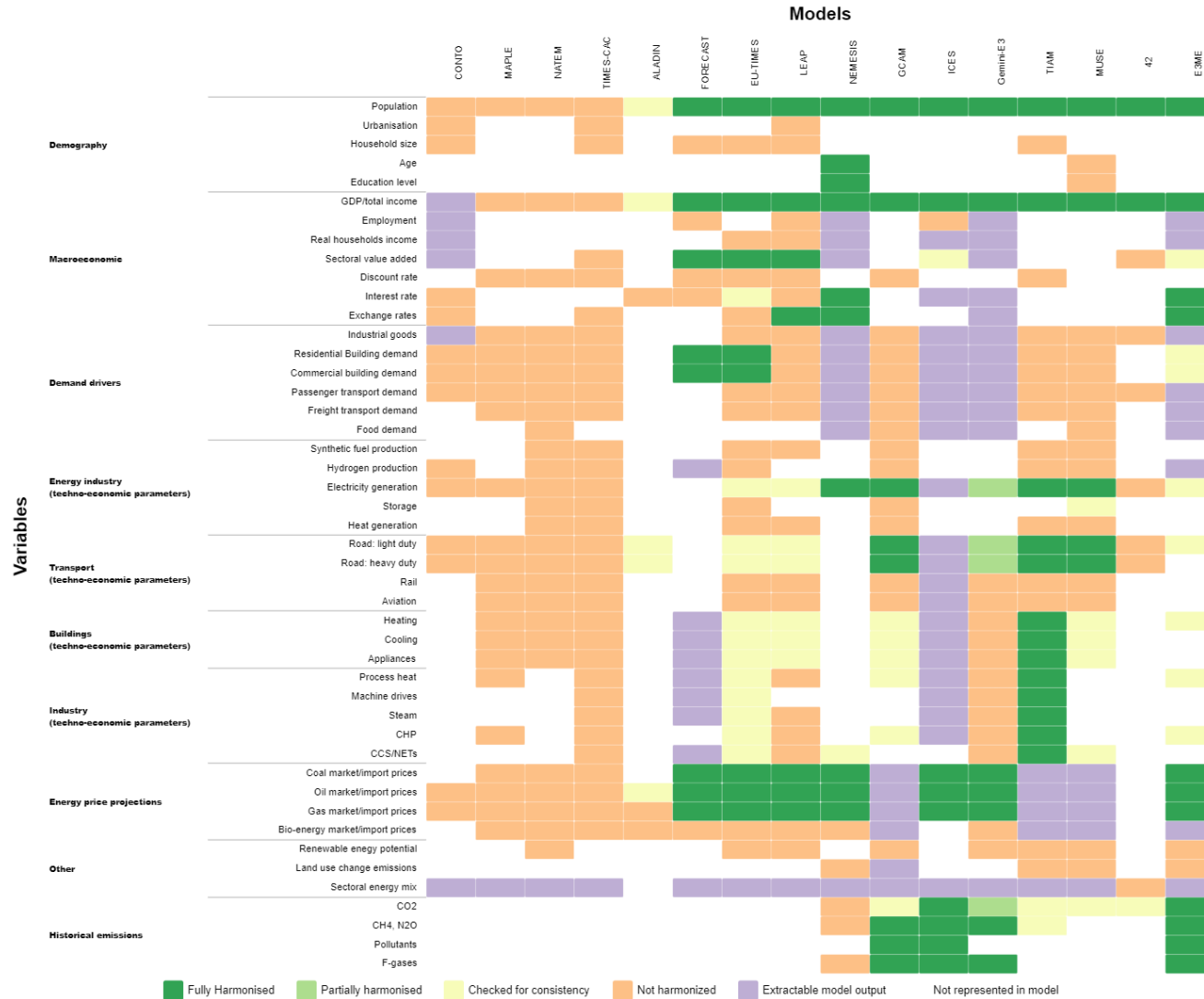
Run

Show Legend



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E.g., WWH (Heatmap)



Variable Harmonisation Heatmap

You can also create on-demand variable harmonisation heatmaps [here](#).

Order Columns By:

Model Name:

Model Geographical Coverage: Global IAMs

Model Type: General Equilibrium

Model Time Step (Years): 1

- Detailed Documentation of ICES
- Dynamic Documentation of ICES

Variable Name:

Category: Demography

Variable Definition: Total number of people living in the specific country or region

Sources

- OECD Population Projections (short- and mid-term)
 - OECD Population Projects, 2020
- Europop (short- and mid-term)
 - Europop, 2020
- SSP2 Population (long-term)
 - KC and Lutz, 2017
- UN (short-term)
 - United Nations 2019

Unit

Million people, Growth rate

Timespan

3

■ Fully Harmonised
 ■ Partially harmonised
 ■ Checked for consistency
 ■ Not harmonized
 ■ Extractable model output
 ■ Not represented in model



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EU Recovery Policy DB

The H2020 PARIS REINFORCE project is coordinating a shared recovery policy database, in which different H2020 research and innovation projects for climate policy modelling take stock of intended/final recovery policies of selected Member States, as well as of other European countries. This shared policy database is intended to align with the ongoing efforts of the modelling community for enhanced transparency of model assumptions, save significant resources (avoiding duplicate work across research projects); enable cross-project comparison of relevant questions; and facilitate/encourage engagement in COVID- and recovery-related modelling work. As of June 22, the database accommodates the Recovery and Resilience Plans for Belgium, France, Germany, Greece, Italy, and Spain.

Data Exploration

The following table contains the Recovery and Resilience Plans for different countries in a tabular format. The data exploration includes ordering, searching and exporting the available data. You can download the entire datasets in the following links:
RRF Policies .

[Export to CSV](#)

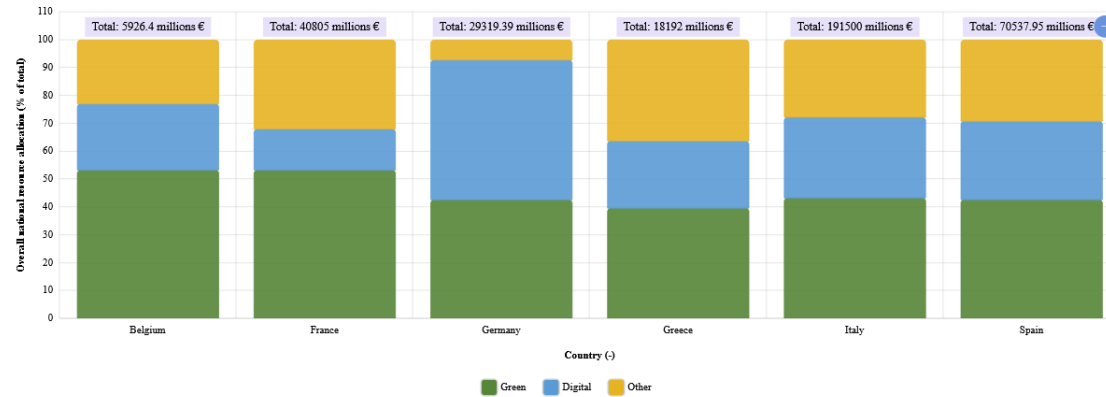
 Search:

Title	Description	Country	Budget	Total Ratio	GDO Classification	Seven Flagship Classification
	Improved protection for victims of gender violence.	Spain	1534	0.22	Other	Other/Uncategorised
Sustainable local transport - Infrastructures and electricity refuelling chargers	The aims is to build refuelling stations for electricity in the highways (7500) and in urban areas (13750), and 10 stations with storages	Italy	750	0.39	Green	Recharge and Refuel
Pursue the care, protection and improvement of environmental quality through integrated management of river basins - National monitoring of environmental pollution	To align regional legislation with national about measures to reduce the GHG emissions and other polluters.	Italy	0	0	Green	Other/Uncategorised
Pursue the care, protection and improvement of environmental quality through integrated management of river basins - National park digitalization	To promote the digitalisation of management of national parks and marine protected areas. 1) Nature preservation, 2) Digital service for visitors, 3) Simplify the administration	Italy	100	0.05	Digital	Modernise
Pursue the care, protection and improvement of environmental quality through integrated management of river basins - Po river	Re-naturation of Po river basin	Italy	360	0.19	Green	Other/Uncategorised

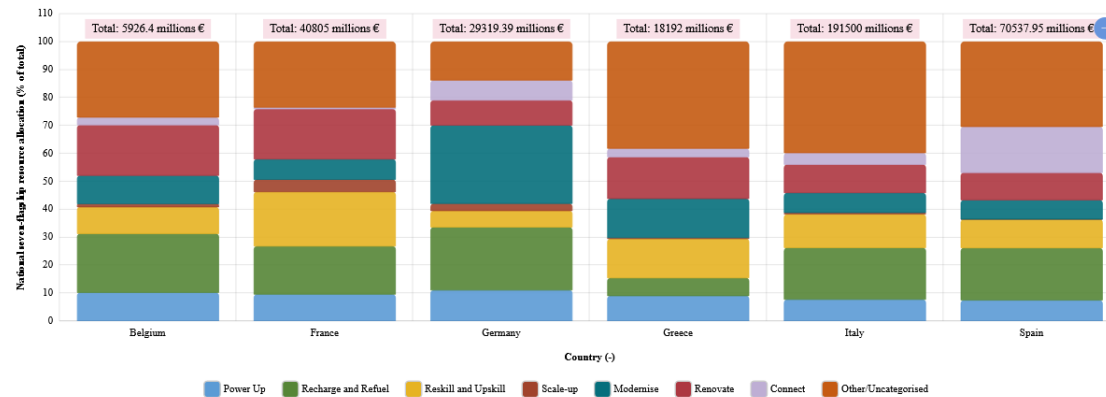


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Overall resource allocation in national recovery and resilience plans
(% of total and € millions)

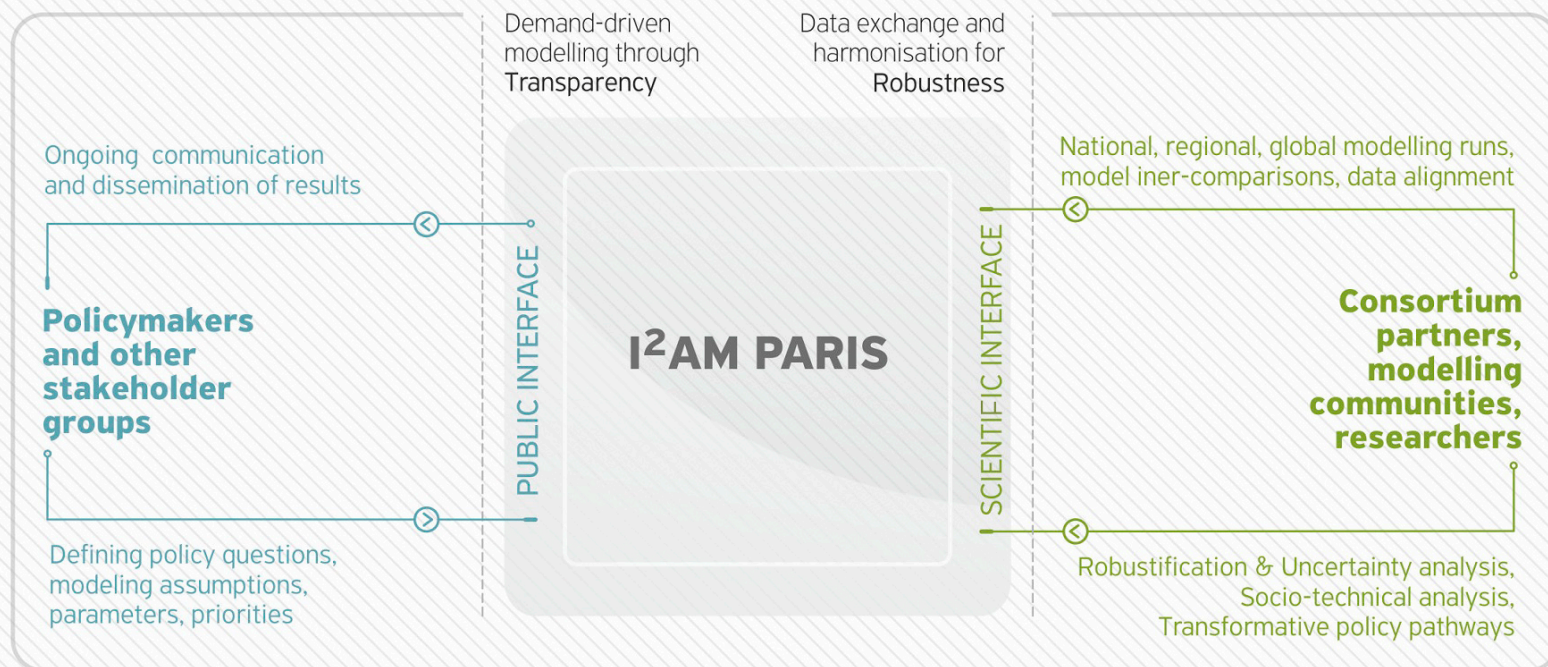


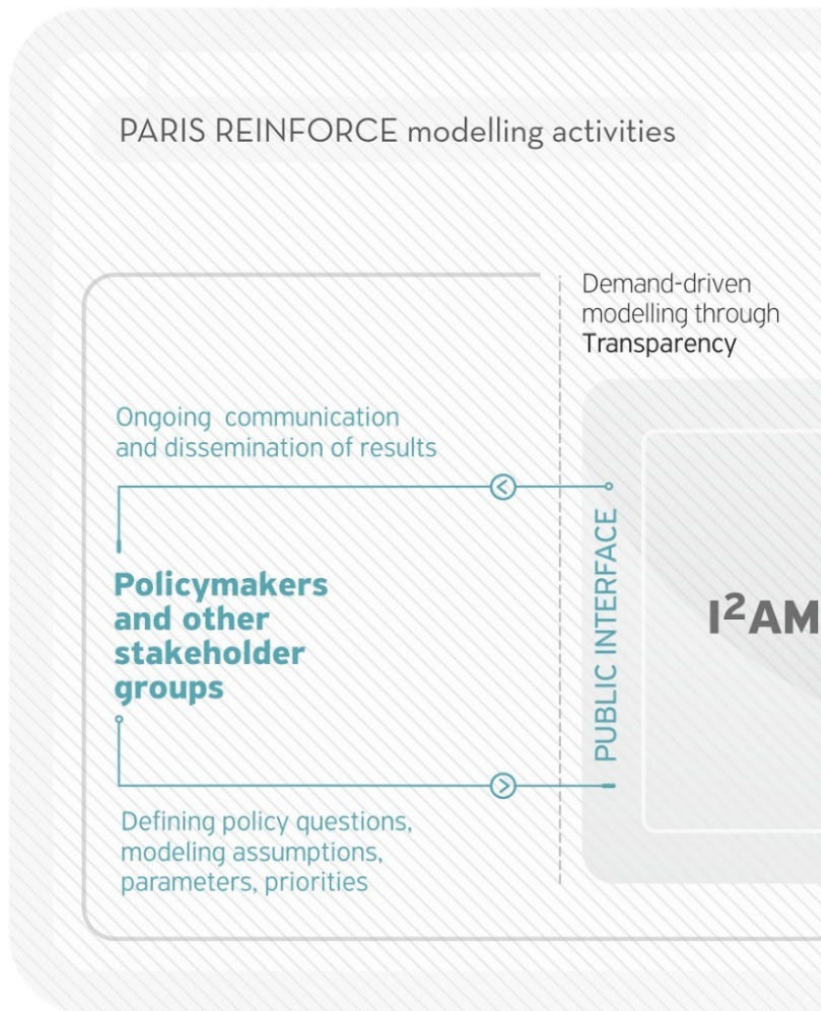
Composition of recovery plans according to the flagship areas defined by the Commission
(% of total and € millions)



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PARIS REINFORCE modelling activities

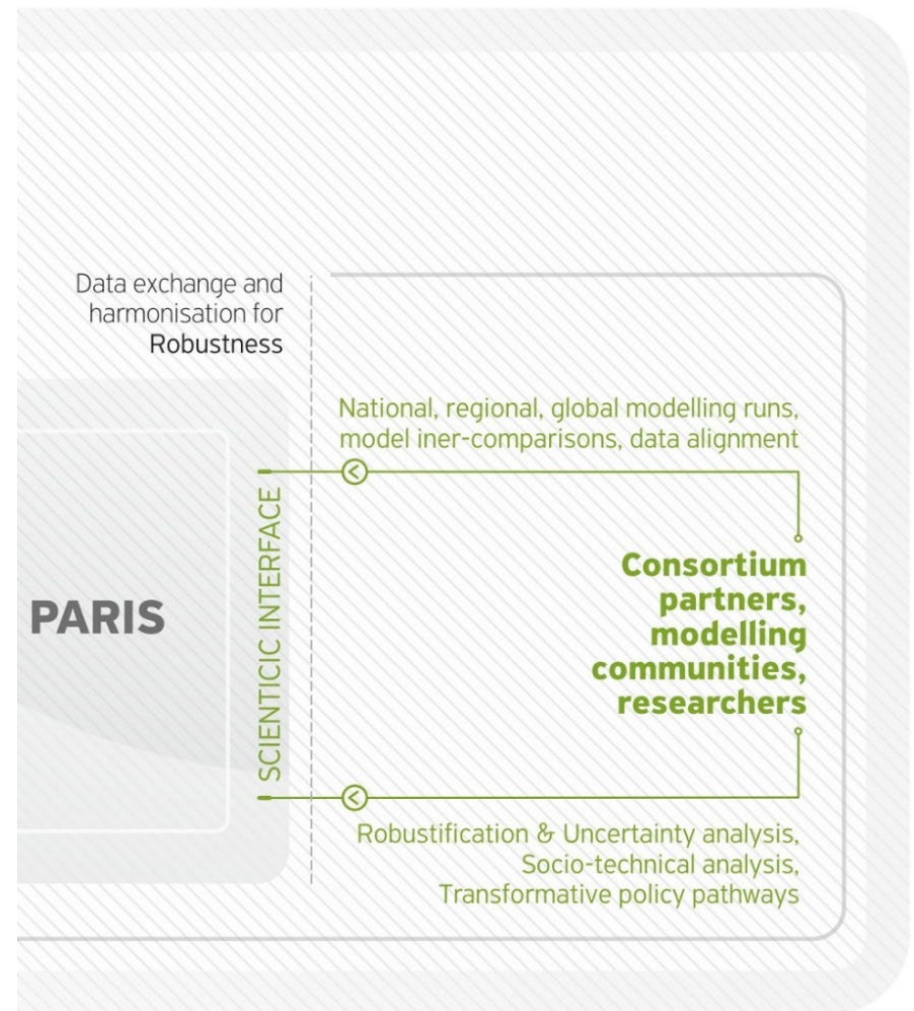




- Allows the presentation of a detailed, dynamic, & comparative **documentation** of models & **harmonisation heatmaps** across models shedding light into 'What can models do?'.
- Theme-specific workspaces can provide a **user-friendly presentation** and visualisation of **policy-relevant results** and **policy prescriptions**, in response to **co-created policy/research questions**, as well as **libraries** with relevant papers and policy briefs.



- Modelling teams around the world can provide a **detailed documentation of their model(s)**, so that we can include it in a common database and documentation.
- Like the public interface, experts can also view the advanced scientific presentation of modelling results, databases, etc.; as well as access similar templates to provide with the **topics** (research questions) they have addressed, as well as their modelling **inputs** and **results**.





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- I²AM PARIS: dedicated to hosting **finding, accessible, interoperable, and reusable data**, and delivering on *comprehensive* and *comprehensible* scientific information in support of climate policymaking.
- Scientific knowledge is served and visualised in a way that **promotes exploitation** and allows policy prescriptions to be transformed into policy action
- **Documentation of modelling characteristics and capabilities** will enable scientists coming from different disciplines and viewpoints to share a *common language*.
- Non-expert stakeholders can be informed on the capabilities and coverages of models, presenting a **channel for stakeholders** to acknowledge assumptions going into models and **trust results**, in an attempt to promote *legitimacy* and *transparency*.
- The platform encourages scientists to develop and implement **open protocols** for interpreting scenarios and parameters.





Thank you!

On behalf of all authors (Skalidakis, Sorman, Galende-Sanchez, Koasidis, Serepas, Van de Ven, Moreno, Karamaneas, Koutsellis, Kanellou, Doukas):

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