PARIS
REINFORCE

22/05/2020

D2.4 I²AM PARIS PLATFORM

WP2 – I²AM PARIS

Version: 1.00

www.paris-reinforce.eu

Disclaimer

Copyright Message

Grant Agreement Number	**820846**	**Acronym**	**Paris Reinforce**	
Full Title	Delivering on the Paris Agreement: A demand-driven, integrated assessment modelling approach			
Topic	LC-CLA-01-2018			
Funding scheme	Horizon 2020, RIA – Research and Innovation Action			
Start Date	June 2019	Duration	36 Months	
Project URL	https://www.paris-reinforce.eu/			
EU Project Officer	Frederik Accoe			
Project Coordinator	National Technical University of Athens – NTUA			
Deliverable	D2.4 – I²AM PARIS platform			
Work Package	WP2 – I²AM PARIS			
Date of Delivery	Contractual	31/05/2020	Actual	22/05/2020
Nature	Report	Dissemination Level	Public	
Lead Beneficiary	HOLISTIC			
Responsible Author	Vangelis Marinakis	Email	vmarinakis@holisticsa.gr	
	HOLISTIC	Phone		
Contributors	Stavros Skalidakis, Alexandros Nikas (NTUA); Filippas Serepas (HOLISTIC)			
Reviewer(s)	Alecos Kelemenis, Alexandros Nikas, Haris Doukas (NTUA); Rocco de Miglio (E4SMA); Zsolt Lengyel (IEECP); Ester Galende (BC3)			
Keywords	I2AM PARIS; platform; modelling harmonisation; open-access; data exchange; integrated assessment models			

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

EC Summary Requirements

1. Changes with respect to the DoA

No changes with respect to the work described in the DoA.

2. Dissemination and uptake

This deliverable is intended to accompany the I²AM PARIS platform, as a documentation report and reference point for all interested stakeholders, primarily aimed at scientists involved in integrated assessment and energy system modelling exercises in support of climate policymaking.

3. Short summary of results (<250 words)

This report provides a documentation of the platform along with a description of its available services, such as Dynamic Model Documentation, Detailed Model Documentation, Overview and Comparative Assessment, and Visualisation.

The Detailed Model Documentation offers a detailed and extended presentation of the characteristics of every available model involved in the PARIS REINFORCE initiative but is currently being enriched with models from modelling teams outside the PARIS REINFORCE consortium. The Overview and Comparative Assessment is useful for comparing and contrasting the models available in PARIS REINFORCE, thus gaining significant insight into their coverage and fields of application. The Dynamic Model Documentation is a single-page application that allows going through all the important features of each model utilising the visual aids of a map to define its geographical coverage as well as several icons that correspond to specific characteristics (e.g. policy, socioeconomic, technology and SDG coverage).

The Visualisation service is provided by a component called Visualisation Engine and aims at producing all the necessary visualisations for the I²AM PARIS platform, including both static and interactive interfaces that will be commonly agreed among the involved partners, promoting co-creation and collaborative thinking, with a view to developing exploitable tools for both scientists and different types of stakeholder groups, like policymakers.

The platform, as of May 19, 2020, counts 637 visits (224 unique visits), with a bounce rate of 36%.

4. Evidence of accomplishment

This report; and the I²AM PARIS platform: http://paris-reinforce.epu.ntua.gr/main.

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

Preface

PARIS REINFORCE will develop a novel, demand-driven, IAM-oriented assessment framework for effectively supporting the design and assessment of climate policies in the European Union as well as in other major emitters and selected less emitting countries, in respect to the Paris Agreement. By engaging policymakers and scientists/modellers, PARIS REINFORCE will create the open-access and transparent data exchange platform I²AM PARIS, in order to support the effective implementation of Nationally Determined Contributions, the preparation of future action pledges, the development of 2050 decarbonisation strategies, and the reinforcement of the 2023 Global Stocktake. Finally, PARIS REINFORCE will introduce innovative integrative processes, in which IAMs are further coupled with well-established methodological frameworks, in order to improve the robustness of modelling outcomes against different types of uncertainties.

NTUA - National Technical University of Athens	GR	
BC3 - Basque Centre for Climate Change	ES	
Bruegel - Bruegel AISBL	BE	
Cambridge - University of Cambridge	UK	
CICERO - Cicero Senter Klimaforskning Stiftelse	NO	
CMCC - Fondazione Centro Euro-Mediterraneo sui Cambiamenti Climatici	IT	
E4SMA - Energy Engineering Economic Environment Systems Modeling and Analysis	IT	
EPFL - École polytechnique fédérale de Lausanne	CH	
Fraunhofer ISI - Fraunhofer Institute for Systems and Innovation Research	DE	
Grantham - Imperial College of Science Technology and Medicine - Grantham Institute	UK	
HOLISTIC - Holistic P.C.	GR	
IEECP - Institute for European Energy and Climate Policy Stichting	NL	
SEURECO - Société Européenne d'Economie SARL	FR	
CDS/UnB - Centre for Sustainable Development of the University of Brasilia	BR	
CUP - China University of Petroleum-Beijing	CN	
IEF-RAS - Institute of Economic Forecasting – Russian Academy of Sciences	RU	
IGES - Institute for Global Environmental Strategies	JP	
TERI - The Energy and Resources Institute	IN	

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

Executive Summary

As the first version of the deliverable documenting the I²AM PARIS platform design and implementation, this report provides a documentation of the platform along with a description of its available services, such as Dynamic Model Documentation, Detailed Model Documentation, Overview and Comparative Assessment, and Visualisation.

The Detailed Model Documentation offers a detailed and extended presentation of the characteristics of every available model involved in the PARIS REINFORCE initiative but is currently being enriched with models from modelling teams outside the PARIS REINFORCE consortium. The Overview and Comparative Assessment is useful for comparing and contrasting the models available in PARIS REINFORCE, thus gaining significant insight into their coverage and fields of application. The Dynamic Model Documentation is a single-page application that allows going through all the important features of each model utilising the visual aids of a map to define its geographical coverage as well as several icons that correspond to specific characteristics (e.g. policy, socioeconomic, technology and SDG coverage).

The Visualisation service is provided by a component called Visualisation Engine and aims at producing all the necessary visualisations for the I²AM PARIS platform, including both static and interactive interfaces that will be commonly agreed among the involved partners, promoting co-creation and collaborative thinking, with a view to developing exploitable tools for both scientists and different types of stakeholder groups, like policymakers.

The platform, as of May 19, 2020, counts 637 visits (224 unique visits), with a bounce rate of 36% (reported by Google Analytics).

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

Contents

Table of Figures

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

Table of Tables

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

1 Documentation of the I²AM PARIS platform

In this section, the set of the available services of the first integrated version of the I²AM PARIS platform are presented, along with the ones that are planned to be implemented until the next release. These services have largely been co-designed with stakeholders, given their inputs during the first stakeholder council dialogue of the PARIS REINFORCE project, which took place at Bruegel, in Brussels, Belgium on November 21, 2019.

To summarise this feedback, which is reported in detail in deliverables D2.2 ('Protocol for model use, scenarios and stakeholder engagement') and D3.3 ('Proceedings of the 1st regional EU workshop'), the feedback from the platform prototype was overall very positive. All stakeholders participating in the regional workshop—and consortium partners—agreed on the quality as well as its user-friendly interface and visualisation and considered it a valuable foundation for further elaboration of the platform in the course of the project.

Aside from the evaluation of the platform, some of the topics raised included the potential for the platform to contribute to emissions ambition and inter-sectoral dependencies; the transparency of input variables, assumptions and datasets; and the need to go beyond quantitative tools and incorporate qualitative techniques and social aspects. Other topics raised during this workshop and forming the near-future directions of I²AM PARIS included better representation of modelling capabilities outside the PARIS REINFORCE consortium; collaboration with past, present and future projects; rich output visualisation; separate interfaces for the public and the scientific community; and the organisation of webinars to engage stakeholders.

At the end of the dedicated session of the event, an online vote was given to the audience, regarding the selection of the design layout to be used in the dynamic documentation of the I²AM PARIS platform. Although the most favoured option of this vote pointed to a "single-page layout – less is better" direction, which can be partly attributed to the significant dominance of researchers among the audience, there was broad diversity in the results; as a result, a more inclusive approach was sought in the project, by incorporating alternative layouts and the capacity for the user to select among them.

1.1 Platform services

In Figure 1, an overview of the platform services is presented, with the green parts representing aspects of the platform that have already been implemented, and the grey parts work in progress.

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

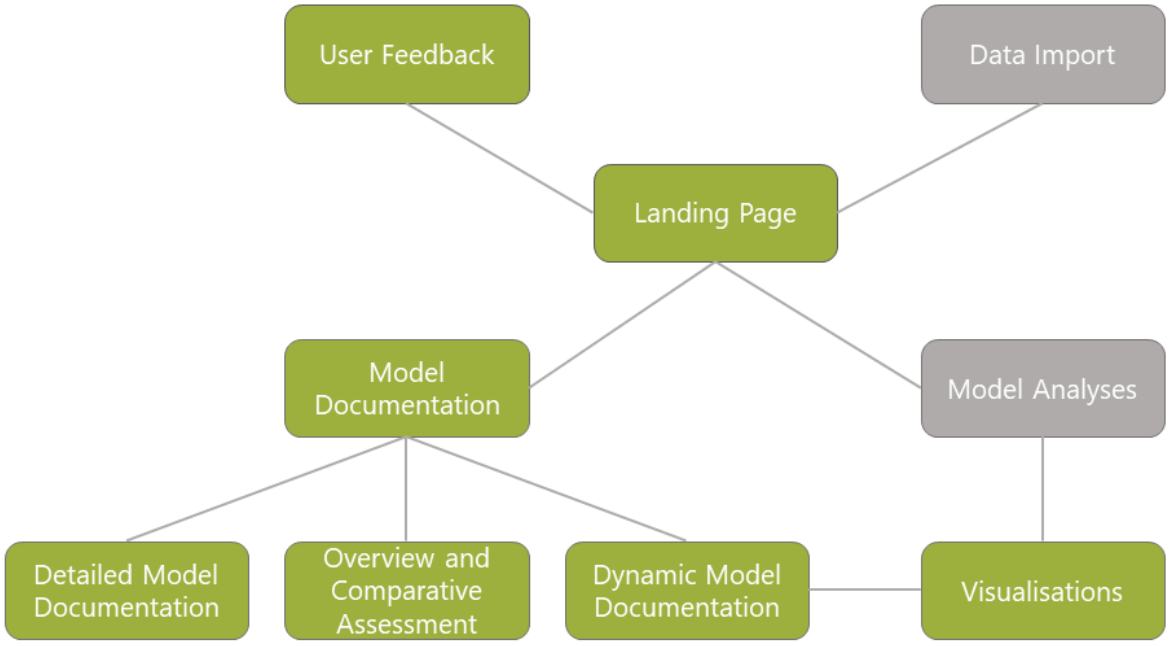

Figure 1: Platform services overview

A first version of the I²AM PARIS platform is available online (http://paris-reinforce.epu.ntua.gr/main), including a landing page that allows navigation throughout the platform, along with services mainly focused on the Model Documentation of the available models. It is a web application based on Django Framework 2.2.5, utilising AM-Charts 4 for the map and chart visualisations. The source code versioning and management is performed through Git version control system and the code is stored in a Github repository[1]. In the figure above, the available parts of the platform are shown in green colour, while the grey boxes represent components that are either currently under development or planned to be implemented in the near future.

The interactive Dynamic Documentation component is an interactive library of the available models, in the form of a responsive "infographic", regarding their features, including geographical coverage as well as sector, emission, policy, SDG, socio-economic and mitigation/adaptation measure granularities. The descriptive Overview and Comparative Assessment consists of a collection of information included in Section 2 of PARIS REINFORCE deliverables D5.1, D6.1, D7.1 and aims at providing an overview of the suitability of each model for specific research needs, compared to one other. The Detailed Model Documentation, in essence, includes a detailed presentation of every model currently available on the platform and is composed of information retrieved from the corresponding deliverables. The User Feedback or Contact Form is useful for collecting feedback from platform users, including requests for new services, bugs and errors on the platform, new ideas/suggestions, etc. The submitted form is forwarded to the developers and accordingly handled or further forwarded to the Project Coordinator to communicate to the consortium.

Concerning the services that are not yet implemented, the Model Analyses component will be a dynamic

[1] https://github.com/sskalidakis/i2amparis

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

representation of data deriving from several runs of the available models, including user-friendly interfaces (which utilise meaningful visualisations) that will allow the user to examine the results of different scenarios by altering specific parameters (to be defined) on the interface. This component will be introduced and described in detail in the next release of the I²AM PARIS platform, in May 2021. Nevertheless, the first version of the module responsible for the creation of visualisations has already been developed and is described in the following chapters.

Moreover, the Data Import, as part of the scientific interface, will allow users to upload CSV files consisting of either model documentation information or scenario modelling results, provided in a specific format that will be circulated in the near future to all consortium partners and relevant research projects and the modelling community, in order to ensure that it fulfils every requirement. After it has been uploaded, the file will be automatically parsed in order to populate the I²AM PARIS Database with the submitted data. This service will initially be used for introducing new models to the Dynamic Documentation but could be further developed for importing data for the Analysis part.

1.2 Landing Page

The landing page of the I²AM PARIS at the moment is composed of a carousel containing information about the project (Figure 2), a navigation bar that helps users easily navigate through each section, and an entire section regarding the model documentation service (Figure 3) comprising links that lead to the Dynamic Documentation, the Overview and Comparative Assessment and the Model Detailed Documentation.

The screenshots below show the main parts of the current version of the Landing Page.

Figure 2: Landing page carousel

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

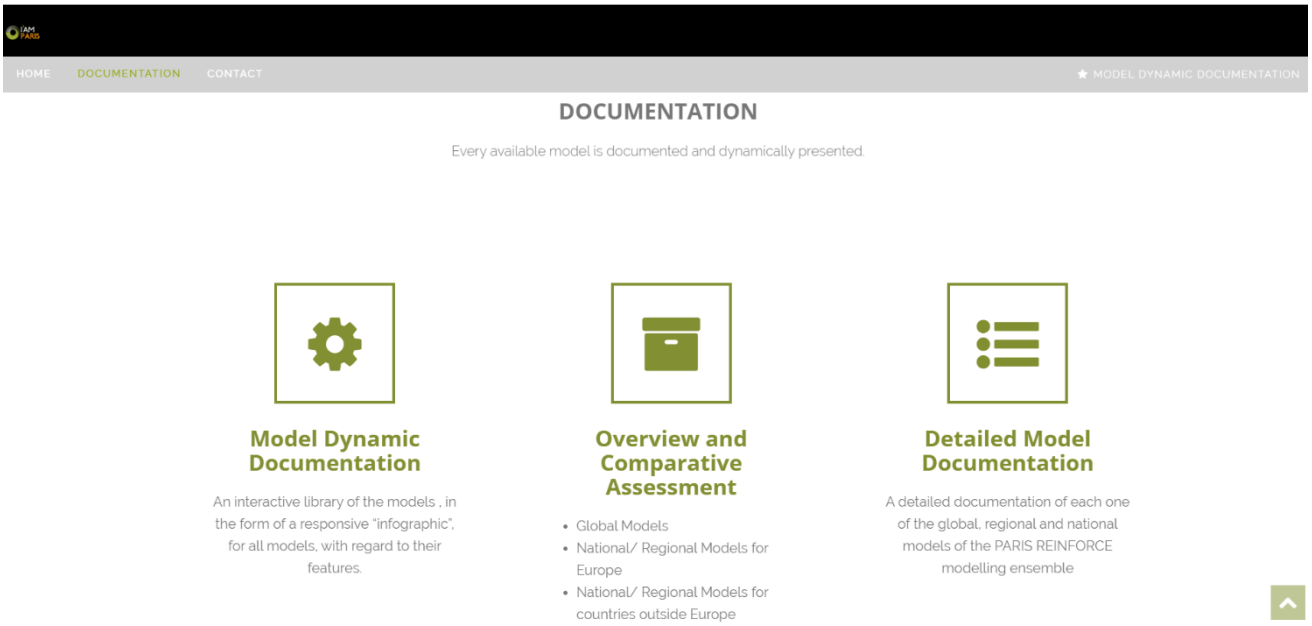

Figure 3: Landing Page- Documentation Section

1.3 Dynamic Model Documentation

The Dynamic Model Documentation is a combination of a backend and a frontend infrastructure and is responsible for presenting the documentation of each model in a user-friendly manner, taking advantage of the information retrieved from the database as well as interactive maps, combined into an elegant user interface.

1.3.1 Backend Services of Dynamic Documentation

1.3.1.1 Django Models

The functionality of the backend services of the Dynamic Model Documentation is based on retrieving and filtering data from the I²AM PARIS database. This database mainly consists of the following entities and its structure is presented in the Entity Relationship (ER) Diagram below:

- Models
- Regions
- Countries
- Sustainable Development Goal (SDG) Categories
- SDG Descriptions
- Mitigation/Adaptation Measure Categories
- Mitigation/Adaptation Measure Subcategories
- Mitigation/Adaptation Measures
- Sector Categories
- Sector Subcategories
- Sectors

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

- Emissions
- Emission- Model States
- Socio-Economics Categories
- Socio-Economics
- Socio-Economics - Model States
- Policy Categories
- Policies
- Policy- Model States

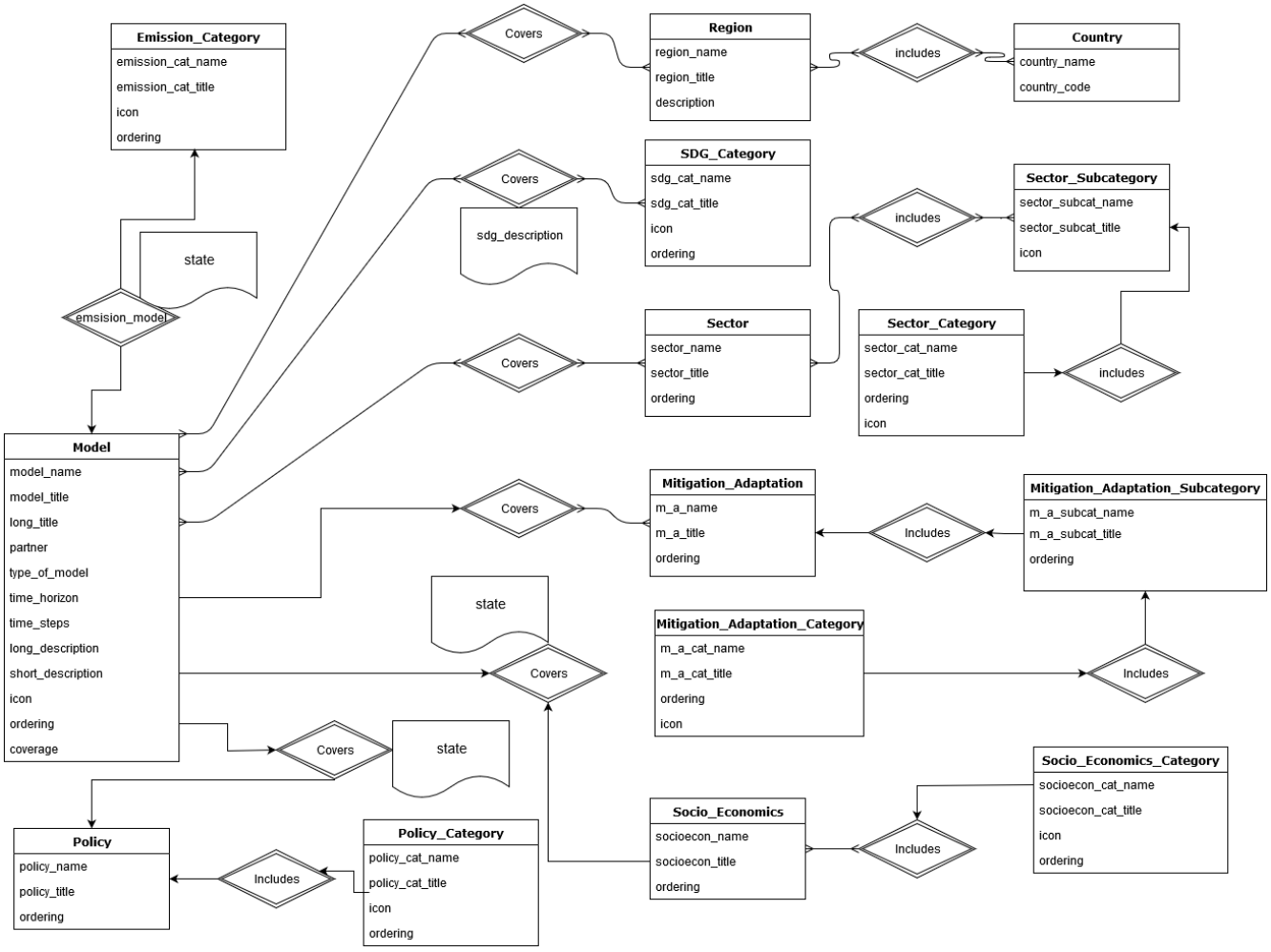

Figure 4: ER Diagram of the I2AM Paris Database

The database has been automatically created utilising Django models and migrations, according to the aforementioned entities. The tables below contain the main information of each Django model:

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

Table 1: Model

Field	Description
model_name	The unique name of each model used inside the code
model_title	The title of each model used on the interfaces
long_title	A more descriptive title of each model
partner	The name of the partner that developed the model
type_of_model	The type of the model according to the domain it focuses on
time_horizon	The time horizon of each model
time_steps	The time step that each model uses to produce results
long_description	An extensive description of the model
short_description	A short description of each model used in popovers, popups etc.
icon	It is the path to an image file (icon) used for each model on the interfaces
ordering	The ordering in the list of models as presented on the interfaces
coverage	A field that describes the geographical coverage of each model and takes one of the following values: a) global b) national_EU (for countries inside Europe) c) national_OEU (for countries outside Europe)

Table 2: Region

Field	Description
region_name	The unique name of each region used inside the code
region_title	The title of each region used on the interfaces
description	A list of the countries included in this specific region
model_name	A many-to-many field used for matching models to regions

Table 3: Country

Field	Description
country_name	The unique name (and title) of each country
country_code	A two-letter abbreviation of each country
region_name	A many-to-many field used for matching countries to regions

Table 4: SDG_Category

Field	Description
sdg_cat_name	The unique name of each SDG category used inside the code
sdg_cat_title	The title of each SDG category used on the interfaces
icon	The path to an image file (icon) used for each SDG category on the interfaces
ordering	The ordering in the list of SDG categories as presented on the interfaces
model_id	A many-to-many field that is used for matching models to SDGs

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

Table 5: SDG_Description

Field	Description
sdg_cat_id	A foreign key to the SDG category entity
model_id	A foreign key to the model entity
sdg_description	The description of the relationship between an SDG and a model
ordering	The ordering in the list of SDGs as presented on the interfaces

Table 6: Sector_Category

Field	Description
sector_cat_name	The unique name of each sector category used inside the code
sector_cat_title	The title of each sector category used on the interfaces
ordering	The ordering in the list of sector categories as presented on the interfaces
icon	The path to an image file (icon) used for each sector category on the interfaces

Table 7: Sector_Subcategory

Field	Description
sector_subcat_name	The unique name of each sector subcategory used inside the code
sector_subcat_title	The title of each sector subcategory used on the interfaces
sector_cat_id	A foreign key to the Sector category each sector subcategory belongs to
ordering	The ordering in the list of sector subcategories as presented on the interfaces

Table 8: Sector

Field	Description
sector_subcat_id	A foreign key to the Sector subcategory each sector belongs to
sector_name	The unique name of each sector used inside the code
sector_title	The title of each sector used on the interfaces
ordering	The ordering in the list of sectors as presented on the interfaces
model_id	A many-to-many field that is used for matching models to sectors

Table 9: Mitigation_Adaptation_Category

Field	Description
m_a_cat_name	The unique name of each mitigation/adaptation category used inside the code
m_a_cat_title	The title of each mitigation/adaptation category used on the interfaces
ordering	The ordering in the list of mitigation/adaptation categories as presented on the interfaces
icon	The path to an image file (icon) used for each mitigation/adaptation category on the interfaces

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

Table 10: Mitigation_Adaptation_Subcategory

Field	Description
m_a_subcat_name	The unique name of each mitigation/adaptation subcategory used inside the code
m_a_subcat_title	The title of each mitigation/adaptation category used on the interfaces
ordering	The ordering in the list of mitigation/adaptation subcategories as presented on the interfaces
m_a_cat_id	A foreign key to the mitigation/adaptation category each mitigation/adaptation subcategory belongs to

Table 11: Mitigation_Adaptation

Field	Description
m_a_name	The unique name of each mitigation/adaptation measure used inside the code
m_a_title	The title of each mitigation/adaptation measure used on the interfaces
ordering	The ordering in the list of mitigation/adaptation measures as presented on the interfaces
m_a_subcat_id	A foreign key to the mitigation/adaptation subcategory each mitigation/adaptation measure belongs to
model_id	A many-to-many field that is used for matching models to mitigation/adaptation measures

Table 12: Emission_Category

Field	Description
emission_cat_name	The unique name of each emission category used inside the code
emission_cat_title	The title of each emission category used on the interfaces
icon	The path to an image file (icon) used for each emission category on the interfaces
ordering	The ordering in the list of emission categories as presented on the interfaces

Table 13: Emission_Model_State

Field	Description
emission_id	A foreign key to the emission entity
model_id	A foreign key to the model entity
state	A field that describes the relationship between a model and a specific emission and takes one of the following values: a) endogenous b) exogenous c) not represented

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

Table 14: Socio_Economics_Category

Field	Description
socioecon_cat_name	The unique name of each socio-economics category used inside the code
socioecon _cat_title	The title of each socio-economics category used on the interfaces
icon	The path to an image file (icon) used for each socio-economics category on the interfaces
ordering	The ordering in the list of socio-economics categories as presented on the interfaces

Table 15: Socio_Economics

Field	Description
socioecon _cat_id	A foreign key to the socio-economics category each socio-economics parameter belongs to
socioecon _name	The unique name of each socio-economics parameter used inside the code
socioecon _title	The title of each socio-economics parameter used on the interfaces
ordering	The ordering in the list of socio-economics parameters as presented on the interfaces
model_id	A many-to-many field that is used for matching models to socio-economics parameters

Table 16: Socio_Economics _Model_State

Field	Description
socioecon_id	A foreign key to the socio-economics entity
model_id	A foreign key to the model entity
state	A field describing the relationship between a model and a specific socio-economics parameter and takes one of the following values: a) endogenous b) exogenous c) not represented

Table 17: Policy_Category

Field	Description
policy_cat_name	The unique name of each policy category used inside the code
policy _cat_title	The title of each policy category used on the interfaces
icon	The path to an image file (icon) used for each policy category on the interfaces
ordering	The ordering in the list of policy categories as presented on the interfaces

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

Table 18: Policy

Field	Description
policy _cat_id	A foreign key to the policy category each socio-economics parameter belongs to
policy _name	The unique name of each policy used inside the code
policy _title	The title of each policy used on the interfaces
ordering	The ordering in the list of policies as presented on the interfaces
model_id	A many-to-many field that is used for matching models to policies

Table 19: Policy_Model_State

Field	Description
policy_id	A foreign key to the policy entity
model_id	A foreign key to the model entity
state	A field that describes the relationship between a model and a specific policy and takes one of the following values: a) feasible b) feasible with modifications c) not feasible

1.3.1.2 Methods and Functionality

The main functionality in the backend services is based on two classes and their constructor methods:

- **RetrieveDB:**

  It creates an object of a specific model, whose name is provided by the user (if not, a default model is selected). The class utilises its methods, requesting data from the database, to determine the geographical coverage of the selected model, in specific, the regions it covers and the countries that belong to every region. A JSON file is then created containing the necessary information for the creation of an interactive map, using the AMCharts Library. The format of this JSON file is described below:

```
[
    {
        "name": the name of the region,
        "colour": the colour of each region,
        "data": [
            {"title": the name of the country,
            "id": the two-letter abbreviation of the country,
            "descr": a short description for each country that is displayed on the map
            }, ...
            ]
    },
... ,
]
```

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

When a model works on national level, the green colour is used on the map for each country. When a model works on a regional level, the colour of each region on the map is determined by the "generate_colour" method, choosing among different colours included in the palette. Last but not least, the "RetrieveGranularities" method is called.

- **RetrieveGranularities:**

  The input of the "RetrieveGranularities" method is the id of the selected model. In turn, this method calls a different method for each granularity describing the selected model, and the retrieved information is returned in the following JSON format:

```
{
        'MitigationAdaptationMeasures': {..} ,
        'Sectors': {..},
        'SDGs': {..},
        'Emissions': {..},
        'Policy': {..},
        'SocioEconomics': {..}
}
```

Mitigation and Adaptation Measures and **Sector** granularities are formatted as shown below:

```
{'category_name':{
        'subcategories':[
                'subcategory_name':{
                        'names': list of names (of Mitigation and Adaptation Measures or Sectors)
                }, ...
        ],
        'icon': a path to an image file (icon) used on the interfaces,
        'is_enabled': True or False,
        'html': the HTML code that will be used in the bootstrap tooltips
        }
}
```

The 'is_enabled' parameter is True if the model covers at least one of the Mitigation and Adaptation Measures or Sectors of a category.

Emissions are formatted as shown below:

```
{'emission_name':
        {'icon': a path to an image file (icon) used on the interfaces,
        'html': the HTML code that will be used in the bootstrap tooltips,
        'is_enabled': True or False
```

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

}, …

}

The 'is_enabled' parameter is True if a gas is calculated Endogenously or used Exogenously.

SDGs are formatted as shown below:

{'**sdg_category**':{

'**name'**: **the name of the SDG**,

'**title'**: **a detailed description of the SDG**,

'**icon'**: **a path to an image file (icon) used on the interfaces**,

'**is_enabled**': **True or False**,

'**html**': **the HTML code that will be used in the bootstrap tooltips**

}

}

The 'is_enabled' parameter is True if an SDG name exists for the selected model.

Socio-economics and **Policy** granularities are formatted as shown below:

{'**category**':{

'**names**': [{"**quantity_name**":"**quantity_state**"}, ….],

'**icon**': **a path to an image file (icon) used on the interfaces**,

'**is_enabled**': **True or False**,

'**html**': **the HTML code that will be used in the bootstrap tooltips**

}

}

For socio-economics, the 'is_enabled' parameter is True if at least one socio-economics quantity in a category is covered Endogenously or Exogenously. For policies, the 'is_enabled' parameter is True if at least one policy in a category is Feasible or Feasible with modifications.

Essentially, the "names" parameter is a list of JSON objects, whose key is a granularity quantity and value a Boolean value that shows if the specific quantity is covered by the model.

1.3.2 Frontend Services of Dynamic Documentation

The Dynamic Documentation utilises "Django HTML Templates", "JQuery" and the "AMCharts4 Library" for its user interfaces. In the context of ***co-creation and collaborative thinking***, ideas were provided by several stakeholders and more than one different interfaces have been created for the Dynamic Documentation, with a view to receiving feedback on each of them and satisfying all the needs of every possible user. Some of them are more detailed and descriptive, others are minimal and compact. At the moment, the user may choose any of the available options through a select/dropdown element positioned at the right top of the "Dynamic Documentation" webpage (Figure 5), in order to allow immediate interface alterations without much effort.

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

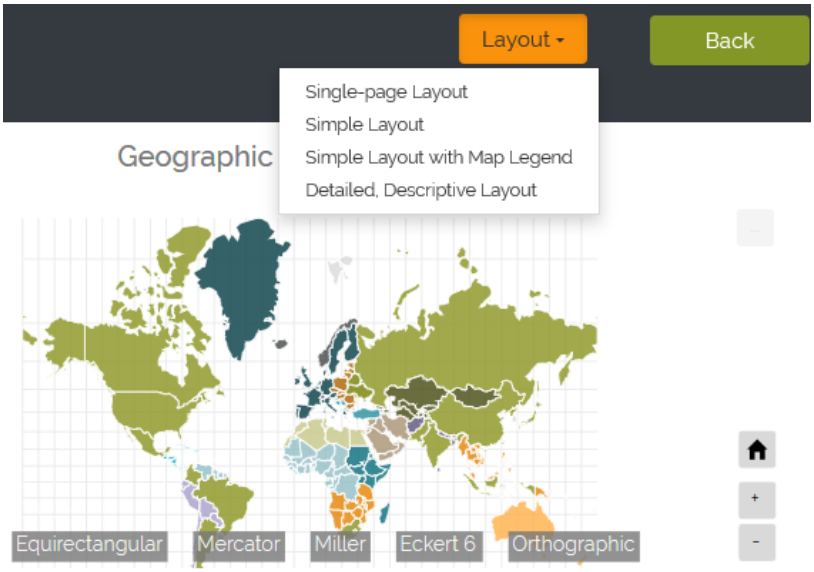

Figure 5: Choosing Different Dynamic Model Documentation Interface

The different interfaces are presented in the screenshots below:

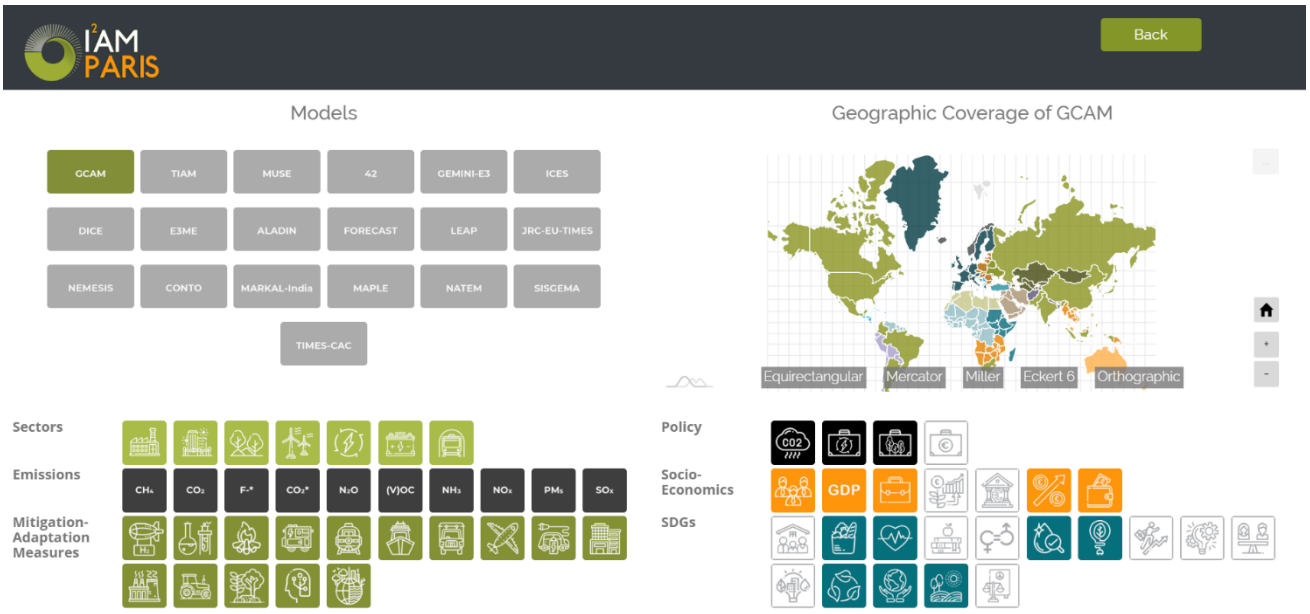

Figure 6: Single-Page layout

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

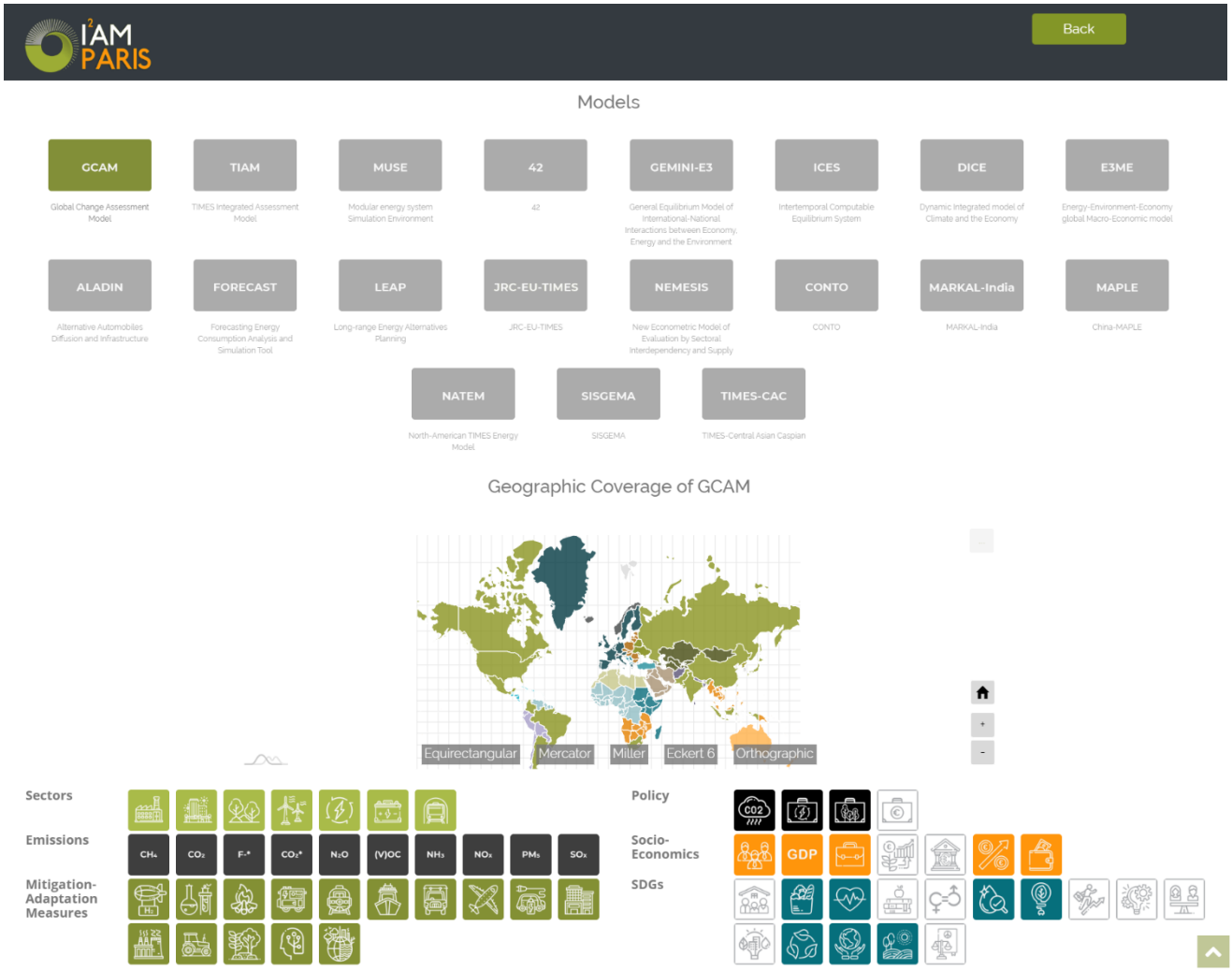

Figure 7: Simple layout

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

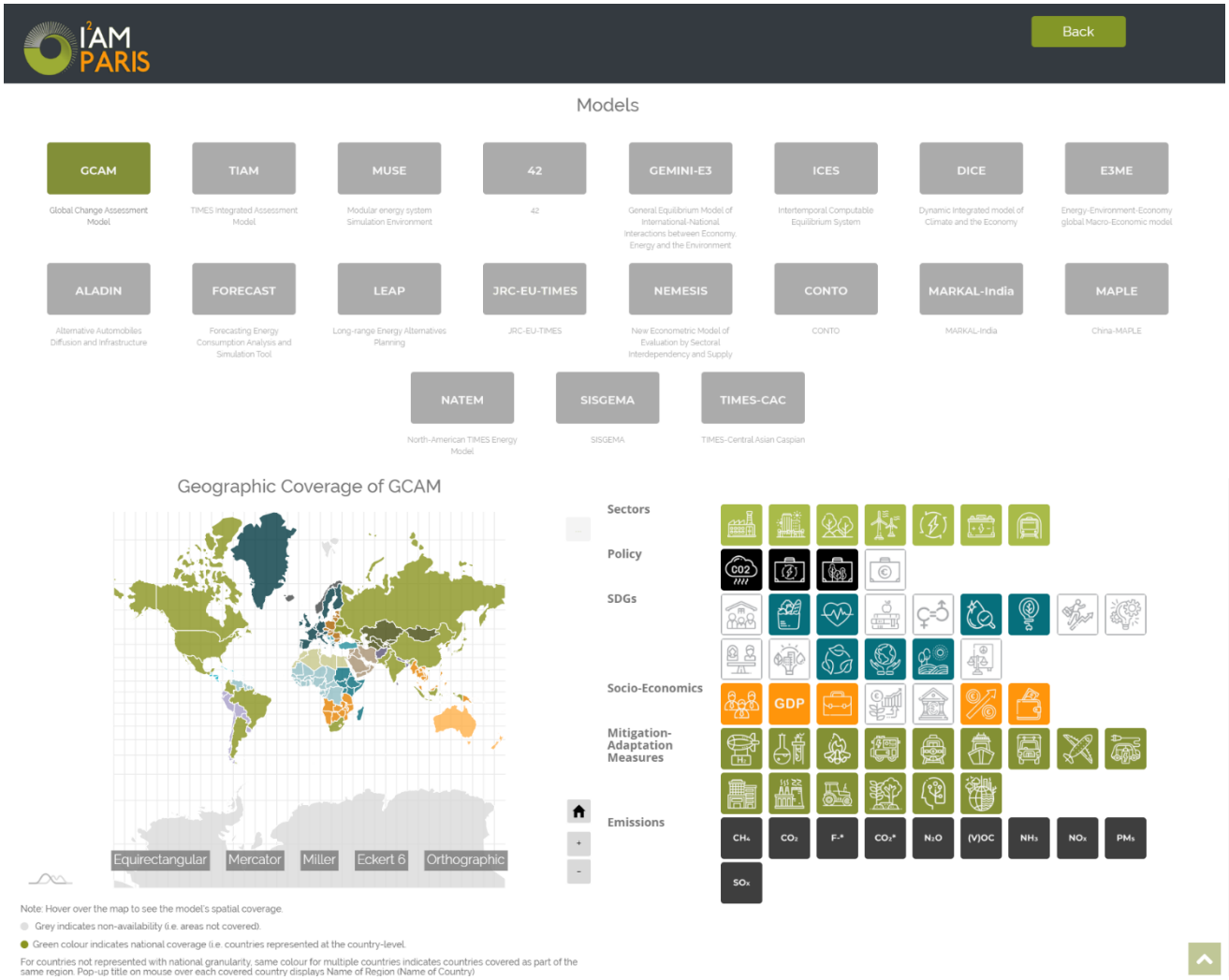

Figure 8: Simple layout with map legend

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

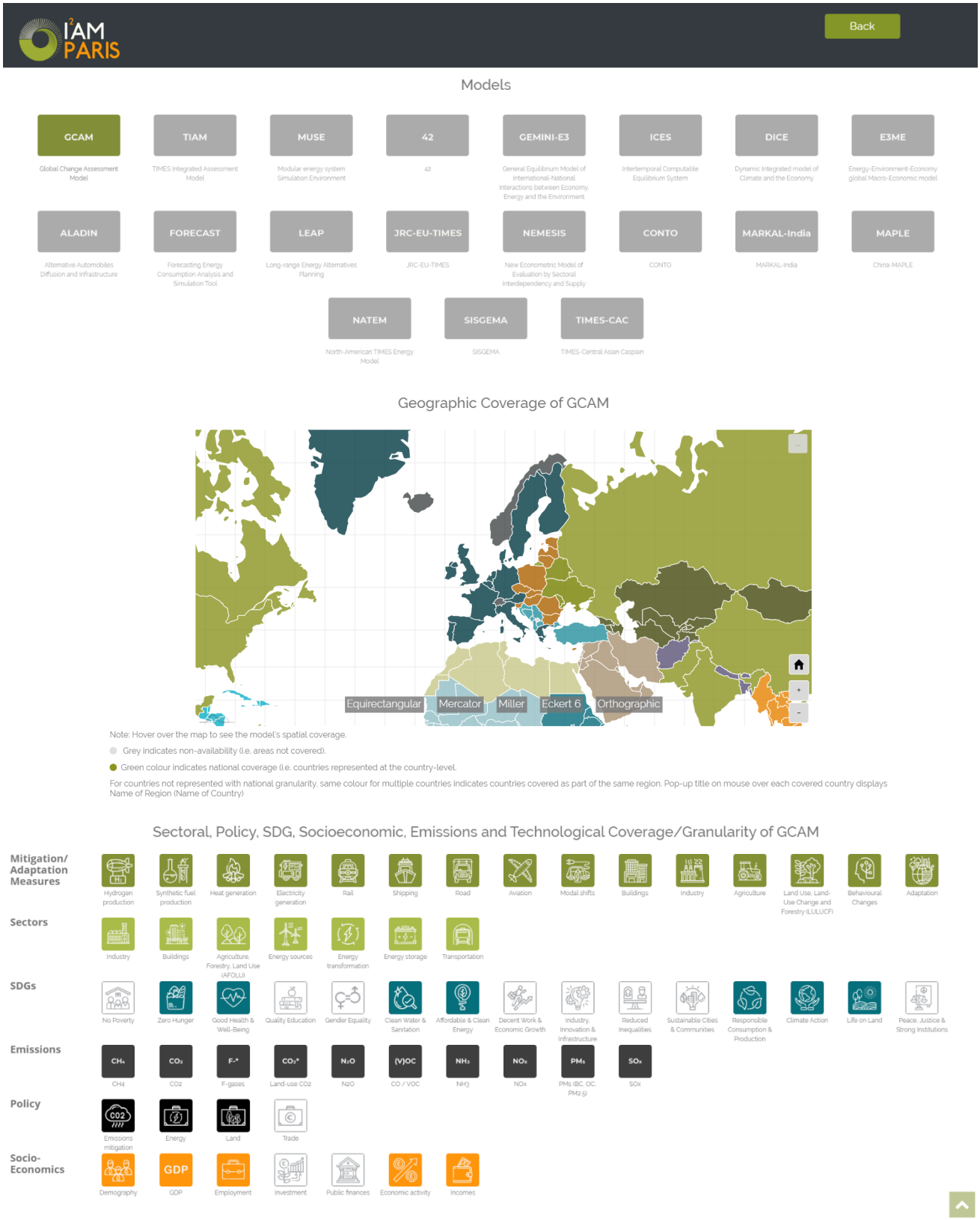

Figure 9: Detailed, descriptive layout

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

In every interface the following rules apply:

- The currently selected model appears in green colour, while the remaining are greyed out.
- In the map: Grey colour indicates areas not covered by the model and (olive) green colour indicates national coverage (i.e. countries represented at the country-level). For countries not represented with national granularity, same colour for multiple countries indicates countries covered as part of the same region. Pop-up title on mouse over each covered country displays the name of the region and the name of the country in the parentheses.
- The coloured icons in the granularity section are the categories (of each type) that are covered by the model (or at least a part of them). The greyed-out icons represent the categories that are not covered at all by the selected model.
- The user may select among different map projections according to their preference using the buttons positioned at the bottom of the map. The available options are: Equirectangular, Mercator, Miller, Eckert 6, Orthographic (Figure 10). Zooming in/out as well as dragging and dropping on the map behave according to the selected projection.

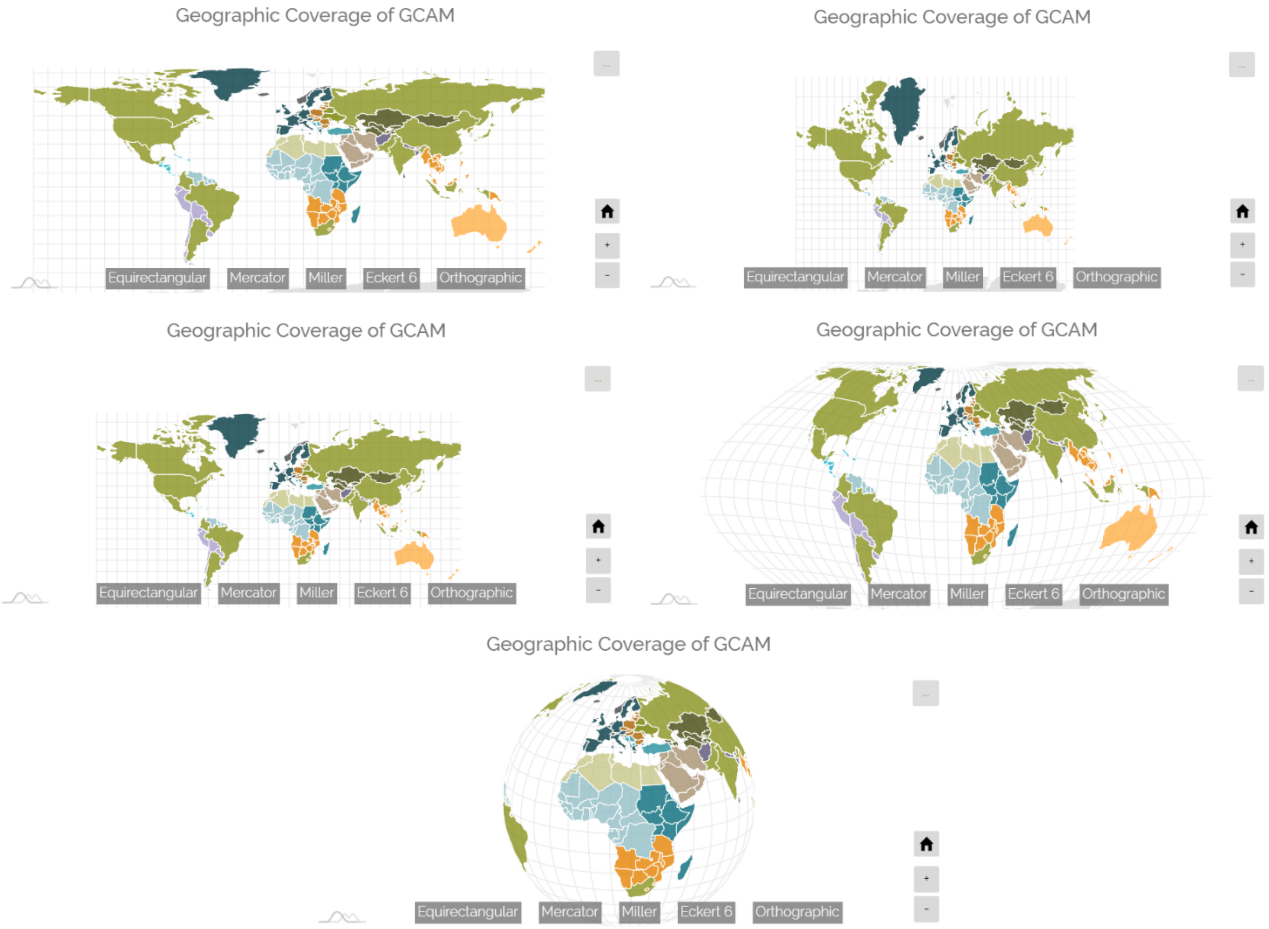

Figure 10: Different Projections (Equirectangular, Mercator, Miller, Eckert 6, Orthographical)

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

- By hovering over the granularity icons, a tooltip appears, showing the subcategories and specific quantities covered by the model in green. The rest are crossed out and shown in grey (Figures 11,12).

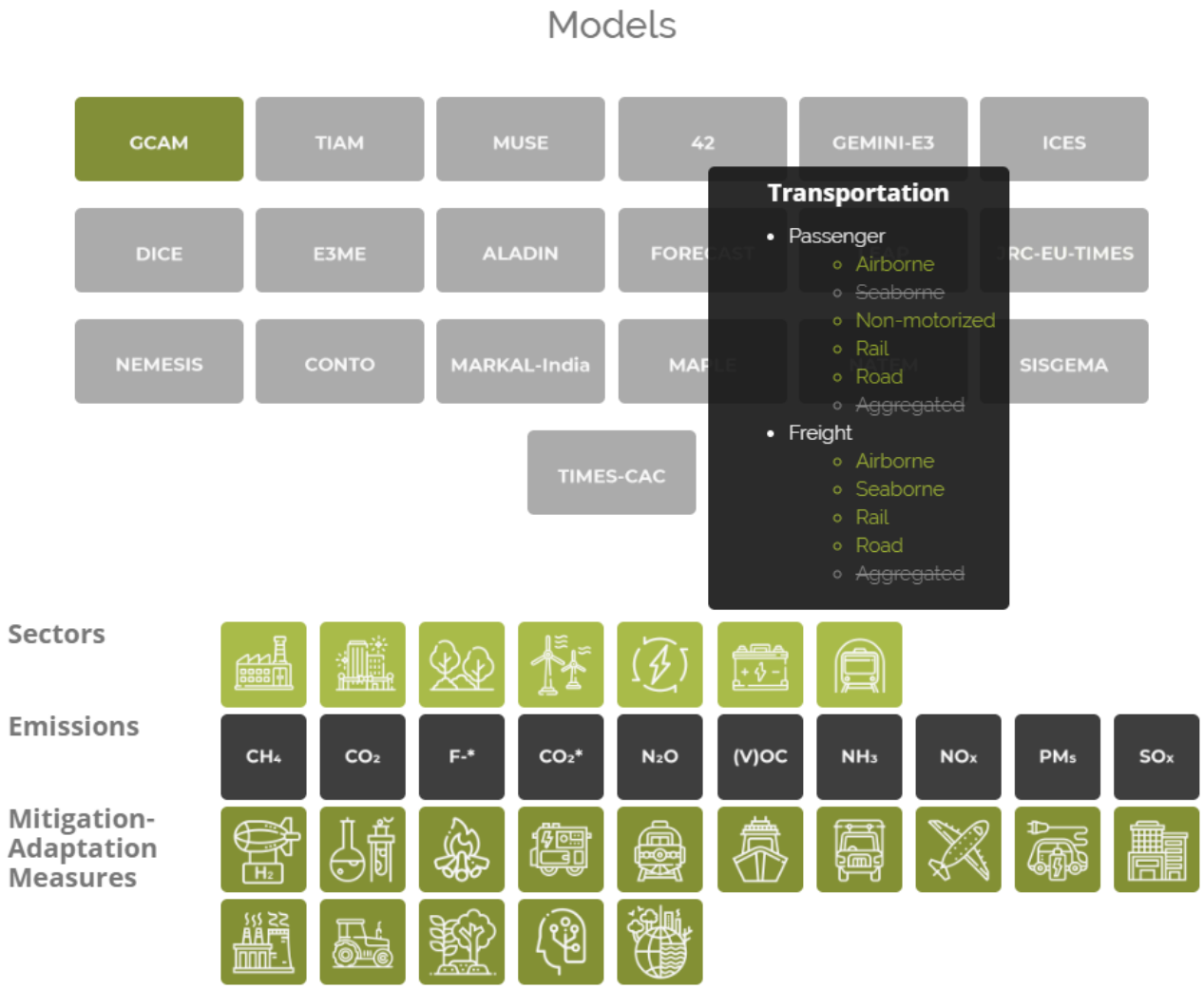

Figure 11: Hovering over the transportation sector

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

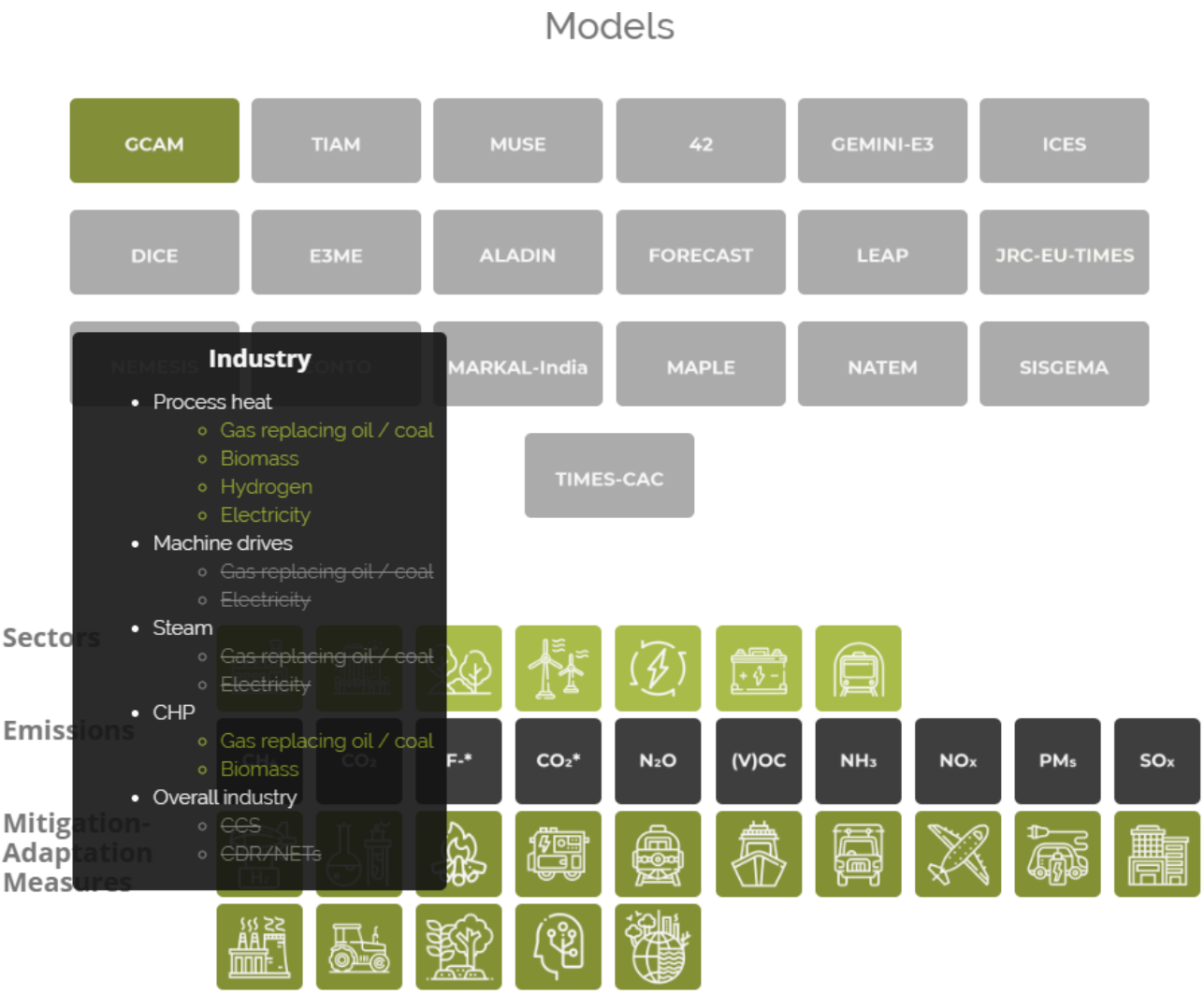

Figure 12: Hovering over the Industry Category of Mitigation and Adaptation Measures

- Hovering over a model button, an "i"-icon appears. Clicking on it, the user is redirected to the corresponding page of the detailed documentation for this specific model (Figure 13).

Figure 13: Information icon on the top-left on hover

1.4 Detailed Model Documentation

The Detailed Model Documentation interface contains detailed information regarding the models included in the I²AM PARIS platform, using a content menu for each model along with a navigation bar in order to seamlessly navigate throughout the entire documentation. The landing page of the Detailed Model Documentation consists of a model catalogue separated by geographical coverage (Global Models, National/ Regional Models for Europe, National/ Regional Models for Countries Outside Europe) as shown in the figure below.

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

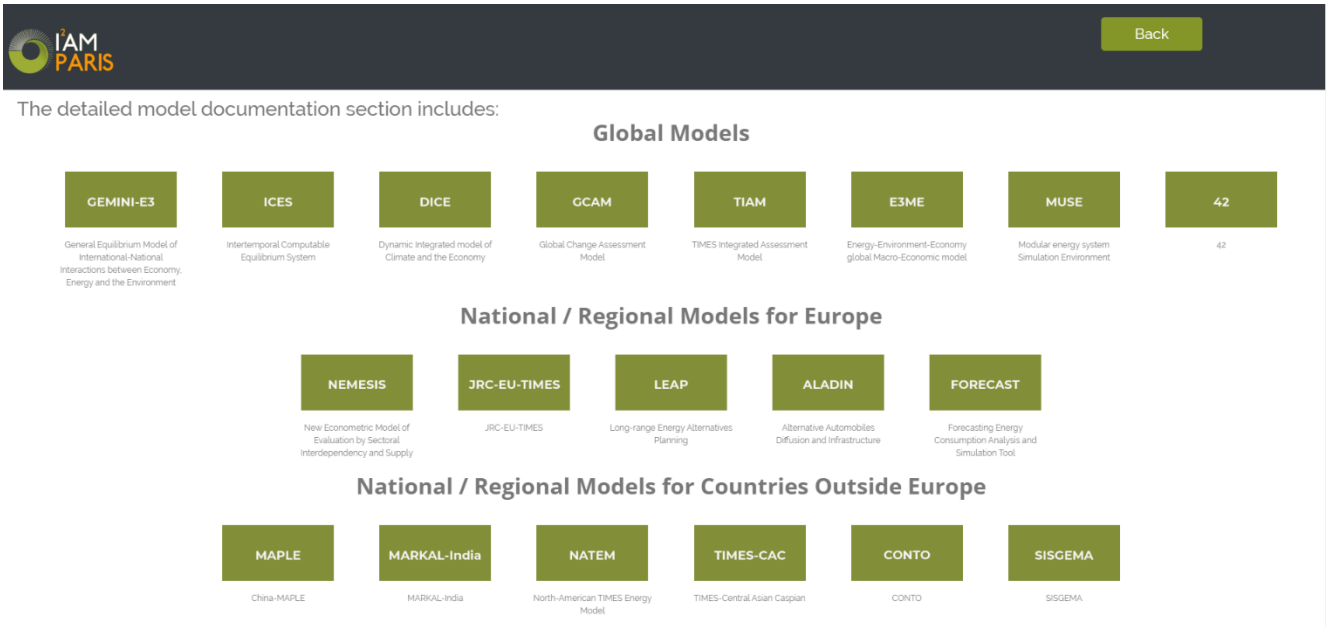

Figure 14: Detailed Documentation Landing Page

Once the user selects the desired model, they are led to the requested page. Each model has its own page, which provides a content menu (by pressing the content button on the top-right of the screen) that can be used to jump to a specific point in the text. Furthermore, a navigation bar is available on the top of each page, providing more flexibility and the ability to switch between models. The screenshots below present the above-mentioned features for the detailed documentation of the GCAM model.

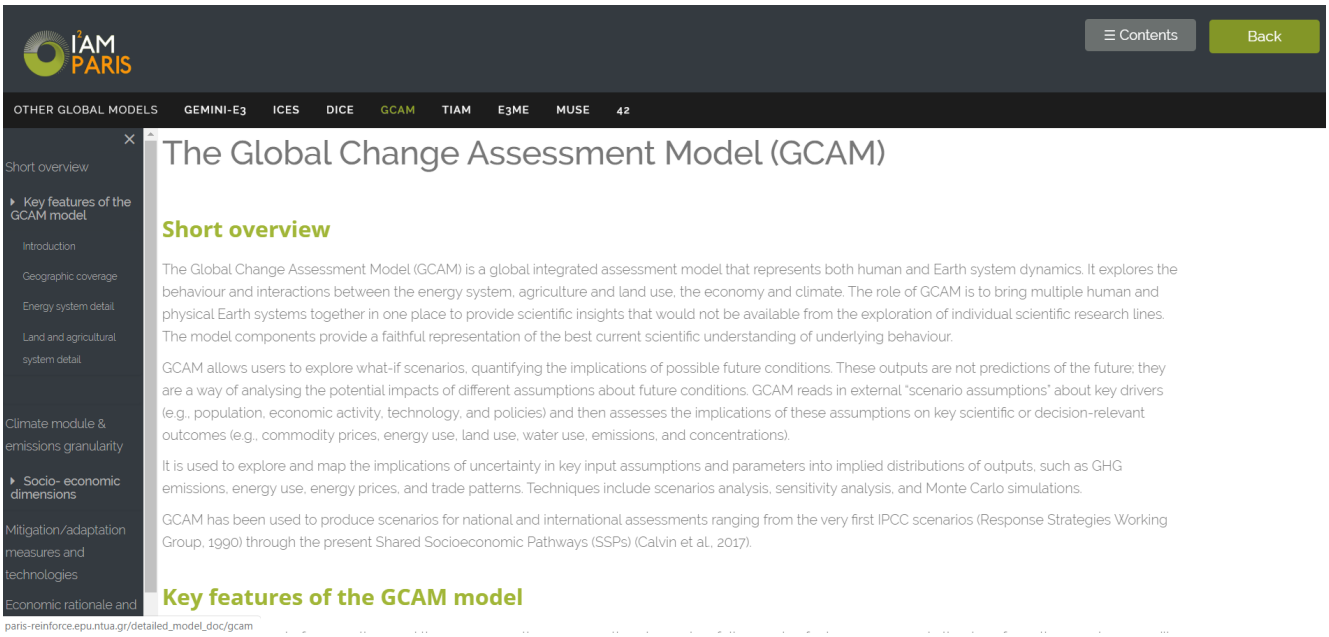

Figure 15: Detailed Documentation of GCAM

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

1.5 Overview and Comparative Assessment

The Overview and Comparative Assessment interface follows the same logic as the Detailed Model Documentation in terms of structure and available features, including the results of the comparison between models of the same coverage in the form of expanding headings. The following screenshots are taken from the global models' overview and comparative assessment.

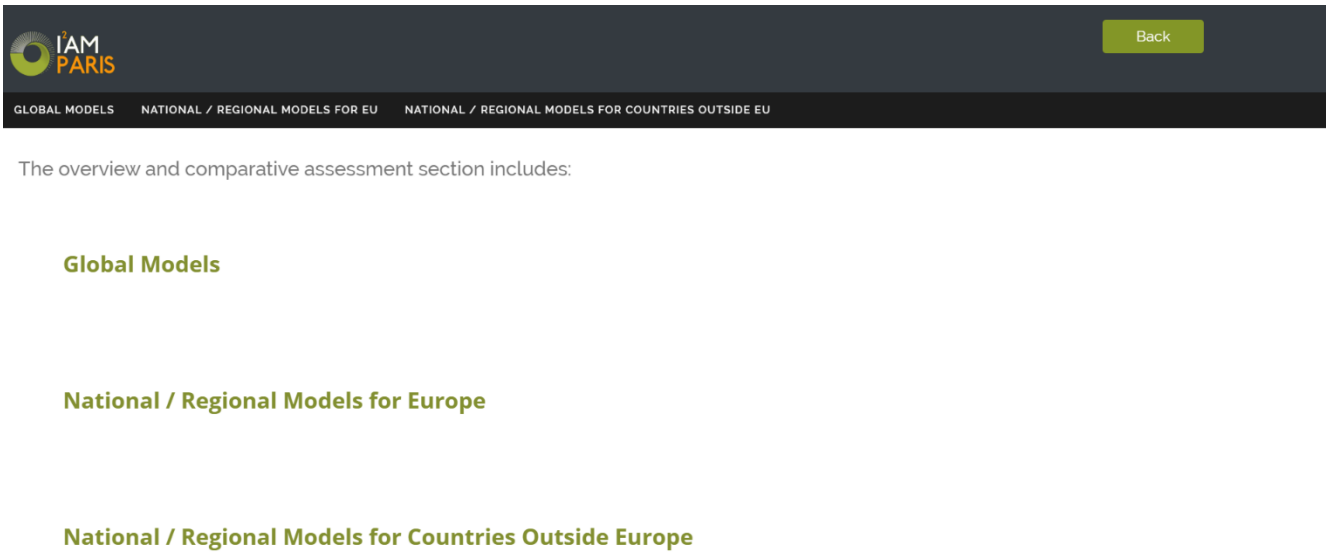

Figure 16: Overview and Comparative Assessment Landing Page

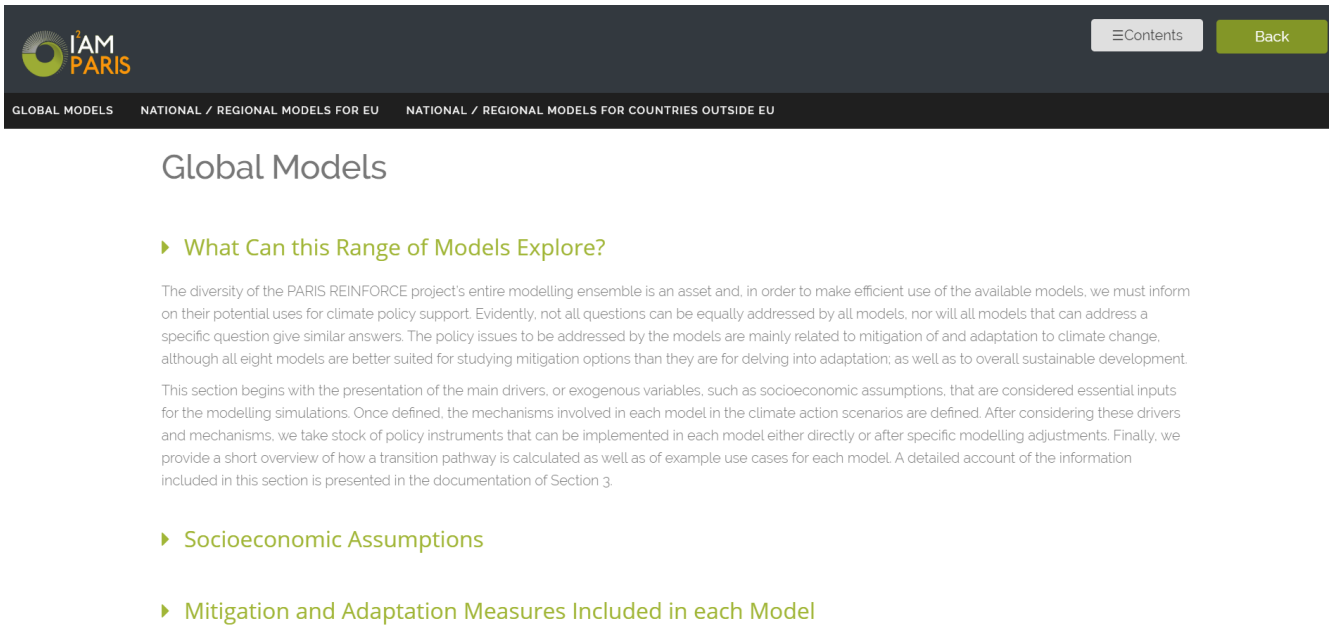

Figure 17: Overview and Comparative Assessment for Global Models

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

1.6 User Feedback Form

The User Feedback Form is placed at the bottom of the landing page of the I²AM PARIS platform (Figure 18) and aims at facilitating the feedback collection, in order to improve platform functionality, fix bugs and handle/respond to requests for new services. Once the form is filled in and submitted, its content is sent to the developers using Python's mail sending interface and Django's wrappers over it, specifying the SMTP host and port in the project settings. The Feedback form utilises Google's reCAPTCHA to protect the website against bots and spam.

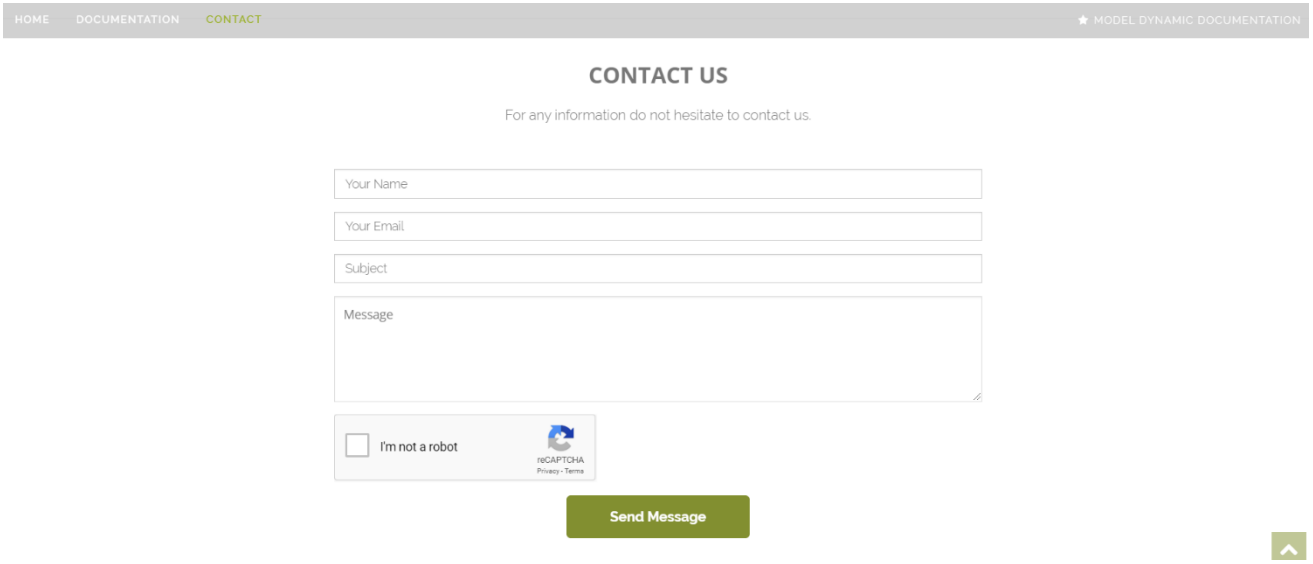

Figure 18: User Feedback Form

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

2 Visualisation Engine

One important service of the I²AM PARIS platform is the generation of different visualisations, based on the available data derived from the model analyses. The visualisations are generated from a standalone component called *Visualisation Engine* and will be viewed at multiple static and interactive interfaces within the platform, which will be developed in the near future, to be reported in the first update of the platform documentation, in May 2021. The visualisations are divided into two groups:

- Chart visualisations: several types of line charts and column charts, pie charts, radar charts, 2d histograms, Sankey diagrams, chord diagrams, Gantt charts, parallel coordinates charts.
- Map visualisations.

2.1 Visualisation Backend Services

Two software libraries are used at the moment, namely AmCharts 4 and D3-charts. Depending on the requirements for new types of visualisations, more libraries will be used.
Instead of implementing different classes for every visualisation, we have opted for creating super-classes for visualisations with common attributes. These classes encompass all arguments and parameters necessary for this particular type of visualisation. The classes are described below, in Table 20-23.

Table 20: XY_chart Class

Field	Description	Type
x_axis_name	The unique name of the selected variable of the X-Axis as used in the code	String
x_axis_title	The title of the selected variable of the X-Axis as displayed in the user interfaces	String
x_axis_unit	The unit of the selected variable of the X-Axis	String
y_var_names	A list of names of the selected variables presented on the Y-Axis as used in the code. In several visualisations that do not support multiple series on the Y-Axis this list contains only one element.	List of Strings
y_var_titles	A list of titles of the selected variables presented on the Y-Axis as displayed in the user interfaces. The order of the elements in the list as well as its length should correspond to the "y_var_names" list.	List of Strings
y_var_units	A list of units of the selected variables presented on the Y-Axis as displayed in the user interfaces. The order of the elements in the list as well as its length should correspond to the "y_var_names" list. This makes sense in multi-axial charts, where different types of variables are presented on different Y-Axes.	List of Strings
chart_data	A JSON object in the appropriate format (depending on the visualisation) that contains the data to be displayed.	JSON Object
chart_type	The type of chart that will be created. It could be one of the following: • line_chart • column_chart • range_chart • bar_range_chart • stacked_column_chart	String

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

	• column_heatmap_chart • pie_chart • radar_chart	
x_axis_type	The type of the X-Axis, as several visualisations support more than one type. Options: "Time", "Text", "Number". The first option is used when the X-Axis includes dates or time. The second option is used when distinct categories are displayed on the X-Axis. The third option is used for continuous values.	String
use_default_colors	If "true", the default colours are used for the chosen visualisation	Boolean
color_list	• A list of colours used for each series of the chosen visualisation in case use_default_colors = "false". Options include "light_blue, blue, violet, purple, fuchsia, red, ceramic, light_brown, mustard, gold, light_green, green, cyan, black, gray, white" • A list of two colours that are used for minimum and maximum values in heatmap charts (i.e. bar_heatmap_chart; if one colour is given in a bar heatmap, then the white colour is selected by default as the other colour) and for creating the gradient legend.	List of Strings
chart_3d	If "true", the chart is displayed in three dimensions. (not all visualisations support 3D)	Boolean
min_max_y_value	A two-element list that contains the minimum and maximum value of the variable presented on the Y-Axis.	List of Numbers

Table 21: XYZ_chart Class

Field	Description	Type
x_axis_name	The unique name of the selected variable of the X-Axis as used in the code	String
x_axis_title	The title of the selected variable of the X-Axis as displayed in the user interfaces	String
x_axis_unit	The unit of the selected variable of the X-Axis	String
y_var_name	The name of the selected variable presented on the Y-Axis as used in the code.	String
y_var_title	The title of the selected variable presented on the Y-Axis as displayed in the user interfaces.	String
y_var_unit	The unit of the selected variable presented on the Y-Axis as displayed in the user interfaces.	String
z_axis_name	The unique name of the selected variable of the Z-Axis as used in the code	String
z_axis_title	The title of the selected variable of the Z-Axis as displayed in the user interfaces	String
z_axis_unit	The unit of the selected variable of the Z-Axis	String
chart_data	A JSON object in the appropriate format (depending on the visualisation) that contains the data to be displayed.	JSON Object

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

chart_type	The type of chart that will be created. it could be one of the following: • heat_map_chart	String
use_default_colors	If "true", the default colours are used for the chosen visualisation	Boolean
color_list	• A list of colours used for each series of the chosen visualisation in case use_default_colors = "false". Options include "light_blue, blue, violet, purple, fuchsia, red, ceramic, light_brown, mustard, gold, light_green, green, cyan, black, gray, white" • A list of two colours that are used for minimum and maximum values in heatmap charts (i.e. heat_map_chart; if one colour is given in a bar heatmap, then the white colour is selected by default as the other colour) and for creating the gradient legend.	List of Strings
min_max_z_value	A two-element list that contains the minimum and maximum value of the variable presented on the Z-Axis.	List of Numbers

Table 22: FlowChart Class

Field	Description	Type
chart_data	A JSON object in the appropriate format (depending on the visualisation) that contains the data to be displayed.	JSON Object
chart_type	The type of chart that will be created. It could be one of the following: • sankey_diagram • chord_diagram	String
use_default_colors	If "true", the default colours are used for the chosen visualisation	Boolean
color_node_list	• A list of colours used for each node in the chosen visualisation in case use_default_colors = "false". Options include "light_blue, blue, violet, purple, fuchsia, red, ceramic, light_brown, mustard, gold, light_green, green, cyan, black, gray, white"	List of Strings
node_list	A list of names/titles of the existing nodes in the charts.	List of Strings
chart_title	The title used for the whole chart that is displayed.	String

Table 23: MapChart Class

Field	Description	Type
map_data	A JSON object in the appropriate format (depending on the visualisation) that contains the data to be displayed on the map.	JSON Object
map_var_name	The name of the selected variable presented on the map as used in the code.	String
map_var_title	The title of the selected variable presented on the map as displayed in the user interfaces.	String
map_var_unit	The unit of the selected variable presented on the map as displayed in the user interfaces.	String

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

min_max_value	A two-element list that contains the minimum and maximum value of the variable presented on the map.	List of Numbers
chart_type	The type of chart that will be created. it could be one of the following: • heatmap_on_map	String
color_list	• A list of colours used for different elements on the map (future implementation). Options include "light_blue, blue, violet, purple, fuchsia, red, ceramic, light_brown, mustard, gold, light_green, green, cyan, black, gray, white" • A list of two colours that are used for minimum and maximum values in heatmap charts (i.e. heat_map_on_map) and for creating the gradient legend.	List of Strings
Projection	The type of projection that will be used for the map. Options include "eckert6, equirectangular, naturalearth, miller, orthographic, mercator"	List of Strings
chart_title	The title used for the whole chart that is displayed.	String

The visualisation generation service is triggered by an HTTP request (either POST or GET) that contains information like the type of visualisation that must be created, all parameters necessary for the configuration of the visualisation (which can vary in number, and depends on the type of each visualisation) and information about the data that will be used, either from a dataset stored in the database or from an external file.

- In the first case, the data are retrieved from the database by executing the corresponding query using the parameters provided in the request.
- In the second case, the data are acquired from a CSV file of a predefined format that will be commonly agreed among the related consortium partners.

In any case, the data are loaded and processed properly, in order to be in the form required by each visualisation type. The processing that is going to take place is not yet completely defined, as it will be based on the format in which the data will be provided, the data volume, the user requirements and the choices that will be made regarding the interaction with the interfaces. In some cases, the data require even more processing before being considered ready for visual representation. Some visualisations may require aggregation functions to be applied on the data, while other need to sort the data according to a field (i.e. time). These actions differ between visualisations and will be described in detail in the next version of the deliverable (D2.5) as they have not been decided yet.; at the moment, the modelling runs have not begun, so no actual data have been provided from the analyses yet.

The final data are sent to the respective libraries that create and render the visualisation, which is finally returned as a response to the initial request.

The different visualisation types currently implemented on the platform (to be finalised as the Data Manager is developed) are described below:

- ***Line chart***, with multiple variables displayed at the same visualisation. The X-Axis and Y-Axis variables along with their type, titles and units as well as the dataset or the file name are obtained from the parameters of the request.
- ***Range line chart***, with multiple variables displayed at the same visualisation. Follows the same logic as the simple line chart but also displays the minimum and maximum values of the examined variables.

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

- ***Column chart***, again with multiple variables displayed side-by-side, in columns. Follows the same logic as the line chart.
- ***Column heatmap chart***, which examines the value of one variable and displays it in columns of different colour depending on its value (according to a heatmap legend).
- ***Bar range chart***, mainly (but not exclusively) used as a Gantt chart, that is a variation of a column chart with (usually) time-based horizontal axis and bars starting at arbitrary values rather than on the axis. This can be used, inter alia, to capture the exact timeline of the PARIS REINFORCE modelling runs; or, for future assessment cycles.
- ***Pie chart***. The examined variable and the key variable for slicing the pie are obtained from the parameters of the request.
- ***Radar chart***, which is used to display directional or circular visual representation of a 2-dimensional data.
- ***2D-Histogram*** (heatmap chart) of one variable that shows the intensity of a variable in function of two other variables acquired from the request parameters.
- ***Chord diagram***, which is used to indicate one-level quantitative relations between multiple items, organised in a circular diagram.
- ***Sankey diagram***, which can be used to depict branched, multi-level flows of values.
- ***Parallel coordinates chart***, for plotting multivariate, numerical data. This chart is ideal for comparing many variables together and seeing the relationships between them.
- ***Heatmap (on map)*** that shows the intensity of a variable or the frequency of events on a map. The examined variable is retrieved from the request.

In most of the aforementioned visualisation alternatives, the option of choosing specific colours for the diagrams is also provided, while some can also be displayed in three dimensions. These two functionalities (colouring and 3D display) are also configured by passing the necessary parameters in the requests.

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

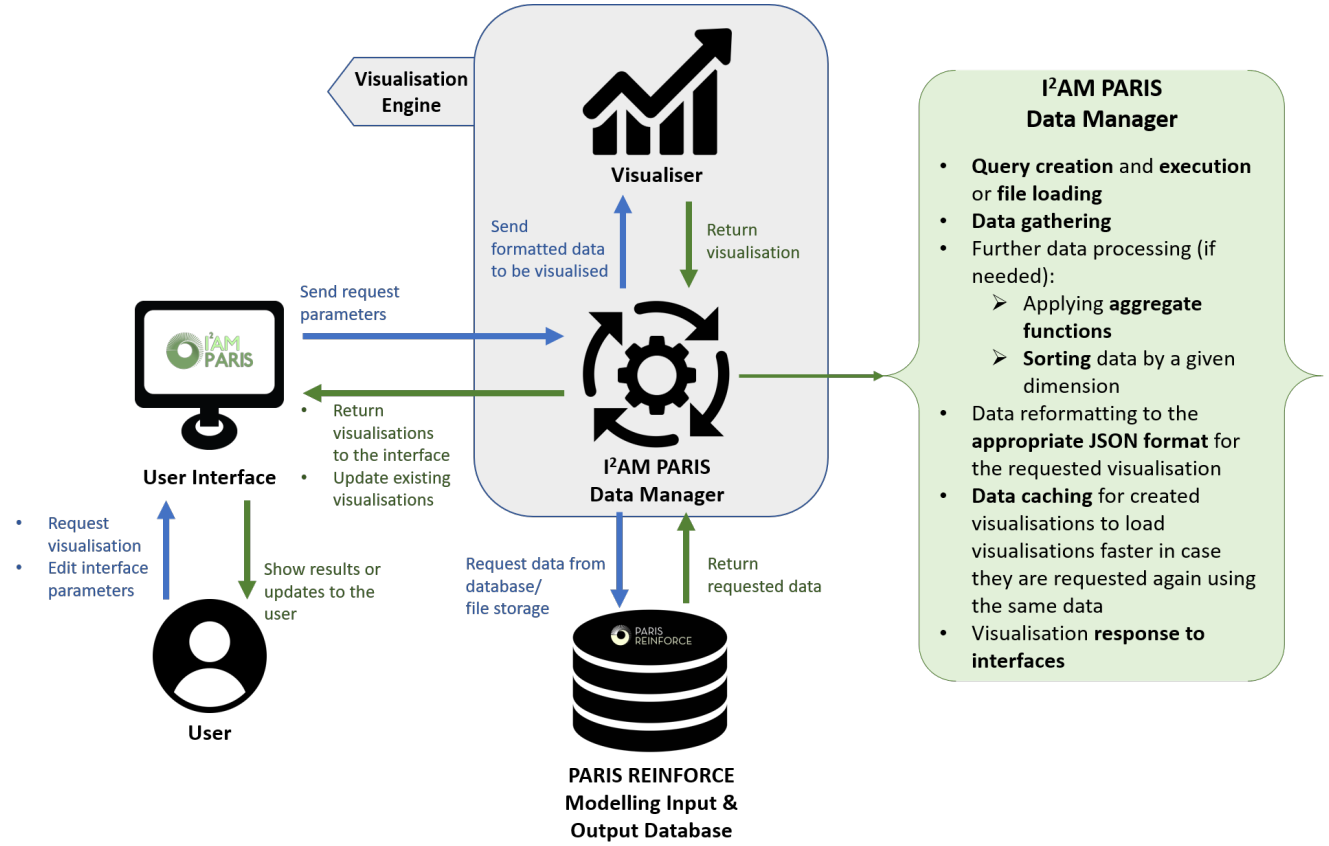

Figure 19: Visualisation Engine Design

2.2 Visualiser API and Request Examples

The Visualiser API receives both GET and POST requests in a specific format (passing the necessary parameters according to the Class the requested visualisation belongs to; see section 1.6.1) and returns an HTML page that contains the requested visualisation. For example, the following requests creates and returns a line chart:

GET Request:

http:// http://paris-reinforce.epu.ntua.gr/ visualiser/ show_line_chart? y_var_names[]=myVariable1 & y_var_names[]=myVariable2 & y_var_titles[]=Variable1 & y_var_titles[]=Variable2 & y_var_units[]=v1_unit & y_var_units[]=v2_unit & x_axis_type=time & x_axis_name=time & x_axis_title=Time & x_axis_unit=-& y_axis_title=YAxisVariable & color_list_request[]=blue & color_list_request[]=red & use_default_colors=false & min_max_y_value[]=0 & min_max_y_value[]=2000

POST Request:

http://localhost:8000/visualiser/show_line_chart

Body: {

"**y_var_names**": **["myVariable1", "myVariable2"]**,

"**y_var_titles**": **["Variable1", "Variable2"]**,

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

```
"y_var_units": ["v1_unit", "v2_unit"],
"x_axis_type": "time",
"x_axis_name": "time",
"x_axis_title": "Time",
"x_axis_unit": "-",
"y_axis_title": "YAxisVariable",
"color_list_request": ["blue", "red"],
"use_default_colors": "false",
"min_max_y_value": [0, 2000],
"dataset": "my_dataset"
}
```


There are three points regarding both types of requests that should be clarified:

- The names of the variables must be the same with those used in the JSON object that contains the data to be visualised as shown below.
- The values of specific parameters should follow the available options provided by the four main visualisation classes**: XY_Chart, XYZ_Chart, FlowChart, MapChart**.
- The "dataset" is used for defining the dataset (either table from a database, or file) that is going to be used as data source for the requested visualisation. Currently, the data used for demonstrating each visualisation are synthesised.

The data used by the visualiser for this specific example are in the following format:


```
[{"time": 1577743200000, "myVariable1": 269.5},
 {"time": 1577829600000, "myVariable1": 129.25},
  .....
{"time": 1577743200000, "myVariable2": 163.2},
 {"time": 1577829600000, "myVariable2": 222.15}]
```


The list of available visualiser URLs is presented below (examples):

- paris-reinforce.epu.ntua.gr/visualiser/show_line_chart
- paris-reinforce.epu.ntua.gr/visualiser/show_column_chart
- paris-reinforce.epu.ntua.gr/visualiser/show_pie_chart
- paris-reinforce.epu.ntua.gr/visualiser/show_radar_chart
- paris-reinforce.epu.ntua.gr/visualiser/show_range_chart
- paris-reinforce.epu.ntua.gr/visualiser/show_bar_range_chart
- paris-reinforce.epu.ntua.gr/visualiser/show_stacked_column_chart

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

- paris-reinforce.epu.ntua.gr/visualiser/show_heat_map_chart
- paris-reinforce.epu.ntua.gr/visualiser/show_bar_heat_map_chart
- paris-reinforce.epu.ntua.gr/visualiser/show_sankey_diagram
- paris-reinforce.epu.ntua.gr/visualiser/show_chord_diagram
- paris-reinforce.epu.ntua.gr/visualiser/show_heat_map
- paris-reinforce.epu.ntua.gr/visualiser/parallel_coordinates_chart

2.3 Visualisation Frontend Services

The Visualisation Engine utilises AmChart4 and D3 Charts, as mentioned above, in order to produce the requested visualisations. The screenshots below show the visualisations that are currently available using the visualiser, presenting synthesised data for the sake of demonstration.

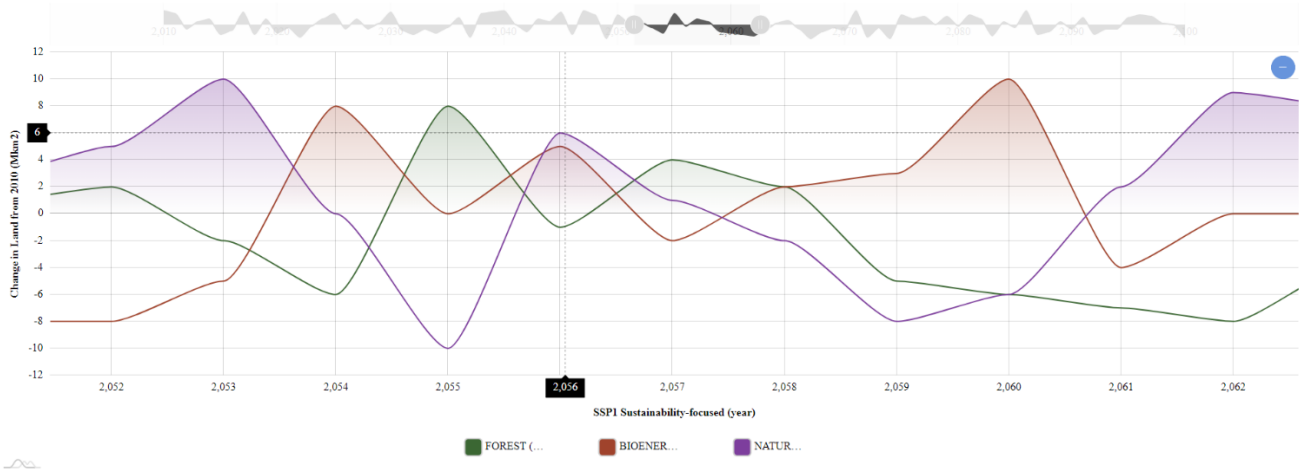

Figure 20: Line Chart

A Line chart displays series of data points connected by straight line segments. Line graphs are often used to display time series chronologically with the x-axis serving as an evenly spaced date-time scale (Figure 20).

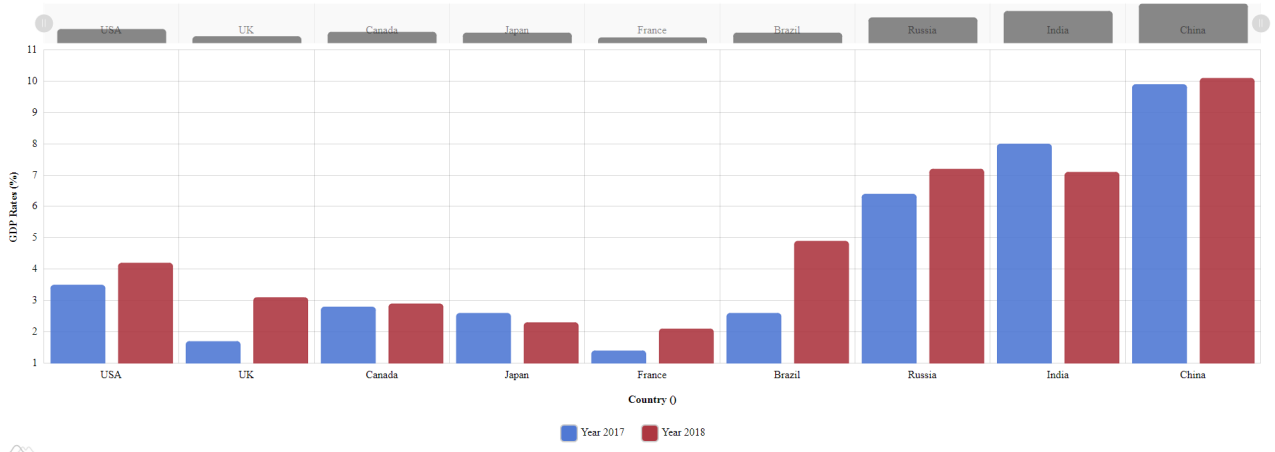

Figure 21: Column Chart

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

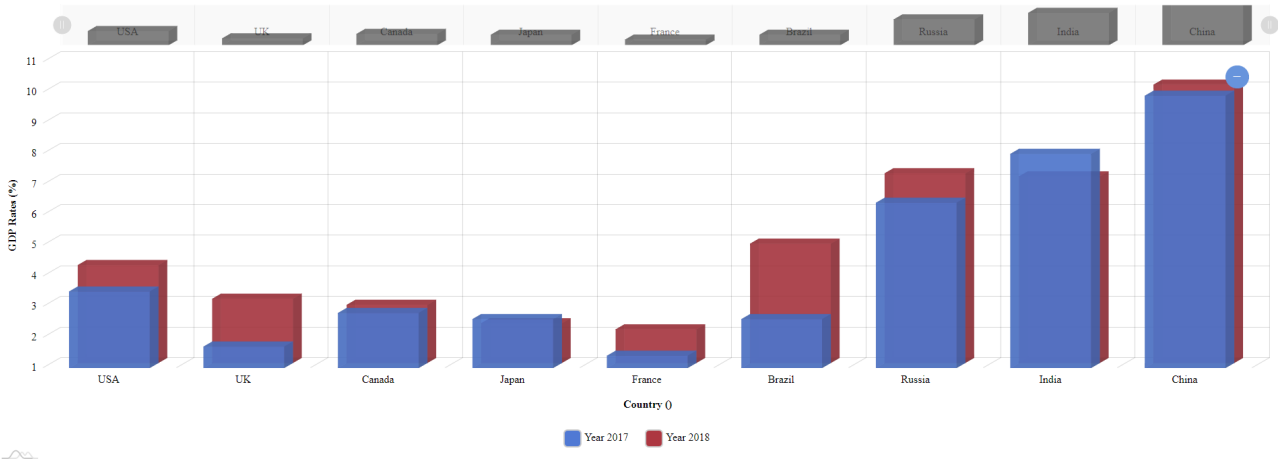

Figure 22: Column Chart 3D

A Column Chart (Figure 21) is one of the most common and, arguably, easiest charts to read when it comes to visualising category-based values. Rectangular bars are placed along the category axis with the bar length representing the value for a specific category. The visualisation engine can also produce three-dimensional column charts (Figure 22).

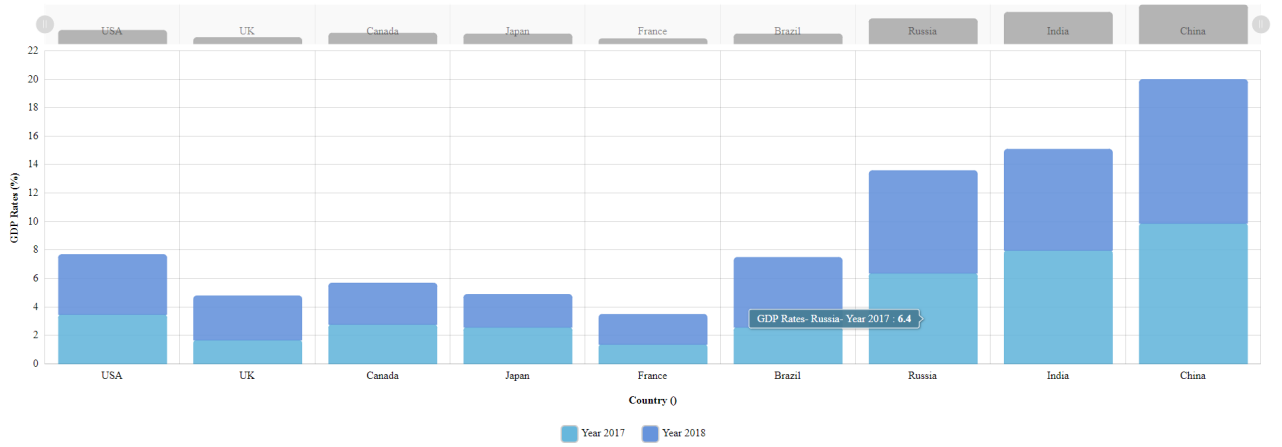

Figure 23: Stacked Column Chart

Stacked Bar Charts (Figure 23) are useful to demonstrate how a larger data category is comprised of smaller categories, and what part each of the smaller categories plays in the total of a larger one.

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

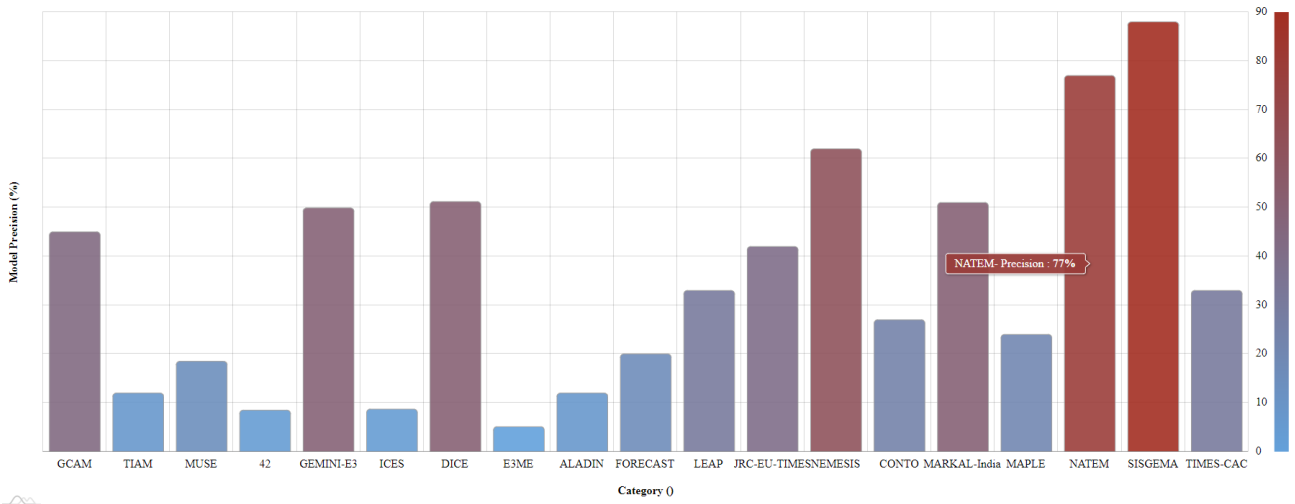

Figure 24: Heatmap Bar Chart

A Heatmap Bar Chart (Figure 24) is used the same way as a simple column chart, but each bar is coloured according to a heatmap legend, showing the value for specific categories using the proper colour (thereby adding an additional data dimension).

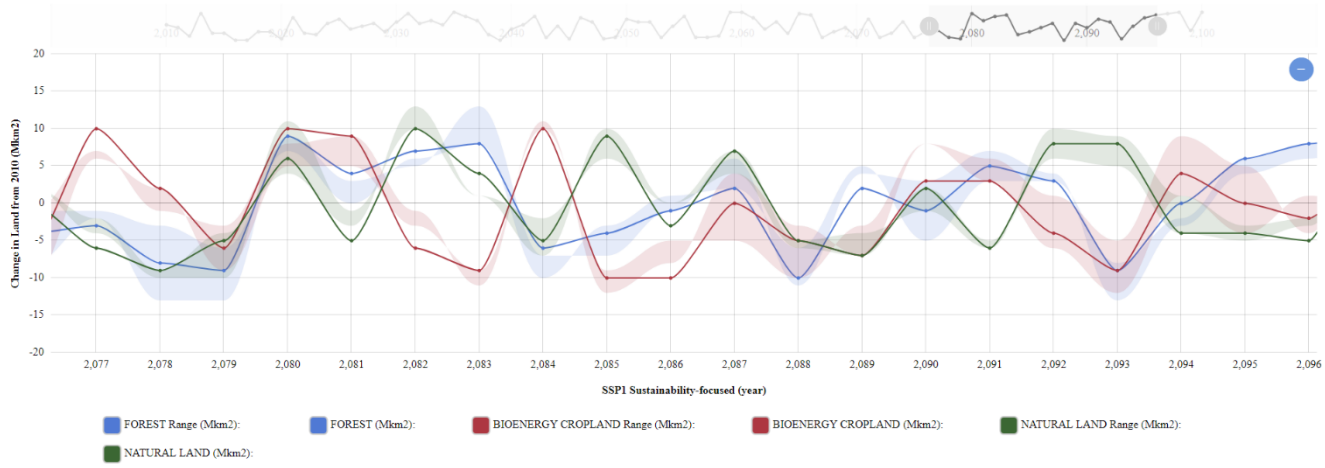

Figure 25: Range Chart

A Range Chart (Figure 25) is a type of area chart where, rather than starting on the axis, the area is represented by the space between two values. These charts are useful for displaying ranges of values, such as between minimum and maximum values over a timespan, or projected values for the future when the projection is represented by a range instead of a specific value.

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

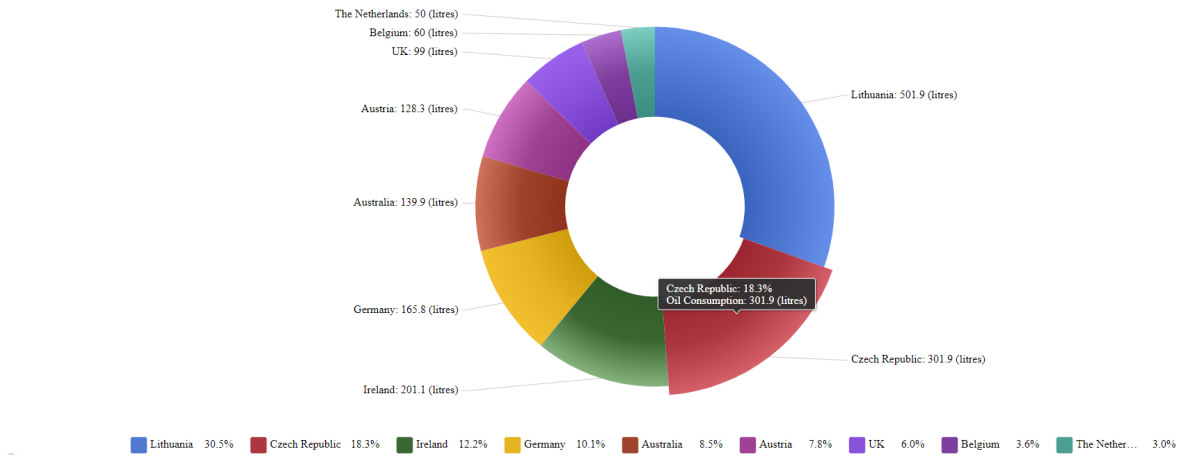

Figure 26: Pie Chart

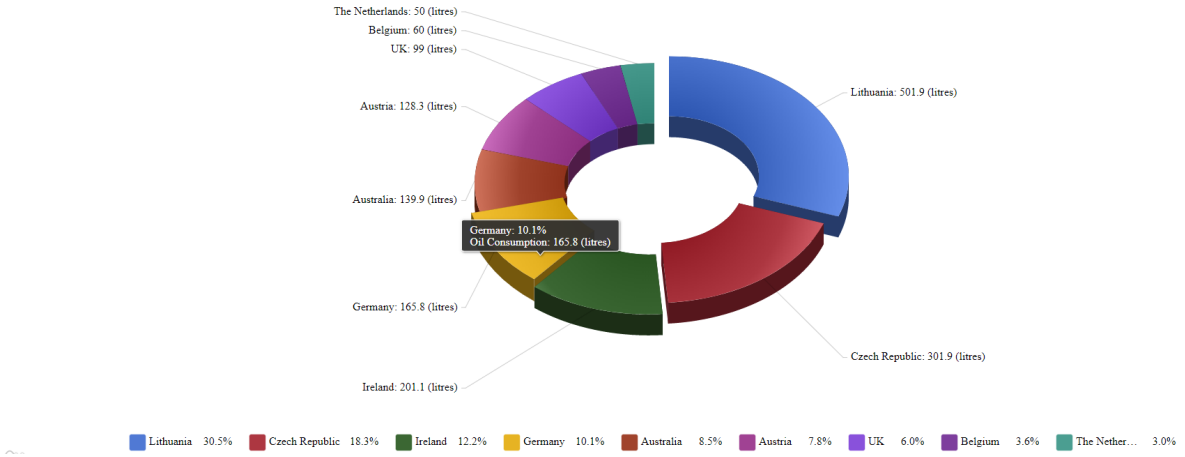

Figure 27: Pie Chart 3D

A Pie Chart (Figures 26-27, for 2D and 3D respectively) is used to represent data series as part of the whole. Each slice in a pie chart represents a data item proportionally to the sum of all the items in the series.

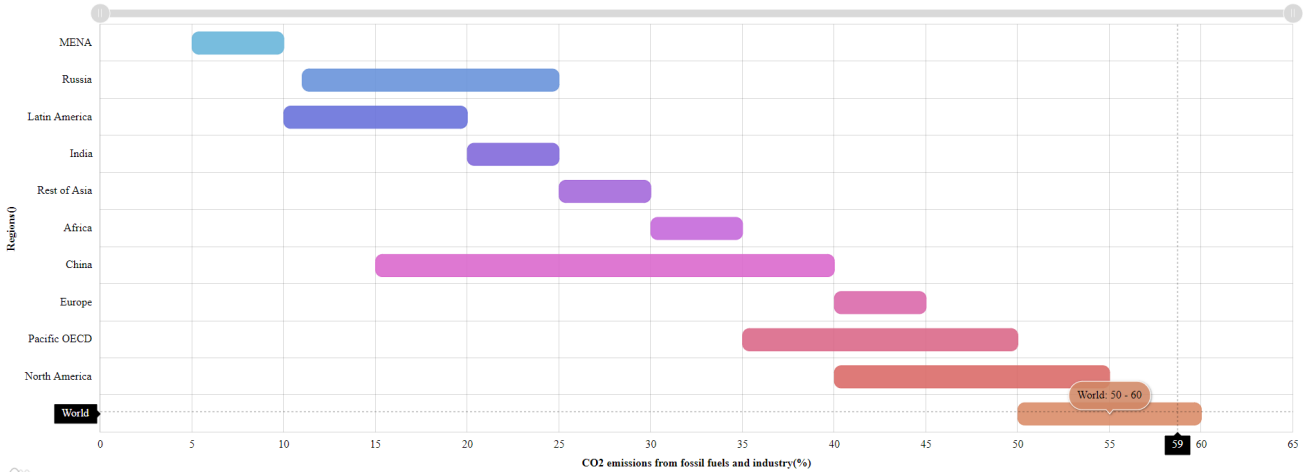

Figure 28: Bar Range Chart

A Bar Range Chart (Figure 28) is a variation of a column chart with a horizontal (time-based when it implements a Gantt diagram) axis and bars starting at arbitrary values rather than on the axis.

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

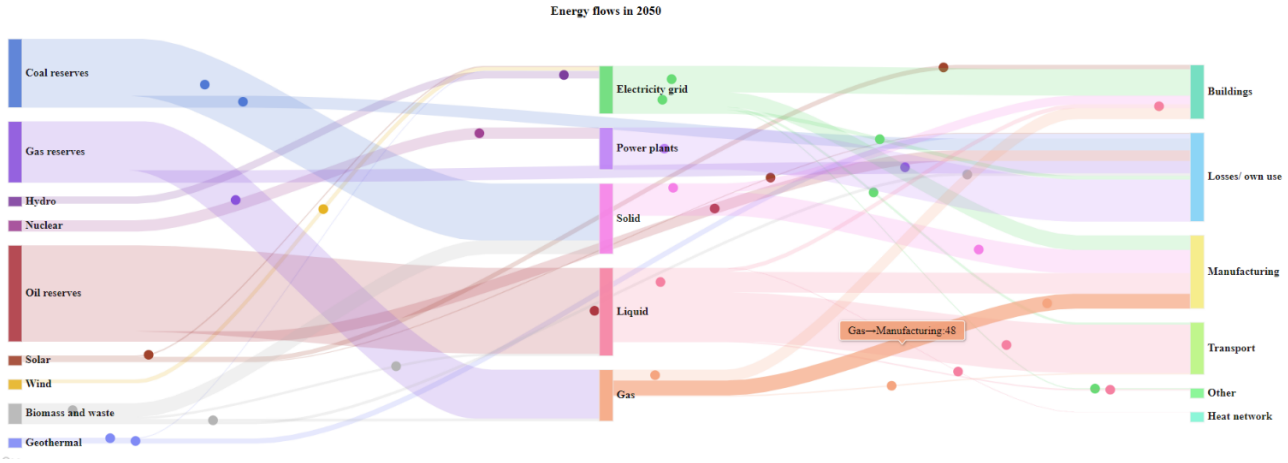

Figure 29: Sankey Diagram

A Sankey Diagram (Figure 29) is an ideal chart to show the flow and relation between stages of a process. It can be used for building pathways and roadmaps.

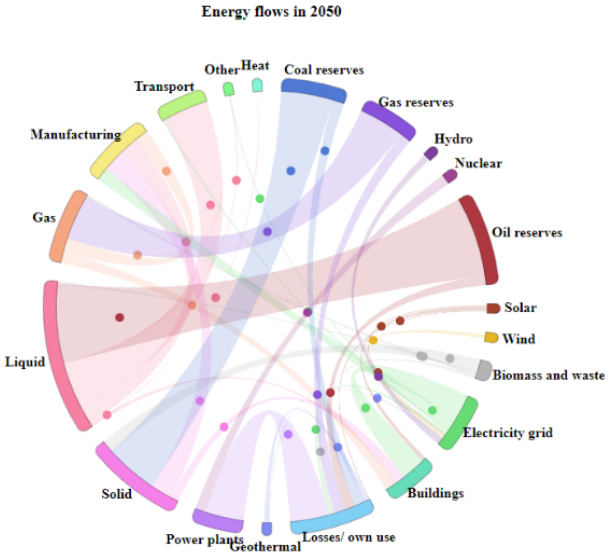

Figure 30: Chord Diagram

Chord Diagrams (also known as Radial network diagram, Chord layout, Dependency wheel) facilitate the visualised representation of relationships between data arranged beautifully in a circle (Figure 30).

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

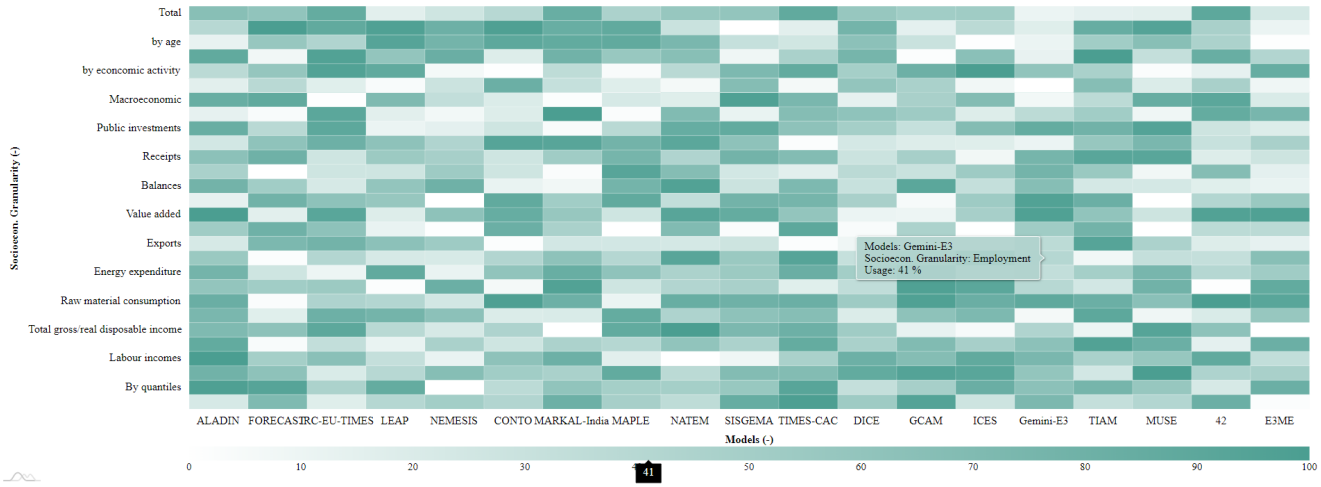

Figure 31: Heatmap Chart (2D Histogram)

Heatmaps (also known as 2D Histograms, Heat tables, Shading matrices) represent data in a rectangular matrix where individual values are differentiated by colour according to a heatmap legend (Figure 31).

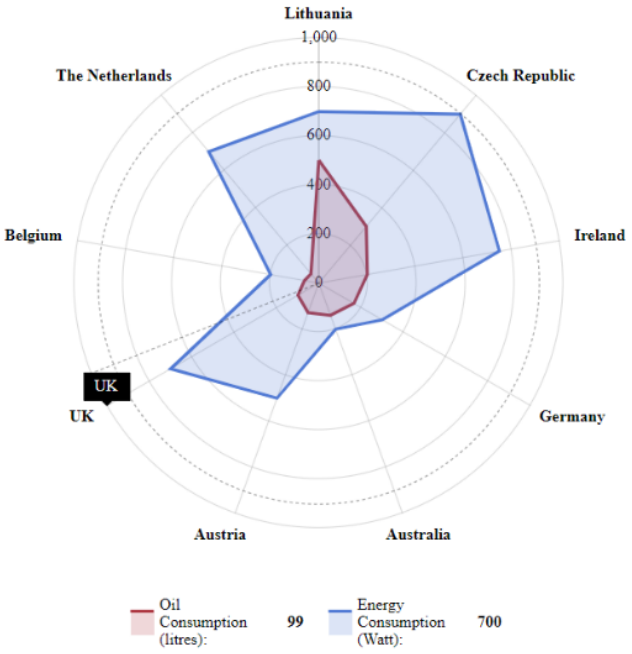

Figure 32: Radar Chart

A Radar Chart (Figure 32) is used to display directional or circular visual representation of a 2-dimensional data and is useful for either comparing and contrasting different instances of one physical quantity or as a visual aid for describing different aspects of a chosen unit.

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

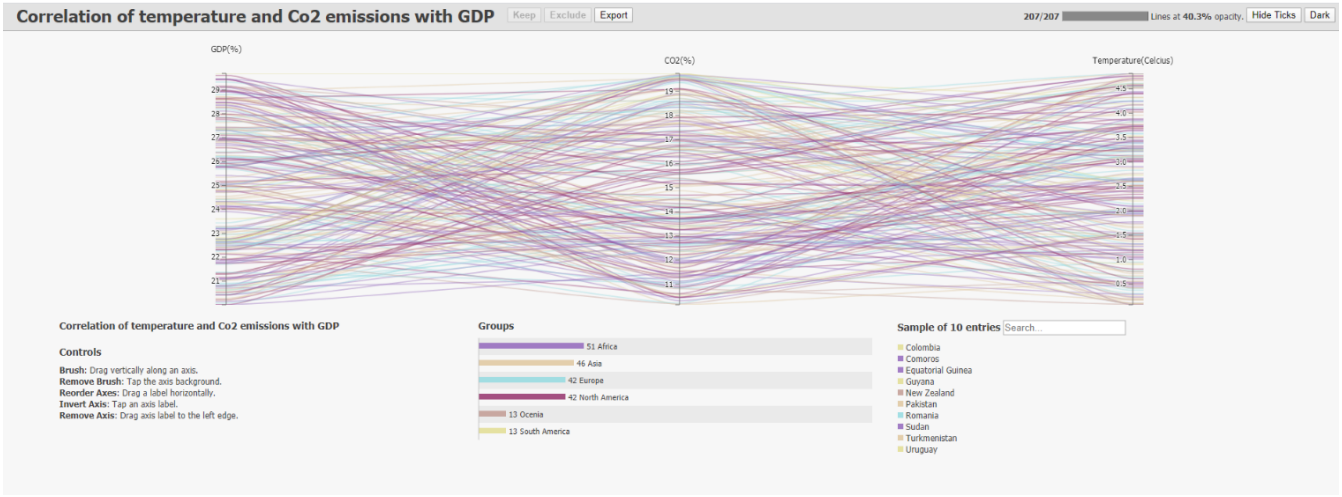

Figure 33: Parallel Coordinates Chart

Parallel Coordinates (Figure 33) are a common way of visualising high-dimensional geometry and analysing multivariate data, and facilitate the comparison among the features of several individual observations on a set of numeric variables. Each vertical axis represents a variable and often has its own scale; the units can even be different. Values are then plotted as series of lines connected across each axis. Showing all data can be confusing sometimes, and that is why the user can choose specific values to be visualised as well as limit output of the visualisation according to a selected range for each axis.

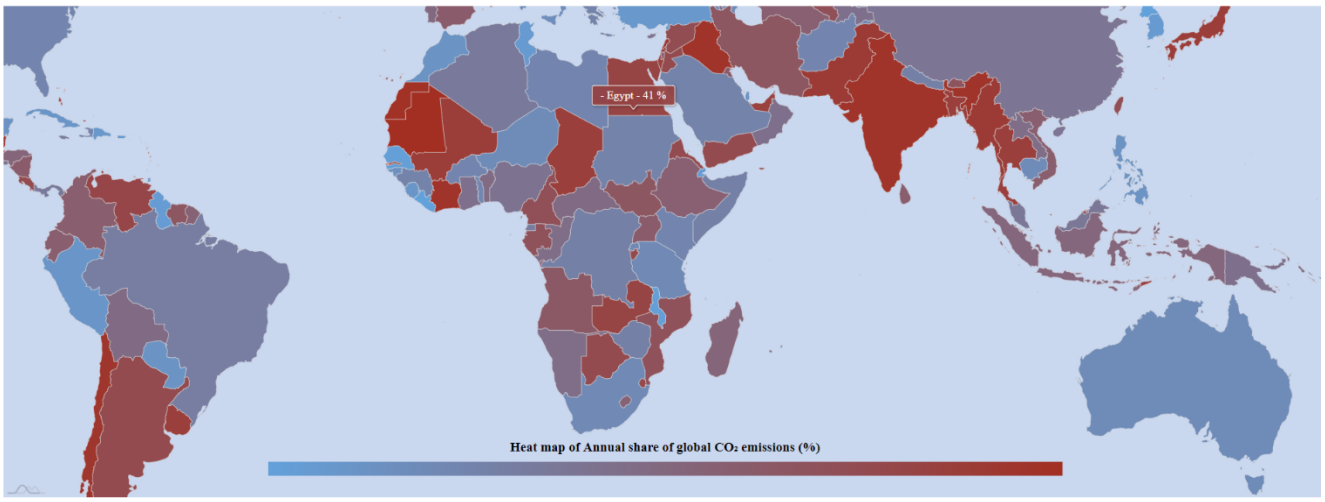

Figure 34: Heatmap

Heatmaps (on an actual map) are used for presenting the value of a selected variable on the map using colours that correspond to specific values according to a given heatmap legend (Figure 34).

All of the presented visualisations are interactive diagrams that allow seeing the desired information by utilising tooltips that pop up when the user hovers over specific elements of a chart, offering zoom-in and zoom-out functionality as well as the ability to enable or disable selected categories on a diagram or temporarily remove selected values or entire series from it, in order to clear up the results of the visualisation. In some cases, there is also animated movement in the diagrams to showcase the data flow or the exchange of information between nodes.

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

3 Static and Dynamic Interfaces

All the visualisations described in the previous section as well as those to be implemented in the near future will be used for populating several interfaces of the I²AM PARIS platform.

In some cases, these interfaces could be described as static meaning that, despite the user not being able to interact with the diagrams, the results of the visualisation engine will not change during the user's interaction with the interface. This follows the common flow of data described below, from querying the database to presenting them in the appropriate diagram:

1. The user loads the interface, providing the necessary information.
2. The page is loading and, for every visualisation existing on the screen, a request is made to the visualiser.
3. The necessary data are gathered from a database, e.g. the PARIS REINFORCE modelling input and output database, or file.
4. The data are processed so as to be compatible with the visualisations of the interface that is being loaded.
5. The data are sent to the visualiser.
6. The visualiser creates all requested visualisations and returns them to the interface, placing them in iframes.
7. The user views the loaded page.

On the contrary, several interfaces (not yet developed) can be described as dynamic. This means that the visualisations on the interface change according to the user's interaction with it (moving knobs, filling in empty fields, selecting values from dropdown lists, etc.). In this case, each interface along with its backend functionalities are designed according to the scenario they serve. In general, the data flow for these is described below:

1. The user loads the interface, providing the necessary information.
2. The page is loading and, for every visualisation existing on the screen, a request is made to the visualiser. Default values are given to the fields of the interface that can change the output of these visualisations.
3. The necessary data are gathered from a database, e.g. the PARIS REINFORCE modelling input and output database, or a file. These data are cached in case they are used again in order to avoid time-consuming re-querying.
4. The data are processed so as to be compatible with the visualisations of the interface that is being loaded. Once again, the data are cached in order to avoid unnecessary re-processing, in case the exact same visualisation is requested.
5. The data are sent to the visualiser.
6. The visualiser creates all requested visualisations and returns them to the interface, placing them in iframes.
7. The user views the loaded page and can make changes in one or more parameters on the interface.
8. An AJAX call is executed for each change, updating only the visualisations that are affected by the changes, thus avoiding reloading the entire page from scratch. In some cases, the change requires making new queries to acquire new data, while in others the data is already cached (or even processed).
9. The visualisations are updated. Since this process takes place asynchronously, the user can still interact

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

with the interface even if the results have not been received yet.

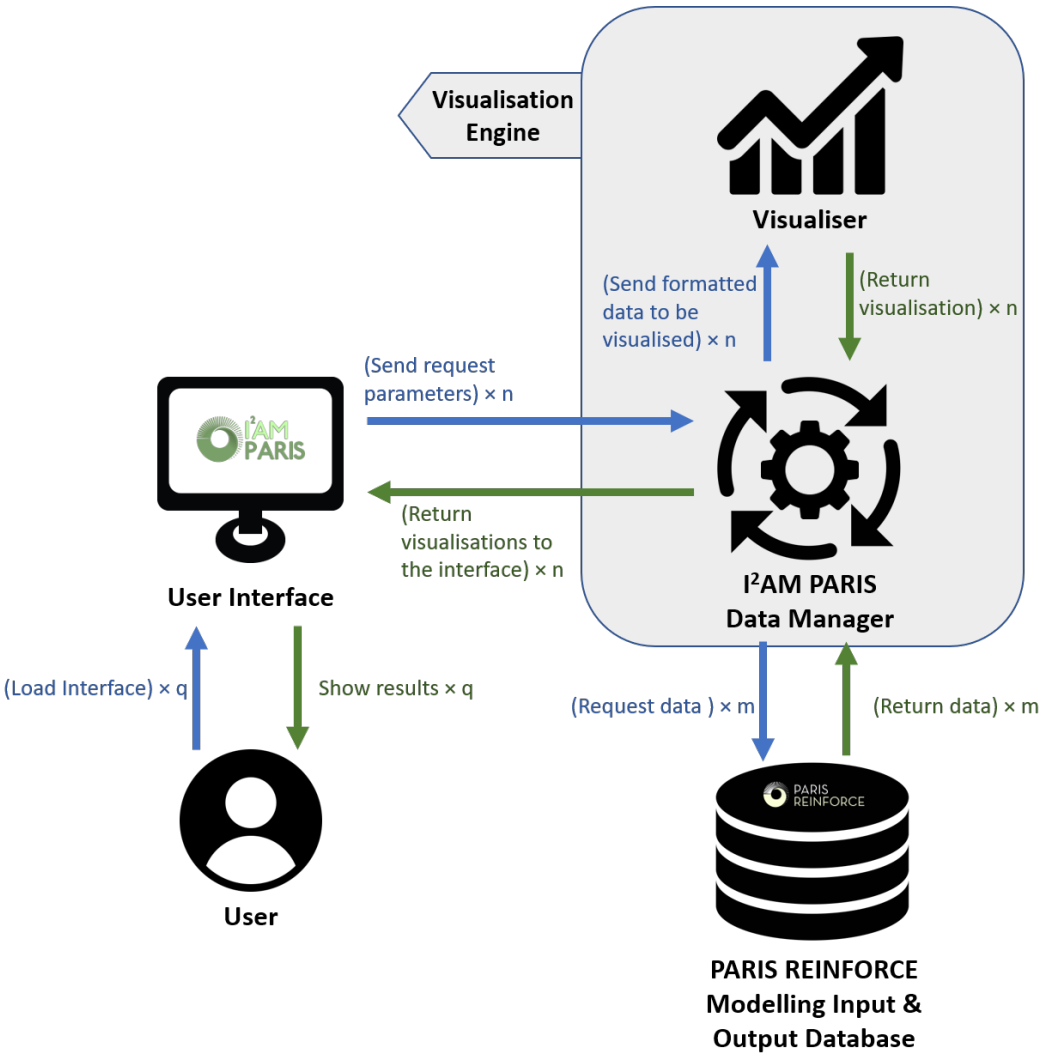

Figure 35: Static Interface Interactions Example

Where:

- q: the number of times the user reloads the page
- n: the number of visualisations included in the interface
- m: the number of datasets required for the requested visualisations

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

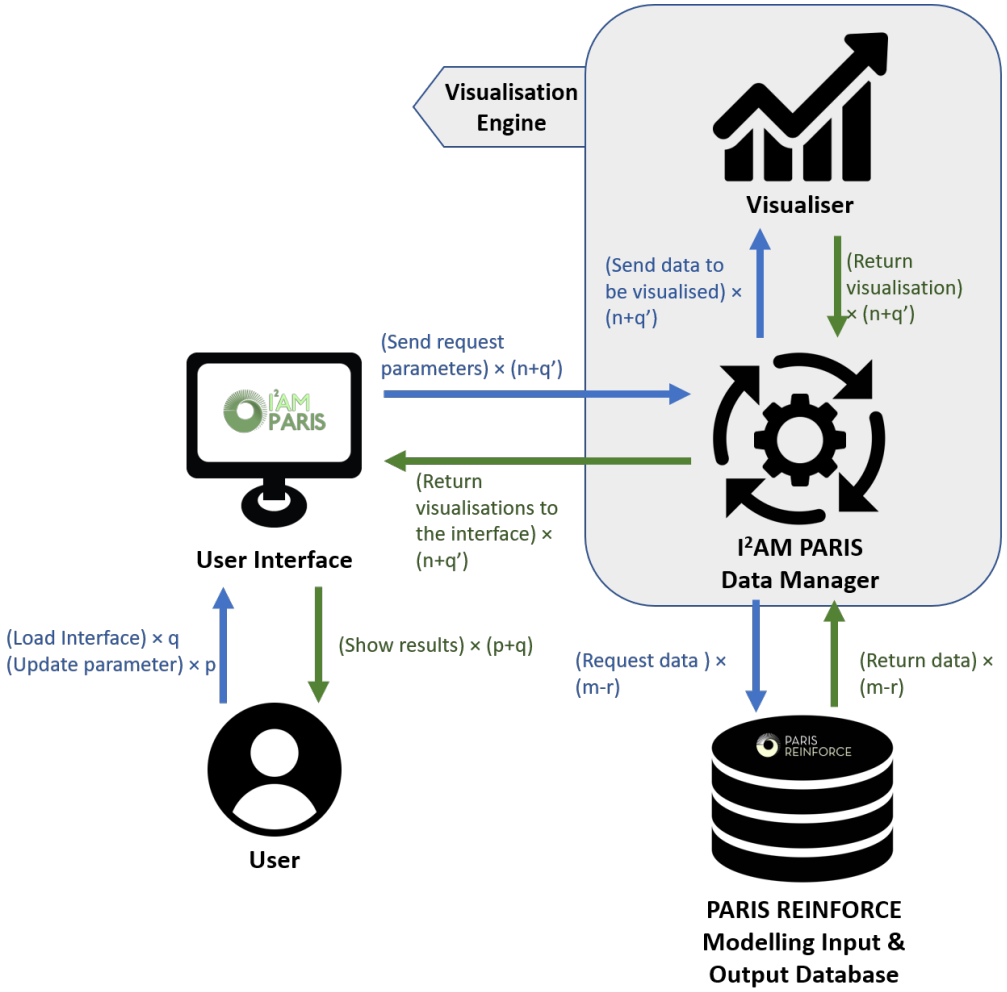

Figure 36: Dynamic Interface Interactions Example

Where:

- q: the number of times the user reloads the page
- p: the number of times a parameter was changed in the interface
- n: the number of visualisations included in the interface
- q': the number of visualisations affected by the interface update
- m: the number of datasets required for the requested visualisations
- r: the number of times the requested data were cached

Examples of simple single-element static interfaces are the visualisations described in the previous chapters. If combined, they can form meaningful and more descriptive interfaces. An example of a dynamic interface is shown in Figure 37.

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

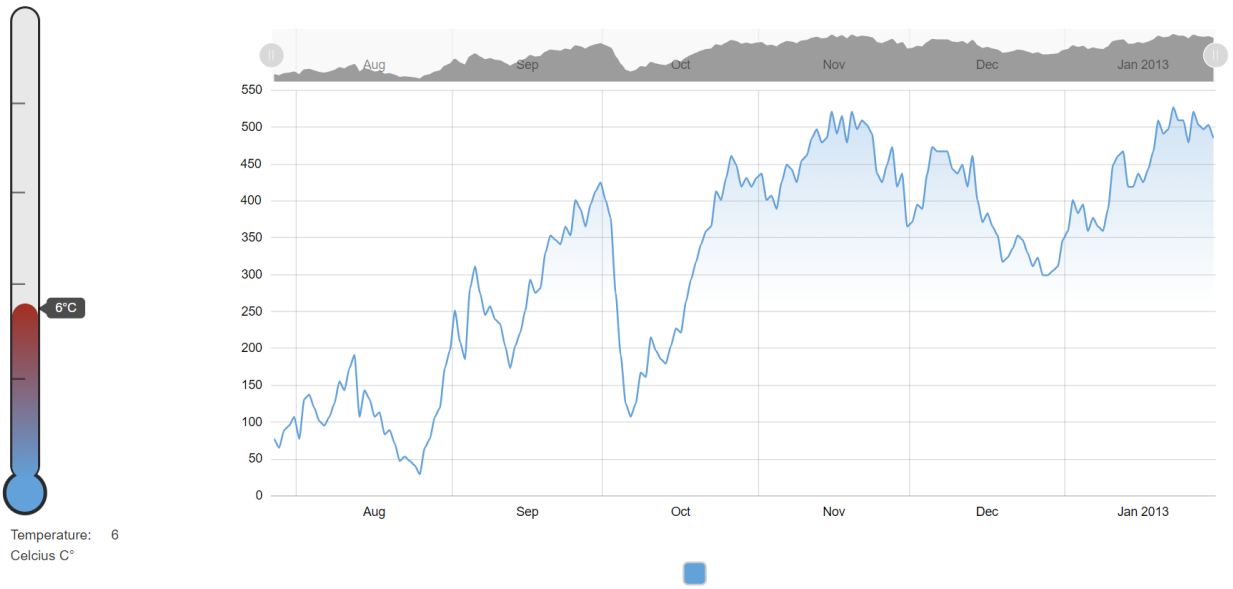

Figure 37: Thermometer with Line Chart Interface

This is a simple example of a dynamic interface, where the user interacts with the thermometer displayed on the left and each change updates the line chart on the right following the logic described above.

The design of every interactive interface will be decided among the involved stakeholders, in order to develop useful and commonly exploited tools to visualise, observe and study specific scenarios related to the data deriving from the model analyses.

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

4 Conclusion and Future Steps

As the first version of the deliverable documenting the I²AM PARIS platform design and implementation, this report provides a documentation of the platform along with a description of its available services, such as Dynamic Model Documentation, Detailed Model Documentation, Overview and Comparative Assessment, and Visualisation. The Data Manager component is not discussed in this version.

The Detailed Model Documentation offers a detailed and extended presentation of the characteristics of every available model involved in the PARIS REINFORCE initiative but is currently being enriched with models from modelling teams outside the PARIS REINFORCE consortium. The Overview and Comparative Assessment is useful for comparing and contrasting the models available in PARIS REINFORCE, thus gaining significant insight into their coverage and fields of application. The Dynamic Model Documentation is a single-page application that allows going through all the important features of each model utilising the visual aids of a map to define its geographical coverage as well as several icons that correspond to specific characteristics (e.g. policy, socioeconomic, technology and SDG coverage).

The Visualisation service is provided by a component called Visualisation Engine and aims at producing all the necessary visualisations for the I²AM PARIS platform, including both static and interactive interfaces that will be commonly agreed among the involved partners, promoting co-creation and collaborative thinking, with a view to developing exploitable tools for both scientists and different types of stakeholder groups, like policymakers.

The second version of this document, D2.5, will update the content of D2.4, by providing an exhaustive account of potential updates to the components and features covered in D2.4, as well as by describing in detail any advancements associated with the I²AM PARIS platform by May 2021, including but not limited to:

- The Data Manager.
- An interface, including a template, that will allow users to directly import/upload new models for the Detailed and Dynamic Model Documentation in the database. An open call, with a dedicated template (and an example), has already been included and scientists can e-mail it filled in as early as of May 2020.
- A parser (or several parsers) responsible for reading and processing model analyses results and automatically importing it into the database in the desired format.
- A scientific interface that will allow manual uploading of data using CSV files, etc.
- More visualisations decided by the involved partners.
- Several commonly agreed interfaces (both static and dynamic) for presenting the model analysis results.
- Caching mechanism to improve the visualiser's performance (avoiding execution of unnecessary queries).

Although the Data Management component will be discussed in detail in D2.5, it should be noted that it will orient on the global/sectoral and national/regional data preparation templates to be used by all contributors to IPCC AR6, as provided by IIASA[2]. This will enable smooth harmonisation of all modelling outputs and interlinkage with the platform, as well as minimise the effort required by non-consortium parties upon submitting their analyses.

The platform currently counts 637 visits (224 unique visits), with a bounce rate of 36% (reported by Google Analytics), during the period December 1, 2019 – May 19, 2020.

[2] https://data.ene.iiasa.ac.at/ar6-scenario-submission/#/about

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.