PARIS REINFORCE

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D3.8 Lessons Learned from Stakeholder Engagement

WP3 – Stakeholder Engagement
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EC Summary Requirements

1. Changes with respect to the DoA

No changes with respect to the DoA.

2. Dissemination and uptake

This report is intended to provide an overview of the lessons learned from engaging with stakeholders throughout the duration of the PARIS REINFORCE research project. It is targeted at both scientists, to learn from the successes and challenges of our stakeholder process in the project, and at stakeholders, to understand how their involvement in science can be more impactful.

3. Short summary of results (<250 words)

This deliverable summarises the lessons learned from the extensive stakeholder engagement carried out within the PARIS REINFORCE research programme. Different sections focus on the initially designed plan, efforts to map stakeholder's roles and interests, as well as lessons learned from actively carrying out stakeholder engagement through workshops and interaction, and from the co-design and development of the I^{2}AM PARIS platform. A unique feature is the viewpoint offered into the shift from in-person to online stakeholder participations as a result of the COVID-19 pandemic and associated lockdowns.

4. Evidence of accomplishment

This report.

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 I^{2}AM 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	
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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	

Executive Summary

This deliverable summarises the lessons learned from the extensive stakeholder engagement carried out within the PARIS REINFORCE research programme. Different sections focus on the initially designed plan, efforts to map stakeholder's roles and interests, as well as lessons learned from actively carrying out stakeholder engagement through workshops and interaction, and from the co-design and development of the I^{2}AM PARIS platform. A unique feature is the viewpoint offered into the shift from in-person to online stakeholder participations as a result of the COVID-19 pandemic and associated lockdowns.

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1   Introduction

The PARIS REINFORCE project set out to implement an innovative and exhaustive stakeholder feedback mechanism for better including the knowledge and preferences of climate policy stakeholders in economic-climate modelling. The main objectives of the project have been to:

1. generate and deliver scientific know-how for policymaking in line with the Paris Agreement,

2. make the use of IAMs more accessible, understandable, and transparent with the aim of closing the gap between scientists and modellers, on the one hand, and the civil society, on the other.

3. improve the real-world representativeness of national mitigation models and IAMs, through "road-testing" results with stakeholders, thereby allowing co-creation of scenario narratives and features.

This deliverable is a report on the lessons learned during that three-and-a-half-year process.

At a high level, the process consisted of the following steps:

1. Identifying appropriate stakeholders and policymakers to participate in the Stakeholder Council; Mapping the interests and capabilities of these stakeholders against core project goals

2. Compiling and clearly communicating the project capabilities

3. Organising workshops and bilateral exchanges to shape the research questions, scenarios, and modelling inputs

4. Exchanging and discussing the results

In total, the PARIS REINFORCE project has hosted 23 Workshops: 2 regional at the EU level; 10 national in Europe, and 11 national/regional outside Europe. We have engaged with diverse types of actors to better understand what kind of information decision-makers and the public need from technical climate-economy modelling and vice versa. Our stakeholders have ranged from high-level policymakers—from UNFCCC Country negotiators and observers; EC Directorates-General (DGs) notably for Energy (ENER), Climate Action (CLIMA), and Research and Innovation (RTD); relevant governmental bodies from the EU Member States, including ministries (notably of energy, environmental, climate, and financial affairs); as well as representatives of international organisations), to scientists and experts from the government and academia, businesses and industries, Non-Governmental Organisations (NGOs), and lay citizens.

Depending on the local conditions and the COVID-19 restrictions, the project has deployed different participatory techniques that varied from 1- or 2-day events to a 3-week discovery journey, from online/virtual to physical/in-person workshops, and from small group settings to large workshop formats. Therefore, lessons can be drawn from different types of interactions.

In Section 2, this deliverable briefly recaps the different elements of the process of stakeholder engagement. Text in bold shows lessons that can be drawn from this process. Section 3 highlights the lessons learned from the workshops organised. Finally, Section 4 covers the milestones achieved by the I^{2}AM PARIS platform and the associated lessons learned from developing such a platform and facilitating/enabling a multiplicity of modelling teams, together with the challenges encountered.

Concrete lessons learned (recommendations for future stakeholder engagement) are highlighted in **bold** throughout.

2 Lessons learned from the process of stakeholder engagement

2.1 Stakeholder Engagement Plan

The project's engagement begins by clearly laying out the principles that were to be respected for stakeholder engagement. This was a useful step both for clarification and to encourage internal project thinking about how to best proceed at the beginning of the project. The deliverable reflected upon the purposes of stakeholder engagement, the purpose of the PARIS REINFORCE project and the structure for stakeholder engagement. A recurring lesson throughout the project is of the importance **for setting clear guidelines and goals for stakeholder engagement.** Stakeholder engagement is not an end in of itself but should be carefully designed and effectively leveraged to push a project's research in a more compelling direction.

When laying out the principles of stakeholder engagement, a non-trivial question is the definition of stakeholders, and how they relate to the project. **Clearly identifying and mapping out how different stakeholders reflect to the project is important**. This step is an important prerequisite for then organising effective workshops and knowledge sharing later in the project. PARIS REINFORCE identified a Stakeholder Council, who were available for contact and discussion on different elements of the workflow. It is, however, the case that different stakeholders are interested in very different aspects of the project; a stakeholder working in industry, for example, might not be interested in joining a workshop that focuses upon the transport sector. Meanwhile a stakeholder with a modelling background will offer a very different perspective on the best way to design an online tool for communicating complex results to the public than a policymaker with a layperson knowledge of models, but strong interest for being able to clearly visualise key results. A lesson from this stage is **reflecting and respecting the fact that stakeholders are interested to feed into different parts of the project.** For a large multinational project, this is a challenge, but also an area for further work.

The Stakeholder Engagement Plan also clearly (D3.1, section 5) laid out the role for stakeholders in identifying the economic and climate policy questions that the project would set out to investigate. A workshop was held in Brussels for exactly this purpose. In general, the structure was viewed as a useful tool for (a) communicating the existence of the project to a wider policy audience, and (b) growing initial stakeholder interest and ownership in the project. Therefore, the project would revert by advising that **including stakeholders from the very first stages of modelling, and particularly when designing effective research questions, is a key element of effective engagement.** A challenge is to then keep key stakeholders engaged and interested in the project as modelling teams proceed through essential, yet time-consuming steps of model validation and model runs.

2.2 'What can our models deliver?'

A second deliverable pertaining to stakeholder engagement was the policy brief discussing "What can our models deliver?'. As suspected prior to the establishment of PARIS REINFORCE, **communicating in concise, clear terms to policymakers exactly what type of questions models can realistically be used to further understanding remains a clear challenge for the modelling community.** More work continues to be needed to foster deeper inclusion of non-modelling stakeholders when designing modelling questions and assumptions. For example, when designing workshops: those with a modelling background are significantly more receptive to invites than those without. This reflects the ongoing challenge that wider swathes of the energy/climate community still struggle to actively engage with models.

There still exists a need for better communication on what type of research models are suited to help with.

Stakeholders often expect models to give definitive answers to questions (e.g., how will the future of road transportation look?) that fundamentally cannot be answered, only explored. Deliverable D3.2 was an attempt to convey these uncertainties and stimulate a deeper understanding and interest in the work of modelling. Bruegel hosted the second European project workshop—discussing this exact issue (agenda below). The important goal remains for stakeholder engagement to **better discuss and advise on sensible uses for modelling output.**

Event Agenda: From Numbers to Insights: How to think about climate-economic modelling

Economic-climate models are a powerful tool for providing insight into sensible climate policy choices and how they would impact our economy. As the EU announces stricter climate targets, there are an increasing number of modelling studies published attempting to do just so. However, these models are highly complex and largely inaccessible to wider audiences.

Therefore, at this event we discussed some of the key issues that policymakers should consider when confronted with new modelling studies. For example, why do different models provide very different perspectives when trying to answer the same question? Why is it that certain models are better suited to certain policy questions? How can we sensibly form our own opinions about how strongly to trust new modelling results?

2.3 Stakeholder Council Mapping

The previous deliverable 3.4 developed a mapping for the Stakeholder Council to allow for more effective inclusion of stakeholders in different stages of the project. An important step was to enhance the existing stakeholder database. An innovative series of identification steps were deployed, using APIs from Google and Wikipedia to enhance the stakeholder database. Positive results confirmed that **non-intrusive, and widely available online tools can offer valuable assistance in improving a project's stakeholder mapping and identification.** Natural language processing, as a rapidly growing field of machine learning can be of significant help here.

Two further innovative steps were deployed for analysis. The first made use of the free Twitter API to map out connections between stakeholders of the climate and energy field on Twitter and develop insights to guide stakeholder engagement. This involved not only data analysis, but also a detailed investigation of the existing literature. **Analysis of online stakeholder interaction must play a growing role in better understanding stakeholders given the global shift to online interaction; however, clear limitations of the approach must be understood and respected.** Particularly, there is a bias when analysing the types of stakeholders that are present in online circles, such as Twitter. For the purposes of this project, gauging public opinion via Twitter was considered to not (yet) be effective enough, whereas network analysis to identify groups of stakeholders was deemed helpful.

In keeping with the offline-online reality that this project existed in, the second innovative analysis technique made use of offline event participation lists. **A wealth of valuable stakeholder information exists in event participation lists.** These publicly available lists detail which types of stakeholders attend which types of events and shed some illumination on existing and perpetuating relationships.

3   Lessons learned from holding workshops: physical & online

3.1   General Lessons

This section offers some brief thoughts on key lessons learned by the consortium from the series of stakeholder workshops. General lessons are offered in this first sub-section, and then lessons specific to the settings both in-person and online are offered in sub-sections 3.2 and 3.3, respectively.

Deliverable 3.6 discusses the general design that was established for workshops. A similar process was used to initiate discussion on the design of each workshop, which then took on its own form following internal consortium discussion to better understand the unique needs and goals of individual workshops.

3.1.1   Transcending typical engagement techniques

In the PARIS REINFORCE project, the participatory initiatives developed have remained within the consultation and involvement spaces, as it is the current trend in the climate and energy realms (Galende Sanchez and Sorman, 2021). In consultation processes, participants express their views on a specific topic, and, in some cases, they may also gain insights or share expertise in a discussion form; yet consultation does not necessarily bring upon transformative change (Scholsberg et al., 2017). In such cases, often, a specific targeted group or experts are the core group of focus (Komendantova et al., 2018).

Therefore, there is a **need and challenge to push for transcending current tools and techniques to further collaboration and re-empower social actors for genuine co-creation to tackle the climate crisis**.

3.1.2   Collaboration with other research initiatives

In order to design collaborations effectively and efficiently, **there is an utmost need to embark on networking rather than acting upon our institutional and/or project silos.** Within PARIS REINFORCE, we have joined efforts with numerous other European Projects (e.g., H2020 projects LOCOMOTION, ENCLUDE, NDC ASPECTS, ENGAGE, and NAVIGATE) and local organisations to promote cross-fertilisation and to develop a common understanding of what models can offer with realities on the ground. For example, in Greece, the first workshop took place together with the Hellenic Society for the Environment and Culture and the Convergences Greece Forum. This not only develops new networks for sustained collaboration, but also helps promote a common goal for the energy transition.

3.1.3   The challenge of opening the black box of models

In an attempt for bridging modelling and participation for climate policy and action, stakeholder participation would greatly benefit from opening the black box of assumptions and variables that go into modelling and design of IAMs. Conversely, opening the mechanisms of modelling principles would create horizontal synergy and inclusivity for delegating of power and decision making. What is desperately needed is to see beyond our decision-making silos and conduct collaborative exercises to expand our science-policy domain into transformative action potential. **Concretely, this requires better communicating the mechanisms and workings of models to stakeholders and actively listening to their concerns and suggestions in return.**

3.2 In person

Workshops were held in-person both prior to the COVID-19 pandemic and in select cases following the resumption of normal activities post-pandemic.

Below we discuss a series of lessons that were drawn from the organisation and implementation of these workshops. This builds on the list of lessons learned already reported in deliverables on the series of workshops (D3.6).

It is of primary importance to **tailor the workshop contents to the invited stakeholders**. It is a useful strategy to try to reach most suitable stakeholders and engage with them prior to a workshop to get their thoughts on optimal areas for discussion. This allows the consortium to better tailor discussion to areas that are of interest to local stakeholders leading to more engaged participants, and more relevant outputs.

Moreover, **inviting stakeholders to present their own work is a sensible tool to create buy-in**, as they are more likely to actively participate and contribute feedback. However, this may be at the cost of diluting the ability to get explicit feedback in desired areas.

Optimal workshop agenda design should involve **regular back-and-forward between presenter and attendees**. It is challenging to do this. While it is tempting to present all the work at the beginning and only then give stakeholders the floor, this appears to discourage active participation.

A challenge for a modelling project is to define effective workshops for being able to accurately hear and record the suggestions of stakeholders. Models are complex tools and concretely including the wishes of stakeholders is a challenge. **Comprehensive internal discussions pre-workshop in the consortium are helpful for brainstorming exactly what outputs are desired from the upcoming workshop.**

Choosing sensible dates and times to organise a workshop is fundamentally important. Care should be afforded not to interfere with other events, and particularly to avoid down-time such as the August period (in a European context at least). Moreover, efforts to link long-term modelling work and outcomes with ongoing policy debates is a sensible approach for spiking the interest of participants. In a sense, events can 'piggyback' onto the hype of policy announcements or real-world events.

Regarding optimal time schedule for organisation, the PARIS REINFORCE project followed the principle of a series of modelling runs followed by reporting to stakeholders. This raised a challenge as all workshops were ready to be hosted at about the same time, and the result was a boom-and-bust cycle with a period of quiet time and no workshops, and then periods of time with lots of workshops. If properly planned, this can be well managed. However, **in the spirit of continuous input into the project and spreading publicity over the course of the project's life, efforts to spread workshops out more could be helpful**. This likely necessitates a rethink of the way, in which workshops are used to feed directly into modelling work.

3.3 Online-specific

As a result of the COVID-19 pandemic and associated lockdowns, a series of workshops were held online.

Below we discuss a series of online-specific lessons, which were drawn from this series.

Using sli.do (online voting tool) to elicit information from stakeholders was a positive experience. It has been a useful tool for modelling teams to translate discussion into quantitative output. Brainstorming on a set of questions for stakeholders is also a useful process for helping workshop organisers to think through desired outputs of the workshop. Presenting the results back to stakeholders immediately following the vote was popular.

Breakout sessions are a very useful tool for facilitating greater stakeholder interaction online. Break-out rooms ensure that everyone has the time and space to speak out; from a more practical perspective, there is more time available for everyone to speak (e.g., in an online room of 80 people, not everyone has the time and space to speak); but, also, from a power imbalance perspective. Certain stakeholders appear to feel more open to discuss when present in smaller groups, meaning there is less domination of discussion by one or two individuals (even though this can still be a challenge). Sensible and supportive moderation of discussion is an important tool to partially alleviate this issue.

Roundtable discussions revealed as another sensible option for receiving stakeholder views and insight. This option is feasible only with limited number of participants (no more than 20-25) and guided by an experienced chairperson. Before opening a proper debate, each roundtable participant is asked to have a brief (2-3 minutes maximum) speech, bringing out their perspective related to the topic. This approach resulted in a very interesting and participated discussion. Potential risks to be considered are related to the possibility of getting off-topic discussions if precise boundaries are not properly established.

Shorter workshops are necessary if conducted online. While it is possible to hold one-day physical workshops, people's attention span is more greatly challenged by staring at a computer screen. For this reason, the PARIS REINFORCE workshops aimed to cap online discussions at 3 hours. This creates a challenge for efficiently fitting in all the required content in a short time frame.

4 Contributions & lessons from the I²AM PARIS Platform

The main aim of this section is to synthesise the contributions and to reflect on the lessons learned during the development of the I²AM PARIS platform (https://www.i2am-paris.eu/).

The platform's foremost objective was (and remains) to improve communication between the public, users of information, and climate experts. It is well known that public support is a key determinant of policy change in democratic countries (Burstein, 2003; Page and Shapiro, 1983) and similarly, climate action is hindered by a disconnect between those creating climate knowledge and those using it (Howarth et al., 2022). Therefore, the aim of the platform was to bring knowledge producers and users closer together and to support the design and assessment of climate policies. In this section, we synthesise the novel contributions that the platform has provided and reflect on the challenges and lessons learned in the process of developing and using the platform.

4.1 The 10 Novel Contributions of the I²AM PARIS platform

As the PARIS REINFORCE project comes to an end, here we reflect on the 10 contributions that the platform has supported since its initial setup in November 2019 to date.

4.1.1 Originality

Previous attempts of making modelling assumptions and variables more visible were within the IPCC 5th Assessment Report (AR) aimed at harmonising model documentation and underlying assumptions within the FP7 EU ADVANCE modelling project[1]. Our sister project H2020 NAVIGATE[2] has made use of this existing model documentation wiki[3] to be integrated into their IAM NAVIGATOR toolbox, to be made publicly available once their scenario data portal is developed (November 2022).

Since the creation of the I²AM PARIS platform (November 2019), we believe that it has completed its role in terms of originality, advancing documentation beyond what was previously attempted in terms of its documentation, communication, and visualisation tools. As of November 2022, the platform has been used by 4.3k unique visitors; with a total of 8.4k initiated sessions averaging 5.5 minutes of use time per session. Users/visitor division by regional breakdown has been 40% EU, 11% US, 7% China, 6.5% UK, 5% Canada, 30% Rest of the World; thus reaching out to extensive coverage.

4.1.2 Inclusivity

Since the design of the Platform, the PARIS REINFORCE project has made an open call to international modelling groups, inviting both consortium and non-consortium models as the project has evolved. Willing groups submitted their modelling documentation on a common template following the IPCC AR6 documentation template—with an example on one model provided—to be uploaded onto the platform. Since the development of the platform in 2019, the platform now hosts the documentation for not just 19 of the original PARIS REINFORCE project models, but for a total of **44 models**. To date, it is one of the most extensive modelling documentation and comparison platforms on an international scale.

4.1.3 Sustainability

One of the foremost concerns prior to the development of the platform was the accumulation of numerous attempts on the web, leading to a graveyard of modelling documentation hubs and/or the need to reinvent "the wheel of documentation and information" with every new funding scheme and project. With PARIS REINFORCE, this problem has been overcome, as currently 2 H2020 projects and 2 new Horizon Europe (HE) Projects have committed to using the I^{2}AM PARIS Platform as a hub for collecting information from project outputs. The platform has confirmed support from the following projects: H2020 NDC-ASPECTS[4] and ENCLUDE[5] and HE IAM COMPACT[6] and DIAMOND[7], extending its overall lifetime for over 5 years (at least). Not only will this ensure its sustainability and longevity but will also give room for the evolution of the platform to take on new identities over time, serving as a hub for gathering modelling results and outputs relevant to policy but also acting as a novel space for information on citizen engagement and participatory pathways.

4.1.4 Comprehensibility

Navigating the language of 'integrated assessment models' and understanding how IAMs are used to study climate change is a complex mission (Evans and Hausfather, 2018). However, the "MODEL DYNAMIC DOCUMENTATION" feature—an initial feature launched at the beginning of the project—makes the model capabilities easily comparable, at a glance, without a priori knowledge on model specificities.

Here, users can get an overall understanding of the **sectors** (e.g., Industry, Building, Agriculture, Forestry, and Other Land Use, and more) that each model covers, the **emissions** that the models can account for (e.g., CH_4, CO_2, N_2O, etc.), **mitigation and adaptation measures** that the models can take into account (e.g., Hydrogen production; Land Use, Land-Use Change and Forestry and more), the **policy Areas** that the models can cover (e.g., emissions mitigation, trade, efficiency measures), **socio-economic sectors** (e.g., demography, GDP, employment, finance) that the models include, and the **Sustainable Development Goals** (SDGs) (e.g., Climate Action; Industry, innovation, and infrastructure, etc.) that the models can respond to. Moreover, the user can get a map of the geographical areas that the model can cover. See Figure 1 for a screenshot of the I^{2}AM PARIS Platform's MODEL DYNAMIC DOCUMENTATION feature.

The disposition of all the information on a hover-over option makes model intercomparison, easily comprehensible.

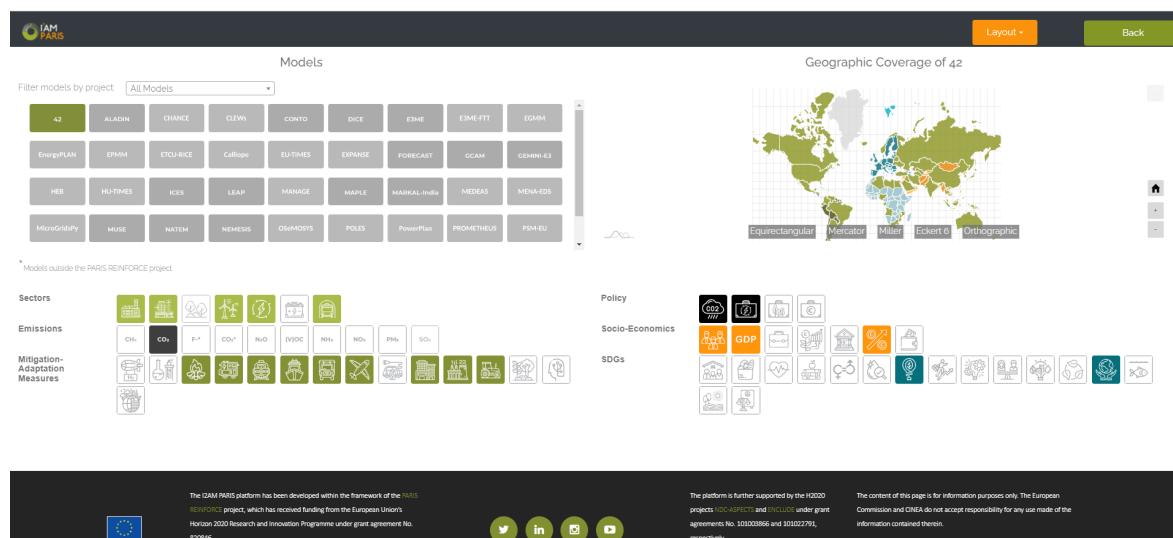[4] https://www.ndc-aspects.eu/
[5] https://encludeproject.eu/
[6] https://www.iam-compact.eu
[7] https://www.climate-diamond.eu

Figure 1: I²AM Paris Platforms, MODEL DYNAMIC DOCUMENTATION feature

4.1.5 Diversity

Bringing together 19 PARIS REINFORCE models and the additional 25 non-consortium models, allows room for extensive regional coverage and global analysis, much beyond the European scale. This initially gives way to a granular analysis, detailed at the regional level. Moreover, it allows for the integration of nuances of regional landscapes and countries from the Global South to take place in modelling analysis for policy development promoting diversity (e.g., a workspace dedicated to looking at regional feasibilities to net zero). The PARIS REINFORCE project has had an entire WP (WP6) dedicated to analysing current and more ambitious NDCs of major and less emitting countries outside Europe. The consortium has undertaken numerous participatory workshops at the regional, European national, and non-European national scales (see Section 1 for detail).

4.1.6 Heterogeneity

While IAMs were brought together on the platform, the project has embraced heterogeneity and united other models in terms of different approximations and accounting mechanisms, such as energy system and sectoral models. The necessity of a multitude of models is crucial to explore different pathways of where emissions are headed based on temporalities, and rising ambitions (NDCs) to 2030, 2050, and beyond. Embracing different models can also help explore the role that different energy innovations, such as the future of hydrogen, electrification of transport, and carbon capture and storage, have and help compare different model outputs viable scenarios going forward.

4.1.7 Variety

In terms of displaying the results on the platform, upon landing on the results section, the user is given the option to select among diverse workspaces—each space carefully designed to respond to different questions and needs of the visitor.

Within the scope of the project, six unique workspaces have been developed: *(1) Where is the world headed?* A multi-model analysis of long-term emissions and warming implications of current global mitigation efforts; *(2) Where is the EU headed?* A stakeholder-driven model inter-comparison assessing where the EU is headed given its current climate policy; *(3) The Recovery Policy Database*: This workspace includes the CINEA Climate Neutrality WGII Shared Recovery Policy Database for modelling research*; (4) Regional feasibilities to Net Zero*:

A global analysis of current policies, NDCs, and net-zero targets with a focus on regional feasibilities; *(5) Index Decomposition Analysis*: An assessment of current policy and net zero emissions scenarios through an index decomposition and sectoral benchmarking exercise; and *(6) COVID-19 Recovery Packages***:** An analysis of climate-employment benefits of green recovery packages in six major emitting regions.

The distinction of each unique workspace allows the user to focus on the details of regional and/or global results as well as specific thematic (e.g., COVID recovery) or process (e.g., Index decomposition analysis) outcomes of modelling results.

4.1.8   Transparency

IAMs have been criticised for being black boxes, with a lack of transparency for the choice behind variables used and for propagating prevalent problematic societal discourses, to the production and reproduction of unjust social relations (Rivadeneira and Carton, 2022).

To overcome such a problem, the I^{2}AM PARIS platform enhances transparency behind assumptions that go into the modelling process with (a) its extensive modelling documentation feature (overview and comparative assessment and Detailed Model Documentation) exhibiting model capabilities and (b) its Variable Harmonisation Heatmap feature, making the assumptions behind models visible, indicating *how* the different variables across the models in the PARIS REINFORCE modelling consortium have been handled. Some variables have been *fully* or *partially* harmonised (e.g., illustrating the degree to which disparate data formats and datasets have been unified), some have *not been harmonised*, some have been *checked for consistency* and other variables have been treated as *extractable outputs* due to the nature of the model (see Figure 2 for detail). This (on-demand and/or custom-built) harmonisation heatmap feature, is the first of its kind feature to bring more clarity on how model variables are treated within IAM "black boxes".
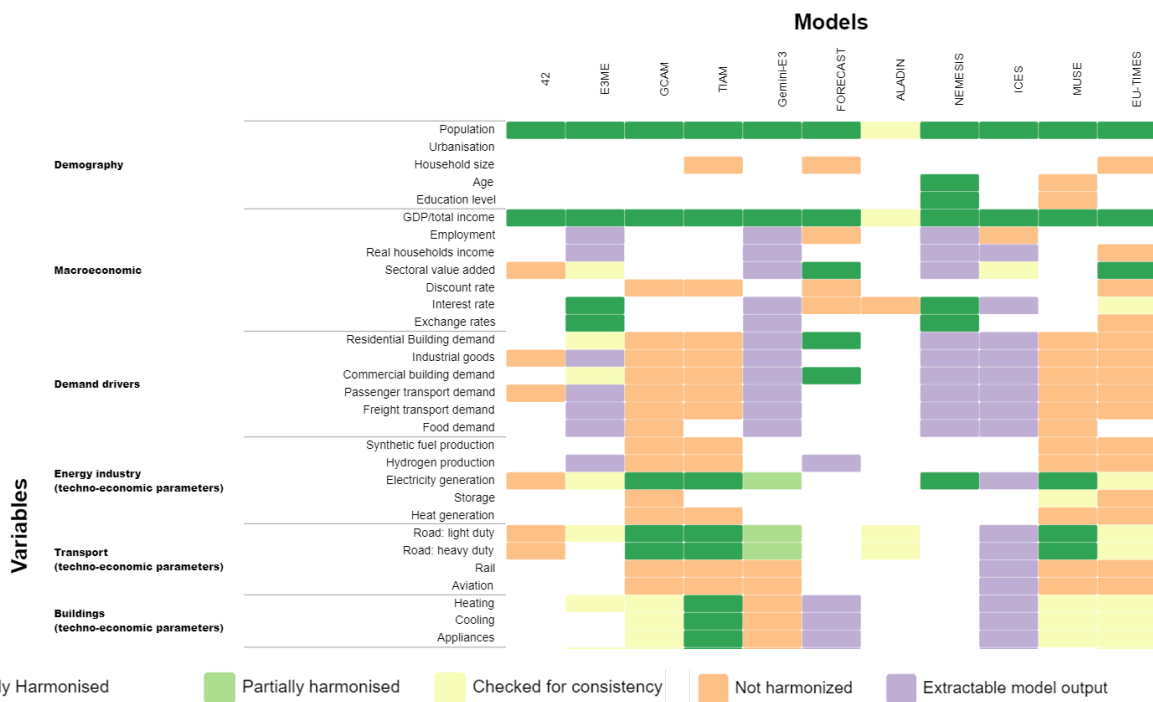

Figure 2: Screenshot of Heatmap of Variable Harmonisation across PARIS REINFORCE models

4.1.9 Versatility

As with a variety of displays of results, the platform also responds to ***user profiles*** and ***preferences*** (with options to select from à-la-carte variables or present a summary of results). In several of the workspaces, if the user has extensive a priori knowledge of the model, an advanced, scientific overview of selected results, is available for the user to access all datasets and create custom-built graphs. In a similar fashion, for policymakers/public, more interested in understanding the message being the results, a user-friendly, public interface featuring a summary of, and insights from, the multi-model analysis is presented in a pre-narrated interface with the selection of some variables available. By targeting different user profiles, the platform intends to reach out to diverse audiences and close the gap between knowledge producers and users.

4.1.10 Community

The COVID-19 pandemic and related restrictions have largely reshaped or reoriented the project's co-creation strategy, shifting stakeholder interactions to the virtual domain for a large part of the project. The diverse activity types (surveys, interviews, online/in-person workshops, workshop series, deliberative dialogue, etc.) have also determined the level of participation and interaction, the number of actors involved, and the duration of the process. Each participatory technique comes with its own advantages, as well as its own temporal and participatory trade-offs (see Figure 3).
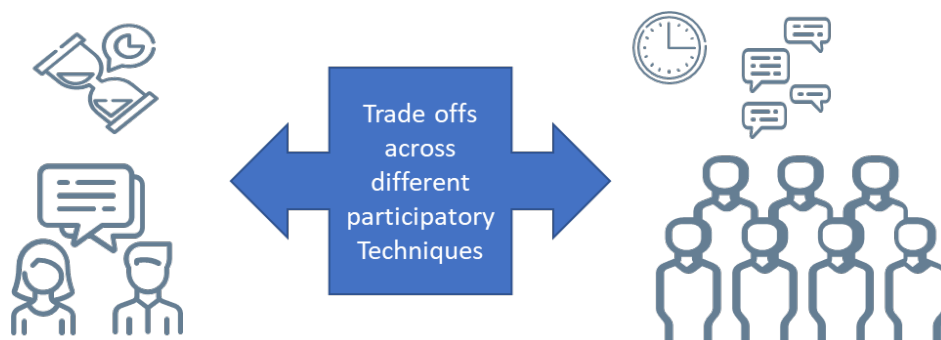

Figure 3: The different trade-offs encountered across online versus offline, small groups settings versus large workshop format, and short 1-2-day events to a 3-week discovery journey

Recently, the "Co" in co-production of climate action has been scrutinised by several authors (See Howarth et al., 2022 for a critical overview of the issue). While there is no consensus on how it should be led, nor a shared understanding of the term itself (Galende-Sanchez and Sorman, 2021), what is vital is that shared spaces such as the I²AM PARIS platform and participatory workshops give room for reflexive governance to take place to resolve tensions (Whitmarsh et al, 2021), increase transparency, and eventually build up a community, strengthening the science-policy interface and enabling climate policy support.

4.2 Challenges and Lessons Learned

Streamlining a lot of data and information has not been an easy challenge and we have encountered ***technical problems*** along the way. Load times have been long in presenting results and datasets. However, our technical teams at HOLISTIC and NTUA have responded to user troubles during the process. For effective data reporting, we have followed the IPCC reporting format and standardised data streamlining (based on the IPCC AR6 template) since the beginning of the project.

During the 3.5 years of the project, a lot of information was generated. A foremost challenge was to ***summarise***

and synthesise the information effectively in order to prevent information overload when navigating the platform. For efficient communication of results, each workspace development was allocated to the authors of the main study for summarising the main results and responses to policy questions.

A live demo video of the I^{2}AM PARIS prototype recorded during our first stakeholder dialogue, in Brussels, in November 2019 was shared on the platform to navigate it efficiently.

Conducting (participatory) research in times of COVID-19 and war has not been an easy challenge either. Organisation of events, changing scenarios and variables, and partnerships were always factors to look out for. This was also coupled with the reality of "stakeholder fatigue", where many experts, policymakers, and interested actors—despite the centrality of the multiple knowledges and expertise that they bring to research—are repeatedly asked to contribute their input in transdisciplinary research (Bracken, Bulkeley, and Whitman 2015). However, the challenge and novelty of trying out different online participatory techniques in times of COVID-19 have partially overcome such an issue, as we were able to reach out to many new and different actors through remote participation.

During the project lifetime, while we were able to communicate effectively within our *disciplinary silos*, harmonise variables across our models, and increase transparency behind modelling assumptions, reflexivity has always been a central issue and challenge when we try to communicate our findings outside of our disciplines, academia, and beyond in true transdisciplinary spirit.

During the construction of the different workspaces (scientific versus policy user interface), the use of *jargon, language,* and *communication* was a fundamental concern. Not only is it important to narrate and disseminate the storylines of the scenarios properly, but it is also crucial to use the right language where for example 1.5°C is defined NOT as a target or goal but rather as a pressing limit. Passing on scientific evidence for policy in a comprehensible and correct vocabulary remains a challenge for the scientific community in general.

Last but not least, the *increasing diversity of actors in the production of climate science* is very significant. With our workshops, we have opened up the conversations to Europe and beyond and given voice to a multitude of different regional experts and actors for them to define *their* climate priorities. Challenges remain in opening up climate-policy discussions to the public and citizens for the co-creation of knowledge.

Overall, we believe that the platform has been unique in terms of making the use of IAMs more accessible, understandable, and transparent with the aim of closing the gap between scientists and modellers, on the one hand, and users of this knowledge, on the other. The I^{2}AM PARIS platform has been especially crucial for grounding the modelling process to more comprehensible terms and opening up the black box of assumptions that go into modelling processes, thereby humanising the overall process.

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