IAM COMPACT

Expanding Integrated Assessment Modelling:
Comprehensive and Comprehensible Science
for Sustainable, Co-Created Climate Action

D2.5 Proceedings of Stakeholder Interactions - Update

WP2 – Listening – Ensuring policy relevance and ownership

28/08/2025

Funded by
the European Union

www.iam-compact.eu

Disclaimer

Copyright Message

Grant Agreement Number	101056306	**Acronym**	IAM COMPACT
Full Title	Expanding Integrated Assessment Modelling: Comprehensive and Comprehensible Science for Sustainable, Co-Created Climate Action		
Topic	HORIZON-CL5-2021-D1-01-04		
Funding scheme	HORIZON EUROPE, RIA – Research and Innovation Action		
Start Date	September 2022	**Duration**	36 Months
Project URL	https://www.iam-compact.eu		
EU Project Advisor	Andreas Palialexis		
Project Coordinator	National Technical University of Athens – NTUA		
Deliverable	D2.5 – Proceedings of Stakeholder Interactions - Update		
Work Package	WP2 – Listening		
Date of Delivery	**Contractual** 31/08/2025	**Actual**	28/08/2025
Nature	Report	**Dissemination Level**	Public
Lead Beneficiary	Bruegel		
Responsible Author	Rutger Broer	**Email**	rutger.broer@bruegel.org
	Bruegel	**Phone**	N/A
Contributors	Eva Jüngling, Ugne Keliauskaite [Bruegel]		
Reviewer(s)	Natasha Frilingou, Alexandros Nikas [NTUA]; Adrián Mateo Martínez [CARTIF]		
Keywords	Stakeholder engagement, workshops, capacity building		

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

Project partners and stakeholders outside the project can use this deliverable to understand the stakeholder engagement process in IAM COMPACT, as well as review the outcomes of the Policy Steering Group and Core Working Group engagements in the second cycle of the project's Policy Response Mechanism, from February 2024 to August 2025, learning about the topics discussed by researchers on the one hand and policymakers, industry representatives, and civil society actors on the other.

3. Short summary of results (<250 words)

Stakeholders were engaged in a series of structured, sequential steps to provide feedback and co-create modelling scenarios in collaboration with IAM COMPACT modelling teams, following the Policy Response Mechanism process. Stakeholders were grouped by research theme within the EU, and by region outside of the EU.

This second cycle of the PRM included two phases similar to those of the first cycle. The first phase of stakeholder engagement was to meet with Policy Steering Groups, consisting primarily of high-level policymakers, and understand the policy priorities for each research theme and region. Research questions from these meetings were used to create a number of model-feasible research studies. The second phase of stakeholder engagement involved the Core Working Groups, consisting of technical policymakers, industry analysts, and civil society policy experts, to discuss research studies in detail and seek feedback from stakeholders.

The four research themes for categorising the stakeholder engagement within the EU, in this second cycle, were "Global Decarbonisation", "Modelling the Clean Industrial Deal", "Citizens in the Transition", and "Land-use and Renewable Energy". The seven non-EU regions again included the United States of America, China, India, Sri Lanka, Ukraine, Kenya, and Ethiopia.

Generally, the PRM has proven to be an effective method to collect relevant research questions to inform modelling studies. The continued engagement with the same stakeholder groups under thematic areas through the two cycles of the PRM seemed an effective stakeholder engagement method that increases responsiveness.

4. Evidence of accomplishment

This report.

Funded by
the European Union

Preface

IAM COMPACT supports the assessment of global climate goals, progress, and feasibility space, and the design of the next round of Nationally Determined Contributions (NDCs) and policy planning beyond 2030 for major emitters and non-high-income countries. It uses a diverse ensemble of models, tools, and insights from social and political sciences and operations research, integrating bodies of knowledge to co-create the research process and enhance transparency, robustness, and policy relevance. It explores the role of structural changes in major emitting sectors and of political, behaviour, and social aspects in mitigation, quantifies factors promoting or hindering climate neutrality, and accounts for extreme scenarios, to deliver a range of global and national pathways that are environmentally effective, viable, feasible, and desirable. In doing so, it fully accounts for COVID-19 impacts and recovery strategies and aligns climate action with broader sustainability goals, while developing technical capacity and promoting ownership in non-high-income countries.

NTUA – National Technical University of Athens	EL	
Aalto – Aalto Korkeakoulusaatio SR	FI	
AAU – Aalborg Universitet	DK	
BC3 – Asociacion BC3 Basque Centre for Climate Change – Klima Aldaketa Ikergai	ES	
Bruegel – Bruegel AISBL	BE	
CARTIF – Fundacion CARTIF	ES	
CICERO – Cicero Senter for Klimaforskning Stiftelse	NO	
E3M – E3-Modelling AE	EL	
KTH –Kungliga Tekniska Hoegskolan	SE	
POLIMI – Politecnico di Milano	IT	
UPRC – University of Piraeus Research Center	EL	
UVa – Universidad De Valladolid	ES	
WI – Wuppertal Institut fur Klima, Umwelt, Energie GGMBH	DE	
IIMA – Indian Institute of Management	IN	
THU – Tsinghua University	CN	
USMF – University System of Maryland	US	
AAiT – Addis Ababa University	ET	
KEI – International Civic Organisation Kyiv Economics Institute	UA	
RUSL – Raja Rata University of Sri Lanka	LK	
TUM – Technical University of Mombasa	KE	
UNIGE – Université de Geneve	CH	
Imperial – Imperial College of Science, Technology and Medicine	UK	

Funded by the European Union

Executive Summary

The Policy Response Mechanism (PRM), IAM COMPACT's stakeholder engagement strategy to ensure policy-relevant modelling research, is a central aspect of the overall project. Stakeholders are engaged in a series of structured, sequential steps to provide feedback and co-create modelling scenarios in collaboration with IAM COMPACT modelling teams. Stakeholders were grouped by research theme within the EU and by region outside of the EU.

Three non-EU regions include the world's major emitters: the United States of America, China, and India. Four further non-EU regions are countries in which IAM COMPACT is carrying out capacity building work in integrated assessment and energy systems modelling. They are Sri Lanka, Ukraine, Kenya and Ethiopia.

The PRM process consisted of two cycles, with each cycle consisting of two phases.

The first phase of stakeholder engagement was to identify and meet with members of the Policy Steering Groups, consisting primarily of high-level policymakers. The aim of these engagements was to understand the policy priorities for each research theme and region. An initial set of policy-relevant research questions (one set for each theme and region) was derived from these discussions with the Policy Steering Groups. The initial set of research questions was then transposed into a number of research studies that captured the key concerns of stakeholders but ensured that the framing was feasible from a modelling perspective.

The second phase of stakeholder engagement involved the Core Working Groups, again categorised by theme and region. The Core Working Groups were made of technical policymakers, industry analysts and civil society policy experts. The idea was to discuss in detail with the Core Working Groups the proposed research studies, understanding from them whether the scenario design was realistic and if there were any key metrics or variables missing from the intended analysis.

The four research themes for categorising the stakeholder engagement within the EU were 'Optimal Transition', focused on decarbonisation of electricity, electrification of energy services, and introducing resilience metrics to modelling analyses; 'Industry and Innovation', exploring the impacts of the energy transition on European industry and its interlinkages with Europe's strategic autonomy as well as the need for innovation in key technologies; 'Global Effects', looking at the role of geopolitics and macroeconomics in Europe's energy transition; and 'Behavioural Change', seeking to model the impacts of sustainable lifestyle changes on the economy. During the second cycle of the PRM, the Core Working Groups were strategically renamed to match ongoing policy debates in Brussels, and rebranded as "Global Decarbonisation", "Modelling the Clean Industrial Deal", "Citizens in the Transition", and "Land-use and Renewable Energy".

During the second cycle of the PRM a tailored stakeholder interaction approach was pursued in the non-EU countries aligned with local conditions and priorities, whereas in the thematic studies the PRM method was applied consistently.

Generally, the PRM has proven to be an effective method to collect relevant research questions to inform modelling studies. The continued engagement with the same stakeholder groups under thematic areas through the two cycles of the PRM seemed an effective stakeholder engagement method that increases responsiveness. One consideration for future projects is that, upon collecting research questions from stakeholders, some of these might diverge greatly in scope. Considering this divergence, it is important to acknowledge the limitations of the modelling tools (i.e., some questions cannot be answered), meaning that research teams might benefit from selecting research questions strategically.

Funded by
the European Union

Contents

EC Summary Requirements ii
1 Introduction 7
1.1 Themes and Regions 8
2 Themes 10
2.1 Policy Steering Groups 11
2.1.1 Optimal Transition 11
2.1.2 Industry and Innovation 12
2.1.3 Global Effects 13
2.1.4 Behavioural Change 14
2.1.5 Transforming suggested research questions into modelling studies 15
2.2 Core Working Groups 17
2.2.1 Global Decarbonisation 17
2.2.2 Modelling the Clean Industrial Deal 20
2.2.3 Citizens in the Transition 23
2.2.4 Land Use and Renewable Energy 27
3 Regions (Major Emitters) 30
3.1 United States of America 30
3.2 China 31
3.3 India 32
4 Regions (Non-high-income Countries) 35
4.1 Kenya 35
4.2 Ethiopia 36
4.3 Ukraine 37
4.4 Sri-Lanka 38
5 Lessons Learned 40
6 References 41

Table of Tables

Table 1. Policy Steering Group in the Optimal Transition theme. 11
Table 2. Policy Steering Group in the Industry and Innovation theme. 13
Table 3. Policy Steering Group in the Global Effects theme. 13
Table 4. Policy Steering Group in the Behavioural Change theme. 14
Table 5. Global Decarbonisation Core Working Group by breakout room. 17
Table 6. Modelling Clean Industrial Deal Core Working Group by breakout room. 20
Table 7. Stakeholders providing feedback on studies on the Modelling Clean Industrial Deal theme. 23
Table 8. Citizens in the Transition Core Working Group by breakout room. 24
Table 9. Stakeholders providing feedback on studies on Citizens in the Transition. 26
Table 10. Land Use Core Working Group. 27
Table 11. Stakeholders providing feedback on the Land Use study. 29

Funded by
the European Union

1 Introduction

The report highlights the nature and type of stakeholder interactions and contributions to IAM COMPACT, focusing on the second phase of the policy response mechanism (PRM) lasting from February 2024 until August 2025. This report is an update to the D2.4 Proceedings of Stakeholder Interactions[1], which covered the period from the start of the project in September 2022 until January 2024.

The report builds on the contributions of other IAM COMPACT deliverables, including:

- D2.3 Scoping policy relevant research questions[2]

- D4.6 National regional mitigation pathways[3]

- D6.8 Open-access models for case-study countries

During the second phase of the PRM, the structured approach, including policy steering groups and core working groups, has been adopted for the **thematic workshops**, while the **major emitters and regional analyses** have tailored their policy engagement to address local needs. Consequently, the report's structure differs slightly from D2.4 regarding the sections on relevant stakeholder interactions for major emitters and countries within the regional scope. The structure for thematic interactions, however, remains unchanged.

Stakeholders are essential in shaping the research produced through IAM COMPACT studies. The PRM is the stakeholder engagement strategy designed to ensure that research outcomes are relevant and applicable in policymaking. A range of European and national policymakers were selected to inform on policy priorities representing institutions, industry, and civil society. Within the EU, in each PRM cycle, stakeholders were grouped thematically and, outside the EU, by seven regions. Stakeholders in each PRM cycle were engaged through two phases: Policy Steering Groups and Core Working Groups.

For the EU-focused studies, the second PRM cycle followed the same logic as the first PRM cycle. The first step included consulting the high-level policymakers in Policy Steering Groups to learn about policy priorities and form relevant research questions. This was done at the same time as getting feedback on the studies developed in the first PRM cycle (see more in D2.3 Scoping policy relevant research questions). The discussions and suggestions within Policy Steering Groups directly shaped research questions for the second PRM cycle studies.

To better reflect the evolving oil policy landscape and tailor to the expertise of Core Working Group stakeholders, the four themes for EU-focused studies were revised. After developing the studies, the researchers met with the Core Working Groups to present their findings and discuss potential improvements in the workshops structured around the four themes. Each study had a dedicated breakout room in each of the four workshops to ensure that researchers could get relevant input from relevant stakeholders.

The research teams then further refined the studies by incorporating feedback from the workshops. The final step of the PRM was to create a set of policy briefs based on selected studies from the second PRM cycle. The purpose of the policy briefs was to communicate the research findings, aiming to inform and enhance policymaking. To ensure the quality and relevance of the policy briefs, drafts were shared with stakeholders involved in developing the studies. The policy briefs were published before the end of the project.

For non-EU studies, a template was provided and the non-EU teams used it in the process of drafting their policy briefs.

[1] DOI 10.5281/zenodo.10848974
[2] DOI 10.5281/zenodo.13132343
[3] DOI 10.5281/zenodo.15593966

Funded by the European Union

1.1 Themes and Regions

The EU-focused studies in the second PRM phase were categorised into four themes. This categorisation facilitated relevant stakeholder engagement and reflected evolving policy priorities from the first PRM cycle. For non-EU-focused research, stakeholder engagement and modelling studies are organised by regions. These regions were determined by the non-EU partners in IAM COMPACT.

Themes

Modelling the Clean Industrial Deal

Investigating infrastructure investments needed to enable a clean economy, with a particular emphasis on decarbonising the steel sector.

Global Decarbonisation

Exploring how the EU's trade and climate finance decisions influence its decarbonisation efforts and global impact

Citizens in the Transition

Examining lifestyle changes in mobility, diets, and housing, household decarbonisation, and distributional impacts of climate policies.

Land-use and Renewable Energy

How does the renewable energy transition (solar PV deployment, bioenergy, etc.) impact land use in terms of competition for land, environmental impacts, and social and economic barriers? What are the appropriate policies to alleviate these impacts while creating positive synergies?

Regions

Ukraine

Energy and climate policies in Ukraine in the wake of the war and regarding the rebuilding of Ukraine's infrastructure.

Sri Lanka

Energy and climate policies in Sri Lanka.

Kenya

Energy and climate policies in Kenya.

Ethiopia

Energy and climate policies in Ethiopia.

Mainland China

Energy and climate policies in China.

India

Energy and climate policies in India.

USA

Energy and climate policies in the USA, especially regarding the Inflation Reduction Act.

The deliverable follows the following structure:

Section 2 outlines the stakeholder engagement under each EU policy theme, covering the participants of each Policy Steering Group, the topics discussed, and the policy-relevant research questions that emerged. This is followed by an account of the Core Working Group workshops under each theme and the studies falling under

Funded by the European Union

each team, including the feedback received. Section 3 and Section 4 follow different structure, tailored to the local conditions within the 'major emitter' and the 'non-high-income' non-EU regions. Section 5 outlines lessons learned from the stakeholder engagement in IAM COMPACT.

Funded by
the European Union

2 Themes

Note that the research themes under which the studies were grouped differ between the first and the second PRM cycle. The final feedback on the studies from the first PRM cycle was collected at the same time as the scoping of the research questions for the second PRM cycle (see D2.3 scoping policy relevant research questions[4] for a detailed account of these meetings). Therefore, stakeholder input in Policy Steering groups falls under the themes of the **first PRM cycle**, which were:

Optimal Transition

- Study 1: How does the implementation of the updated draft National Energy and Climate Plans compare to the cost-optimal EU approach?
- Study 2: What are the different cost, energy security and resilience metrics, and how do they compare for different scenarios?

Industry and Innovation

- Study 4: What are the implications of European industry decarbonisation, considering possible off/re-shoring scenarios?
- Study 5: What is the contribution of earlier-stage technologies if they undergo rapid cost reductions?

Global Effects

- Study 3: How could geopolitics affect decarbonisation pathways?
- Study 6: How do interest rates influence decarbonisation pathways?

Behavioural Change

- Study 7: What are the economic impacts of a given behavioural change?

Each study has resulted in a policy brief[5] addressed to policymakers of the themes involved, in which our policy team has transpose technical modelling results in clear policy recommendations.

In the **second PRM cycle**, to better tailor the workshops with Core Working Groups to ongoing policy developments and stakeholders' expertise, the studies were grouped into the following themes:

Modelling the Clean Industrial Deal

- Study 9: The future of a decarbonised European steel industry
- Study 10: Critical grid infrastructure investments to support the EU's 2030 targets

Global Decarbonisation

- Study 8: Global trade dynamics and the EU's decarbonisation efforts
- Study 12: Enabling governance structures for (international) climate finance

Citizens in the Transition

- Study 11: Redistribution mechanisms to balance climate policy impacts
- Study 13: Benefits of clean technologies for households' emissions and costs and policies to support

[4] DOI 10.5281/zenodo.13132343
[5] https://iam-compact.eu/publications/policy-briefs

Funded by the European Union

behavioural change

- Study 14: Lifestyle changes in transport, buildings, and food sectors

Land-use and Renewable Energy

- Study 15: Land-based policies to mitigate impact of the energy transition in land use

This section summarises the outcomes of stakeholder interactions during the second PRM cycle. Firstly, this includes discussions with high-level policymakers interviewed as part of the Policy Steering Groups during the formulation of research questions for the studies. It then provides details on attendees, discussions, and insights from the Core Working Group meetings with technical stakeholders. Finally, it includes information on the last step of the PRM, which involved asking stakeholders for feedback on the final set of policy briefs aiming to communicate research findings for policymaking.

2.1 Policy Steering Groups

The policy steering groups provided the initial research questions for the Second Cycle of PRM. During the meetings, project partners shared key findings from the first cycle studies to update stakeholders on the project's progress to date. Stakeholders were then invited to reflect on how useful the first-cycle studies were for their own work, to suggest possible improvements, and to highlight any ongoing policy debates in which the results might be particularly relevant. They were also asked whether further extensions of the first cycle studies would add value.

In a broader sense, policymakers were encouraged to propose additional research questions for the second cycle, with a particular focus on the changing EU policy landscape shaped by the newly elected European Commission. This process enabled the PSGs to give feedback on the first cycle, recommend refinements and extensions for the second, and contribute fresh, policy-relevant research questions.

2.1.1 Optimal Transition

IAM COMPACT partners held individual calls with each of the organisations listed in **Table 1**.

Dates: 2024-06-20; 2024-06-24; 2024-06-28.

Table 1. Policy Steering Group in the Optimal Transition theme.

Organisation	Name	Position
DG ENER, European Commission	Derck Koolen	Chief Economist Unit
DG ENER, European Commission	Clement Serre	Chief Economist Unit
ACER Agency for the Cooperation of Energy Regulators	Francois Beaude	Strategy Lead
ACER Agency for the Cooperation of Energy Regulators	Patrick Luickx	Team Leader Market Monitoring
Department of the Environment, Climate and Communications (DECC), Ireland	Paul Kenny	Special Adviser to Minister Eamon Ryan
ENTSO-E	Alban Joyeau	Adequacy Manager
IAM COMPACT Partners		
Bruegel	Conall Heussaff	
Bruegel	Ugne Keliauskaite	
Bruegel	Georg Zachmann	

Aalborg University	Rasmus Johannsen	
BC3	Dirk-Jan van de Ven	
BC3	Claudia Rodes	

Discussion

Suggested research questions for the studies in the second PRM cycle:

- What are the investment needs for different energy system solutions and configurations? Can we estimate the costs associated with security, resilience, and flexibility?
- How does the evolving geopolitical context impact energy system security, resilience, flexibility, and costs (e.g., high trade tariffs, disrupted supply chains, or limited critical raw materials)?
- How do various redistribution instruments, like windfall taxes and carbon dividends, affect market outcomes?
- How do energy system investments influence costs for different consumer types, including energy, network, and tax costs?
- How do national model outputs in Europe compare to the 2030 renewable energy source (RES) and energy efficiency (EE) targets, and which countries appear to be on track?
- What are the transmission capacity needs within and between countries? Which countries need the most investment in transmission and cross-border connections?
- What market mechanisms can effectively incentivise components of a decarbonised energy system?
- How much is electricity demand expected to increase to achieve net-zero emissions, and what implications does this have for grid investment? How will average prices change, and what will be the impact on price volatility?
- What are the expected levels of renewable energy curtailment, and what are the reasons for it?
- Can we build grids quickly enough to meet renewable targets? What governance framework can promote coordinated planning and funding across Member States?
- How can we encourage flexible electricity consumption? What types of electricity contracts should be offered?
- What is the best way to spread the costs of capital expenditure investments over time and among consumers?
- How can we subsidise electricity costs for specific consumers while ensuring an efficient power system, promoting energy-efficient and flexible consumption?
- Can we scale decentralised flexibility models, like demand response, across the EU?
- Are European energy efficiency targets feasible, and what technologies or policies are required to meet them?
- Can integrated assessment models capture energy market dynamics to identify suitable policy instruments for clean technology investments?
- What policies and economic conditions best facilitate the deployment of key clean technologies like electrolysers, batteries, and electric vehicles (EVs)?
- What is the efficient method for redistributing carbon revenues to achieve societal welfare and decarbonization goals?
- What technology mix can provide long-term seasonal flexibility, and what are the benefits of explicit versus implicit demand-side responses?
- What are the offshore grid investment needs to achieve the EU's 2030 targets?

2.1.2 Industry and Innovation

Dates: 2024-07-03; 2024-07-04; 2024-07-05

Table 2. Policy Steering Group in the Industry and Innovation theme.

Organisation	Name	Position
European Commission, DG COMP	Philipp Dimakopoulos	Chief Economist Unit
European Commission, DG CLIMA	Stefaan Vergote	Adviser, Innovation for a Low-Carbon, Resilient Economy Unit
European Commission, DG BUDG	Peter Zapfel	Energy and Climate Policy Adviser
IAM COMPACT Partners		
Bruegel	Conall Heussaff	
Bruegel	Ugne Keliauskaite	
Bruegel	Georg Zachmann	
WI	Georg Holtz	
WI	Alexander Jülich	

Discussion

Suggested research questions for the studies in the second PRM cycle:

- Where might steel production relocate within the EU under different subsidies and support for green steel?
- How much steel should Europe produce locally to balance security, competitiveness, and cost? Additionally, what amount of relocation (both within the EU and outside) is economically viable?
- What intermediates might we import, such as green hydrogen and direct-reduced iron? In what quantities, at what costs, and with what carbon levels? How would these imports impact EU steelmaking?
- What is the effect of cheaper imported intermediates on the EU green steel value chain and the value added?
- When comparing targeted support to broad subsidies, which approach is more beneficial for low-carbon steel, and at what cost?
- What are the country-specific differences in decarbonization paths across Member States? How do factors like power prices, resources, industrial bases, and policy capacity contribute to these variations?
- With regards to circularity, what are the benefits and limitations of increased scrap usage, recycling, and material efficiency?
- In terms of energy needs, how much electricity and renewable fuel of non-biological origin (RFNBOs) would a decarbonised steel and industrial sector require? What implications would this have for energy grids and infrastructure?
- Regarding innovation tools, which instruments—such as Contracts for Difference (CCfDs), standards, public procurement, Important Projects of Common European Interest (IPCEIs), and tax credits—are most effective in driving new technology and deployment?
- Should policy shift more towards support for deployment if clean technology becomes cheaper at a faster rate?
- How would a world characterised by high tariffs between the US and China impact EU steel, and is the CBAM resilient in this context?

2.1.3 Global Effects

Dates: 2024-07-11; 2024-07-15; 2024-07-24

Table 3. Policy Steering Group in the Global Effects theme.

Organisation	Name	Position
Former European Commission, DG TRADE	Ignacio Garcia Bercero	Former Director

ECB	John Hutchinson	Principal Economist
ECB	Carolin Nerlich	Senior Lead Economist
National Bank of Belgium	Thomas Stoerk	Climate Economist
IAM COMPACT Partners		
Bruegel	Conall Heussaff	
Bruegel	Ugne Keliauskaite	
Bruegel	Georg Zachmann	
NTUA	Natasha Frilingou	
CICERO	Shivika Mittal	

Discussion

Suggested research questions for the studies in the second PRM cycle:

- What actions can the EU take to reduce financing costs in developing countries?
- Which countries (e.g., Latin America, India, Indonesia) are best positioned to supply key green technologies, and does geographic proximity play a role?
- How realistic are the manufacturing targets set by the Net Zero Industry Act?
- How would increased trade tariffs for sectors such as solar, electric vehicles (EVs), and green steel influence Europe's decarbonization efforts? Which factors are most significant for emissions?
- What impact do varying global carbon prices have on EU carbon leakage and overall global decarbonisation? (Assess against findings that suggest limited effects.)
- What additional policy tools beyond CBAM could encourage low-carbon production of essential goods and technologies?
- What are the implications of smooth versus abrupt policy implementation for investment and outcomes?
- How would the completion of this research initiative alter risk perceptions and enhance investment by reducing uncertainty?
- How much funding is expected to flow from advanced to developing economies, and through which channels can this funding facilitate the transition?
- How do foreign exchange risk, interest rates, and capital flow restrictions in developing countries impact renewable investment and mitigation costs?
- What best practices can be employed to de-risk clean energy projects in developing countries, drawing on lessons from EU-Chile green hydrogen agreements?
- What would be the impact and optimal design of a European fund aimed at supporting decarbonisation investments in the developing world?
- How could targeted de-risking initiatives in specific Western or European partner countries expedite the transition?

2.1.4 Behavioural Change

Dates: 2024-07-03; 2024-07-08; 2024-07-11

Table 4. Policy Steering Group in the Behavioural Change theme.

Organisation	Name	Position
European Commission, DG ENER	Tadhg O'Briain	Deputy Head of Unit, Consumers, Local Initiatives, Just Transition
IEA	Emma Mooney	Energy Analyst
JRC	Emanuele Ciriolo	Head of Competence Centre on Behavioural Insights
JRC	Hendrick Bruns	Competence Centre on Behavioural Insights
JRC	Mario Scharfbillig	Science for Policy Analyst

IAM COMPACT Partners		
Bruegel	Conall Heussaff	
Bruegel	Ugne Keliauskaite	
BC3	Jon Sampedro	
UVa	Gonzalo Parrado Hernando	
BC3	Dirk-Jan van de Ven	

Discussion

Suggested research questions for the studies in the second PRM cycle:

- What are the system-level emissions and cost impacts? Can we quantify the benefits for consumers versus the system (i.e., individual-frame vs. system-frame)?
- What emissions, cost savings, and resilience benefits can we achieve through the widespread and efficient use of heat pumps and managed EV charging? How do implicit and explicit demand-side responses compare?
- What are the costs associated with supporting behaviour change in the building sector (e.g., grants, advice), and how does this impact affordability for citizens? How do the effects vary by socioeconomic group?
- How do upgrades to building fabric compare with technology replacements (e.g., heat pumps) in terms of emissions, total costs (CAPEX + OPEX), comfort, and required behaviour change?
- What emissions and cost benefits arise from shifting trips to walking, cycling, public transport, and electric vehicles (EVs)?
- When dietary habits change, what agricultural and land-use adjustments are necessary, and what are the associated environmental and economic impacts?
- How do the evolving energy use profiles of households and businesses (peak shifting and electrification) affect emissions, system costs, and reliability?
- How do differences in diet, transport, and building preferences across EU demographics and regions influence the outcomes of green behaviour policies?

2.1.5 Transforming suggested research questions into modelling studies

The series of meetings with the Policy Steering Groups (PSGs) in June and July 2024 marked the end of the first PRM cycle and enabled a seamless transition into the beginning of the second. Within each PSG, modellers first communicate the scope and limitations of integrated assessment models (IAMs) and, together with policymakers, co-create research questions under each policy theme. These questions are designed to capture both long-term priorities and near-term policy challenges. The modellers then translate the questions into researchable problems, clustering them into modelling studies. At this stage, Core Working Groups (CWG) are formed, composed of 10–20 technical stakeholders from policy, industry, and civil society, in order to provide a broader and more applied expertise base. In collaborative workshops, these core working groups refine the proposed studies, map the policy questions onto IAM frameworks, and co-design scenarios to be analysed. Based on this design, the modellers conduct a first iteration of multi-model analyses, the results of which are disseminated back to the core working groups. Stakeholders are invited to interpret findings, highlight gaps, and provide structured feedback, which then informs a second round of modelling exercises. This iterative process increases robustness and alignment with stakeholder needs, while also strengthening the relevance of the analysis. A second round of results is subsequently shared with the core working groups to ensure that the co-created knowledge reflects both technical modelling insights and stakeholder perspectives. In the final stage, results are synthesised and disseminated back to the policy steering groups, where targeted policy briefs are co-produced with policymakers under each policy theme, ensuring that the outcomes are actionable and directly relevant to policy agendas.

Funded by
the European Union

Altogether, the PSGs of the 2nd PRM put forward 46 research questions. An important element of the PRM was to translate all these thematic questions into seven new modelling studies, which were linked to the themes of the core working groups (see Figure 1). One additional core working group was hosted upon request of partner (land use and renewable energy) and is therefore not reflected in Figure 1. These preliminary scenario designs were later presented to the Core Working Groups (CWGs) – see section 2.2 below - for joint review and co-design across four workshops.

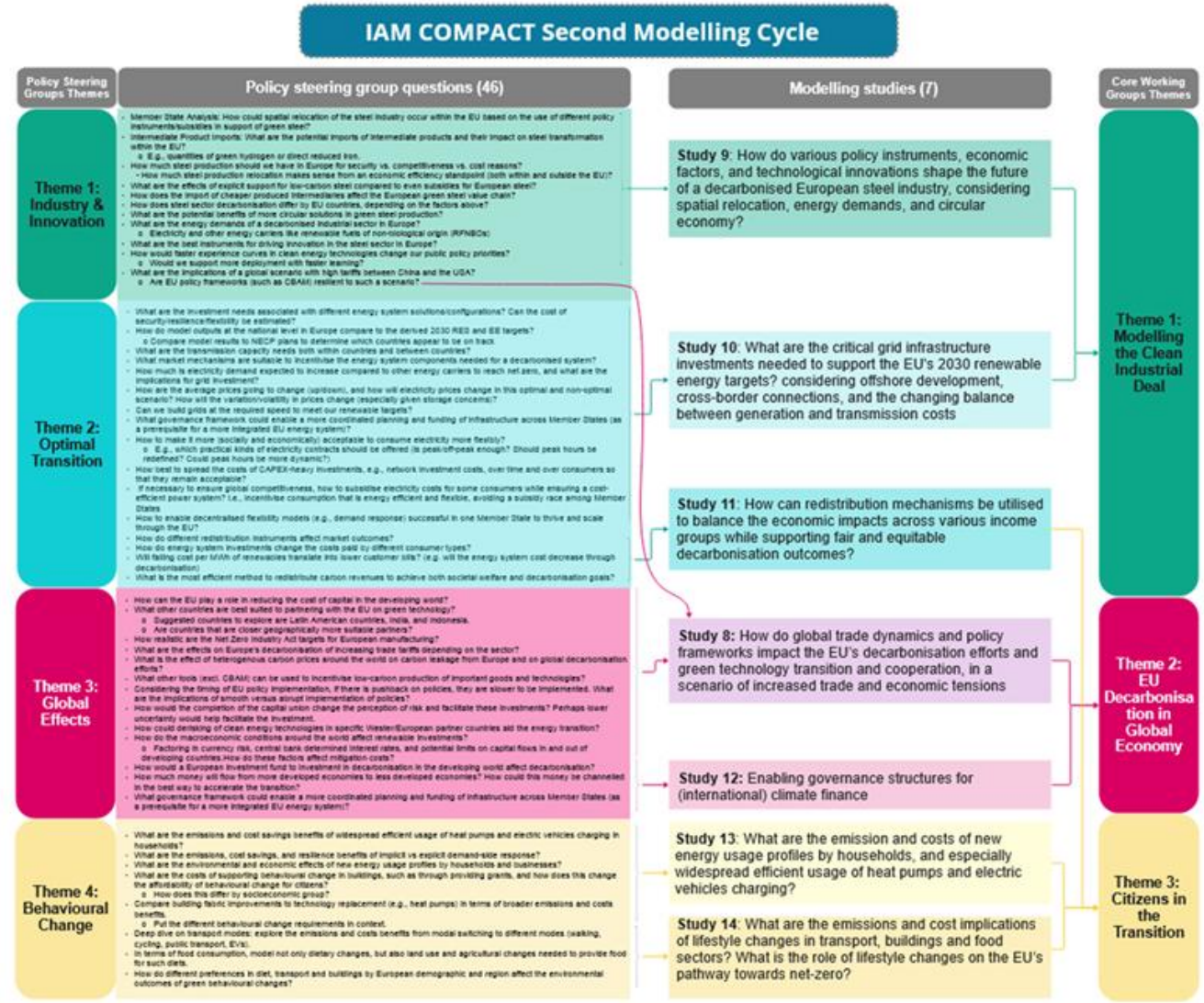

Figure 1 Transforming RQ into modelling studies

Our PRM builds on, but also extends, established participatory modelling and stakeholder engagement approaches. It resonates with the co-production of knowledge (Lemos & Morehouse, 2005; Norström et al., 2020), which stresses joint problem definition and iterative feedback between scientists and stakeholders, as well as with participatory integrated assessment (van Asselt & Rijkens-Klomp, 2002; Kok et al., 2007), which seeks to enhance the legitimacy and usability of IAMs by involving stakeholders in framing and interpreting results (Nikas et al., 2017). Similarly, the approach draws on traditions of scenario co-design and deliberation (Kemp-Benedict, 2012; Schweizer & Kriegler, 2012), where stakeholders guide scenario development to ensure plausibility, and on iterative participatory modelling frameworks (Voinov & Bousquet, 2010; Reed et al., 2014), which emphasise continuous iteration, trust-building, and joint learning. It also aligns with efforts to elicit policy needs in IAMs through stakeholder engagement (Frame et al., 2018; McDowall et al., 2014), highlighting the translation of policy demands into modellable research questions. The innovative contribution of the PRM lies in explicitly linking policy steering groups, which provide high-level agenda-setting input, with core working groups, which contribute

technical and implementation-oriented expertise. This two-layered feedback structure ensures that both strategic and operational policy priorities are integrated into the modelling cycle, thereby enhancing the policy salience, legitimacy, and credibility of IAM-based insights.

2.2 Core Working Groups

2.2.1 Global Decarbonisation

Date: 2024-11-28

Setup

The workshop on ***Global Decarbonisation*** started with a brief introduction of IAM COMPACT and the aims of the workshop set by Bruegel. The study leads then outlined the background and approach of two studies before splitting into breakout sessions with key stakeholders focused on two themes: "trade" and "finance".

Stakeholders in the "trade" breakout room discussed Study 8, led by Imperial – How do global trade dynamics and policy frameworks impact the EU's decarbonisation efforts and green technology transition and cooperation, in a scenario of increased trade and economic tensions?

Stakeholders in the "finance" breakout room discussed Study 12, led by NTUA – Enabling governance structures for (international) climate finance.

Table 5. Global Decarbonisation Core Working Group by breakout room.

Name	Organisation	Position
Trade Breakout Room		
Jacopo Tattini	DG GROW	Policy Officer
Alessandro Antimiani	DG TRADE	CGE Modeller and Trade Analyst
Indre Vaicekauskaite	DG TRADE	Policy Officer, Trade and Climate Policy
Mykyta Sobko	BEUC - The European Consumer Organisation	International Affairs, Policy Officer
Mélanie Auvray	European Heat Pump Association	Policy Manager
Maria Assumpció Rojo Torrent	Hydrogen Europe	Director, Trade and International Relations
Sandra Maria Hanni	International Chamber of Commerce	Global Policy Lead - Trade & Climate
Carmen Correas Lopez	SolarPower Europe	Policy Advisor
Marushia Gislén	World Economic Forum	Community Lead, Europe and Eurasia
Ellie Belton	E3G	Senior Policy Advisor
Bessie Noll	ETH	Researcher
Claudia Azevedo	Europe Jacques Delors	Policy Analyst
Louise Mollenhauer	Heinrich-Boll Stiftung	Head of Programme for Climate, trade and Agricultural Policy
Franziska Grüning	T&E	Raw Materials Officer
Julia Poliscanova	T&E	Senior Director, Vehicles & Emobility Supply Chains
Finance Breakout Room		
Joachim Monkelbaan	KAPSARC	Senior Fellow, Climate and Sustainability
Francesco Lombari Stocchetti	Bellona	Policy Advisor, Sustainable Finance and Economy
Fabio Passaro	Climate Bonds Initiative	Senior Transitions Policy Analyst

Paul Waidelich	ETH	PhD Researcher
Sarah Bendahou	I4CE	Research Fellow – Development finance
Elise Dufief	IDDRI	Senior Research Fellow, Financing Sustainable Development
Carsten Elsner	Wuppertal Institute	Researcher, Global Climate Governance
IAM COMPACT Partners		
Conall Heussaff	Bruegel	
Alaa Al Khourdajie	Imperial	
Natasha Frilingou	NTUA	
Alexandros Nikas	NTUA	
Lorenzo Rinaldi	POLIMI	
Konstantinos Koasidis	NTUA	

Discussion

1. In the breakout room on **trade,** three themes emerged:

- Trade restrictions and decarbonisation: What are the expected short- and long-term implications of restricted trade with China and the United States for the EU's decarbonisation objectives? Which economic, environmental, and technological indicators are most relevant to track these impacts?
- Alternative partnerships for green technology: Which countries are best positioned to supply the EU with critical green technologies? Could Latin American countries, India, or Indonesia be viable partners? Should trade partner selection be driven primarily by geography, productive capacity, or other factors such as resource availability and skills?
- Scenario uncertainties and policy relevance: What are the most critical uncertainties in these scenarios? How should these be addressed when interpreting results, and how might this shape effective policy responses?

Stakeholders pointed out that:

- Trade restrictions are likely to raise costs for green technologies, with consumers bearing much of the burden, potentially slowing technology adoption.
- Expanding manufacturing within the EU could lower lifecycle emissions due to the low CO_2 intensity of the European electricity mix. At the same time, reduced reliance on a narrow set of trade partners could promote circularity, resource efficiency, and recycling.
- Carbon intensity, renewable resource endowment, and skilled labour availability matter more than geography in identifying suitable partners.
- Economic stability and supportive policy frameworks in partner countries are essential for long-term cooperation. Therefore, geopolitical, technological, and market uncertainties should be integrated into scenario design or addressed explicitly in narrative interpretation.
- IAMs should incorporate technological learning and could be extended to upstream supply chains for a fuller picture of risks and opportunities.
- Suggested introducing contrasting scenarios for analysis: open trade with diversified partnerships that imply global market access and multiple suppliers, reducing concentration risk, versus geopolitical tension with domestic or allied production, which means prioritising self-reliance but may increase costs and slow deployment.

2. In the breakout room on **finance,** three themes were discussed with the stakeholders:

Aligning the NCQG with the Needs of Vulnerable Countries:

- Stakeholders emphasised that the New Collective Quantified Goal (NCQG) must be based on a better understanding of vulnerable and developing countries' priorities—something currently hindered by the lack of an agreed definition of "vulnerability" and by the tendency to assume recipient needs rather than

assess them systematically.

- Concerns were raised over accounting inconsistencies, with not all pledged funds reaching intended recipients, and a limited distribution network in the most climate-affected regions. Mapping the global climate finance landscape—including sources, allocations, and overlaps—was proposed as a way to track fund flows, avoid duplication, and identify gaps.
- Stakeholders also called for greater transparency in bilateral, regional, and national funding channels, fairer distribution mechanisms, and stronger links between national, regional, and global funds. The Climate Policy Initiative's methodology for combining top-down and bottom-up needs assessments was cited as a strong reference point. Within the EU, more stringent regulations and potentially a dedicated EU fund were suggested to ensure credible commitments.

Reforming the Climate Finance System:

- It was suggested that a starting point for the study could be the evaluation of existing funds (e.g., the Green Climate Fund) to identify structural bottlenecks. Japan's Climate Transition Bonds were presented as a good practice, despite past pricing issues in green bonds for developing economies, showing that sovereign-level instruments can complement corporate finance tools.
- Potential of results-based finance, carbon credit trust-building via mechanisms like the Pilot Auction Facility, and taxonomies to help private investors identify eligible activities. The role of smaller actors, such as national and regional development banks, should be strengthened alongside better coordination among providers.
- Caution was expressed over aggregating finance sources with different levels of efficiency, and recognition that a global taxation scheme remains politically blocked by the G20. In the EU, the next Multiannual Financial Framework negotiations in late 2025 were identified as a key opportunity to embed climate finance reforms. The European Hydrogen Bank was cited as a positive example of targeted financing.

Several policy instruments were highlighted for unlocking finance:

- results-based finance for measurable impact and accountability;
- green and climate bonds for developing economies, with design improvements to address past pricing challenges;
- designing emission-based contributions from high-emitting companies;
- debt-for-climate swaps to ease fiscal pressure;
- CBAM-type measures adapted to developing country contexts;
- value-chain decarbonisation finance to target industrial emissions step-by-step;
- mapping EU fund recipients and strengthening climate finance networks.

The discussion emphasised that scaling climate finance is not only about mobilising more capital, but also about trust, governance, and precise targeting. Clear definitions of vulnerability, rigorous tracking of fund flows, diversification of financing instruments, and deeper integration between local and global frameworks are seen as prerequisites for an NCQG that is both credible and operational.

Overall Takeaways

- Discussion on Study 8 emphasised the importance of diversifying green technology partnerships beyond geography, while accounting for higher costs from trade restrictions and integrating geopolitical and market uncertainties into scenario design.
- Discussion on Study 12 stressed the need for clear vulnerability definitions, transparent fund tracking, and diversification of targeted financing instruments to strengthen credibility and trust.

Both discussions underscored the importance of diversification, transparency, and resilience to uncertainty when designing strategies that balance ambition with real-world economic and policy constraints.

Funded by
the European Union

2.2.2 Modelling the Clean Industrial Deal

Date: 2025-12-04

Setup

The workshop on ***Modelling Clean Industrial Deal*** began with a brief introduction of IAM COMPACT and the aims of the workshop that Bruegel set. The study leads then briefly presented the background and approach of two studies before splitting into breakout sessions with key stakeholders focused on two key themes: "infrastructure" and "steel".

Stakeholders in the "**infrastructure**" breakout room discussed Study 10, led by NTUA – Updated NECPs and Cost-Optimal Pathways: How do the updated NECPs compare to a cost-optimal pathway for achieving EU climate targets, considering grid infrastructure, offshore development, cross-border connections, and generation-transmission cost balance?

Stakeholders in the "**steel**" breakout room discussed Study 9, led by WI – Decarbonising the Steel Industry: How do policies influence the pathway to a decarbonised European steel industry, affecting energy demand, CO_2 emissions, and the industry's geographical shifts within the EU and globally?

Table 6. Modelling Clean Industrial Deal Core Working Group by breakout room.

Name	Organisation	Position
Infrastructure Breakout Room		
Patrick Luickx	ACER	Team Leader Market Monitoring
Manuel von Mettenheim	DG ENER	Energy economist
Alberto Toril Castro	Breakthrough Energy	Director, Europe
Ewan Ramsay	CurrENT	Policy and Communications Officer
Abi Afthab Olikathodi	Eurelectric	Policy Advisor
Raffaele Rossi	SolarPower Europe	Head of Market Intelligence
Martin Roach	European Association for Storage of Energy	Senior Energy Analyst
Marija Dabrisiute	WindEurope	Senior Advisor, Electrification and Renewable Hydrogen
Nicolai Bech Kofoed	Concito	Senior Analyst
Vilislava Ivanova	E3G	Research Manager
Elisabeth Cremona	Ember	Senior Energy Analyst
Zsuzsanna Pato	Regulatory Assistance Project	Senior Advisor
Juliette Egal	T&E	Analyst
Elisabetta Cornago	Centre for European Reform	Senior Research Fellow
Phuc-Vinh Nguyen	Jacques Delors Institute	Research Fellow
Krzysztof Bocian	Wise Europa	Senior Analyst
Steel Breakout Room		
Hadi Yassin	CEFIC	Climate and Energy Modelling Officer
Ioana Petcu	Eurelectric	Advisor - Climate Change
Abi Afthab Olikathodi	Eurelectric	Senior Analyst - Energy Data & Scenarios
Jonathan Tavenier	European Aluminium	Climate and Energy Policy Assistant
Marton Antal	Hydrogen Europe	Policy Officer
Megan Anderson	Agora	Senior Associate
Lidia Tamellini	Carbon Market Watch	Expert on EU Industrial Decarbonisation
Edoardo Righetti	CEPS	Researcher, Energy, Resources and Climate Change Unit

Aleksandra Waliszewska	E3G	Senior Researcher
Ysanne Chokey	E3G	Policy Advisor
Carolina Bedocchi	ECCO	Researcher, Industry
Oliver K. Saltoft	ECF	Senior Associate, Industry and Innovation
Eileen Torres Morales	Stockholm Environment Institute	Research Associate, Industry
Maciej Giers	Wise Europa	Analyst
IAM COMPACT Partners		
Conall Heussaff	Bruegel	
Ugne Keliauskaite	Bruegel	
Natasha Frilingou	NTUA	
Georg Holtz	WI	
Alexandre Torne Diaz De Heredia	UNIGE	
Shivika Mittal	CICERO	
Alexander Jülich	WI	
Lorenzo Rinaldi	SESAM	
Russell Horowitz	BC3	
Dirk-Jan Van De Ven	BC3	

Discussion

1. In the breakout room on **steel decarbonisation,** the discussion centred around:

Discussing scenario design and modelling approaches:

- exploring ways in which modelling could better illustrate the role of secondary steel production in reducing emissions;
- discussing the setup of "CBAM_green" scenario to assess the impact of a Carbon Border Adjustment Mechanism, such as modelling financial support;
- giving technical inputs on how to incorporate detailed process-level changes in steelmaking and the potential influence of scrap availability and quality.

Proposing policy instruments to incentivise and de-risk investment in green steel:

- direct investment support through EU and national funds;
- subsidies for green hydrogen and low-carbon electricity to lower operational costs;
- establishment of an electrification bank and auctions as a service to aid scale-up;
- strategic utilisation of cohesion funds and long-term Power Purchase Agreements (PPAs) to secure price stability;
- Carbon Contracts for Difference (CCfDs) to provide revenue certainty and promote first-mover projects;
- creation of green lead markets and sector-specific content requirements — for example, mandating green steel in automotive manufacturing;
- combined CAPEX and OPEX support to tackle both initial capital costs and ongoing operational expenses.

2. In the breakout room on **energy infrastructure**, the discussion focused on:

Discussing scenario design:

- expressed caution against modelling based too literally on announced plans, given their tendency to shift;
- suggested allowing for model-driven optimisation alongside policy inputs;
- minimal focus on technical modelling details, moving quickly to policy instruments;

Exploring policy instruments and how to model them:

- stressed the importance of mechanisms like green lead markets;
- pointed to challenges of translating real-world instruments (taxes, electrification banks, auctions) into model parameters
- noted that many instruments may converge in their modelling effects, even if they differ in implementation

Suggesting indicators to assess the impact of decarbonised electricity:

- Economic: wholesale and retail energy prices, system-level costs, upfront investment requirements, annual and cumulative carbon budgets.
- Environmental: improvements in air quality linked to reduced fossil fuel use.
- Electricity/grids: household electricity bills, temporal price volatility, network tariff design, origin and availability of natural gas, and a detailed breakdown of transmission and storage costs.
- Social: share of prosumers, changes in energy poverty rates, and co-benefits of integrating renewable energy systems.

Integrating competitiveness and resilience into modelling frameworks:

- competitiveness: the need to track the fossil fuel versus clean energy cost share in electricity bills, sector-by-sector cost comparisons, regional price variations over time, and renewable energy penetration alongside residual load profiles;
- resilience: net imports of energy and dependence on critical raw materials.

Addressing key uncertainties for policy planning in achieving the Fit-for-55 and net-zero targets:

- the political nature of NECPs, and frequent reforms to the electricity market design.
- assumed commodity prices (which significantly impact results);
- market dynamics: potential for sector coupling (electricity, heat, mobility) to improve flexibility and cost efficiency; development of ancillary services markets;
- technology deployment: varying electrification rates, risk of stagnant demand, and limited system flexibility;
- external factors: trade tensions, access to clean technologies, volatility in hydrogen and fossil fuel prices, and climate-driven changes in electricity demand (e.g. cooling needs);
- acknowledged the need for post-meeting reflection to digest complex links between real-world tools and modelling assumptions.

Overall Takeaways

- Study 9 highlighted the importance of integrating economic, technical, and social indicators in modelling steel decarbonisation, while considering system volatility and structural uncertainties.
- Study 10 stressed the importance of adopting a flexible approach to scenario design, avoiding rigid reliance on volatile policy announcements.

Both discussions emphasised the challenge of balancing policy complexity and model simplification, especially when translating various instruments into consistent modelling inputs. A key shared insight was the need to balance model optimisation with real-world constraints and policy variability.

Policy Briefs

Both studies were developed into policy briefs to communicate the research findings concisely and clearly to policymakers. The drafts of the policy briefs were shared with the participants of the Core Working groups. Feedback was received from stakeholders on **Table 7.**

Table 7. Stakeholders providing feedback on studies on the Modelling Clean Industrial Deal theme.

Name	Organsiation	Position
Infrastructure reviewers		
Patrick Luickx	ACER	Team Leader Market Monitoring
Manuel von Mettenheim	DG ENER	Energy economist
Vilislava Ivanova	E3G	Research Manager
Elisabeth Cremona	Ember	Senior Energy Analyst
Steel reviewers		
Hadi Yassin	CEFIC	Climate and Energy Modelling Officer
Ioana Petcu	Eurelectric	Advisor - Climate Change
Carolina Bedocchi	ECCO	Researcher, Industry
Maciej Giers	Wise Europa	Analyst
Edoardo Righetti	CEPS	Researcher, Energy, Resources and Climate Change Unit

Both studies were very well received by the stakeholders, praising the quality of the research. Feedback for Study 10 included adding clarification on how electricity trading is modelled, especially regarding commercial transmission capacity. High price levels in specific scenarios were questioned, given unchanged nuclear capacity. The reviewers also recommended providing more detail on the nature of grid upgrades and assessing the impact of added flexibility through simulations. It was advised to relocate the scenario definition table from the annexe to the main text to enable side-by-side comparison of components, making the key messages more straightforward to understand.

For Study 9, reviewers found the scenarios plausible but questioned the heavy reliance on CCS in steel production, noting limited industry interest and potential public acceptance issues for large-scale CO_2 storage in some regions. Another recommendation is to make the roles of renewable energy, grids, and flexibility more explicit, emphasising the need for policy coordination to secure a clean energy supply and avoid overdependence on CCS. Reviewers also raised questions about the decline in iron production, potential targeted hydrogen support, and measures to mitigate price impacts. A clarification was sought on whether the reported electricity prices were wholesale or final, and on the assumptions behind their rapid decline by 2050. Lastly, interest was expressed in exploring the model's sensitivity to lower ETS costs and varying energy prices, based on their own sector-specific modelling work.

2.2.3 Citizens in the Transition

Date: 2024-12-05

Setup

The workshop on ***Citizens in the Transition*** began with a brief introduction of IAM COMPACT and the aims of the workshop that Bruegel set. The study leads then briefly presented the background and approach of three studies before splitting into breakout sessions with key stakeholders focused on three key themes: "redistribution", "households" and "lifestyle".

Stakeholders in the "redistribution" breakout room discussed Study 11, led by BC3 – How can redistribution mechanisms be utilised to balance the economic impacts across various income groups while supporting fair and equitable decarbonisation outcomes?

Stakeholders in the "household" breakout room discussed Study 13, led by UPRC – What are the emissions and costs of new energy usage profiles by households, and especially widespread efficient usage of heat pumps and electric vehicles charging?

Stakeholders in the "lifestyle" breakout room discussed Study 14, led by UVa – What are the emissions and cost

implications of lifestyle changes in transport, buildings and food sectors? What is the role of lifestyle changes in the EU's pathway towards net-zero?

Table 88. Citizens in the Transition Core Working Group by breakout room.

Name	Organisation	Position
Redistribution Breakout Room		
Matthias Weitzel	JRC	Economics of Climate Change, Energy and Transport
Ruth Shortall	JRC	Project Officer
Eleanor Scott	Carbon Market Watch	Expert on EU Carbon Markets
Eva Jungling	Bruegel	Research Assistant
Flora Dicke	Ecologic Institute	Researcher
Iryna Holovko	Adelphi	Advisor
Johanna Cludius	Oeko-Institut	Senior Researcher
Household Breakout Room		
Giulia Dangiolini	IEA	Energy Efficiency Policy Analyst
Mine Isik	IEA	Energy Efficiency Policy Analyst
Essam Elnagar	Buildings Performance Institute (BPIE)	Data Analyst
Leah Le Penuizic	SolarPower Europe	Junior Market Analyst
Veerle Beelaerts	European Heating Industry	Head of Technology
Erman Erogan	CAN Europe	Buildings Policy & Campaign Assistant
Thomas Trevisan	ECOS	Programme Manager for the Built Environment
Lifestyle Breakout Room		
Chiara Gioia	JRC	
Claudio Costanzo	JRC	
Nives Della Valle	JRC	Scientific Project Officer
Jacques Lovell	Cycling Industries Europe	Cycling Manager
Silvia Livoni Colombo	Bike Hub (Bikeconomy Osservatorio)	Vice President & Marketing Expert
Ana Berdzenishvili	EPC	Junior Policy analyst
Emma Bergeling	IEEP	Policy Analyst
Katarina Axelsson	Stockholm Environment Institute	Senior Policy Fellow
Laura Rayner	EPC	Senior Policy Analyst
IAM COMPACT PARTNERS		
Conall Heussaff	Bruegel	
Ugne Keliauskaite	Bruegel	
Rutger Broer	Bruegel	
Natasha Frilingou	NTUA	
Natalie Wergles	UVa	
Gonzalo Parrado Hernando	UVa	
Dirk Jan van de Ven	BC3	
Xaquin GM	BC3	
Claudia Rodes	BC3	
Alexandros Nikos	NTUA	
Nikos Kleanthis	UPRC	
Vasilis Stavrakas	UPRC	
Juan Perez Marcos	UVa	

Funded by the European Union

Discussion

1. In the breakout room on **distributional** impacts, the discussion centred around:

Discussing scenario design and modelling approaches:

- suggested decomposing Fit-for-55 into constituent policies (EPBD, vehicle standards) and testing counterfactuals such as delayed ETS II implementation;
- identified the need to compare "policies-in-place" baselines with more ambitious and counterfactual scenarios to make equity effects visible;
- flagged indirect impacts of carbon pricing (pass-through into goods/services) that current setups may under-capture;
- raised digitalisation constraints (e.g., lack of internet for smart metering) as real-world frictions models should reflect;
- suggested treating green public goods explicitly in scenarios (e.g., shared infrastructure or services).

Clarifying and expanding redistribution mechanisms:

- identified a shortlist of instruments to test systematically — tax rebates, lump-sum transfers, targeted allowances, and energy-poverty supports;
- suggested comparing the incidence and effectiveness of each mechanism across income deciles and household types;
- flagged the importance of transparency on who pays and who benefits under each policy package.

Specifying distributional indicators and outputs:

- suggested tracking energy-poverty rates, household energy expenditures, and disposable-income impacts by income/age/region;
- identified additional social dimensions (e.g., digital access, housing tenure) not yet captured in previous work;
- raised the need to present results at multiple granularities (EU, national, vulnerable groups) to inform policy design.

2. In the breakout room on **household** decarbonisation, the discussion focused on:

Embedding realism and context in modelling:

- suggested integrating contextual drivers of the pace of household decarbonisation — climate zone, policy environment, infrastructure availability, housing stock characteristics;
- identified adoption barriers (upfront costs, split incentives, information gaps) that models should represent to avoid overly optimistic uptake;
- flagged climate-change impacts on energy demand (e.g., heatwaves increasing cooling needs; cold snaps increasing heating) as key sensitivities;
- raised alignment with household preferences and financial capabilities as a prerequisite for credible pathways.

Linking policy options across governance levels:

- suggested assessing EU-level options for residential decarbonisation and their household impacts within Fit-for-55;
- identified national-level levers to address barriers (targeted subsidies, low-interest finance, rental-sector instruments);
- flagged the need to connect global best-practice policies to EU/national implementation constraints.

Improving segmentation and heterogeneity:

- suggested refining modelling by demographics (age, income), region, and dwelling type to reflect

different energy profiles;
- identified the value of distinguishing flexible versus inelastic household consumption to capture behavioural and tariff responses.

3. In the breakout room on **lifestyle changes**, the discussion centred around:

Prioritising lifestyle levers and their co-benefits:

- suggested ranking mobility, housing, and diet actions: living car-free, shifting to public transport, fuel-efficient driving; downsizing living space and extending lifetimes of goods/buildings; reducing meat consumption and food waste;
- identified health and community co-benefits as essential to report alongside emissions and cost outcomes;
- flagged the role of social norms and consumer behaviour in enabling uptake, beyond price signals.

Modelling system interactions and tariff design:

- suggested analysing how new consumption patterns affect system costs and emissions (load profiles, peaks, residual demand);
- identified two-part tariffs as a way to incentivise flexible consumption while protecting consumers;
- raised the need to model flexible vs. inelastic household demand explicitly.

Framing results and implementation realism:

- suggested presenting results relative to policy targets and clearly stating realism limits and assumptions;
- identified the need to cost implementation measures (e.g., subsidies for renovations, support for walking/public transport) and reflect administrative feasibility;
- flagged the importance of stating whether actions rely on individuals ("i-frame") or societal/system changes ("s-frame"), and testing graduated degrees of lifestyle change.

Overall Takeaways

• Household decarbonisation pathways should embed contextual constraints (climate, infrastructure, finance) and climate-impact-driven demand shifts, with clear links between EU-, national- and local-level levers.

• Lifestyle-policy modelling should pair system-level effects (load, cost, emissions) with co-benefits and acceptability, using tariffs and segmentation to capture behavioural responses.

Across all studies, stakeholders suggested making assumptions explicit, testing counterfactuals (e.g., delayed ETS II), and clarifying where responsibility lies (i-frame vs. s-frame) to improve policy relevance and credibility. The studies should also incorporate stronger equity analysis by income, age, region and housing tenure; expand redistribution instruments; and report standardised distributional indicators.

Policy Briefs

Two studies, Study 11 on distributional impacts and Study 13 on households, were developed into policy briefs to communicate the research findings concisely and clearly to policymakers. The drafts of the policy briefs were shared with the participants of the Core Working groups. Feedback was received from stakeholders on **Table 9.**

Table 9. Stakeholders providing feedback on studies on Citizens in the Transition.

Name	Organisation	Position
Redistribution reviewer		
Matthias Weitzel	JRC	Economics of Climate Change, Energy and Transport
Household Reviewers		
Volodymyr Vladyka	BPIE	Energy Efficiency Policy Analyst
Jonathan Volt	JRC	Energy Efficiency Researcher

For Study 11 on redistribution, the reviewers focused their feedback on varying aspects of the brief. The review included points relating to an improved discussion of existing EU climate architecture, such as the representation of existing policies and legislation more accurately in the explanation of scenarios. Further, it discussed the implementation strategy of the constraints within the model and how they were modelled. It also touched on the drivers of the results relating to welfare losses and the related input variables. Finally, the review also supported authors in the clarification of the text, by pointing out sections that need further elaboration or explanation (such as asking to specify the achievement of emission levels in the scenarios).

For Study 13 (households), the reviewers generally perceived the policy brief as being of good quality and validated the results. Their comments focused on several aspects: better embedding the policy implications and recommendations in EU policy landscape (e.g., by referring to specific policy initiatives of relevance, such as the Social Climate Plans), increasing the specificity of the recommendations (referring for which policy files the recommendations are relevant, such as the Multi-Annual Financial Framework discussions, the European Grid Package, and others), and commenting on some of the modelling findings and assumptions (for example relating to the pace of electricity consumption reduction and direct CO_2 emissions in the residential sector). The authors of the studies indicated that the recommendations contributed to improving the quality of their work.

2.2.4 Land Use and Renewable Energy

Date: 2025-02-13

Setup

The Land Use workshop was organised upon request of the consortium partners, in addition to the three themes resulting from the policy steering groups.

Table 1010. Land Use Core Working Group.

Name	Organisation	Position
Tsjerk Terpstra	DG AGRI	Policy Officer, Environmental Sustainability
Andrus Meiner	European Environment Agency	Head of Unit, Earth Observation
Daniela Russi	WRI Europe	Food, Land and Water Policy Lead for WRI Europe
Dominique Dejonckheere	Copa-Cogeca	Senior Policy Advisor
Lucile Sever	European Biogas Association	Senior Policy Advisor
Ana Rocha	European Landowners Organisation	Director, EU Agri and Forestry Policy
Luke O'Callaghan-White	E3G	Head, EU Energy Transition
Cosimo Tansini	EEB	Senior Policy Officer for Renewable Energy
Maya Perera	EEB	Associate Policy Officer for Climate and Energy
Tatiana Mindekova	Ember	Policy Advisor - European Energy
Johannes Svensson	IDDRI	Research Fellow, Climate and Land Use, Deep Decarbonization Pathways
Jula Bognar	IEEP	Head of Programme. Land Use and Climate
Krystyna Springer	IEEP	Senior Policy Analyst, Land Use
Arnaud Van Dooren	WWF European Policy	Policy Officer
Sofia Ghezzi	WWF European Policy	Policy Officer
Flore Belin	CAN	Renewable Energy Policy Coordinator
Barbara Smailagic	T&E	Fuels Policy Officer
IAM COMPACT Partners		
Ugne Keliauskaite	Bruegel	

Natasha Frilingou	NTUA	
Noelia Ferreras Alonso	CARTIF	
Adrián Mateo	CARTIF	
Camilla Lo Giudice	KTH	
Margarita Mediavilla	UVa	
Iñigo Capellán	UVa	
Dirk-Jan Van de Ven	BC3	
Theo Rouhette	BC3	

Discussion

The discussion was structured in five themes:

- Environmental and climate impacts:

Stakeholders identified that ground-mounted solar in areas rich in carbon can increase LULUCF emissions, and they highlighted habitat fragmentation caused by roads, fencing, and lighting. They also pointed out biodiversity impacts from wind energy due to habitat disturbance and fragmentation. Bioenergy risks were noted, including weaker carbon sinks from increased harvesting, ILUC, greater water use and pollution, and the fundamental scarcity of sustainable biomass. For green hydrogen, stakeholders flagged water demand and the additional land required for renewables and storage, as well as the risk of oversizing supply relative to efficient end uses. Across all options, stakeholders emphasised the importance of making the net effect on LULUCF sinks clear.

- Socio-economic barriers:

Stakeholders expressed concerns about distribution and geography: generation facilities located far from demand, industrialisation of rural and natural areas, concentrated land rents, and limited local employment. They noted increasing difficulty in gaining acceptance (rising anti-wind protests, low trust, health claims) and highlighted local pollution issues around bioenergy plants. They also mentioned risks to food prices and food security from expanding bioenergy and raised human rights concerns in some biofuel supply chains. Lastly, stakeholders pointed out weak engagement processes and barriers to scaling up 'less-land' feedstocks such as secondary residues.

- Policy solutions and instruments:

Stakeholders proposed ecosystem-based spatial planning, stronger land protections, and nature restoration. They emphasised the need to align LULUCF/NRL with bioenergy policies and to ensure protected-area constraints are incorporated into modelling. They recommended prioritising limited biomass for higher-value uses, reducing subsidies to land-inefficient bioenergy, and reviewing bioenergy, BECCS, and biochar against LULUCF/NRL targets. To foster acceptance, stakeholders highlighted the significance of Renewable Energy Communities, non-price auction criteria that reward ecosystem restoration and local engagement, and clearer communication of local benefits. They identified locational pricing and dual-use, such as agrivoltaics (with fair compensation) as siting tools. Additionally, they proposed demand-side measures including diet shifts and the pricing of agricultural emissions.

- Indicators and accounting principles:

Stakeholders highlighted that biomass should be regarded as non-neutral, accounting for foregone sequestration, ILUC, and full feedstock emissions. They emphasised carbon opportunity cost as a key metric. They identified the importance of tracking land efficiency (energy/ha) across technologies and extending monitoring beyond GHGs to include biodiversity and water withdrawals/pollution, re-using NRL-aligned indicators where appropriate. They also stressed the need to track national implementation of EU environmental law and noted that some stakeholders support moderating expectations of continual economic growth.

- Modelling asks and clarifications:

Stakeholders asked modellers to include hydrogen system losses/EROI, additional land/RE needs, and water constraints; to differentiate rooftop from ground-mounted PV with realistic rooftop limits; and to test agrivoltaics where evidence permits. They also urged modelling forest-growth/biomass balances with explicit sustainability constraints while exploring trade-offs, including efforts to reduce tropical deforestation. They requested toggleable policy levers (land protections, non-price criteria, locational pricing, diet shifts, agricultural-emissions pricing), highlighted the importance of within-region distributional analysis and biodiversity indicators, and pointed out the EEA "European biomass puzzle" and civil-society scenarios as inputs. Additionally, they identified the need for more empirical evidence on agrivoltaics.

Overall, stakeholders urged treating land as a binding, multi-dimensional constraint; de-risking social acceptance through planning, local ownership and non-price criteria; re-prioritising scarce biomass away from low-value uses; measuring what matters (energy/ha, carbon opportunity cost, biodiversity); and stress-testing hydrogen and bioenergy pathways under realistic resource limits, EROI and enforceable policy constraints.

Policy Brief

Study 15 on land use was developed into a policy brief to communicate the research findings concisely and clearly to policymakers. The draft of the policy brief was shared with the participants of the Core Working groups. Feedback was received from stakeholders in **Table 11.**

Table 11. Stakeholders providing feedback on the Land Use study.

Name	Organisation	Position
Daniela Russi	WRI Europe	Food, Land and Water Policy Lead for WRI Europe
Sofia Ghezzi	WWF European Policy	Policy Officer

Reviewers of Study 15 generally found the policy brief to be valuable and appreciated its attention to the risks of land-intensive renewable energy, also the reference to biofuels and their ILUC impact outside of the EU. Their comments focused on several areas for improvement: placing greater emphasis on the differing land-use efficiency of renewable technologies, particularly the much higher efficiency of photovoltaics compared to bioenergy, clarifying key concepts and terms to avoid misinterpretation and embedding stronger guidance on how policy recommendations could be operationalised. This included conditioning targets on clear sustainability metrics. They also encouraged the brief to address overlooked consideration (such as the role of urban PV deployment in reducing land pressure) and to more explicitly discuss trade-offs between competing land uses, including food production and ecosystem restoration.

Funded by
the European Union

3 Regions (Major Emitters)

During the **second PRM cycle** the stakeholder interactions in the Major Emitter Regions were tailored to local needs, and therefore different from the approach taken for the thematic workshops described in Section 2. Section 3 describes the stakeholder interaction activities and how these contributed to the modelling activities from February 2024 until now.

For an overview of the **first PRM cycle** activities in the USA, India and China, including the members of the Policy Steering Group, the topics discussed with them and their suggested initial policy-relevant research questions, and the Core Working Group session summaries, see D2.4 Proceedings of Stakeholder Engagement Interactions. The sections highlight i) some general information on the stakeholder interactions, ii) content of discussion and stakeholder inputs, and iii) impact on modelling.

3.1 United States of America

1. General

In the USA, **during the first PRM cycle,** stakeholders highlighted the importance to look more closely into state-level results. IAM COMPACT partners therefore aimed to integrate this in their future work. Furthermore, three scenarios were developed related to the land use: i) a no policy/BAU scenario, ii) a scenario with current policies fully implemented, and iii) a scenario with enhanced policies. The recommendation by stakeholders to include air quality and associated health impacts was integrated into the no-policy scenario.

During the **second PRM cycle**, the IAM COMPCAT team engaged stakeholders in context of the *America Is All In* in the USA through a series of **12 "listening'' sessions across sectors and with a variety of stakeholders**, which supported updating the scenarios. These inputs have been derived and restructured based on D4.6 national regional global mitigation pathways[6].

The *America Is All In* coalition brings together leaders from USA cities, states, tribal nations, businesses, academic institutions, and other sectors to advocate for climate action. Serving as the analytical lead for the coalition's research team, CGS collaborates with a range of think tanks and NGOs, including the Rocky Mountain Institute (RMI), Ceres, the World Wide Fund for Nature (WWF), the Bloomberg Sustainable Cities Fund, and FGS Global. In the past year, CGS supported *America Is All In* in conducting an extensive 2035 NDC consultation process, focusing particularly on turning policy into action.

2. Discussion and stakeholder input

The sessions involved small-group discussions, brainstorming activities (written) and verbal feedback focussing on the current and enhanced ambition scenarios, allowing the stakeholders to share their expertise. As described in D4.6 national regional global mitigation pathways, a total of 214 stakeholders took part, representing 140 organizations across the non-profit, corporate, and federal, state, and local government sectors. Participation also included several membership-based organizations, whose reach spans all 53 states and territories, over 350 cities, 400 higher education institutions, and 250,000 individuals. The listening sessions featured notable national climate leaders such as John Podesta (Senior Advisor to the President for Clean Energy Innovation and Implementation), Mayor Vi Lyles (Charlotte, NC), Mayor Satya Rhodes-Conway (Madison, WI), Gina McCarthy (America Is All In Managing Co-Chair and former White House National Climate Advisor), and Ann Shikany (Deputy Assistant Secretary for Transportation Policy at the U.S. Department of Transportation).

Beyond the listening sessions, CGS maintained ongoing engagement with a range of stakeholders in the policy and research community, including federal agencies (e.g., State Department, EPA, DOE, White House Climate

[6] DOI 10.5281/zenodo.15593966

Policy Office), the United Nations, the State of Maryland, and others.

3. Impact on modelling

Feedback received by stakeholders was considered and integrated into the new report on how to achieve ambitious NDCs and improve the feasibility of the results and assumptions. Stakeholder feedback also allowed to identify additional opportunities and challenges relating to ambitious climate action across sectors. Examples of themes stakeholders mentioned included CCS, improving modelling on state level, and land sector improvements.

CCS improvements

Stakeholders expressed concern that the gas CCS levels in our scenarios were set too high, leading us to reduce these assumptions in the updated models. Feedback also indicated that implementing a methane fee in the agriculture sector would be politically unviable, so the final version presents agricultural methane reduction efforts as incentive-based rather than fee-based. Additionally, in response to comments on other high-ambition measures, we incorporated federal industry CCS standards and state-level biofuels policies into the high-ambition scenario. We also raised the upper limit for state-level building energy efficiency standards from 3% to 4% annual savings by 2035.

State level improvements

To enhance state-level modelling and support the development of pathways for Maryland's climate action plan, we held regular meetings with various Maryland state agencies. For example, our bilateral discussions with the Maryland Department of Transportation focused on refining projections for vehicle miles travelled and electric vehicle adoption. Using their data, we updated GCAM inputs to more accurately reflect Maryland's post-COVID-19 trajectory.

Lands sector improvements

Because GCAM had limitations in modelling the land sector, we partnered with key research and policy organizations to improve understanding of emissions reduction potential in the U.S. land sector. Stakeholders recommended emphasising the importance of fully implementing land sector funding from the Bipartisan Infrastructure Law and the Inflation Reduction Act, noting that these funds could be redirected if policymakers doubted their impact. In response, we developed three scenarios: i) a no-policy/BAU scenario, ii) a scenario with full implementation of current policies, and iii) a scenario with enhanced policies. For the high-ambition scenario, stakeholders also advised assuming that cities and counties implemented their own land policies and that expansion was limited. Consequently, we used Shared Socioeconomic Pathway 1 (SSP1) for this scenario to reflect the lowest level of settlement expansion.

3.2 China

1. General

In China, **during the first PRM cycle**, stakeholders highlighted the importance integrating several aspects into the modelling analysis, including material constraints and COP28 commitments. An important discussion revolved around the difference between greenhouse gas neutrality and CO_2 neutrality, critical technologies required to achieve carbon neutrality, and discount rates. Furthermore, a discussion of the impact on China's economy from an ambitious climate target was useful for the modelling team to frame its research.

During the second PRM cycle, the Chinese IAM COMPACT team hosted a Stakeholder Engagement Workshop on "Green Barriers or Transformational Opportunities? EU Carbon Tariffs on China's Export Industries" (January 2025). As detailed in D4.6 national regional global mitigation pathways, the event aimed to facilitate in-depth discussions among policymakers, ISAP sector engineers and experts, and academics, including professors, researchers, and postgraduate and PhD candidates. A total of 20 stakeholders took part in the workshop, comprising approximately 5 policymakers, 7 ISAP and energy sector experts, and 8 academics. Participants discussed the opportunities and challenges of adapting the ISAP sector to the EU CBAM, conducted dynamic

impact assessments of the mechanism, and explored future decarbonization technology roadmaps.

2. Discussion and stakeholder input

The workshop was kicked off by a brief introduction of the IAM COMPACT project, and the objectives of the workshop were presented by Yu Wag. This was followed by Tianpeng Wang who briefly presented the modelling work, scenario design and results of the research.

The workshop content focussed on the impact of the EU Carbon Border Adjustment Mechanism (CBAM) on China's related industries and aimed to foster collaboration between the IAM COMPACT modelling team and policymakers, as well as representatives from the ISAP (iron, steel, and aluminium products) sectors. China had been the EU's largest import source, with the embodied emissions of its exports to the EU continuing to rise (Li et al., 2020; Xiao et al., 2015). Among the goods covered by the EU CBAM, China's exports included iron, steel, aluminium, cement, and fertilizers. Iron, steel, aluminium, and their related products (ISAP) dominated these exports, with China shipping 7.43 Mt worth €13 billion to the EU in 2023, exceeding all other categories (Pan et al., 2025). ISAP production accounted for roughly 20% of China's total carbon emissions (Chen et al., 2023), making it particularly vulnerable to CBAM's effects. At the time, CBAM targeted direct emissions from ISAP and required reporting of indirect emissions from electricity use, though its scope was expected to expand in the future to include emissions from the entire industrial chain.

3. Impact on modelling

As detailed in D4.6 national regional global mitigation pathways, the EU CBAM kicked off testing in October 2023 and will be formally implemented in 2026, expanding from an initial scope of six products - iron and steel, cement, aluminium, fertilisers, electricity and hydrogen - to eventually cover more than 50% of emissions from sectors covered by the EU's Carbon Emissions Trading Scheme (CETS).

The following stakeholder inputs were collected provided by key stakeholders, and considered in the modelling study. **China's Ministry of Commerce** engaged in multiple discussions on the EU CBAM within the multilateral trading system, seeking to ensure green trade policies do not become new trade barriers. **The Ministry of Industry and Information Technology** warned in its feedback that CBAM poses significant risks to China's high-energy, high-emission industries, particularly steel and aluminium, which dominate China's exports to the EU. Full implementation could add carbon tariff costs, eroding price competitiveness, diverting trade to lower-carbon-cost regions, and increasing compliance burdens due to unclear rules. In 2023, 76% of the total exports of the six categories concerned iron and steel, directly facing the impact of CBAM. As the EU tightens its emission reduction policy and expands the scope of CBAM, it faces the twin challenges of rising costs and eroding global competitiveness. **Iron and steel producers** that provided inputs stressed that they accelerated low-carbon R&D, adopted technologies such as hydrogen-rich blast furnaces and CCUS, and shifted toward electric furnace production to cut emissions, though costs and competitiveness pressures remain. **The aluminium sector** representatives underscored in their inputs that they also faces heavy impacts due to high energy consumption, requiring accurate emissions accounting or payment of high fees. Companies in the aluminium sector pursued process optimisations and international collaborations to reduce energy use and strengthen carbon management, but high capital demands and slow technology adoption—especially for SMEs—pose ongoing challenges, which could intensify if CBAM standards expand.

Stakeholder feedback was considered in the modelling study on CBAM. The policy implications of the research highlight the importance to of CBAM for Chinese industry and the necessity to strengthen international cooperation on this front.

3.3 India

1. General

In India, **during the first PRM cycle**, stakeholders highlighted the importance to consider the decarbonisation

pathway of the Indian building stock due to the foreseen growth and expected emissions this might cause. Furthermore, Indian stakeholders highlighted the opportunities of technological leapfrogging to increase energy efficiency and providing thermal comfort based on low carbon energy. The core working group, hosted at the end of the first PRM cycle, led to the following research questions (see D2.4 proceedings of stakeholder interactions[7] for more details):

• What are the decarbonisation strategies for building sector in India?

• What should be the policy priorities for building sector of India towards Net Zero 2070?

During the second PRM cycle, the Indian IAM COMPACT team hosted a workshop on "Building Sector and India Net Zero 2070" held at IIM in Ahmedabad in August 2024, as detailed in D4.6 national regional global mitigation pathways. The workshop, centred on India's commitment to achieving Net Zero by 2070, focused on decarbonising the building sector and clearly reflected the questions flowing from the first PRM cycle.

The event aimed to facilitate in-depth discussions among building sector experts, real estate financial managers, and academics, including professors, researchers, and postgraduate and PhD students. A total of 65 stakeholders participated in the workshop, comprising approximately 8 building sector experts, 5 real estate financial managers, and 52 academics.

2. Discussion and stakeholder input

The scene for the event was set by highlighting the importance of the building sector of the Indian energy landscape, responsible for 33% of total final energy consumption. The energy consumption was expected to grow with 8% annually by an increased demand for housing, space cooling, and appliances. The construction sector contributes significantly in both operational and embodied emissions, and is thereby essential for a transition towards a Net Zero Future. Two key questions posed to the stakeholders were:

1. What are the NZ pathways for residential buildings towards India's NZ 2070?

2. What are the high impact opportunities (policy priorities) for residential buildings towards India's NZ 2070

Participants discussed the opportunities and challenges in building sector decarbonisation, focusing on implementation gaps, energy demands, and policy priorities. Workshop participants emphasised the need to prioritise decarbonising India's building sector due to significant policy gaps at both the design and implementation stages. They also noted that the limited availability of scientific and peer-reviewed literature made it necessary to conduct an in-depth analysis of decarbonisation and Net Zero pathways for residential buildings in India, in support of achieving the country's updated NDC targets submitted to the UNFCCC by 2030.

3. Impact on modelling

The workshop underscored the pivotal role of the building sector in reaching India's Net Zero 2070 goal. Key recommendations included reinforcing policy frameworks, promoting green building practices, enhancing financial mechanisms, and encouraging cross-sector collaboration. Discussions highlighted the importance of prioritising resource efficiency, accelerating retrofitting initiatives, and improving demand-side management practices.

Participants also stressed the urgency of addressing the growing energy demand in the building sector. Stronger collaboration between the government and the building and construction industry was deemed essential to overcome challenges related to energy-efficient appliances and to align efforts toward developing energy-efficient and environmentally sustainable solutions.

D4.6 national regional global mitigation pathways concluded that two scenarios would be developed based on the

[7] DOI 10.5281/zenodo.10848974

feedback received from stakeholder engagement workshop in India, highlighting the effects of the stakeholder interactions:

1. Business as Usual (BAU) scenario: 2018 as base year with projections until 2050

2. Net Zero scenario (NZS): 2018 base year with projections until 2050

NZS will focus on increasing the adoption of energy-efficient appliances—such as super-efficient air conditioners, energy-saving ceiling fans, LED lighting, clean cooking devices, and other EE appliances—within India's residential sector. The findings of this study are included in "Study 13 – Household Decarbonisation" and are presented in Deliverable D5.7: Behaviour, Social, and Disruptive Innovation – Update.

Funded by
the European Union

4 Regions (Non-high-income Countries)

Similar to the Regions (Major emitters), during the **second PRM cycle** the stakeholder interactions in the Non-high-income countries were tailored to local needs, and therefore different from the approach taken for the thematic workshops described in Section 2. Section 3 describes the stakeholder interaction activities and how these contributed to the modelling activities from February 2024 until now.

For an overview of the **first PRM cycle** activities in the Kenya, Ethiopia. Ukraine, and Sri-Lanka, including the members of the Policy Steering Group, the topics discussed with them and their suggested initial policy-relevant research questions, and the Core Working Group session summaries, see D2.4 Proceedings of Stakeholder Engagement Interactions.

4.1 Kenya

1. General

The CLEWs Kenya stakeholder engagement was held as a two-day in-person workshop in Mombasa from August 31 to September 1, 2023. Hosted by RECCReC (Technical University of Mombasa) with contributions from KTH Royal Institute of Technology, Politecnico di Milano, Bruegel, NTUA, and Strathmore University, the event brought together Kenyan and international researchers and modelling experts to explore how open-source integrated assessment models can support sustainable policy planning.

At the time, the CLEWs Kenya model version 2.0 had not yet been initiated (development began in February 2025). Nevertheless, the workshop provided valuable conceptual guidance for its design. Participants were introduced to energy system models, scenario development methods, and applications relevant to Kenya's policy context, including examples from the Climate Compatible Growth (CCG) Programme.

During the early months of the project, the Director of RECCReC conducted several interviews with Kenyan stakeholders, including bilateral informal meetings with the Gen. Secretary of Renewables in the Ministry of Energy, Dr. Isaac Kiva, and the Director of the Ministry of Environment and Climate Change, Dr. Pacifica F. Achieng Ogola. Both expressed interest in receiving the final project conclusions.

2. Discussion and stakeholder input

The workshop focused on the water-energy-food nexus and demonstrated how multi-resource planning tools like CLEWs can address interconnected challenges in food security, water scarcity, and clean energy access. Practical sessions included the use of the UN DESA scenario explorer, basic input-output analysis for understanding energy–economy linkages, and running a simplified CLEWs nexus model using OSeMOSYS.

Stakeholders participated in group activities mapping county-level resource interactions, which revealed gaps in policy coherence and emphasised the need for scenario-based planning. Although most participants were academic and technical experts rather than formal policymakers, they identified several modelling priorities:

- Addressing competing land-use objectives
- Simulating regional water constraints
- Supporting cross-sectoral coordination in national planning

In addition to the Mombasa workshop, the Director of RECCReC was officially invited to take part in consultations for Kenya's upcoming National Energy Plan, further embedding the project's findings into national policy discussions. This built on earlier bilateral stakeholder engagements and reinforced the relevance of CLEWs Kenya in addressing real-world planning needs.

Following the workshop, TUM collaborated with the Wuppertal Institute to conduct further policy research. This work reviewed Kenyan policies affecting sectors such as energy, industry, buildings, transport, and AFOLU,

identifying gaps, overlaps, and coordination challenges. The findings highlighted critical policy conflicts and missing links to be tested in the CLEWs Kenya model version 2.0.

An additional milestone took place on April 2, 2025, when a half-day workshop was held at TUM Mombasa presenting the two HORIZON projects IAM COMPACT and FUELPHORIA. Dr. Alexandros Nikas, Dr. Francesco Gardumi, and Ms. Salsabila Abdulhalim presented project findings to an audience of professors and students, helping strengthen academic and institutional awareness of integrated modelling approaches.

3. Impact on modelling

Insights from the Mombasa workshop, the Director of RECCReC's direct engagements with senior government officials, participation in the National Energy Plan consultation, and the subsequent policy review informed the structure and scope of CLEWs Kenya version 2.0.

Key model updates included the integration of standardised modelling workflows, strengthened capacity-building for local institutions, and the prioritisation of cross-sectoral analysis to ensure policy relevance. These improvements were designed to enhance the model's ability to support Kenya's climate and development planning processes.

4.2 Ethiopia

1. General

The Ethiopian CLEWs model version 2.0 was developed as part of the second PRM cycle under IAM COMPACT. The modelling effort began with a workshop on "land requirements and potential land use competition" in April 2025. This event brought together project partners and stakeholders from the European Commission's Agriculture and Rural Development, the European Environment Agency, Climate Action Network (CAN) Europe, and WWF European Policy. While the workshop primarily focused on the European context, it also explored the types of indicators relevant for measuring sustainable energy and land use transitions, as documented in D5.9 (Section 4.1).

The feedback gathered was then extended to inform Ethiopia-specific priorities, through complementary engagement with the WRI Water Program in Ethiopia and Addis Ababa University. This process moved from a broad, general overview of sustainable transition challenges to a more targeted focus on Ethiopia's context, ensuring the policy relevance of the CLEWs modelling work.

Ethiopia's **OnSSET**-based modelling began with key stakeholder engagement in April 2023 during the scoping of policy-relevant research questions (deliverable D2.2). Senior staff from the Ministry of Water and Energy (MoWE) acted as the policy steering group, guiding the selection of critical modelling areas such as electrification strategies, energy security, micro- and mini-grid optimisation, and renewable energy investment planning.

2. Discussion and Stakeholder Input

CLEWs Stakeholder input during the CLEWs process highlighted policy coherence challenges in Ethiopia's long-term low-emission strategy (Ministry of Planning and Development, 2022). The adaptation strategy combines goals to expand irrigated land for food security with increasing forest cover and biodiversity. This raised questions about resource stress, land-use change, and competing demands for land.

Participants stressed the need for transparency in assumptions and modelling outputs. In response, the team developed a standardised workflow for model input/output documentation and for quantifying and comparing modelling results. This workflow was also used in the joint effort on "Truly sustainable decarbonisation pathways, including biodiversity, materials and biophysical limits" (deliverable D5.9) to compare scenarios and improve result interpretation.

The April 2023 OnSSET stakeholder dialogue revealed Ethiopia's heavy reliance on hydropower (86% of 2022 installed capacity) and the vulnerability of this generation mix to climate risks such as drought. Participants recommended decentralising generation with renewables to diversify the portfolio, expand rural access, and strengthen reliability and energy security.

In January 2024, a capacity development workshop trained a diverse group of stakeholders on the basics of energy systems modelling and the application of the Open-Source Spatial Electrification Tool (OnSSET) and MicroGridsPy. The training supported evidence-based policymaking and was complemented by occasional bilateral exchanges with stakeholders through other project activities.

These discussions shaped the decision to focus OnSSET modelling on electrification pathways. The approach combined OnSSET for geospatial and techno-economic least-cost electrification planning with MicroGridsPy for detailed community-level hybrid micro-grid modelling, especially for rural areas.

3. Impact on modelling

The Ethiopian CLEWs model version 2.0 incorporated stakeholder-driven priorities, including the ability to simulate land-use trade-offs between agriculture and afforestation, assess biodiversity impacts, and apply transparent, standardized workflows for scenario comparison. These updates ensured the model could address both climate adaptation and biodiversity goals within Ethiopia's development planning.

On the electrification side, the integration of OnSSET and MicroGridsPy created a complementary modelling framework. OnSSET provided guidance on grid extension versus mini-grid or standalone systems, while MicroGridsPy enabled the simulation of optimal mini-grids - primarily solar PV-based, with optional diesel backup (based on OnSSET results). This dual approach reinforced the policy relevance of modelling outputs, particularly for decentralized electrification strategies in rural Ethiopia.

4.3 Ukraine

1. General

Restoring the power sector in a secure and resilient manner has become one of the government's top priorities. To support this effort, the KSE Institute chose to focus on modelling the restoration of Ukraine's power sector, aiming to ensure electricity and heat remain available and affordable for both the population and businesses. The restoration vision was developed through discussions with experts from the Ministry of Energy, Ukrenergo (TSO), Distribution System Operators, and non-governmental Ukrainian scientists active in energy sector studies. These conversations took place in multiple policy forums addressing:

1. Rebuilding the power sector ahead of winter 2025 and beyond
2. Deployment of distributed energy resources (DER)
3. Modernisation of transmission and distribution networks in anticipation of large-scale DER integration
4. Development of energy storage

2. Discussion and Stakeholder Input

Most government and independent experts agreed on the "build-it-better" principle, advocating for a sustainable restoration of the sector that fully replaces the coal-fired power fleet with large-scale variable renewable energy, balanced by energy storage and ultra-flexible (peak) gas generation. Nuclear power was recognized as crucial for

providing most of the baseload and for meeting the net-zero target by 2050. These perspectives were incorporated into the baseline and optimistic scenarios for the modelling exercise. A pessimistic scenario was also included for illustrative purposes, in which repaired coal-fired units continue operating as base and semi-peak generation in 2035. KSE Institute engaged with stakeholders through several high-level forums and workshops, including:

1. Empowering Ukraine: Addressing Barriers to Increased use of Distributed and Renewable Energy Resources towards 2030 – IEA Workshop, Copenhagen, Denmark, 10 June 2025 (Ministry of Energy, National Energy and Utilities Regulatory Commission, Ukrenergo, state-owned DSOs)

2. EU4Energy Policy Forum: Cross-Border Power Integration and Trade – Chisinau, Moldova, 2–3 December 2024 (Ministry of Energy, National Energy and Utilities Regulatory Commission, Ukrenergo)

3. Empowering Ukraine: Battery Storage – IEA Workshop, Kyiv, Ukraine, 9 July 2024 (Ministry of Energy, National Energy and Utilities Regulatory Commission, Ukrenergo, DSOs, DTEK, Market Operator, Guaranteed Buyer, Institute for Economics Forecasting)

4. Empowering Ukraine: Modelling Assumptions and Scenarios for a Distributed Energy Roadmap for Ukraine – Kyiv, Ukraine, 28 May 2024 (Ministry of Energy, National Energy and Utilities Regulatory Commission, Ukrenergo, DSOs, Market Operator, Guaranteed Buyer, Institute for Economics Forecasting)

5. Empowering Ukraine: Smart Grids for a Resilient Future – IEA Workshop, Kyiv, Ukraine, 13 October 2023 (Ministry of Energy, National Energy and Utilities Regulatory Commission, Ukrenergo, DSOs, Market Operator, Guaranteed Buyer, Institute for Economics Forecasting)

The originally planned stakeholder workshop for the first modelling cycle had to be cancelled due to constant missile and air strikes on energy infrastructure. Rolling blackouts during this period meant that all stakeholders were fully engaged in emergency power supply efforts and requested to postpone the meeting indefinitely.

3. Impact on modelling

The stakeholder feedback directly informed the design of scenarios assessing investment and infrastructure needs through 2035, including renewable energy deployment, storage integration, grid modernization, and flexible gas generation to complement nuclear baseload. The results of the modelling were featured in the Ukraine Recovery Conference in Rome on 10–11 July 2025. The presentation, jointly prepared by the KSE Institute and the World Bank, outlined investment requirements for the power sector and was attended by KSE Institute Director Nataliia Shapoval and Director of Strategic Projects Maxym Fedoseenko. These scenarios and analyses provide a roadmap for rebuilding Ukraine's power sector on a more resilient, low-carbon foundation, ensuring long-term reliability, sustainability, and alignment with the country's 2050 net-zero target.

4.4 Sri-Lanka

1. General

The development of the Sri Lankan CLEWs model has been guided by ongoing engagement with policymakers, stakeholders, and project partners to ensure its relevance and applicability. The first Policy Steering Group meeting was held on 8 June 2023 via Zoom, with participation from key institutions such as the Sri Lanka Sustainable Energy Authority (SLSEA), Public Utilities Commission of Sri Lanka (PUCSL), Dr. Tilak Siyambalapitiya (later appointed Chairman of the Ceylon Electricity Board in late 2024), and UNDP Sri Lanka. Project partners from RUSL, KTH, and Bruegel were also present.

These early discussions identified critical challenges in Sri Lanka's energy and climate policy landscape, including:

1. Lack of coordination among key institutions (e.g., Mahaweli Authority, Sri Lanka Wildlife Department, Forest Department, Land Commission)
2. The need for consistent policy frameworks
3. Attractive investment opportunities and appropriate renewable energy tariffs
4. Balancing affordability for consumers with cost-reflective tariffs

The model's design was therefore focused on capturing interlinkages between sectors and providing an evidence base for policymaking, informed by feedback on the need for improved modelling capabilities and sector-inclusive analysis.

2. Discussion and Stakeholder Input

The CLEWs workshop for Sri Lanka was held on 30 January 2024, bringing together stakeholders from academia (University of Peradeniya, University of Sri Jayawardanapura), the private sector (e.g., Energysolve International Pvt Ltd), and government departments (e.g., PUCSL). Discussions explored the potential of CLEWs for both academic research and government decision-making.

Additional stakeholder interactions included:

1. 8 July 2024 – Presentation at the "Agrivoltaic-Based Community Energy Solutions Webinar Series," hosted by Cardiff University in collaboration with the University of Peradeniya. Preliminary findings from the CLEWs Sri Lanka model were shared, with a focus on Integrated Assessment Modelling methods.
2. 18–19 March 2025 – Participation in a two-day workshop introducing the Agrivoltaics pilot project in Sri Lanka. This provided an opportunity to engage with private stakeholders such as DIMO Agri Business, exploring synergies between energy and agriculture sectors.

Throughout these engagements, stakeholders reiterated the importance of evidence-based policy analysis, cross-sectoral coordination, and the integration of renewable energy in ways that enhance affordability, investment attractiveness, and system resilience.

3. Impact on modelling

Stakeholder feedback has directly shaped the scope of the Sri Lanka CLEWs model. Key updates include:

1. Expanding scenario design to address cross-sectoral policy coherence issues
2. Incorporating renewable energy tariff structures and affordability trade-offs
3. Including potential synergies between agriculture and energy, informed by agrivoltaics discussions
4. Enhancing transparency and multi-sector integration in model outputs to support government decision-making

These updates have positioned the CLEWs Sri Lanka model as a tool not only for academic research but also for informing national energy and climate strategies.

Funded by
the European Union

5 Lessons Learned

General Lessons related to the Policy Response Mechanism

- Generally, the implementation of the PRM has proven that high level policy steering groups are an effective tool to identify policy relevant research questions that can guide the modelling work.
- Strong engagement of modellers contributes to high quality research outcomes.
- In the first PRM was implemented consistently across partners, as reflected in D2.4, however in the second PRM a tailored approach for the non-EU workstreams was adopted. This reflects the heterogeneous policy contexts within which the research and modelling studies are being implemented. In light of recent global developments and the different nature of global political developments and the ease of access to policymakers, the PRM might not be implementable in the same manner and with the same ease everywhere.
- Policy briefs are a tool to reach policymakers with the outcomes of the research. Timing of publication of these policy briefs is important.
- Ensure stakeholders and modellers feel empowered to speak freely to get optimal interactions. The Chatham House Rule is an effective approach for this.
- Sticking with a single stakeholder group could be helpful as stakeholders throughout the process seem more likely to reply and are already aware of the background of the project. Drawbacks include among others stakeholder fatigue.

Lessons for hosting effective stakeholder engagement meetings

- A sufficiently large sample of interviews and meetings with policymakers can reveal a clear picture of policy priorities.
- Contact high-level policymakers in good time with clear communication of expected inputs.
- Successful combination of workshop policy steering group – feedback on first studies, identifying new questions – this was an effective solution considering the time constraints of high-level stakeholders.
- Updating the focus of the themes of the core-working groups and the focus of the studies ensure higher policy relevance of the studies and facilitated stakeholder interest.
- Various tools are available to support the organisation of workshops. Miro-board supported the engagement with the stakeholders during the workshops. AI-note takers might prove useful to collect consistent and comprehensive minutes.

Suggestions for future projects

- Be strategic about which questions from policy stakeholders you want to answer. Try to focus on answering specific questions, rather than tackling a broad range of diverse questions posed by policymakers while acknowledging the limitations of models.

Funded by
the European Union

6 References

Frame, D., Lawrence, C., Ausseil, A. G., Daigneault, A., Evison, D., Kerr, S., … & Reisinger, A. (2018). Adapting global shared socio-economic pathways for national and local scenarios. Climate Risk Management, 21, 39–51.

Gardner-Gee, R., Stanley, M. C., & Beggs, J. R. (2015). Re-forestation restores native dominance in an island beetle fauna. *Restoration Ecology*, *23*(3), 268-276.

Kemp-Benedict, E. (2012). Telling better stories: strengthening the story in story and simulation. *Environmental Research Letters*, *7*(4), 041004.

Kok, K., Patel, M., Rothman, D. S., & Quaranta, G. (2006). Box 1 The European and Mediterranean scenarios in MedAction. *Futures*, *3*(38), 285-311.

Lemos, M. C., & Morehouse, B. J. (2005). The co-production of science and policy in integrated climate assessments. *Global environmental change*, *15*(1), 57-68.

Nikas, A., Doukas, H., Lieu, J., Alvarez Tinoco, R., Charisopoulos, V., & Van Der Gaast, W. (2017). Managing stakeholder knowledge for the evaluation of innovation systems in the face of climate change. *Journal of Knowledge Management*, *21*(5), 1013-1034.

Norström, A. V., Cvitanovic, C., Löf, M. F., West, S., Wyborn, C., Balvanera, P., ... & van der He, S. l, van Putten, I. and Österblom, H. 2020. Principles for knowledge co-production in sustainability research. *Nature Sustainability*, 1-9.

Schweizer, V. J., & Kriegler, E. (2012). Improving environmental change research with systematic techniques for qualitative scenarios. *Environmental Research Letters*, *7*(4), 044011.

van Asselt Marjolein, B. A., & Rijkens-Klomp, N. (2002). A look in the mirror: reflection on participation in integrated assessment from a methodological perspective. *Global environmental change*, *12*(3), 167-184.

Voinov, A., & Bousquet, F. (2010). Modelling with stakeholders. *Environmental modelling & software*, *25*(11), 1268-1281.