IAM COMPACT

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

D2.4 - Proceedings of Stakeholder Interactions

WP2 – Listening: Ensuring policy relevance and ownership

31/01/2024

The IAM COMPACT project has received funding from the European Union's HORIZON EUROPE Research and Innovation Programme under grant agreement No 101056306.

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Keywords	Stakeholder engagement; workshops; capacity building		

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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 can use this deliverable to understand the status of stakeholder engagement in IAM COMPACT from the beginning of the project to January 2024, as well as review the outcomes of the Policy Steering Group and Core Working Group engagements. Stakeholders outside the project can use this deliverable to understand the stakeholder engagement strategy in IAM COMPACT and learn about the topics discussed by modellers and policymakers, industry representatives, and civil society actors.

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.

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 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 are 'Optimal Transition'; 'Industry and Innovation'; 'Global Effects'; and 'Behavioural Change'. The seven non-EU regions include the United States of America, China, India, Sri Lanka, Ukraine, Kenya, and Ethiopia.

Lessons learned from the stakeholder engagement process to date in IAM COMPACT included taking a more structured strategy to reach out to high-level stakeholders, refining online workshop approaches, and clearly defining the expected inputs from stakeholders. The next steps in stakeholder engagement will be to share initial modelling results with stakeholders for feedback before a second iteration of modelling, with final results then published in a policy brief for each theme and region.

4. Evidence of accomplishment

This report.

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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	
AAıT – 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	

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Executive Summary

The Policy Response Mechanism (PRM), the IAM COMPACT project'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.

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) were derived from these discussions with the Policy Steering Groups. The initial set of research questions were 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 are '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.

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

Lessons learned from the stakeholder engagement process to-date in IAM COMPACT are as follows:

1. A sufficiently large sample of interviews and meetings with policymakers can reveal a clear picture of policy priorities.
2. High-level policymakers should be contacted in good time with clear communication of expected inputs.
3. Online tools such as Miro can facilitate online workshops.
4. Stakeholders must be empowered to speak freely and challenge modellers within all interactions.
5. Expected inputs from stakeholders should be clearly defined before interactions.

The next steps in the project's stakeholder engagement will be to share initial modelling results from the various themes and regions with the stakeholders in the Policy Steering Groups and Core Working Groups in a structured and coordinated way, through a survey format. A second iteration of modelling may then take place, based on feedback from stakeholders. The final step in the first cycle of the project's PRM will be to produce policy briefs, one for each theme and region, providing key insights based on the policy-relevant modelling work. The second PRM cycle will then begin, starting from the Policy Steering Groups.

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1 Introduction

Stakeholder interactions are pivotal elements of the research process within IAM COMPACT. Through the Policy Response Mechanism (PRM), the project's stakeholder engagement strategy, stakeholders have been directly involved in shaping the research agenda. Stakeholders from a range of backgrounds, including European and national policymakers, industry leaders, and civil society representatives, were engaged in a structured process to ensure that IAM COMPACT delivers policy-relevant modelling studies. Stakeholders were categorised by four policy themes (e.g., electrification) within the EU and by seven non-EU regions (e.g., Sri Lanka). Stakeholders were engaged within the PRM in two sequential phases: through policy steering groups and core working groups.

Engagement with Policy Steering Groups was the first step in the PRM process. The Policy Steering Groups consist primarily of high-level policymakers, as well as some senior members of industry associations and academics. The aim with these initial stakeholder engagements was, through a series of semi-structured interviews and meetings, to understand the major energy and climate policy priorities for the given theme or region. Project partners with the appropriate expertise, for example in models that can well capture the dynamics of the policy topic under discussion, were brought into the relevant stakeholder meetings. The outcome of these interactions with high-level stakeholders was a set of initial policy-relevant research questions, categorised by policy theme and region. These research questions are provided in the following sections.

Following this initial phase of engagement with the policy steering groups the consortium discussed the set of initial research questions internally. For Europe, the initial policy-relevant research questions were grouped into 7 studies cutting across four themes. IAM COMPACT partners were assigned to each study as either Study Leads or Study Contributors.

The second phase of stakeholder engagement involved the organisation of Core Working Group workshops. One workshop was organised for each theme and region. The Core Working Groups brought together technical policymakers, industry analysts, and civil society policy experts to discuss the proposed research studies developed from the initial set of policy-relevant research questions. The aim of this step was to ensure that the studies and associated scenarios captured the most important aspects of the policy or regional topic, and that their inputs were validated by stakeholders to be realistic.

Following the Core Working Group workshops, the project teams began their modelling for each study. Initial results (which are already available and documented in a series of deliverables across Work Packages 4 and 5) will be sent to the Core Working Group members to validate that the IAM COMPACT project's research is in line with their expectations based on our previous interactions with them. The tentative results will also be reviewed with the Policy Steering Groups, with views on the framing of the studies and scenarios requested by the project. A second iteration of modelling may take place for each study across themes, in case stakeholders wish to see the research take a slightly adjusted approach and modelling scenarios adapted to their needs. The final results will then be shared with all stakeholders for feedback and dissemination.

This iterative PRM process, from Policy Steering Group to Core Working Group to modelling, back to Core Working Groups and Policy Steering Group, with potentially another round of modelling and a final dissemination of results, will be repeated in the second cycle of the PRM.

1.1 Themes and Regions

For EU-focused research, stakeholder engagement and modelling studies in IAM COMPACT are organised by policy theme[1]. For non-EU-focused research, the stakeholder engagement and modelling studies are organised

[1] Note: the name of some of the themes in the EU were adjusted slightly between the Policy Steering Group and Core Working

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by region. The themes and their coverage were determined through a process of discussion by the partners in IAM COMPACT, with the aim to broadly capture the essential aspects of the energy transition over the course of the project, while also ensuring a clearly defined research agenda that would allow for straightforward identification of stakeholders. The regions were determined by the non-EU partners in IAM COMPACT.

Themes

Industry & Innovation

Exploring the impacts of the energy crisis on European industry and the innovation needs required to meet decarbonisation targets.

Optimal Transition

Investigating the effects of electrification of heating and transport on the power sector demand-side and the consequences of the Member States' declared climate and energy plans.

Global Effects

Examining the global and European distributional implications of global effects such as geopolitics, trade, the financial sector and interest rates.

Behavioural Change

Researching the role of behaviour in the energy transition and its potential representation in modelling.

Regions

Ukraine

Energy and climate policies in Ukraine in the wake of the war and regarding the rebuild 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.

Group phases, namely, *Electrification* became *Optimal Transition, European Industry* became *Industry & Innovation* and *Global Green Investment* became *Global Effects.* Furthermore, Policy Steering Group were brought together for Kenya & Ethiopia and for India & Sri Lanka but disaggregated at the Core Working Group phase.

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The deliverable is structured as follows. Section 2 outlines the stakeholder engagement under each EU policy theme, covering the participants of each Policy Steering Group, the topics discussed, and the initial policy-relevant research questions that emerged. The seven studies are then described, followed by an account of the Core Working Group workshops under each theme. Section 3 follows a similar structure, describing the Policy Steering Groups, initial policy-relevant research questions, and Core Working Group workshops for each of the 'major emitter' non-EU regions. Section 4 does the same for each of the 'non-high-income' non-EU regions. Section 5 outlines lessons learned from the stakeholder engagement in IAM COMPACT to-date. Section 6 sets out the next steps for the stakeholder engagement in IAM COMPACT.

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2 Themes

For each theme, the following sets out the members of the Policy Steering Groups, the topics discussed and the initial policy-relevant research questions, the model studies developed, and the proceedings of the Core Working Group workshops.

2.1 Optimal Transition

2.1.1 Policy Steering Group

Date(s): 30/01/23 – 07/03/23

Table 1. Optimal Transition Policy Steering Group

Organisation	Name	Position
International Energy Agency (IEA)	Yasmine Arsalane	World Energy Outlook Analyst
Agency for the Cooperation of Energy Regulators (ACER)	Patrick Luickx	Team Leader, Electricity Market Monitoring
Agency for the Cooperation of Energy Regulators (ACER)	Vasilis Papandreou	Policy Officer, Adequacy
DG ENER, European Commission	Francesco Ferioli	Policy Analyst, Chief Economist Unit
DG ENER, European Commission	Clement Serre	Policy Analyst, Chief Economist Unit
Department of Climate, German Federal Chancellery	Frauke Braune	Head of Power Market Design and Security of Supply for Electricity

Discussion

The focus of the discussions was on decarbonisation of electricity supply and the electrification of energy demand sectors. Specific issues that emerged were the increasing role of the demand side in the electricity system, electricity affordability for consumers, consumers heterogeneity, biodiversity impacts of electricity decarbonisation, technology options to provide essential system flexibility, and supply chain constraints.

Initial Research Questions

- How will increasing electrification impact customers' bills?
  - Are real-world consumer prices higher than the resource costs produced by models?
- Which technologies are best placed to provide flexibility in a low-carbon system?
- Are there supply-chain constraints on the potential ramp-up of clean technologies?
  - Industrial capacity, rare earth materials, impacts on trade.
- To what extent are we reliant on innovation to reduce carbon emissions in the power sector?
- What are the land-use implications of increasing renewable electricity capacity and, specifically, what are the biodiversity impacts?
- What are the flexibility needs for the future electricity system?
  - What technologies can replace the flexibility provided by gas in the power system?
  - Are certain technologies better for balancing and others for congestion management?
  - Will there be different requirements during the transition and once the system is decarbonised?
- What are the infrastructure needs for the future electricity system?

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- To what extent are grids and storage complementary?
- What will the demand for hydrogen be in the future electricity system?
- What benefits can interconnection provide for system balancing?
- How much can increasing levels of interconnection reduce renewables curtailment?
  - What are the costs and benefits of increasing levels of interconnection capacity?
- How can local, distribution-level flexibility reduce the need for grid expansion?

- What energy carriers are most likely to dominate in future (2040 and beyond) power systems and what are the implications for markets?
  - Could traders be indifferent to energy carriers as many options will have comparable costs?
  - What are the implications for system cost of subsidising clean technologies to a certain level?
- Are there certain future system configurations that are more susceptible to disruption from geopolitical events?
  - E.g. are there more supply chain risks for certain energy carriers?
- What will the peak demand be in 2040 and 2050 and how can a responsive demand side reduce system costs (e.g., by mitigating the need for capacity investment)?
- In what sectors/for which uses can hydrogen compete with electricity as an energy carrier?
- What will the demand for hydrogen be in the future if the European targets for hydrogen are met? Can European production meet this demand?
- What is the impact of smart grids and flexibility solutions on capacity needs?
- Which contracts and pricing schemes best incentivise demand side flexibility?
- How does the implementation of the updated draft National Energy and Climate Plans compare to the cost optimal approach at a European level?
- How does the share of generation vs. transmission & distribution change in the total cost of a decarbonised power system?

2.1.2 1st PRM Cycle Research Studies

The extensive list of research questions set out in 2.1.1 was formulated into the following two studies, which capture the key aspects of these questions. The process for transforming the research questions into research studies involved significant discussion between project partners. Research questions were categorised by subject. In the case of the Electrification theme, two broad categories were identified: least cost system optimisation and security/resilience metrics. Questions that were challenging to answer using the model suite on hand in IAM COMPACT were filtered out, such as questions related to biodiversity and land use.

Study 1 (reported in D4.5 - National, regional, global mitigation pathways)

How does the implementation of the updated draft National Energy and Climate Plans compare to the cost optimal EU approach?

Lead: **BC3**

Study 2 (reported in D4.9 - European sub-national deep dives)

What are the different cost, energy security and resilience metrics and how do they compare for different scenarios?

Lead: **Aalborg**

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2.1.3 Core Working Group

Date: 18/07/2023

Table 2. Optimal Transition Core Working Group

Organisation	Name	Position
DG ENER, European Commission	Clement Serre	Policy Analyst, Chief Economist Unit
DG ENER, European Commission	Manuel von Mettenheim	Policy Analyst, Chief Economist Unit
Agency for the Cooperation of Energy Regulators (ACER)	Patrick Luickx	Team Leader, Electricity Market Monitoring
Agency for the Cooperation of Energy Regulators (ACER)	Vasilis Papandreou	Policy Officer, Adequacy
SolarPower Europe	Jonathan Bonadio	Senior Policy Advisor
SolarPower Europe	Christoph Lits	Market Analyst
Climact	Dimitri Krings	Energy and climate change consultant

Discussion

The initial theme of electrification was broadened to 'Optimal Transition' to account for the other sectoral aspects that are associated with the decarbonisation of electricity supply and the electrification of end-use energy sectors, as well as the implantation of EU Member State's National Energy and Climate Plans (NECP).

The workshop was divided into two breakout rooms, both of which used the online Miro platform to gather stakeholder input. The first room discussed Study 1 and explored what indicators could be used to compare NECP model scenario results with cost optimal scenarios, as well as the conditions under which the electricity system might contribute to the EU's renewable targets. Stakeholders were interested in the connection between IAM COMPACT's integrated assessment models (IAMs) and its dedicated electricity system model, EXPANSE, as well as the role of interconnectors and flexibility. Specific model outputs that were highlighted as relevant for stakeholders were industry and household energy prices, energy system investment cost, renewable energy penetration, and uptake of energy storage and electric vehicles.

The second breakout room, also facilitated via Miro, discussed Study 2, exploring possible model indicators for energy security, system resilience and overall system costs. In terms of security, stakeholders suggested evaluating aspects of supply diversity, import dependency, clean tech manufacturing, reliability, and interconnection needs as potential metrics. Security and resilience were also distinguished, with security referring more to long-term issues while resilience relates to the management of short-term problems and shocks. Resilience metrics that were suggested included available dispatchable capacity, dependency on fossil fuel based capacity (less dependent meaning more resilient), dependency on hydro capacity, and resilience of infrastructure to more intense weather conditions. Energy system flexibility measures were also a core part of the discussion, as stakeholders identified them as a fundamental question for the energy systems going forward. Both the need for flexibility (i.e. demand) and the technologies that could provide it (i.e. supply) were discussed in detail.

Project Takeaways

IAM COMPACT partners learnt from stakeholders about the most relevant aspects of energy system security, resilience and flexibility and also received highly constructive suggestions of specific metrics that could be used to assess model results along these criteria. Stakeholders developed an understanding of the IAM COMPACT model suite, in particular regarding the connection between broad IAMs and sector specific models like EXPANSE and EnergyPLAN. Through discussion of the scenario designs, stakeholders also obtained an insight into the modelling process.

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2.2 Industry and Innovation

2.2.1 Policy Steering Group

Date(s): 26/01/23 – 30/03/23

Table 3. Industry and Innovation Policy Steering Group

Organisation	Name	Position
Department of Climate, German Federal Chancellery	Christian Büchter	Head of Department of Climate
Department of Climate, German Federal Chancellery	Vera Zipperer	Economist at Department of Climate
DG BUDG, European Commission	Peter Zapfel	Senior Expert, Emissions Trading Scheme
DG CLIMA, European Commission	Stefaan Vergote	Deputy Director General, Innovation, adaptation and resilience

Discussion

The impact of climate and energy policy on European industrial competitiveness and the innovations needed to meet our climate targets were the focus of this theme. Topics such as industrial policy (especially Europe's response to the Inflation Reduction Act), hydrogen supply and demand, carbon pricing through the Emissions Trading Scheme (ETS) and the Carbon Border Adjustment Mechanism (CBAM), the potential relocation of industrial hubs, and the pace of innovation in specific technologies were central in the discussion with the Industry and Innovation Policy Steering Group.

Initial Research Questions

- What are the potential levels of hydrogen demand, available volumes, costs, and optimal usage in 2030 and 2040?
- How different future (2030 and 2040) scenarios of European industry (e.g., in terms of production, location, energy-intensiveness, and input costs) are in terms of cost, resilience, and social (labour market) perspectives?
- What are the overall costs and emissions saving potentials for circular economy and energy efficiency measures in European industry?
- Is it more economically sensible to produce energy-intensive industrial inputs (such as ammonia) in other regions (in Europe or globally) and import them to industrial clusters?
- What are the energy, climate, and labour implications of reshoring critical industries?
- How can a potential European hydrogen market compete with other hydrogen production regions, such as the Gulf of Mexico?
- What are the policy implications of heterogenous readiness for decarbonisation in the European industrial sector?
- What are the economic impacts of European industrial adjustment/relocation in response to higher energy costs?
    - What are the effects on value chains in Europe and abroad?
- Which areas of the economy require innovation to decarbonise?
- How is necessary carbon capture and storage (CCS) in decarbonisation of industry and power?

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- What are the most economic forms of long-duration energy storage?
    - Will hydrogen be economic as long-duration storage? What power price arbitrage would be needed for it to be affordable?

2.2.2 1st PRM Cycle Research Studies

Using the same method as for the Electrification theme, the broad list of research questions related to Industry and Innovation was first categorised, then considered against the capabilities of the model suite available in IAM COMPACT. The primary policy question at the time of speaking to the policy steering group members was what the impact of the energy crisis, and the sustained increase in European energy prices, might have on European industry. These questions, related to industrial relocation, onshoring, hydrogen hubs and supply chain constraints were captured in Study 4. The innovation questions were drawn into Study 5, looking at the effect of rapid cost reductions on broader decarbonisation, for example with clean hydrogen production.

Study 4 (reported in D4.7 - Sectoral and cross-sectoral analysis)

What are the implications of European industry decarbonisation, considering possible off / re-shoring scenarios?

Lead: **WI**

Study 5 (to be reported in D5.6 - Behaviour, social and disruptive innovation)

What is the contribution of earlier stage technologies if they undergo rapid cost reductions?

Lead: **Imperial**

2.2.3 Core Working Group

Date: 21/06/2023

Table 4. Industry and Innovation Core Working Group

Organisation	Name	Position
Bellona	Ariane Giraneza	Climate Policy Manager for Industrial Decarbonisation
BDI	Joachim Hein	Senior Adviser on Climate Policy
World Steel	Rizwan Janjua	Head of Technology
Breakthrough Energy	Philippe Offenberg	Senior Manager
Frequentis & Terrians	Daniel Valverde Lobejón	Transport Sector and Sustainability Consultant
European Roundtable for Industry	Philippe Adriaenssens	Policy Director
CEFIC	Hadi Yassin	Climate and Energy Modelling Officer
Agora	Julian Somers	Project Manager for Industry
Commillas University	Timo Gerres	Industrial Decarbonisation Professor
Climate Action Network Europe	Boris Jankowiak	Steel Transformation Policy Coordinator
LeadIT	Eileen Torres Morales	Research Associate
Hydrogen Europe	Grzegorz Pawelec	Director, Intelligence
DG COMP	Vaclav Trejbal	Policy Officer

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Discussion

The Industry and Innovation workshop was led by the Study 4 leaders, Wuppertal Institute, and the Study 5 leaders, Imperial College London. Bruegel provide organisational and facilitation support. Bruegel provided a short introduction to the project and the aims of the workshop, before the study leads presented the background and approach of their respective research studies. The workshop then divided into two breakout rooms.

Breakout room 1 focused on European industry and Study 4. The aim was to understand from stakeholders what their expectations were regarding the off- and -reshoring of various industrial sectors. A number of scenarios of industrial organisation were presented: 'Baseline', 'Open Trade', and 'Strategic Independence'. Stakeholders noted that the latter scenarios are both extremes, and that the 'Open Trade' scenario is somewhat unrealistic as trade constraints are always in place, such as CBAM.

A major input from stakeholders was the representation of intermediate products, which are currently not covered by IAMs. The stakeholders noted that the most likely relocations will occur in the production of intermediate products, such as ammonia and methanol, which may be produced elsewhere in the world using hydrogen but then imported to Europe. Stakeholders highlighted the absence of intermediates in the IAMs was a major drawback of the study. Further comments related to restrictions on the colour of hydrogen that could be traded in each scenario, as well as on the policy framework surrounding the question of industrial relocation.

Breakout room 2 was centred on innovation and Study 5. The online platform Miro was used to facilitate the session and gather feedback. Specific topics for discussion were the technologies that might see significant cost reductions in the coming years and the importance of carbon removals to meet climate targets. Discussions about the technological innovations needed to facilitate a significant role for hydrogen in a decarbonised economy were core to this session. In a neat mirroring of the parallel breakout room 1 discussion, stakeholders placed a lot of emphasis was placed on intermediate products and their role in a hydrogen economy. Other points raised were the technological challenge of storing hydrogen. Another major discussion point was the forces that might drive technological cost reduction at a pace needed to meet our decarbonisation targets, such as clear policy signals, policy roadmaps, and most importantly, investment de-risking.

Project Takeaways

Regarding the modelling of industrial relocation in Study 4, stakeholders provided excellent insights on the realism of the scenarios and, in particular, on the importance of representing the trade of intermediate products such as methanol and ammonia wherever possible. The innovations needed regarding hydrogen storage and the scaling of intermediate products were also important priorities communicated by stakeholders, as well as the role of clear policy signals and investment de-risking to drive innovation.

2.3 Global Effects

2.3.1 Policy Steering Group

Date(s): 03/02/23 – 20/04/23

Table 5. Global Effects Policy Steering Group

Organisation	Name	Position
DG COMP, European Commission	Pierre Regibeau	Chief Economist
DG ECFIN, European Commission	Martin Koch	Policy Officer, InvestEU
European Central Bank	Daniel Kapp	Deputy Head of Division, EU Institutions & Fora
European Central Bank	Carolin Nerlich	Senior Lead Economist, Climate Change Centre

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Discussion

The Global Effects theme was focused on structural, macroeconomic factors that might influence European decarbonisation, such as financing, geopolitical events, and supply chain constraints. Discussions with stakeholders emphasised the importance of understanding the total investment needs for the energy transition in Europe and investigating how such investment might be financed. Another major point raised by several stakeholders related to geopolitical instability affecting decarbonisation efforts. Finally, a number of points that dovetail with the other themes were made by stakeholders, including the availability of critical raw materials and the long-term response of European industry to high energy prices.

Initial Research Questions

- Which energy-intensive industries are best suited to Europe from an economic efficiency perspective?
- What are the consequences of a multipolar world in terms of impacting supply chains?
- Which manufacturing sectors are most likely to switch to hydrogen?
    - How mobile are those sectors? (i.e. can they move production to other regions)
- Which countries and companies globally are likely to own critical rare materials?
- How does the distribution of critical raw materials affect investment costs in Europe and around the globe?
- How does the EU green taxonomy spur additional green investments?
- What will be the impacts of the electricity market reform proposals on power prices?
- How will decarbonisation affect the location of European industry?
- How will relative prices change throughout the energy transition?
- What are the investment needs in Europe to reach net-zero and what is the gap from committed funding?
- What are the implementation risks of Europe's energy policies, for example in terms of land use constraints?

2.3.2 1st PRM Cycle Research Studies

The same process applied for the other research themes, of filtering and categorising the policy-relevant research questions, was used for the Global Effects theme. As many over the research questions overlapped with those raised in the Industry and Innovation theme, so those were excluded from this theme on that basis. The two major categories were related to geopolitical induced trade constraints and the role of financing in the energy transition. The former topic was captured in Study 3 and the second was set out in Study 6, below.

Study 3 (to be reported in D5.4 - Modelling out-of-ordinary extremes)

How could geopolitics affect decarbonisation pathways?

Lead: **E3M, BC3**

Study 6 (to be reported in D5.6 - Behaviour, social and disruptive innovation)

How do interest rates influence decarbonisation pathways?

Lead: **NTUA**

2.3.3 Core Working Group

Date: 26/10/2023

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Table 6. Global Effects Core Working Group

Organisation	Name	Position
National Bank of Belgium	Dennis Essers	Economist
European Central Bank	Carolin Nerlich	Senior Lead Economist, Climate Change Centre
European Central Bank	Ivan Frankovic	Climate Change Centre
European Central Bank	Matthias Rau-Goehring	Climate Change Centre
DC ECFIN	Martin Gorcak	Sustainability of Public Finance Unit
E3G	Michele Rimini	Programme Lead on Industrial Decarbonisation, Macro, and Political Economy
AVERE	Gabriele Ferrara	Policy Officer
GIZ	Alessia De Vita	Technical Advisor, Long-Term Energy Planning and Renewable Energy Grid Integration
RGI	Amanda Schibline	Manager, Socio Economic Systems
CEPS	Edoardo Righetti	Energy, Resources and Climate Change Unit
OECD	Yuko Ishibashi	Policy and Research Officer
OECD	Coline Pouille	Policy and Research Officer
World Resources Institute	Ke Wang	Strategy Lead, Energy Materials and Circularity
Transport & Environment	Alina Racu	Batteries & Metals Analysis Manager
EBRD	Sung-Ah Kyun	Climate Strategy and Delivery
EBRD	Isik Mine	Climate Strategy and Delivery
Danish Ministry of Finance	Mads Libergren	Senior Advisor, Climate Policy
Utrecht University	Friedemann Polzin	Associate Professor
Utrecht University	Sasha Serebriakova	Researcher
OECD	Ruben Bibas	Economist and Modeller

Discussion

The workshop followed IAM COMPACT's standard template for such discussions, with an introduction by Bruegel to the project and presentation by the study leads on the planned research. Two breakout rooms were then formed, one for each study.

The first breakout room looked at Study 3 regarding the impact of geopolitical events that could impact material, technology and fuel availability. Potential bottlenecks for specific technologies were explored as well as considerations about plausible geopolitical scenarios that could limit the growth or availability of certain key clean energy technologies. Stakeholders identified lithium-ion batteries and electricity motors as have specific vulnerabilities, as well as the production of solar photovoltaic panels, while wind turbine production was highlighted as being less concentrated and therefore less vulnerable. The economic growth of the global south was suggested as an opportunity for supply chain and manufacturing capacity diversification. Miro was used to facilitate the discussion and gather stakeholder inputs.

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Breakout room 2 focused on Study 6, the impact of interest rates on decarbonisation. The breakout room began with an anonymous survey about how investment risks for technologies might change by 2050. These results were then used to frame the central topic of interest rate impacts that are relevant for energy and climate policy. Stakeholders suggested that the study could explore the distributional impacts of technology affordability due to differences in interest rates and look at empirically defined cost of capital for a broader set of technologies. Miro was again used for the session.

Project Takeaways

IAM COMPACT researchers gained a useful understanding of the plausible ramifications of geopolitical instability on the energy transition, specifically in terms of technologies that could be vulnerable and the potential for economic growth in the global south to support diversification. Stakeholders also suggested points of emphasis for the research on interest rates impacts that were taken on board by researchers, as well as a fruitful sharing of ideas regarding policy solutions.

2.4 Behavioural Change

2.4.1 Policy Steering Group

Date(s): 24/01/23

Table 7. Behavioural Change Policy Steering Group

Organisation	Name	Position
Joint Research Centre	Emanuele Ciriolo	Head of Competence Centre on Behavioural Insights
Joint Research Centre / European Commission	Hendrik Bruns	Policy Analyst
International Energy Agency	Brian Motherway	Head of Energy Efficiency
DG ENER, European Commission	Tadhg O'Briain	Deputy Head of Unit, Consumers, Local Initiatives, Just Transition

Discussion

Behavioural Change covers the consumer choices and lifestyle habits that require altering to ensure a reduction in carbon emissions. These questions are notoriously difficult to model and it was communicated up front to stakeholders that the aim of this theme was both to find appropriate research questions but also transfer knowledge about modelling limitations in this field. Major points that emerged across the discussions were the consequences of different preferences and risk aversion amongst consumer groups, policy choices that can drive behavioural change, and, most importantly, that modelling could be best suited to understanding the impacts of behavioural change but less useful for understanding the drivers of the change itself.

Initial Research Questions

- What are the distributional impacts of climate and energy policies on different consumer categories, such as male and female, young and old, as well as income categories? In particular, how do mitigation measures impact those living in energy poverty?
- How do the same behavioural interventions compare in the context of a price shock and in the context of no price shock?
- What are the effects of habit formation on low-carbon consumer choices?
- How does intrinsic motivation impact on consumer mitigation strategies given various capabilities to act (e.g., motivation to drive an EV but insufficient infrastructure for charging EVs)?

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- How do heterogenous discount rates across consumer categories affect the adoption rates of clean technologies?
- How can certain digital innovations (such as remote working) reduce energy consumption?
- How can consumer preferences, represented in IAMs, be validated without sufficient empirical data?
- Do certain policies have a greater impact on changing behaviour than others?
- How can the market impacts (rather than the cost of policy implementation) of a behavioural change be modelled?
- How does heterogenous risk aversion amongst consumers impact on total system cost (i.e., if consumers had lower risk aversion, they may be willing to enter into more novel contract types or engage in novel behaviours that could reduce system cost)?
- How would segmenting consumer risk preferences across their consumption (e.g., high risk aversion for essential energy services but low risk aversion for less essential segments) reduce system cost?

2.4.2 1st PRM Cycle Research Studies

As noted, modelling behavioural change is a notoriously difficult challenge. IAM COMPACT researchers aimed to make the questions suggested by researchers tractable by focusing on behavioural changes that could be readily represented in their models and then exploring the economic impacts of such a behavioural change. Study 7 collects the various feasible questions from the policy steering group into a framing of economic impacts.

Study 7 (to be reported to D5.6 - Behaviour, social and disruptive innovation)

What are the economic impacts of a given behavioural change?

Lead: **UVa, BC3**

2.4.3 Core Working Group

Date: 31/10/23

Table 8. Behavioural Change Core Working Group

Organisation	Name	Position
DG ENER, European Commission	Tadhg O'Briain	Deputy Head of Unit, Consumers, Local Initiatives, Just Transition
Joint Research Centre	Nives Della Valle	Scientific Policy Officer, Energy Efficiency and Renewables
Joint Research Centre	Emanuele Ciriolo	Head of Competence Centre on Behavioural Insights
OECD	Francesca Papa	Behavioural Economics Advisor
Transport & Environment	Max Molliere	E-mobility Analyst
Transport & Environment	Yoann Gimbert	E-mobility Analyst
Transport & Environment	Luca Poggi	E-mobility Analyst
SolarPower Europe	Jan Osenberg	Policy Advisor
Ughent	Peter Conradie	Behavioural Science Researcher
Ecologistas en Acción (EeA)	Carmen Duce	Coordinator, Clean Cities Campaign

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BEUC - The European Consumer Organisation	Irina Popescu	Food Policy Officer
Climate Action Network	Agata Meysner	Sustainable Consumption Coordinator

Discussion

The aim for the Core Working Group session on Behavioural Change was to discuss the most anticipated behavioural changes that would impact the climate and energy policy space, explore potential barriers to such changes (e.g. clean tech adoption) and understand the structural requirements for facilitating behavioural changes. The standard format – Bruegel introduction, presentation by study lead – was followed, although without a breakout room as there was only one research study in this theme. Miro was used to facilitate the session.

Regarding the most necessary and anticipated behavioural changes, stakeholders focused on lifestyle changes in the transport sector, such as modal shifts from cars to public transport or air travel to trains. Dietary changes were also highlighted as necessary for reducing agricultural emissions. Behavioural changes in the buildings sector were also discussed, such as renovations and the use of heat pumps or other electrified technologies. Cultural barriers and conditioning to existing lifestyles were cited as the major barriers to green behavioural change, as well as a lack of information.

A robust discussion took place surrounding the necessary structural changes need, with certain stakeholders introducing the concept of *i-framed* (individual) changes vs. *s-framed* (system) changes. Potential s-framed changes that could be needed included energy taxes, information regarding carbon intensity of products, and time-of-use tariffs for electricity usage. Stakeholders also highlighted some of the drivers of s-framed changes, like informed policy making, sharing of success cases, and effective public administration at different levels.

Project Takeaways

The Behavioural Change workshop was a productive exchange of knowledge between the IAM COMPACT modellers and policymakers working on behavioural change. Modellers gained a clear categorisation of the anticipated behavioural changes as well as the helpful *i-framed* vs. *s-framed* concept. While IAMs have often been criticised for a poor representation of behavioural change, the models in the IAM COMPACT suite aim to cover some gaps and provide fresh insights, informed by the strong stakeholder contributions, with a particular focus on the most pertinent policy concerns.

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3 Regions (Major Emitters)

For the USA, India and China, 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 are provided below.

3.1 United States of America

The stakeholders participating in the Policy Steering Groups and Core Working Groups for USA preferred to remain anonymous.

3.1.1 Policy Steering Group

Date(s): September 2023-January 2024

Table 9. USA Policy Steering Group

Organisation
Maryland Department of Environment
Maryland Department of Transport
The Executive Office of the President, White House

Discussion

Discussions with the Maryland governmental departments focused on their expectations regarding technological deployment levels. IAM COMPACT researchers asked the governmental officers about how many vehicle miles travelled they are currently estimating, as well as their projections for electric vehicle deployment. Another point of discussion was the expected time for deploying carbon capture and storage (CCS) technology in Maryland. Given that there are uncertainties about locations suitable for CCS and on applications in the pipeline, the governmental officers did not anticipate CCS being deployed before 2035. IAM COMPACT researchers used these valuable inputs to update their inputs to the GCAM model for the United States modelling.

IAM COMPACT researchers from the University of Maryland also spoke to White House representatives and provided an overview of the policy platform currently represented in their scenarios. The team then discussed the 2035 NDC submissions, with the policymakers asking whether the policy platform captures the full suite of policies. The team arranged to have follow-up meetings with relevant sectoral policy experts from the office for feedback and input to the scenario design going forward in the project.

Initial Research Questions

- What should be included in the USA's 2035 NDC submission to balance its international commitments with affordability and economic competitiveness?

3.1.2 Core Working Group

Date: September 2023-January 2024

Table 10. USA Core Working Group

Organisation
World Resources Institute
Rocky Mountain Institute
U.S. Climate Alliance
Environmental Protection Agency
Research Triangle Institute

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Ceres
World Wild Fund for Nature
Sustainable Cities Fund
FGS Global

Discussion

IAM COMPACT researchers met with the America is All-In coalition as part of the Core Working Group. The America Is All-In coalition is a group of leaders from U.S. cities, states, tribal nations, businesses, schools, and more in support of climate action. Several important topics emerged from the discussion. First, input on sectoral policies and implementation from the sectoral experts and teams was helpful. Second, while the current modelling analysis assumes full implementation of policies, implementation progress and challenges need to be assessed separately. Third, motivated by requests several members of the coalition, it is helpful to better understand pathways for key states such as Pennsylvania, Michigan, Arizona, North Carolina, Georgia and Ohio and their climate platforms and involvements.

Other key discussions related to the land sector to better understand emission reduction potential in the U.S. Stakeholders advised IAM COMPACT to emphasise the importance of fully implementing the available land sector funding, as these funds have the potential to be used for other purposes if policymakers do not think they will be impactful. Stakeholders also provided input on the resource changes observed in model results, for example the transition from oak to planted pine and cropland conversion, and whether or not these results were realistic.

Discussions on air quality and associated health impacts, especially related to the implementation of the Inflation Reduction Act.

Project Takeaways

Based on input from the stakeholders, IAM COMPACT decided to look more closely into state-level results and decide on which states to highlight in future work. Furthermore, three scenarios related to the land use were developed: a no policy/BAU scenario, a scenario with current policies fully implemented, and a scenario with enhanced policies. The no policy scenario also included related to air quality and associated health impacts, based on stakeholder recommendations.

3.2 China

The stakeholders participating in the Policy Steering Groups and Core Working Groups for China preferred to remain anonymous.

3.2.1 Policy Steering Group

Date(s): June 2023

Table 11. China Policy Steering Group

Organisation
Ministry of Ecology and Environment of the People's Republic of China
National Energy Administration, China
China Electricity Council

Discussion

Discussions with stakeholders about China's energy and climate policy priorities focused on its NDC commitments, firstly to peak its carbon emissions by 2030 and secondly to achieve carbon neutrality by 2060. Stakeholders said that these goals must be balanced in the context of the classic energy trilemma: sustainability, security and

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affordability. Specific aspects of Chinese energy policy discussed with stakeholders included the need security of supply through fossil fuels, promoting sustainable consumption patterns, policies to drive innovation in key clean energy technologies, and improving international energy cooperation with key fossil fuel producing countries. Challenges include managing geopolitical relations with key energy partners, adapting to extreme weather events that could affect the supply and demand or energy, and, most importantly, decarbonising while increasing energy demand. Stakeholders also specifically expressed an interest in learning more about IAMs.

Initial Research Questions

- What would be the total cost of a decarbonised Chinese energy system?
- What impact would a capacity mechanism for coal have on emissions and costs?
- How profitable will clean energy technologies be in China?

3.2.2 Core Working Group

Date: 13/01/24

Table 12. China Core Working Group

Organisation
National Energy Administration, China
Department of Climate Change, China
Ministry of Ecology and Environment, China
The Administrative Center for China's Agenda 21
National Center for Climate Change Strategy and International Cooperation, China
The Foreign Economic Cooperation Office (FECO) of the MEE of China
China Electricity Council
China Metallurgical Industry Planning and Research Institute
SinoChem Energy High-Tech Co.,LTD
State Grid
China Building Materials Federation
China Petroleum and Chemical Industry Federation
China Nonferrous Metals Industry Association
Chinese Academy of Engineering
China's Academy of Social Science
Energy Research Institute, National Development and Reform Commission
Peking University
University of Chinese Academy of Sciences
Beijing Normal University
Beijing Institute of Technology
State Grid Energy Research Institute

Discussion

The Core Working Group workshop for China began with a presentation by Tsinghua University colleagues on the IAM COMPACT project and the modelling framework. Topics for discussion were framed by the distinction between

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carbon dioxide neutrality and greenhouse gas neutrality, something which is unspecified in China's most recent Nationally Determined Contribution (NDC). Stakeholders noted the significant burden of achieving carbon neutrality by 2060 (the NDC target), and China's lack of core technologies for the transition such as bearings and converters, as well as a deficit in cutting-edge technologies such as high-performing battery materials, for example. Another topic discussed was the funding gap in China, with both public and private sector finance needed for the energy transition. Stakeholders also pointed out that the outputs from COP28 should be included in the modelling scenarios, like the call for a tripling of renewable energy capacity and a doubling of energy efficiency.

The value of the discount rate in the modelling assumptions was also discussed in detail, balancing the needs of China's economic development in the present against the future rights of citizens to live in a stable climate. The effect of a low discount rate, which would emphasise the need to reduce emissions as soon as possible, would bring greater pressure on developing countries in the short-term, it was noted.

Project Takeaways

Stakeholders raised several important points to include the IAM COMPACT modelling analysis, including material constraints and COP28 commitments. 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.

3.3 India

The stakeholders participating in the Policy Steering Groups and Core Working Groups for India preferred to remain anonymous.

3.3.1 Policy Steering Group

Date(s): August 2023

Table 13. India Policy Steering Group

Organisation
Government of India
Indian Private Sector, Implementation of Energy Efficiency
Senior Professor working on Energy and Climate Policy

Discussion

IAM COMPACT representatives discussed India's climate and energy policy aims with stakeholders and specific challenges that India might face in this policy area. In terms of climate policy, based on India's NDC, the priorities are to meet its aims of reducing emissions intensity of GDP by 45% below 2005 levels by 2030 and achieving net zero by 2070. India has several sub-aims, such as creating significant carbon sinks, decarbonising Indian railways, and encouraging sustainable lifestyle choices. Energy policy aims are to achieve a 50% non-fossil installed capacity by 2030 and have full energy access, as well as enhancing energy efficiency in the process.

Energy sector challenges include enabling affordable electricity while expanding access, integrating renewables to the grid, exploring the feasibility of biofuels, enhancing energy efficiency in industry, and maintaining land for afforestation. Stakeholders also raised specific difficulties for large developing countries like India, like attracting low-cost and low-risk climate finance and having a better allocation of capital at both supply-side and demand-side, as well as obtaining access to advanced clean energy technologies such as novel batteries.

Initial Research Questions

- What should be India's carbon budget by taking into account its development priorities, equity, and just transitions?
- What are the various pathways (taking realistic development scenarios such as integration of RE, DSM

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initiatives, hydrogen economy, the feasibility of integrating new technologies such as CCUS, BECCS, BES, etc.) to achieve India's NZ target?

- What could be the sectoral-level investments required to achieve India's NZ target?

3.3.2 Core Working Group

Date: 13/12/23

Table 14. India Core Working Group

Organisation
CEPT University, Ahmedabad
Alliance for Energy Efficient Economy (AEEE), New Delhi
International Management Institute (IMI), Kolkata
Governmental Departments, Government of Gujarat

Discussion

The Core Working Group workshop for India was attended by 30 stakeholders, including government officers, industry leaders and academics. India's climate policy priorities were discussed in detail, including its aim to achieve net zero emissions by 2070 and its energy policy goal of energy independence by 2047. Stakeholders highlighted the need to prioritise the decarbonisation of India's buildings, both because of its expected growth and consequent impact on emissions, but also because of a clear policy gap in the sector. Building space in India is expected increase by 250% by 2050 and now accounts for 33% of final energy consumption. The stock of air-conditioners is also expected to increase by a factor of 30, noted the stakeholders.

Despite these challenges, stakeholders noted that India has opportunities to leapfrog to advanced building policies. For example, novel building codes could be implemented with net-zero standards for buildings and encouraging energy efficiency measures and the use of smart appliances. India can feasibly provide thermal comfort to all Indian citizens in a low-carbon way. Other specific measures suggested by stakeholders included reducing embodied energy in buildings, integrating more renewables in buildings energy usage, accelerating the retrofit of existing buildings, and promoting the adoption of low-carbon practices and lifestyles by building occupant.

Project Takeaways

Key research questions that emerged from the stakeholder workshop included:

- 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?

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4 Regions (Non-high-income Countries)

The following section provides, for Kenya, Ethiopia, Ukraine and Sri Lanka, the members of the Policy Steering Group, their proposed initial policy-relevant research questions, and a summary of the Capacity Development workshops, where available. While the other regions and themes refer to Core Working Groups, the focus in the below region is on capacity building. Stakeholders are therefore categorised accordingly in the following section.

4.1 Kenya

Date(s): 13/03/23-16/03/23

4.1.1 Policy Steering Group

Table 15. Kenya Policy Steering Group

Organisation	Name	Position
Ministry of Environment and Forestry, Kenya	Dr Pacifica F. Achieng Ogola	Director, Climate Change
Ministry of Energy, Kenya	Kihara Mungai	Renewable Energy Engineer
Ministry of Energy, Kenya	Benson Mwakina	Senior Principal Engineer
UN Environment Programme	Thadeous Idi	Programme Coordination Assistant
Environment Institute of Kenya	Ronald Kimtai	Chief Executive Officer

Discussion

A wide range of topics were discussed with Kenyan stakeholders, with an emphasis on energy policy. Energy access is a central aim, with improvements seen in recent years, as well as expanding the availability of clean cooking facilities. Policies that prioritise renewables were being instated, such as a mandate for solar panels on new buildings. Kenya has a commitment to achieve 100% renewable electricity production by 2030, relying on extensive geothermal and new solar and wind deployments. Integrating these renewables into the grid in a short time will be a major challenge, according to the Policy Steering Group members. Another challenge in this space is the financing of such projects, with Kenya relying on partnerships with the European Union and other international collaborators.

Sectoral aims include the challenge of promoting e-mobility as well as sustainable lifestyles that link with circular economy practices. The latter point was highlighted as having the co-benefit that it would also reduce pollution, a serious problem in Kenya.

On the climate policy side, adaptation and resilience across the economy was a key concern. A reforestation target of 30% by 2032 was noted by a stakeholder, with the caveat that the previous 10% target in 2022 was missed. The major climate policy aim is to develop a legal framework for carbon markets.

Initial Research Questions

- How might the addition of carbon markets affect Kenya's decarbonisation objectives?
- What might the emission savings be for Kenya through the widespread adoption of low-emission e-mobility?
- What models could be developed that would be useful in modelling renewable energy systems in Kenya?
- How can Kenya's renewable electricity generation assets be integrated in the lost cost way?
- What is the optimal strategy to improve energy access in Kenya, especially for cooking, while developing the energy system in a sustainable and low-carbon way?

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- How would significant afforestation affect Kenya's carbon budget in meeting its long term climate neutrality goals?

4.1.2 Choice of modelling tools

The concerns raised by Policy Steering Group stakeholders related mainly to energy system planning questions. The open-source CLEWs framework is suitable for such questions, as well as taking a nexus conceptual framing, and therefore it was decided to focus on this tool for the capacity building and Core Working Group sessions.

4.1.3 Capacity Development Workshop

Date: 31/08/23

Table 16. Kenya Core Working Group

Organisation	Name	Position
Climate Compatible Growth Programme	Martin Mutembei	Programs Manager
Climate Compatible Growth Programme	Joshua Oduor	Green H2 and E-mobility researcher
Technical University of Mombasa	Samson Soshyo	Lecturer
Meteorological Department, Kenya	Absae Sedah	Engineer

Discussion

The workshop in Kenya aimed to demonstrate the use of open source and accessible energy system, economic, and environment modelling tools, with a particular focus on the energy planning needs of Kenya, as suggested by stakeholders. Bruegel presented on the use of energy system models in the development of Europe's climate and energy policy, highlighting successes and failures. Stakeholders emphasised the need for Kenya to devise its own climate policy strategy and sustainable financial model, without relying exclusively on external solutions.

Stakeholders from the Climate Compatible Growth Programme then presented its work in Kenya, such as energy planning support and the development of an energy system modelling toolkit. The Kenyan IAM COMPACT team then presented their work applying the CLEWs nexus framework for integrated policy planning, with work ongoing to build a more advanced representation of Kenya's energy system. Further discussions took place regarding the nexus approach for water, energy, land use, and climate that can facilitate policy coherence. A hands-on session with the CLEWs framework was also provided.

The final point of discussion related to Kenya's NDC targets and its future energy system and climate plans. Stakeholders suggested afforestation as the most pressing issue, followed by access to sustainable finance and issues with governance and corruption.

Project Takeaways

IAM COMPACT representatives understood the clear need for Kenya to develop its own strategy for its energy system planning and climate goals. The use of energy planning tools, such as the CLEWs framework, were noted as essential aspects to inform Kenya's energy policy. Major challenges that the project should be aware of include the access to sustainable finance and overcoming political economy problems related to governance and corruption.

4.2 Ethiopia

4.2.1 Policy Steering Group

Date(s): 04/04/23

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Table 17. Ethiopia Policy Steering Group

Organisation	Name	Position
Ministry of Water and Energy, Ethiopia	Gosaye Mengistie Abayneh	Power Sector Reform Policy and Regulatory Advisor
Ministry of Water and Energy, Ethiopia	Kaleb Tadesse	Energy Resource Study Lead Executive Officer

Discussion

Energy access was stated by the stakeholders in the Ethiopian Policy Steering Group as the main priority for the country's energy policy agenda. This growing demand is planned to be met with expanded renewable capacity. Surplus electricity could be traded to Ethiopia's neighbours, said the stakeholders, strengthening economic ties and cohesion in the region. However, Ethiopia faces many challenges in meeting its growing demand with clean energy, with bottlenecks in terms of technical knowledge, inadequate technology transfers from the developed world, and trade imbalances in critical energy technologies. Ethiopia's dependence on hydropower is also at risk in the view of massive droughts due to climate change.

Initial Research Questions

- What is the most cost-efficient electricity generation mix for Ethiopia to meet its growing electricity demand?
- What is the most secure electricity generation mix for Ethiopia as it develops its system?
- How can the use of micro and mini grids be optimised as Ethiopia develops its transmission system?
- How could Ethiopia's power system manage a severe drought?
- What are the cost and benefits of local manufacturing of energy technology? Or, to what extent would removing foreign exchange spending reduce energy system costs in Ethiopia?

4.2.2 Choice of modelling tools

Like Kenya, the emphasis from stakeholders was on energy system planning, including microgrids. Therefore, the capacity development work led by KTH and the corresponding session focused on exploring energy system modelling approaches, with a specific focus on MicroGridsPy, a tool for sizing and dispatching energy grids in isolated micro-grids.

4.2.3 Capacity Development Workshop

Note: the stakeholders in the Ethiopian Capacity Development workshop preferred to stay anonymous.

Date: 23/01/24-24/01/24

Discussion

The workshop took place at Addis Ababa Institute of Technology (AAiT) in Ethiopia. The aim was to equip participants with fundamental energy modelling concepts and policy insights to support data-driven policymaking and planning. The workshop was split into two days, with the first focused on modelling beginners and the second day targeted at more advanced model users.

IAM COMPACT partners presented on the basics of energy systems modelling approaches and provided a demonstration of MicroGridsPy on the first day. On the second day, work focused on deepening the concepts discussed on day one, using hands-on work with a specific modelling tool (OnSSET) with a guided step-by-step set up with the trainers (POLIMI).

Project Takeaways

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The desire for more advanced energy system modelling capacity in Ethiopia was clear from the interest in the workshop. Building on this interest and ensuring that the tools presented and developed with the Ethiopian partners are key for the project's future capacity development.

4.3 Ukraine

4.3.1 Policy Steering Group

Date(s): 25/05/23 & 08/06/23

Table 18. Ukraine Policy Steering Group

Organisation	Name	Position
Ministry of Energy, Ukraine	Oleksandr Tarasenko	Deputy Head of European Integration
Ministry of Environmental Protection and Natural Resources	Victoria Kireeva	Deputy Minister
Ministry of Environmental Protection and Natural Resources	Oleh Hladchuk	Reform Support Centre
Ministry of Environmental Protection and Natural Resources	Olga Yukhymchuk	Department of Climate Policy
Ministry of Environmental Protection and Natural Resources	Yaroslava Kuharuk	Advisor to the Deputy Minister

Discussion

The new Ukrainian energy strategy out to 2050 was discussed with stakeholders, noting that its publication and emphasis has been impacted by the ongoing war. The energy and climate targets for Ukraine will also be update after the war. The centre of the discussion was on Ukraine's energy system reconstruction and development going forward. Another key consideration was the effect of European integration on Ukraine's energy system in terms of investment needs. More broadly, stakeholders had an interest in the role of modelling in supporting a green recovery in Ukraine, especially related to energy system planning.

Initial Research Questions

- How might European integration affect the development of the Ukrainian energy system, in terms of investment needs?
- How can Ukraine rebuild its energy system in a sustainable, low-carbon way at least cost?

4.3.2 Choice of modelling tools

Given the prioritisation of using models for energy system planning and green reconstruction in Ukraine, the capacity building work aims to focus on developing an OsEMOSYS model of Ukraine, which can explore exactly the questions of interest to Ukrainian policymakers.

4.3.3 Capacity Development Workshop

The Capacity Development Workshop for Ukraine is planned for February 2024.

4.4 Sri Lanka

Date(s): 08/06/23

The IAM COMPACT project has received funding from the European Union's HORIZON EUROPE Research and Innovation Programme under grant agreement No 101056306.

4.4.1 Policy Steering Group

Table 19. Sri Lanka Policy Steering Group

Organisation	Name	Position
Sri Lanka Sustainable Energy Authority	J.M. Athula	Director General
Public Utilities Commission of Sri Lanka	Shantha Jayasinghe	Deputy Director
Public Utilities Commission of Sri Lanka	Gamini Sarachchandra	Director, Renewable Energy
Resource Management Associates	Tilak Siyambalapitiya	Director
United Nations Development Programme (UNDP)	Sureka Perera*	Programme Quality and Design Analyst

**Sureka Perera is also a member of the Scientific Advisory Board and will be replaced on the Policy Steering Group by another UNDP representative going forward.*

Discussion

The shifting priorities of Sri Lankan energy policy was discussed with stakeholders, with the expansion of affordable electricity now balanced against ambitious decarbonisation objectives. Sri Lanka has strong NDC commitments, noted the stakeholders, including a 70% renewable energy target by 2030 and carbon neutrality by 2050. Furthermore, the government has stated that no new coal capacity will be added. Stakeholders claimed that much of these policies are not evidence-based and have not been subject to an impact assessment or modelling studies. The potential for IAMs to provide insight here was welcomed and encouraged by the stakeholders. They said the most important thing for Sri Lanka was to develop realistic and achievable climate and energy policy goals and implement a consistent policy framework that could facilitate investment. The specific challenges faced by Sri Lanka were also discussed, such as renewables expansion under strict planning laws related to land conservation and a foreign currency-driven economic crisis impeding progress.

Initial Research Questions

- How can Sri Lanka meet its ambitious climate and energy goals while conserving other environmental goods?
- What would be the electricity cost impact of shutting down existing coal plants?
- Which policies could form a policy framework to accelerate decarbonisation in Sri Lanka?

4.4.2 Choice of modelling tools

In similar fashion to the other capacity development countries, stakeholders in Sri Lanka were interested in energy planning modelling tools as well as tools that could capture broader dynamics in the climate, water, land, and energy nexus. Therefore, CLEWs was chosen as the appropriate tool, given its ability to represent many of these factors and their relationships.

4.4.3 Capacity Development Workshop

Date: 30/01/2024

Table 20. Sri Lanka Core Working Group

Organisation	Name	Position
CBL Plenty Foods (Pvt) Ltd.	Mr R.D.M.L. Senadheera	Cluster AM Eng & EHS
Public Utilities Commission of Sri Lanka	Mr H.P.R.C.Kumara	Assistant Director-EER
SLIIT	Dr Priyantha Bandara	Senior Lecturer
University of Peradeniya	Prof. Prasanna Gunawardane	Professor

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EnergySolve International (pvt) Ltd	Mr. Pathum Dulanjana	Consultant - Green Buildings & Sustainability Projects
Rajarata University of Sri Lanka	T. Kugaranan	Lecturer
Rajarata University of Sri Lanka	Nayanajith Kurukulasooriya	Lecturer
University of Peradeniya	Ms. Kamani Sylva	Senior Lecturer
University of Peradeniya	Dr Achala Pallegedara	Senior Lecturer
RMA	Ms. Thirasara Gunaruwan	Project Engineer
RMA	Dr Tilak Siyambalapitiya	Managing Director
University of Ruhuna	Dr Chithral Ambawatte	Senior Lecturer
USAID	Mr Gayan Subasinghe	Project Specialist
Löwener Vacuum Technology AB	Mr K.A.L. Srilal	Designer (R&D)

Discussion

The workshop took place online and aimed to introduce participants to the concept of integrated assessment modelling (IAM) for enhancing the comprehensibility of Sri Lanka's ambitious energy and climate policies. As an island nation, Sri Lanka faces critical interdependencies between climate, energy, water, and land-use systems. The workshop thus focused on existing local modelling knowledge and capacity gaps and hence bolsters in promoting fit-for-purpose and sustainable modelling knowledge transfer in our capacity development activities on the selected models. It kicked off with a discussion on key policy priorities towards meeting the climate targets in Sri Lanka and the interlinkages that exist, or may arise, across energy, land, climate, and water systems in the country with regards to the key polices identified. It then proceeded with an introduction to the Climate, Land-use, Energy, Water Systems (CLEWs[2]) framework, on which it concluded with a hands-on session.

Project Takeaways

Participants stressed the importance of assessing the feasibility of climate targets and pledges in Sri Lanka, mentioning that they could be at odds with its necessity for economic growth, given its very low historical responsibility in terms of emissions as well as its low per capita emissions. Difficulty in acquiring reliable data, and lack of communication between authorities were identified as main bottlenecks in energy modelling and policy planning. Land availability and water scarcity are considered key barriers for the development of ground-mounted solar and pumped hydro, with possible areas for further research and development being the utilisation of micro hydro along irrigation channels, ocean energy technologies, rooftop PV, agricultural waste from biomass, and agrovoltaics.

[2] https://www.i2am-paris.eu/detailed_model_doc/clews

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5 Lessons Learned

Several positives can be taken from the stakeholder engagement in the first PRM cycle within IAM COMPACT. During the Policy Steering Group process, the team managed to bring on board many high-level stakeholders working on energy and climate policy at the European Commission, the European Central Bank, national ministries, and other key organisations. This success was based on clear communication and structured outreach. The Policy Steering Group members also provided a consistent picture of the energy and climate policies both within and outside of Europe (for example, on the future of European industry or supply chain and material constraints). The clear policy picture validated the Policy Steering Group process and indicated that the project successfully identified highly policy-relevant research questions.

In the Core Working Groups, there were also a number of successful aspects to report. First, tools such as Miro and Mentimeter were useful for gathering stakeholder inputs in a live, dynamic way during the online workshops. Second, stakeholders were encouraged to contribute from the outset of the workshop and to feel free to challenge the views of the modellers, allowing for a frank and open exchange. Third, the workshop breakout rooms, focusing on specific research studies, facilitated a focused and deep discussion on relevant policy topics, as intended when designing the PRM. Both stakeholders and modellers shared knowledge on policy priorities, scenario design, and model representation.

The first phase of stakeholder engagement also encountered a number of challenges than can be learned from. In terms of Policy Steering Groups, many of the targeted stakeholders were extremely high-level and therefore short on time. Several meetings with these stakeholders had to be postponed or cancelled, leading to a drawn-out process for some themes. For the Core Working Groups in the EU, while many conversations in the breakout rooms were stimulating, some drifted from points of discussion that were most relevant for the project. Finally, targeting stakeholders in non-EU countries proved harder than in the EU, with some stakeholders less amenable to participation in the project. A few factors may have contributed to this challenge, such as bigger distance between the leaders of the IAM COMPACT PRM (Bruegel) and the stakeholders themselves or less familiarity amongst the stakeholders with Horizon projects and/or integrated assessment modelling.

5.1.1 Lessons for the second PRM cycle:

- A sufficiently large sample of interviews and meetings with policymakers can reveal a clear picture of policy priorities.
- High-level policymakers should be contacted in good time with clear communication of expected inputs.
- Online tools such as Miro can facilitate online workshops.
- Stakeholders must be empowered to speak freely and challenge modellers within all interactions.
- Expected inputs from stakeholders should be clearly defined before interactions.

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6 Next Steps

Modelling based on the scenario design that emerged from the Core Working Groups is ongoing as of the completion of this deliverable. Once initial modelling results are ready, they will be shared with members of the Core Working Group for feedback. It is intended that this step take place via email, with project partners available to discuss details via video call if required. Policy Steering Group members will also be consulted for their views on the study design and initial modelling results. With this feedback, a second iteration of modelling will take place. The final results will then be disseminated to stakeholders in the form of policy briefs, one per theme and region.

The second PRM cycle will begin after this step, with a review of the policy themes and their associated stakeholders. A new list of stakeholders for the Policy Steering Groups will be identified. Significant continuity in membership from the first PRM cycle is expected. IAM COMPACT partners will then consult these stakeholders for their views on the main energy and climate policy priorities for the second half of the project.

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