



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

D2.2 – Scoping Policy Relevant Research Questions

WP2 – Listening – Ensuring policy
relevance and ownership

30/01/2023

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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. The deliverable was submitted in January 2023, in line with the DoA deadlines. However, an updated version was submitted in May 2023, upon completion of the planned/outstanding exchanges with high-level EU policy actors, to document the additional research questions obtained.

2. Dissemination and uptake

This deliverable will be used by the project to shape its research agenda, providing input to the next steps of the stakeholder engagement process, which will refine the research questions scoped here and develop scenarios for modelling. It is, therefore, offered for use by both the different stakeholder groups of the project (including the policy steering groups and the core working groups) and researchers interested in identifying and addressing policy-relevant questions.

3. Short summary of results (<250 words)

Engagement and the exchange of knowledge between researchers and stakeholders is a fundamental part of IAM COMPACT. This deliverable summarises the results of the initial meetings with policy steering groups for the first iteration within the first modelling cycle, providing details of who attended, what topics were discussed, and the initial research questions that arose from the engagements. Background information on the Policy Response Mechanism, the central instrument of the IAM COMPACT stakeholder engagement strategy, is also provided, as well as the next steps for the project.

4. Evidence of accomplishment

This report.

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	

Executive Summary

Engagement and the exchange of knowledge between researchers and stakeholders is a fundamental part of IAM COMPACT. This deliverable summarises the results of the initial meetings with policy steering groups for the first iteration within the first modelling cycle, providing details of who attended, what topics were discussed, and the initial research questions that arose from the engagements. Background information on the Policy Response Mechanism, the central instrument of the IAM COMPACT stakeholder engagement strategy, is also provided, as well as the next steps for the project.

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1 Policy Response Mechanism

Engagement and the exchange of knowledge between researchers and stakeholders is a fundamental part of IAM COMPACT. The Policy Response Mechanism (PRM) is the central instrument in the stakeholder engagement strategy within the project, aiming to directly involve stakeholders in the modelling process. Through a structured process involving stakeholders at multiple levels from a broad range of backgrounds, the PRM ultimately seeks to co-create policy-relevant modelling.

The general approach for the PRM is to first identify stakeholders for policy steering groups and core working groups. Both sets of groups are organised by theme for stakeholders within the EU and by region for stakeholders outside the EU (discussed further below). The policy steering groups are comprised of high-level influential policymakers across the European institutions and national governments' ministries and agencies. The role for these groups is to provide input at an initial stage through a series of structured meetings regarding the primary priorities in European energy and climate policy, such that the modelling research can be oriented in a policy-relevant direction from the outset. These initial meetings will involve project partners with appropriate expertise matching the area of the policymakers and will be used to scope the initial policy-relevant research questions.

Going forward in the PRM, the research questions from the engagement with the policy steering groups will be discussed internally, with modellers within the consortium matched to research areas. The core working groups, who consist of technical policymakers, industry representatives, and civil society actors, will be invited to a series of meetings and workshops to further refine the research questions and collaborate in the scenario building for the first modelling iteration. The aim of this step is to ensure the research questions and scenarios are realistic from a broader social perspective.

After the first round of modelling, discussions will be held with stakeholders from the core working groups to gauge the relevance of the outputs. Research questions will then be reviewed once more with the policy steering groups, before the second iteration of modelling begins, incorporating the core working groups for scenario building and discussion of the results. The overall process described above will be repeated across two cycles within the project.

This deliverable sets out the results of the initial meetings with policy steering groups for the first iteration within the first modelling cycle, providing details of who attended, what topics were discussed, and the initial research questions that arose from the engagements.

1.1 Themes and Regions

The stakeholder engagement in IAM COMPACT is organised into themes (for stakeholders within the EU) and regions (for stakeholders outside the EU). The themes and regions were collaboratively determined within the project, with Bruegel proposing an initial list that was refined based on comments from consortium partners.

For the themes, the aim was to have a broader enough coverage to capture a range of issues, but also sufficiently selective to lead a clear research agenda later in the project. Topics such as the just transition and biodiversity were considered universal and therefore to apply to all themes.

The regions were determined by the non-EU project partners, who are based across the five areas.

Themes

European Industry

Exploring the impacts of the energy crisis on European industry.

Electrification

Investigating the effects of electrification of heating and transport on the power sector demand-side.

Global Green Investment

Examining the distributional implications of investment in decarbonisation from a global perspective.

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.

Mainland China

Energy and climate policies in China.

India & Sri Lanka

Energy and climate policies in India and Sri Lanka.

Kenya & Ethiopia

Energy and climate policies in Kenya and Ethiopia.

USA

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

The rest of the deliverable is structured as follows: Section 2 provides details of the meetings with stakeholders in the *policy steering groups* under each of the four themes; while Section 3 covers the results of the *policy steering group* engagements under the five regions.

2 Themes

2.1 Theme 1: European Industry

Under the theme of European Industry, stakeholders from national governments and the European Commission were engaged to understand the policy issues in the context of the energy crisis, with a focus on the impacts on industry as a consequence of increasing energy costs. Topics such as competitiveness, industrial policy, response to the Inflation Reduction Act, the Emissions Trading System (ETS) and the Carbon Border Adjustment Mechanism (CBAM), and potential relocation of industrial centres were discussed.

2.1.1 Department of Climate, German Federal Chancellery

Date: 26/01/23

Attendees

IAM COMPACT

German Federal Chancellery

Georg Zachmann (Bruegel)

Christian Büchter, Head of Department of Climate

Conall Heussaff (Bruegel)

Vera Zipperer, Economist at Department of Climate

Giovanni Sgaravatti (Bruegel)

Jakob Zinck Thellufsen (Aalborg University)

Rasmus Johannsen (Aalborg University)

Discussion

Researchers and modellers from the IAM COMPACT consortium met with Christian Büchter, Head of Department of Climate in the German Federal Chancellery, and Zera Zipperer, economist at the same department, to discuss the policy agenda for European industry from an energy and climate perspective. The challenges of assessing the future of European industry given the current energy crisis and the decarbonisation push was noted. Topics such as the ETS and its consequences for competitiveness were discussed, the efficiency of European funding mechanisms, the future industrial mix, the role of hydrogen, the CBAM, labour market effects and potential of scenario modelling to provide evidence in this space were all discussed.

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?

2.1.2 DG BUDGET

Date: 03/02/23



Attendees

IAM COMPACT

Georg Zachmann (Bruegel)

Conall Heussaff (Bruegel)

Giovanni Sgaravatti (Bruegel)

Stefan Lechtenböhmer (Wuppertal)

Policy Steering Group Stakeholders

Peter Zapfel, Senior Expert, ETS, DG BUDGET

Discussion

A key area for investigation that emerged in the discussion with Mr. Zapfel related to understanding the different segments of European industry regarding their readiness for decarbonisation. Having such an understanding, for example of the suitability of certain parts of the steel industry compared to parts of the cement industry for rapid decarbonisation, could inform what policy mix is likely to drive an orderly transition in the industrial sector. Representing heterogeneity in industry in the IAM COMPACT models was pointed out as a possible approach to such research. The question of industrial adjustment to increased energy costs in Europe was also discussed, especially the impact on value chains. A discussion on CBAM and its consequences for European industry also took place.

Initial Research Questions

- 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?

2.2 Theme 2: Electrification

Project partners met with stakeholders from DG ENER, the Agency for the Cooperation of Energy Regulators (ACER) and the International Energy Agency (IEA) to discuss the theme of Electrification. The increasing role of the demand side, affordability for consumers, consumers heterogeneity, biodiversity impacts, technologies to provide flexibility, and supply chain constraints were all discussed.

2.2.1 World Energy Outlook Team, IEA

Date: 24/01/23

Attendees

IAM COMPACT

Georg Zachmann (Bruegel)

Conall Heussaff (Bruegel)

Ajay Gambhir (Imperial)

Eleftheria Zisarou (E3M)

Jan Sasse (UNIGE)

Policy Steering Group Stakeholders

Yasmine Arsalane, World Energy Outlook analyst, IEA

Discussion

Yasmine Arsalane began the call by describing some key areas of policy interest on the topic of electrification, such as consumer affordability, supply-side flexibility, supply chain constraints, reliance on innovation, stranded assets, market design, and biodiversity impacts. A discussion took place between Ms. Arsalane and the IAM COMPACT researchers around these topics, focusing on market prices vs. resource costs, the capital costs in developing countries, and accessibility to energy. The ability of the project’s modelling suite to represent various technological scenarios, such as long duration storage capabilities, was also discussed. Finally, the question of feedback between climate change and macroeconomic assumptions was raised.

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?

2.2.2 Agency for the Cooperation of Energy Regulators

Date: 30/01/23

Attendees

IAM COMPACT

Georg Zachmann (Bruegel)

Conall Heussaff (Bruegel)

Ajay Gambhir (Imperial)

Eleftheria Zisarou (E3M)

Jan Sasse (Unige)

Policy Steering Group Stakeholders

Patrick Luickx, Electricity Department, ACER

Vasilis Papandreou, Electricity Department, ACER

Discussion

Colleagues from ACER had two sets of prepared questions for the consortium partners to take forward for use in defining the IAM COMPACT research agenda. The first set of questions were centred on electricity sector-related issues—specifically, flexibility needs and infrastructure needs. The discussion that followed touched upon the potential of various measures to reduce electricity system costs, the ability of IAM COMPACT’s modelling suite to address these types of questions, and the potential use by ACER of IAM COMPACT modelling research in its work. The second set of questions related to broader concerns, such as the configuration of the 2050 holistic energy system, the potential of non-wired solutions, and transition risks.

Initial Research Questions

- What are the flexibility needs for the future electricity system?
 - What technologies can replace the flexibility provided 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?

- 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)?

2.2.3 DG ENER

Date: 17/02/23

Attendees

IAM COMPACT

Georg Zachmann (Bruegel)

Conall Heussaff (Bruegel)

Policy Steering Group Stakeholders

Francesco Ferioli, Policy Analyst, Chief Economist Unit, DG ENER

Clément Serre, Policy Analyst, Chief Economist Unit, DG ENER

Discussion

The colleagues from DG ENER confirmed that electrification in itself was a policy priority for the European Commission. They highlighted the relationship of electrification with hydrogen as an important sub-question, especially understanding for which uses hydrogen can compete with electricity as an energy carrier. The 2040 targets as an upcoming policy process for IAM COMPACT to input to was noted. A discussion took place about the use of electricity market models for policy analysis. Finally, a new round of draft National Energy and Climate Plans (NECPs) are scheduled for submission by June 2023. It was suggested that analysis of these NECPs could be a relevant contribution to the policy debate.

Initial Research Questions

- 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 an decarbonised power system?

2.2.4 Department of Climate, German Federal Chancellery

Date: 07/03/23

Attendees

IAM COMPACT

Policy Steering Group Stakeholders

Georg Zachmann (Bruegel)

Frauke Braune, Head of Power Market Design and Security of Supply for Electricity Unit

Conall Heussaff (Bruegel)

Stefan Lechtenböhmer (WI)

Ajay Gambhir (Imperial)

Discussion

The meeting focused on the topic of electricity market design, but also considered industrial decarbonisation, and the future role for hydrogen. The point that future power systems will be fundamentally different from the current system was highlighted, with the question raised of how this affected the function of power markets in the future (in terms of sending appropriate operational and investment signals). The role of hydrogen ready gas fired power plants was also discussed, with gas plants installed now potentially providing low-carbon flexibility in the future. Another important aspect of future security of supply that was noted is industrial flexibility (or demand side response). The discussion concluded by exploring the idea of introducing energy security indicators to IAMs.

Initial Research Questions

- What are the implications of changing power systems for the optimal electricity market design?
 - What technologies will need to be remunerated in future power systems?
- What will be the level of supply and cost of hydrogen in Europe going forward?
- What would be the benefits (in terms of cost reduction and emissions saving) of better industrial demand side response in power and gas systems?
- Could model indicators for energy security be developed to reflect the primacy of this objective in current policy discussions?

2.3 Theme 3: Global Green Investment

On the theme of Global Green Investment, project partners met with stakeholders from the European Commission and academia to address European policy issues related to energy security and investment, global distributional concerns, the macroeconomic context impacting on the energy transition, and investment conditions in developing countries.

2.3.1 Innovation, adaptation and resilience, DG CLIMA

Date: 30/03/23

Attendees

IAM COMPACT

Georg Zachmann (Bruegel)
 Conall Heussaff (Bruegel)
 Lorenzo Rinaldi (POLIMI)
 Shivika Mittal (Imperial)

Policy Steering Group Stakeholders

Stefaan Vergote, Deputy Director General

Discussion

Consortium partners gave an overview of the project aims, highlighting potential areas for research in relation to green investment. Mr. Vergote explained his background and his view of the energy transition at this point. The pace of innovation was highlighted, noting that new technologies are needed and that IAM COMPACT could explore which areas are most in need of innovation, as well as the effects of a multipolar geopolitical situation. The discussion covered the areas in which the Innovation Fund is providing support.

Initial Research Questions

- Which areas of the economy require innovation to decarbonise?
- What are the consequences of a multipolar world in terms of impacting supply chains?
- How necessary carbon capture and storage (CCS) is in decarbonisation of industry and power?
- 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?

2.3.2 Chief Economist, DG COMP

Date: 03/02/23

Attendees*IAM COMPACT*

Georg Zachmann (Bruegel)
 Conall Heussaff (Bruegel)
 Diana Shendrikova (Polimi)
 Nicolo' Golinucci (Polimi)
 Lorenzo Rinaldi (Polimi)
 Shivika Mittal (Imperial)

Policy Steering Group Stakeholders

Pierre Regibeau, Chief Economist, DG COMP

Discussion

After the standard introductions, Mr. Regibeau explained why the work of IAM COMPACT is of interest to his team. The immediate question of responding to the Inflation Reduction Act (IRA) has made understanding which industries are best suited to Europe extremely relevant. A discussion took place regarding the potential global development of the hydrogen industry. Colleagues from POLIMI explained their modelling approach that could help to investigate some of the questions suggested by Mr. Regibeau. The call concluded with a recommendation of further policymakers to speak to on the subject to Global Green Investment.

Initial Research Questions

- Which energy-intensive industries are best suited to Europe from an economic efficiency perspective?
- 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?

2.3.3 InvestEU implementation, DG ECFIN

Date: 06/02/23

Attendees

IAM COMPACT

Georg Zachmann (Bruegel)

Conall Heussaff (Bruegel)

Haris Doukas (NTUA)

Shivika Mittal (Imperial)

Policy Steering Group Stakeholders

Martin Koch, Policy Officer, InvestEU implementation, DG ECFIN

Discussion

The responsibilities of DG ECFIN in relation to green investment in Europe were discussed. The context of the increasingly accelerated timeframes for investment was highlighted. The goals of the Green Industrial Plan were examined, especially regarding dependencies on raw materials. The role of the EU taxonomy was also touched upon, as regards provide guidance for green investment and increasing transparency.

Initial Research Questions

- 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?

2.3.4 European Central Bank

Date: 20/04/23

Attendees

IAM COMPACT

Conall Heussaff (Bruegel)

Nicolo' Golinucci

Policy Steering Group Stakeholders

Daniel Kapp, Advisor

Carolin Nerlich, Climate Change Centre

Romanos Priftis

Friderike Kuik

Ana-Simona Manu

Francesca Romane

Discussion

Initial Research Questions

- 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?

2.4 Theme 4: Behavioural Change

Discussions about Behavioural Change, as it pertains to energy and climate policy, took place with stakeholders from the European Commission's Joint Research Centre, the International Energy Agency, and DG ENER. Topics involved heterogeneous consumer preferences like risk aversion and discount rates, the difference between one-time decisions and habits, and the importance of understanding how policies drive behavioural change.

2.4.1 Competence Centre on Behavioural Insights, Joint Research Centre

Date: 24/01/23

Attendees:

IAM COMPACT

Policy Steering Group Stakeholders

Georg Zachmann (Bruegel)

Emanuele Ciriolo, Head of Competence Centre on Behavioural Insights

Conall Heussaff (Bruegel)

Andrea Blasco

Jon Sampedro (BC3)

Marion Dupoux

Xaquín Garcia (BC3)

Hendrick Bruns

Ilkka Keppo (Aalto)

Discussion

IAM COMPACT project partners, including representatives from Bruegel, Aalto, and BC3, met with researchers from the Competence Centre on Behavioural Insights at the Joint Research Centre (JRC) led by Emanuele Ciriolo to understand their research areas and policy priorities for the area of behavioural change as it relates to energy and climate issues. Mr. Ciriolo outlined some of the past research areas of his team, including vaccine hesitancy, misinformation, and the perceptions of Ukrainian migrants. A pilot study on behavioural interventions at the level of the firm investigating the barriers for clean tech investment was also highlighted. Modellers from IAM COMPACT discussed their research areas, specifically related to behavioural change, as well as giving an overview of the project aims.

The JRC researchers then noted potential areas of overlap between their work and the aims of the project in the context of behavioural change. Information provision, such as through labelling, was noted in addition to the possibility of using models at the individual agent level through agent-based models. The relevance of understanding the distributional impacts of policy choices for behavioural insights was agreed upon as a key area, in which the IAM COMPACT modelling suite had the potential to explore. Other behavioural questions, such as habit formation, intrinsic motivation, and beliefs, were discussed.

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)?
- How do heterogeneous discount rates across consumer categories affect the adoption rates of clean technologies?
- How can certain digital innovations (such as remote working) reduce energy consumption?

2.4.2 Energy Efficiency, International Energy Agency

Date: 24/01/23

Attendees:

IAM COMPACT

IEA

Georg Zachmann (Bruegel)

Brian Motherway, Head of Energy Efficiency

Conall Heussaff (Bruegel)

Jon Sampedro (BC3)

David Alvarez Antelo (UVa)

Andreas Andreou (E3M)

Discussion

Colleagues from IAM COMPACT met with Brian Motherway, Head of Energy Efficiency at the International Energy Agency, to discuss the policy priorities for governments in the area of energy efficiency improvements and behavioural change. Mr. Motherway emphasised that a priority for governments, especially since the energy crisis, was information on policies that lead to behavioural change, and less so on the specific impacts of a given change in behaviour. He also noted that behavioural change is also seen as a category in its own right, distinct from energy efficiency. The types of policies used to drive different kinds of behavioural change were discussed, such as financial incentives for one-time purchases or targeted campaigns and gamification to instigate more lasting habitual changes.

Initial Research Questions

- 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?

2.4.3 Consumers, Local Initiatives, Just Transition, DG ENER

Date: 24/01/23

Attendees:

IAM COMPACT

DG ENER

Georg Zachmann (Bruegel)

Tadhg O’Brian, Deputy Head of Unit, Consumers, Local Initiatives, Just Transition

Conall Heussaff (Bruegel)

Xaquin Garcia (BC3)

David Alvarez Antelo (UVa)

Discussion

Tadhg O’Brian, Deputy Head of the DG ENER unit focused on Consumers, Local Initiatives, and Just Transition, discussed with project partners some key policy areas for the European Commission related to energy that overlap with behavioural change considerations. Specifically, he highlighted questions around electricity consumer empowerment, energy poverty and capital constraints, and energy sharing. The question of different risk aversion levels among consumers, and their predilections for long-term contracts or installation of renewable technologies, was discussed in the context of electricity system costs. The point of willingness to pay vs. willingness to accept (i.e., willingness to accept a disruption of service) was also discussed in detail. Finally, the possibility of consumers having different preferences for different segments of their consumption was also addressed.

Initial Research Questions

- 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?

3 Regions

3.1 Region 1: Ukraine

3.1.1 Ministry of Energy, Ukraine

Date: 25/05/23

Attendees:

IAM COMPACT

European Integration, Ministry of Energy, Kenya

Georg Zachmann (Bruegel)

Oleksandr Tarasenko, Deputy Head of European Integration

Conall Heussaff (Bruegel)

Borys Dodonov (Kiev Economics Institute)

Francesco Gardumi (KTH)

Matteo Rocco (Polimi)

Discussion

Borys Dodonov explained the IAM COMPACT project, its aims, specifically those to develop modelling capacity in Ukraine that could be of use to policymakers. The models that could be used for building a Ukrainian integrated assessment model were also described, including OSeMOSYS, EnergyPLAN, Calliope, and MARIO. Oleksandr Tarasenko set out the immediate energy policy priorities for Ukraine, such as publishing the new energy strategy for 2050 and an action plan for post war reconstruction. The use of models in the Ministry was discussed, including the current role for consultancies and the technical capacity within the Ukrainian state for such research. Mr Tarasenko indicated that staff from the Ministry would find a workshop on modelling to be useful.

Initial research questions

- How might European integration affect the development of the Ukrainian energy system, in terms of investment needs?

3.2 Region 2: Mainland China

To be documented in D2.4 – Proceedings of Stakeholder Interactions.

3.3 Region 3: India & Sri Lanka

To be documented in D2.4 – Proceedings of Stakeholder Interactions.

3.4 Region 4: Kenya & Ethiopia

3.4.1 Ministry of Environment and Forestry, Kenya

Date: 13/03/23

Attendees:

IAM COMPACT

Ministry of Environment and Forestry, Kenya

Ioannis Tsiouridis (TUM)

Dr. Pacifica F. Achieng Ogola, Director, Climate Change

Discussion

Dr. Achieng stated that the climate policy priority for Kenya is to develop a legal framework for carbon markets. She highlighted the latest version of the National Climate Change Action Plan for 2023-27 which sets out what needs to be implemented in terms of mitigation and adaptation over that period. A recent commitment to 100% renewable electricity production in Kenya by 2030 was also noted. On the transport side, a key policy question is how to promote e-mobility, for example through proper standards for locally manufactured vehicles.

Several climate finance questions were also discussed, such as potentially creating a green bank. Dr. Achieng said that the Kenyan central bank has been working on climate finance topics, such as green bonds and debt-for-climate swaps, although the latter is in early stages of development. Finally, the concept of loss and damage was discussed, with the potential role for Kenya and similar countries to support the introduction of a loss and damage fund.

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?

3.4.2 Ministry of Energy, Kenya

Date: 16/03/23

Attendees:

IAM COMPACT

Ministry of Energy, Kenya

Ioannis Tsipouridis (TUM)

Kihara Mungai, Renewable Energy Engineer

Discussion

Mr. Mungai outlined some of the tools used by the Ministry in making assessment of energy and climate policy, such as models that explore the supply needed to meet energy demand at least cost. The models also inform emission levels. However, they do not necessarily address broader environmental issues from an integrated assessment perspective. Mr. Mungai did note that the Ministry are beginning to use the OSeMOSYS model.

From the Ministry of Energy perspective, Mr. Mungai emphasised their interest in tools that can be used to better model renewable energy systems and also take into account climate change challenges.

Initial research questions

- What models could be developed that would be useful in modelling renewable energy systems in Kenya?

3.4.3 Ministry of Energy, Kenya

Date: 13/03/23

Attendees:

IAM COMPACT

Ministry of Energy, Kenya

Ioannis Tsipouridis (TUM)

Benson Mwakina, Senior Principal Engineer

Discussion

Kenyan policy is to ensure each citizen has affordable energy and develop in the energy system in a sustainable way. Mr. Mwakina discussed the energy system challenges for Kenya, such as its exploitation of geothermal, wind

and solar. The main challenge is in integrating these renewable assets. The Least Cost Power Development plan was referenced as the key electricity system policy document. Mr. Mwakina noted that Kenya is intending to retire its thermal power plants. From a climate and emissions point of view, the priority is to increase the levels of clean cooking as well as afforestation in Kenya. A major challenge is the financing of the projects to achieve these goals, but there are strong partners such as the European Union and German Agency for International Cooperation or (GIZ).

Mr. Mwakina discussed the models used by the Ministry, including OSeMOSYS, as well as numerical models for energy system planning.

Initial research questions

- How can Kenya's renewable electricity generation assets be integrated in the lost cost way?

3.4.4 UN Environment Programme

Date: 13/03/23

Attendees:

IAM COMPACT

UN Environment Programme

Ioannis Tsipouridis (TUM)

Thadeous Idi, Programme Coordination Assistant

Discussion

Mr. Idi discussed the priorities for Kenya from a climate and energy policy perspective, noting the importance of energy access, but energy access based on renewable energy. Energy efficiency is also a priority. Kenya has strong climate commitments on paper, according to Mr. Idi, but strong action and implementation is still required. For example, LPG is promoted as a solution for clean cooking (a health and emissions improvement on charcoal) but in the long-term this will hold Kenya back from meeting its climate ambitions. Another example provided by Mr. Idi was the possibility of a coal mining project going ahead. Kenya's strong afforestation ambitions were discussed, as well as concept of the loss and damage, which is supported by Kenya.

Initial research questions

- 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?

Environment Institute of Kenya

Date: 13/03/23

Attendees:

IAM COMPACT

Environment Institute of Kenya

Ioannis Tsipouridis (TUM)

Ronald Kimtai, Chief Executive Officer at Environment Institute of Kenya

Discussion

Mr. Kimtai noted that the Kenyan government is focused on the climate and energy issues that IAM COMPACT is seeking to address. One topic of interest is adaptation to climate change and developing resilience across the economy. In the energy sector, policies that prioritise renewables are taking precedence. For example, building standards require that new constructions must have solar panels installed. Regional partnerships on geothermal energy were discussed. On the topic of circular economy, especially important for Kenya as it faces severe problems with pollution (including from imported waste such as second-hand clothes), there have been

developments in the banning of single use plastic bags. A reforestation target of 30% by 2032 was mentioned, although the failure to meet the 10% target in 2022 was noted. The implementation of this national target to the regional level was also discussed.

Initial research questions

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

3.4.5 Ministry of Water and Energy, Ethiopia

Date: 04/04/23

Attendees:

IAM COMPACT

Ministry of Water and Energy, Ethiopia

Conall Heussaff (Bruegel)

Gosaye Mengistie Abayneh, Power Sector Reform Policy and Regulatory Advisor

Solomon Teferi (Addis Ababa University)

Fitsum Kebede (Addis Ababa University)

Discussion

Mr. Gosaye outlined his background as former CEO of Ethiopia’s public utility company before he joined the Ministry of Water and Energy as an advisor. He stated that the critical concern for Ethiopia regarding energy and climate policy is to increase energy access. The latest version of Ethiopia’s National Electrification Program 2.0 was discussed, including plans to install significant wind, solar and geothermal generation capacity to meet the country’s growing electricity demand. The levels of interconnection between Ethiopia and its neighbouring countries were covered. Regarding improving energy access, the bottlenecks of technical knowledge, technology transfers, and trade imbalances were highlighted. Finally, the use of modelling in the Ministry of Water and Energy was discussed, with efforts to develop modelling capacity in Ethiopia welcomed.

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?

3.4.6 Ministry of Water and Energy, Ethiopia

Date: 04/04/23

Stakeholder: Kaleb Tadesse, Energy Resource Study Lead Executive Officer

Mr. Tadesse provided his comments via email as he was unable to attend the meeting.

Mr. Tadesse noted that hydropower will continue to be the dominant power source in Ethiopia, but that it comes with its own drawbacks such as the risk of drought, earthquakes, and deterioration. Localised power generation is expected to reduce the share of hydropower in the generation mix and improve reliability, cost and security of supply, especially to rural communities.

Also stated by Mr. Tadesse was the requirement for increased private sector investment in the Ethiopian energy system. Inadequate transfer of technology is seen as the major bottleneck to energy development. At present, there is insufficient manufacturing capacity and most energy technology is imported, leading to spending on foreign exchange. This spending can reach up to 80% of project cost.

Initial Research Questions

- How could Ethiopia’s power system manage a severe drought?
- What are the cost benefits of local manufacturing of energy technology? Or, to what extent would removing foreign exchange spending reduce energy system costs in Ethiopia?

3.5 Region 5: USA

To be documented in D2.4 – Proceedings of Stakeholder Interactions.

4 Takeaways and Next Steps

4.1 Takeaways

The key takeaways from the meetings with stakeholders in the Policy Steering Groups are summarised below, structured by theme and region. Potential research questions related to each takeaway are marked with an arrow bullet.

Themes

European Industry

Policymakers are interested in the economic effects of different potential scenarios of European industrial organisation.

- How do different future (2030 and 2040) scenarios of European industry (e.g., in terms of production, location, energy-intensiveness, and input costs) compare in terms of cost, resilience to shocks, sustainability and social (labour market) perspectives?
 - Industrial relocation in response to increased energy costs could form part of the scenario assessment.

The security of supply, cost-saving, and emissions impacts of reshoring vs. importing of essential green technologies is of interest.

- What are the energy, climate, labour and cost implications of reshoring critical industries?

Understanding the potential for European hydrogen, specifically its possible production, demand, and cost in Europe, is a policy priority.

- What will be the available supply and cost of hydrogen in Europe? (both produced domestically and imported)
- How will this compete with other regions of the world? (e.g., the Gulf of Mexico)

Electrification

The affordability dimension of increasing electrification will continue to be a central policy question.

- Will the reducing cost per MWh of renewables translate into lower customer bills? (e.g. will the energy system cost decrease through decarbonisation)

Flexibility needs in future power systems is of vital importance and potentially underexplored.

- Which technologies are best placed to provide flexibility in a low-carbon system?

The optimal balance between grid investment on the one side and demand response, smart grids, and flexibility on the other is crucial to understand.

- 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)?
- What would be the benefits (in terms of cost reduction and emissions saving) of better industrial demand side response in power and gas systems?
- What is the impact of smart grids and flexibility solutions on capacity needs?
- What are the costs and benefits of increasing levels of interconnection capacity?
- How does the share of generation vs. transmission & distribution change in the total cost of an decarbonised power system compared to our existing system?

Transition risk (e.g., supply chain disruptions of essential materials and products due to geopolitical instability) is a primary concern for policymakers regarding electrification.

- Could model indicators for energy security be developed to reflect the primacy of this objective in current policy discussions?
- How do supply-chain constraint the potential ramp-up of clean technologies?
- 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?

Taking a holistic energy system perspective regarding electricity is becoming increasingly relevant.

- How does the implementation of the updated draft National Energy and Climate Plans compare to the cost optimal approach at a European level?
- What energy carriers are most likely to dominate in future (2040 and beyond) energy systems and what are the implications for markets?

Global Green Investment

Understanding which countries are likely to be able to produce cheap hydrogen will inform investment decisions and cost distributions.

- Which manufacturing sectors are most likely to switch to hydrogen?
 - How mobile are those sectors? (i.e., can they move production to other regions)

Access to critical raw materials is relevant from both a strategic autonomy and an investment perspective. Understand where such materials is cheapest would be informative.

- What are the consequences of a multipolar world in terms of impacting supply chains?

Understanding which sectors require further innovation to decarbonise can support policymaking in climate finance.

- Which sectors require innovation to decarbonise?
- How necessary is carbon capture and storage (CCS) to decarbonise of industry and power?
- What are the most economic forms of long-duration energy storage? (will hydrogen be competitive?)

Behavioural Change

Providing estimates of which policies can drive behavioural change, in addition to the cost-saving and emission reductions of those changes, is of utmost interest to policymakers, but many such behavioural questions are challenging to implement in the IAM COMPACT model suite.

Understanding the effects of heterogenous consumer preferences on model results could inform policymakers regarding the value of promoting behavioural change.

- How do heterogenous discount rates across consumer categories affect the adoption rates of clean technologies?
- What are the market impacts (rather than the cost of policy implementation) of a given behavioural change?

Regions

Ukraine

In the short term, the energy and climate policy for Ukraine are related to creating sustainable war reconstruction plans and considering how European integration might affect the optimal development of Ukraine's energy system. A key document will be the new energy strategy to 2050 of Ukraine which will set out the country's intended pathway.

Mainland China

To be documented in D2.4 – Proceedings of Stakeholder Interactions.

India & Sri Lanka

To be documented in D2.4 – Proceedings of Stakeholder Interactions.

Kenya

Kenya is exploring carbon markets, incentivising e-mobility, and climate finance measures such as green bonds. Financing is a central challenge in this respect. Several policymakers mentioned that Kenyan ministries use numerical models in their work and are beginning to apply the OSeMOSYS model. The Least Cost Power Development plan is a key policy document. Finally, reforestation ambitions are high in Kenya and quantifying their benefits to the carbon budget would be relevant.

Ethiopia

Energy access is the priority for Ethiopia, whose electricity demand increase is aimed to be met with renewable capacity. The areas of mini and micro grids are of importance, as well as understanding how to ensure reliability and energy security as Ethiopia deploys more renewables. One notable vulnerability is the country's dependency on hydropower, which may be threatened by increasing droughts.

USA

To be documented in D2.4 – Proceedings of Stakeholder Interactions.

4.2 Next Steps

The detailed results of our interactions with all stakeholder groups in the first modelling cycle will be recorded in project deliverable D2.4 - Proceedings of Stakeholder Interactions (alongside outputs of pending exchanges with the Policy Steering Groups for China, the USA, and India & Sri Lanka). The initial research questions scoped with the Policy Steering Groups will be discussed between project partners, then further refined in collaboration with the Core Working Groups. Scenarios for the first modelling cycle will then be co-created with the Core Working Groups based on the refined research questions.

The update to this deliverable (D2.3, in July 2024) will document all research questions arising from the exchanges with the Policy Steering Groups during both PRM cycles.