IAM COMPACT

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

A robust policy assessment framework through integrated research practice:
Insights from IAM COMPACT

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1 Introduction

IAM COMPACT is a Horizon Europe research project, with the objective to support the assessment of global climate goals, the collective progress towards them, and the feasibility space in delivering on those goals. It aims to involve relevant stakeholders in the process to help promote acceptable, robust, sustainable transitions, as well as to enhance trust on both ends, yielding outputs intelligible in terms of real-world implications and actionable in terms of concrete policy recommendations.

The IAM COMPACT project kicked off in September 2022 and was successfully concluded in August 2025, having implemented an efficient research coordination and management approach, ensuring genuine co-production of scientific knowledge and policy outputs that were continuously aligned with the policy debate. By organising activities around a set of shared core objectives rather than isolated work packages, the project enabled all partners to contribute meaningfully across tasks and where needed, thereby fostering integration, ownership, and interdisciplinary learning. This technical brief outlines the IAM COMPACT management and research integration practice, with the aim is to transform this internal project coordination approach into a replicable framework that helps future modelling research initiatives and policy institutions co-design, jointly manage, evaluate, and co-own complex transdisciplinary collaborations with concrete scientific and societal impact.

2 Context: the need for robust policy effectiveness assessment frameworks

Despite growing ambition, neither current climate policies nor the first round of Nationally Determined Contributions (NDCs) placed the world on track to meet the Paris Agreement's temperature goals. Countries must continuously assess and upgrade their climate pledges for the post-2030 period, while bridging the "triple gap" of implementation, ratcheting, and ambition[1]. To close this gap, there has been a growing need for systematic assessments of how effective different policy measures are in delivering real progress, and under which conditions they can be feasibly implemented. A policy effectiveness assessment framework can provide such a foundation, offering a consistent, transparent approach to evaluating policy outcomes across regions and contexts and to identifying barriers to implementation. Integrated assessment modelling (IAM) approaches in support of climate policy often underrepresent behavioural, political, or institutional dynamics in a constantly evolving sociopolitical landscape, including critical (emerging) factors that determine whether technically feasible pathways are politically and socially implementable[2] and relevant[3]. IAM COMPACT sought to respond to this challenge, by setting up and operationalising a co-creative, policy-driven, dynamic scientific process, structured around collaboration between researchers, policymakers, and stakeholders across multiple countries, contexts, and areas of expertise.

[1] van de Ven, D. J., Mittal, S., Gambhir, A., Lamboll, R. D., Doukas, H., Giarola, S., ... & Nikas, A. (2023). A multimodel analysis of post-Glasgow climate targets and feasibility challenges. *Nature Climate Change*, *13*(6), 570-578.
[2] Gambhir, A., & Nikas, A. (2023). Seven key principles for assessing emerging low-carbon technological opportunities for climate change mitigation action. *PLOS Climate*, *2*(7), e0000235.
[3] Nikas, A., Gambhir, A., Trutnevyte, E., Koasidis, K., Lund, H., Thellufsen, J. Z., ... & Doukas, H. (2021). Perspective of comprehensive and comprehensible multi-model energy and climate science in Europe. *Energy, 215*, 119153.

3 Organising research around core objectives

The project's management practice was built around eight core objectives (O1–O8), which together defined the project's scientific and policy vision:

O_1. Supporting the assessment of global climate progress, needs, and feasibility, and the preparation of national policies for the post-2030 period, toward mid-century **climate neutrality** based on comparable modelling activities, between global and regional/national scenarios as well as between IAMs and other models, in inter-comparison exercises with extensive sectoral representation (water, energy, transport, industry, AFOLU, etc.).

O_2. Placing climate action in a **holistic sustainable development** framework, working across the broad spectrum of sustainability (e.g., biodiversity, planetary boundaries, human development, institutions, equalities), and exploring the interplay of Paris-compliant mitigation pathways, COVID-19 recovery, and sustainability policies.

O_3. Enhancing the **robustness** of scientific outputs via an interdisciplinary toolbox benchmarking and validating IAM results with sectoral models and coupling modelling with uncertainty analysis tools, and by incorporating social, political, behaviour, and innovation aspects in models with insights from political and social sciences, providing granular and detailed information about barriers, impacts, drivers, and sequencing of transitions.

O_4. Co-creating policy-relevant modelling via an international **policy response mechanism** that brings together modelling teams, policymakers, and stakeholders in the EU and countries of diverse economic development and institutional capacity, to scope and link policy/societal needs to models, co-define model scope and scenarios based on pertinent priorities in the climate debate, collaborate in modelling, and enhance mutual learning.

O_5. Establishing an **integration process** that co-produces science and policy prescriptions by adding layers of tools, models, methods, and bodies of knowledge, moving from an interdisciplinary to a transdisciplinary lens (across actors and across sectors), and highlighting a political ecology agenda in the scientific and policy perspectives.

O_6. Opening the 'black box' of scientific inputs, processes and outputs in line with the principles of open science, ensuring the data used/produced are FAIR (findable, accessible, interoperable, reusable), documenting model capabilities and specifications for expert and non-expert audiences, including open-source models among the project's model ensemble, providing open access to data and code produced (new modules, model integration, meta-analysis), transparently mapping outputs onto assumptions, and exploiting/expanding the IAM PARIS open exchange platform with open databases, briefs, papers, and policy support toolboxes for each exercise.

O_7. Engaging in the deep/**extreme uncertainty space** in the modelling and non-modelling work carried out, toward supporting robust and adaptive decision-making for energy, climate, and sustainability at all geographic scales.

O_8. Boosting **international cooperation, partnership, and capacity** during and after the project, supporting design of climate pledges across the globe while developing scientific and technical capacities in selected countries.

These objectives were not treated as isolated targets but as interconnected pillars guiding all research, modelling, and engagement activities. Each work package contributed to multiple objectives, ensuring coherence across disciplines and consistency between scientific outputs and policy needs. Among the project's novelties in effective stakeholder engagement, the Policy Response Mechanism (PRM) acted as the central link translating these eight objectives into coordinated, policy-relevant activities. By systematically connecting modelling work with stakeholder input, the PRM transformed the project's goals into concrete research actions, creating a continuous feedback loop between science and policy and ensuring that outputs remained timely, context-sensitive, and socially grounded. Through this mechanism, IAM COMPACT also strengthened technical and institutional capacity in four partner countries (Kenya, Ethiopia, Sri Lanka, and Ukraine), supporting the co-development of national

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tools for integrated assessments rooted in these countries' contexts as well as nationally relevant scenarios and policy insights. This objective-centred and participatory structure fostered active engagement and collaboration among partners, smooth information exchange across tasks and work packages and a collective sense of ownership over results. It also helped align modelling, stakeholder engagement, and dissemination efforts and enhance clarity towards the overreaching goal of the project: to produce integrated, actionable knowledge for effective climate policy design. Most importantly, we strived to ensure that *all partners were involved in or led research* components and studies, providing targeted support and methodological guidance where needed to strengthen participation and coherence across the consortium.

4 Structuring project workflows through five pillars

The project's integrated process can be summarised through five highly intertwined components: Listening, Exchanging, Modelling, Expanding, and Explaining. Although core objectives may differ among research initiatives, these five pillars instead constitute a highly reproducible framework for transdisciplinary research management.

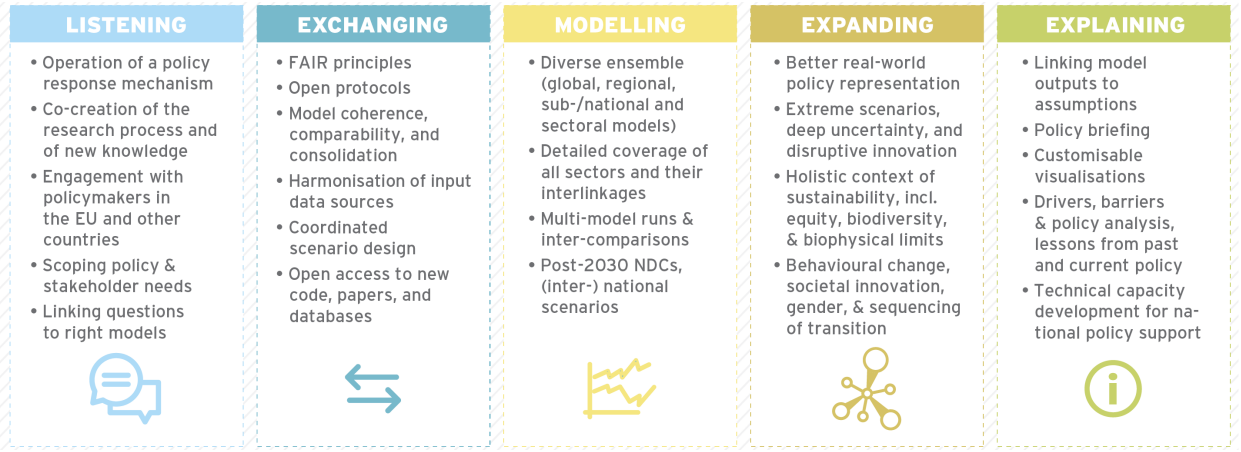

Figure 1: The five pillars of the IAM COMPACT project work structure

Taken together, they form more than just an internal coordination mechanism: they provide a methodological foundation for aligning modelling, stakeholder engagement, and dissemination efforts in a coherent and iterative way. This structure enabled IAM COMPACT to operate as both a research project and a prototype for a broader framework that can assess the effectiveness and feasibility of climate policies across diverse contexts.

5 From internal practice to a robust policy assessment framework

Building on this internal structure, the IAM COMPACT project's approach can be generalised as a robust policy effectiveness assessment framework and understood as a structured, transparent, and replicable method that enables researchers and policymakers to evaluate to what extent a given policy or policy mix achieves its objectives, under which conditions, and how it aligns with emerging risks or opportunities. Such a framework combines quantitative modelling, qualitative insight, and participatory processes to assess not only what works, but also why and how a policy performs across different social, economic, and technological contexts. For the framework to be robust, it must apply consistently across modelling tools (including but not limited to IAMs), regions, and sectors, thereby producing findings that remain valid across varying levels of data granularity and model detail as well as maintaining coherence and comparability across analytical scales. It should also aim to capture the interactions between technical feasibility, economic efficiency, societal desirability, policy relevance,

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as well as operate in a transparent, open scientific process that enables verification, comparison, and learning.

Robustness in this context emerges from direct policy relevance and responsiveness, beginning with identified policy and stakeholder needs that are translated into concrete research questions. It achieves integration and coherence by linking multiple models, disciplines, and scales to enable broader and more detailed assessments and to capture systemic interactions and interdependencies[4]. Transparency and openness are ensured through adherence to open science and FAIR data principles, which dictate the use and development of open-source tools and make data, assumptions, and results traceable and reproducible[5]. Feasibility and inclusiveness are reflected in the integration of social, behavioural, and institutional dimensions, ensuring realism and ownership among stakeholders[6,7]. Finally, continuous learning and adaptation are built into the process through feedback loops between analysis and policy cycles, allowing for ongoing refinement and improvement[8]. The project's organisational and management practice offers a blueprint for robust policy effectiveness assessments by demonstrating how structured coordination and cross-cutting objectives can generate scientifically and policy-relevant outcomes.

Central to our policy-driven co-creation process, embodied in the **Listening** pillar, was our novel stakeholder engagement process, i.e., the PRM, which systematically gathered policy and stakeholder needs from the EU, major emitters, and partner countries. These needs directly informed scenario design, ensuring that modelling activities would address real decision contexts.

Under the **Exchanging** pillar, qualitative policy questions were translated into quantitative scenario and harmonisation protocols, ensuring that assessments of policy pathways—such as Russian gas phaseout[9], alignment with the Fit for 55 policy package[10], CBAM implementation, IRA implementation, etc.—were not only based on consistent assumptions but also designed to maximise policy relevance and comparability across models and contexts. In this regard, our vetting and validation process further reinforced robustness by standardising internal checks of data and model outputs.

The **Modelling** pillar linked global, regional, and sectoral modelling tools, enabling cross-scale analyses of policy measures and their interactions. This integration supported testing both policy effectiveness, in terms of delivering intended outcomes, and feasibility, in terms of implementation under economic and social constraints.

The **Expanding** pillar, in turn, incorporated behavioural, social, and political dimensions into modelling and interpretation, by extending the assessment beyond technical feasibility to capturing societal acceptability, equity,

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[4] Keppo, I., Al Khourdajie, A., Gardumi, F., Holtz, G., Nikas, A., Xexakis, G., ... & Zamanipour, B. (2026). Model linking for low-carbon transitions: Technical and conceptual challenges and best practices. *Renewable and Sustainable Energy Reviews*, *226*, 116384.

[5] Rodés-Bachs, C., Sampedro, J., Frilingou, N., Gardumi, F., & Giudice, C. L. (2025). Open Science Practices in Integrated Assessment Models. *Open Research Europe*, *5*, 12.

[6] Nikas, A., Frilingou, N., Heussaff, C., Fragkos, P., Mittal, S., Sampedro, J., ... & Van de Ven, D. J. (2024). Three different directions in which the European Union could replace Russian natural gas. *Energy*, *290*, 130254.

[7] McGookin, C., Süsser, D., Xexakis, G., Trutnevyte, E., McDowall, W., Nikas, A., ... & Gallachóir, B. Ó. (2024). Advancing participatory energy systems modelling. *Energy Strategy Reviews*, *52*, 101319.

[8] Nikas, A., Gambhir, A., & Boitier, B. (2024). Promoting sustainable transitions across the globe requires scenario co-creation with key stakeholders. *Renewable and Sustainable Energy Transition*, *5*, 100076.

[9] Nikas, A., Frilingou, N., Heussaff, C., Fragkos, P., Mittal, S., Sampedro, J., ... & Van de Ven, D. J. (2024). Three different directions in which the European Union could replace Russian natural gas. *Energy*, *290*, 130254.

[10] Boitier, B., Nikas, A., Gambhir, A., Koasidis, K., Elia, A., Al-Dabbas, K., ... & Mittal, S. (2023). A multi-model analysis of the EU's path to net zero. *Joule*, *7*(12), 2760-2782.

broader sustainability, and implementation challenges.

Finally, through the **Explaining** pillar, we ensured transparency and openness through the IAM PARIS Platform and a machine-actionable Open Data Management Plan, which guaranteed compliance with FAIR data principles and strengthened reproducibility and credibility. Finally, capacity development and policy learning was supported by the active engagement of national teams in Kenya, Ethiopia, Sri Lanka, and Ukraine, who co-developed and now own context-relevant modelling capabilities. This contributed to transferability and laid the foundations for long-term institutional readiness, as well as technical and organisational capacity of partner institutions to interpret, apply, and sustain model-based insights in national policy processes beyond the project's duration.

6 Codification of the framework beyond IAM COMPACT

Drawing from the project's management and research coordination experience, the IAM COMPACT project's practice can be codified into a standardised methodological framework built around six interlinked steps (***Figure 2***):

1. **Defining shared objectives and work structure**

This includes establishing a clear set of cross-cutting objectives that reflect *both scientific and policy priorities*, as well as aligning all work packages and partners' roles around these objectives rather than siloed tasks, ensuring coherence and shared ownership.

2. **Engaging stakeholders through iterative co-creation**

This entails the design and operationalisation of continuous engagement through a structured co-creation process that captures stakeholder needs and priorities early on, while embedding feedback loops to ensure responsiveness to evolving policy contexts.

3. **Translating policy needs into model protocols**

This encompasses the conversion of qualitative insights and stakeholder inputs into harmonised quantitative scenario frameworks, the definition of assumptions, indicators, and timeframes, and the implementation of vetting and validation procedures to guarantee data quality and comparability across models.

4. **Integrating and testing across scales and sectors**

This includes combining global, regional, and sectoral modelling efforts through transparent data exchange and consistent methodological baselines (e.g., data sources, scenario definitions) and evaluating policy effectiveness (achievement of intended outcomes) and feasibility (economic, social, and institutional implementability).

5. **Expanding to include behavioural and social dimensions**

This requires embedding political economy, behavioural, and equity considerations in modelling and policy analysis, among others by incorporating disruptive events, sustainability dimensions, innovation dynamics, and social justice perspectives to ensure pathways are not only technically feasible but socially acceptable.

6. **Explaining, communicating, and developing capacity**

Finally, this encompasses efforts to ensure transparency and traceability through open-data platforms compliant with FAIR principles, as well as to provide targeted capacity development and training to empower national teams and institutions to interpret, apply, and sustain model-based insights beyond the project's lifespan.

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Figure 2: Key steps towards a standardised policy assessment framework in research

Together, these six steps form a codified, standardised methodology that integrates scientific modelling with co-creation, ensuring that research outputs are comprehensive, comprehensible, transparent, reproducible, and directly usable for policy design and evaluation.

By documenting this framework, IAM COMPACT aims to disseminate a transferable best practice for managing transdisciplinary projects which aspire to assess and enhance policy effectiveness across multiple contexts, scales, and capacities.

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Policy Brief

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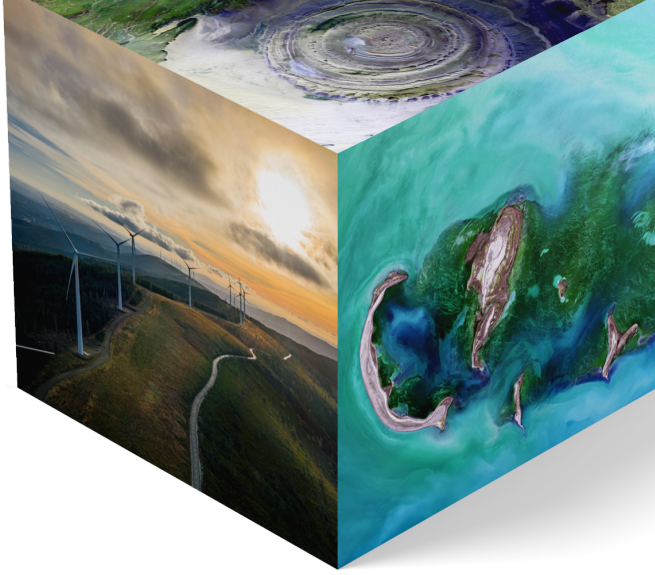

In a nutshell

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 aligns climate action with broader sustainability goals, while developing technical capacity and promoting ownership in non-high-income countries.

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Consortium

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