Providing operational economic appraisal methods and practices for decision-making on climate and environmental policies

Policy recommendation for bridging of ex-post and ex-ante

Deliverable 5.4

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Short text describing the deliverable to the general public:

This report is primarily targeting policymakers, aiming to show them the benefits of integrating ex-post and ex-ante evaluations. Specific bridging techniques are discussed, and insights into the contribution of enabling frameworks for evaluation are shared. Finally, recommendations are formulated to enhance the systematic integration of ex-post and ex-ante evaluations within EU, national, and local policymaking.

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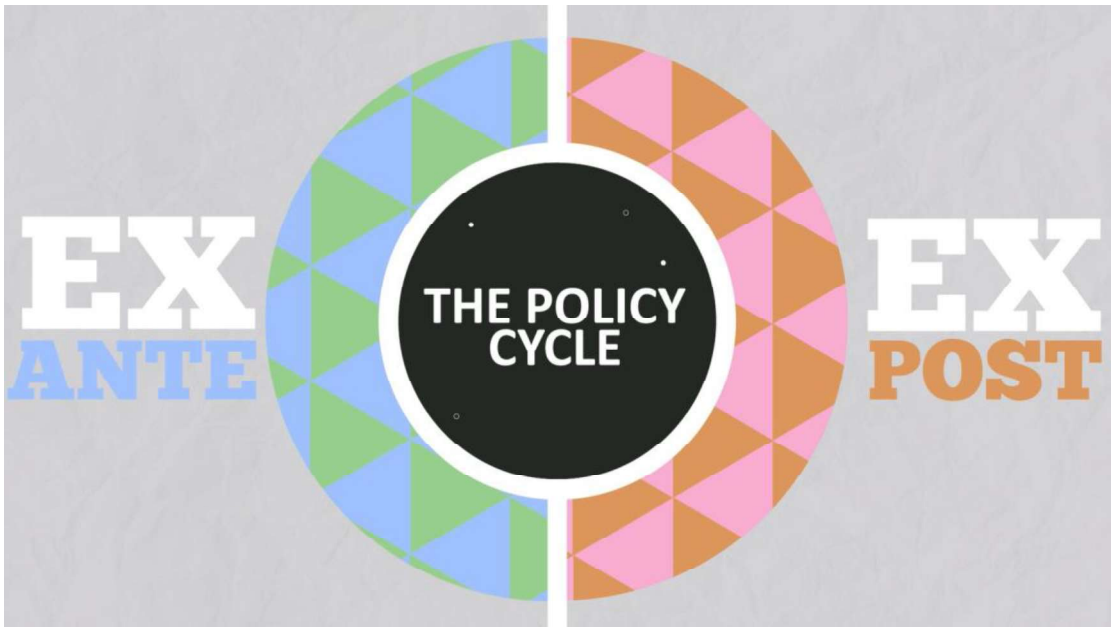

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EXECUTIVE SUMMARY

Effective policymaking requires robust evaluation methods to ensure interventions are efficient, impactful, and publicly supported. To improve evaluation practices and increase their usability towards policymaking, bridging *ex-ante* (forward-looking) and *ex-post* (retrospective) evaluations in environmental and climate policy is needed. While both types of assessments are essential to the policy cycle, they are typically conducted in isolation, occurring within distinct communities that employ different methods and fulfil different purposes. However, using insights from one evaluation practice to inform the other – what is called bridging – can significantly enhance policy learning, design, and effectiveness. However, several institutional, procedural, political, and methodological barriers hinder this integration.

This deliverable aims to address those barriers and recommend to policymakers practices and techniques to link ex-ante and ex-post evaluations. The evaluation process is divided in three stages: setting up the evaluation, data collection and monitoring processes, and conducting the evaluation by means of an economic appraisal method. For each of these phases, bridging solutions are elaborated, indicating the benefit of using a particular technique and how these can be applied. The techniques discussed comprise: (1) alignment of data inputs and assumptions; (2) improved and aligned monitoring; (3) empirical validation of results and inputs; (4) calibration of ex-ante baselines and outcomes; (5) uncertainty analysis informed by ex-post; and, (6) comparative analysis. For each of these techniques, examples are provided to inspire policymakers on particular use cases. Regarding the calibration technique, more elaborate work has been performed throughout the project by Aggregation Model Tool (AMT), an agent-based model, and REMES-EU Computable General Equilibrium (CGE) model. The lessons learned from those experiences are captured here as well. Two key observations are presented here (1) unidirectional bridging might overshoot the evaluation of productivity changes, and (2) productivity tends to decrease as resources are reduced or production patterns are disrupted, while it increases with technology upgrades. These insights contribute to a deeper understanding of how micro-level behavioural responses can be effectively integrated into macroeconomic projections to support more robust and reliable policy assessments.

In addition to the more methodological challenges and possible solutions, this deliverable also looks at other factors enabling bridging practices. We examined how bridging can be embedded within policymaking by focusing on three key areas: institutional arrangements, policymaking procedures, and capacity building. Institutional arrangements refer to the formal integration of (bridging) evaluation into government systems through laws and allocated resources. Procedural arrangements provide structured frameworks for conducting evaluations consistently. Meanwhile, capacity building focuses on enhancing the skills and fostering the culture necessary for effective evaluation and bridging practices.

1. THE NEED FOR BRIDGING: CONNECTING EX-POST AND EX-ANTE APPRAISAL

1.1 The role of ex-post and ex-ante economic appraisal in policy evaluation

Evaluation is essential for sound policymaking, providing evidence-based insights that enhance decision-making, accountability, and learning (Broc et al., 2019; HM Treasury, 2020; Van Der Meer & Edelenbos, 2006). It promotes transparency, guarantees stakeholder engagement, and ensures policies are more effective, efficient, and impactful (European Commission, 2021a; OECD, 2020c; Smismans, 2015). By systematically assessing progress and resource use, evaluation strengthens public services and policy coherence, as emphasised by the European Commission's "evaluate first" principle (European Commission, 2021a; Smismans, 2015). Ultimately, evaluation strengthens governance by balancing regulatory oversight with continuous learning, leading to more responsive and effective public policies.

To fulfil accountability and learning objectives, evaluation needs to generate evidence that improves policymaking. "*Conventionally, we assume that reliable knowledge provides a sound basis for effective action*" (Sanderson, 2002). Evidence-based policymaking (EBPM) relies on rigorous evaluation to ensure that policy decisions are guided by empirical findings (Mergaert & Minto, 2015). A crucial component of EBPM is the incorporation of knowledge gained through the ex-post evaluation of a policy in the ex-ante stage of the next (Mergaert & Minto, 2015; Smismans, 2015).

By embedding evaluation within the policy cycle, the impression is created that the policy process is linear or staged (Cairney, 2016). The policy cycle is a framework used to examine the various stages of policy development. It exists in different formats but most commonly includes the following stages: agenda setting, formulation, decision-making, implementation, and evaluation, which then lead to the policy's continuation, adaptation, or termination (Cairney, 2016; HM Treasury, 2020; Mergaert & Minto, 2015). **Hence this approach assumes that what was learned from ex-post evaluations, which assess past policies, will automatically feed into ex-ante evaluations, which inform future policy choices, thereby creating a continuous cycle of learning and adaptation. This perspective on EBPM is somewhat idealistic or simplistic, as it assumes a straightforward and seamless connection between evidence, policy decisions, and outcomes.** On the one hand, there are more roles that research can play in the policy process (Cairney, 2016); on the other hand, the stages in the policy cycle, and their sequence, are not so clearly demarcated as displayed below (Broc et al., 2019; HM Treasury, 2020; Mergaert & Minto, 2015).

Figure 1: The policy cycle & Evaluation (European Commission, 2021a).

Evaluation in policymaking typically revolves around two key types: ex-post and ex-ante evaluations. Ex-post evaluation, often simply referred to as "evaluation" and included explicitly in the policy cycle as depicted above, assesses adopted, ongoing, or completed interventions by examining their effectiveness, efficiency, relevance, coherence, and added value (European Environment Agency, 2016). This retrospective approach can be interim (mid-term), final (at conclusion), or strictly ex-post (several years post-intervention), offering insights into whether progress is made towards the original objectives, whether these objectives were met, whether costs were justified, and how well the intervention aligned with broader policy frameworks (Smismans, 2015).

By contrast, ex-ante evaluation occurs before an intervention is implemented, providing strategic insights during the planning stages. It helps identify the most promising approaches among possible alternatives, maximising the potential to shape the course of an intervention before it begins(Samset & Christensen, 2017). **While ex-ante evaluation is essential for guiding initial decisions and optimising policy design, ex-post evaluation facilitates learning by analysing outcomes and informing future projects** (Frontier Economics, 2016)**. When brought together, these evaluations form a complementary system that enhances policy development through both foresight and hindsight.** Typical examples of both can be seen in the box below.

Example ex-ante appraisal (PATTERN): discrete choice experiment for agricultural policy in Flanders

The discrete choice experiment (DCE) is a survey-based method used to model preferences by presenting respondents with hypothetical choice scenarios. It is grounded in welfare economics and aims to elicit trade-offs individuals are willing to make between various attributes of the choices. In frame of the PATTERN case for Belgium, DCE was applied to evaluate farmers' preferences regarding the newly introduced eco-schemes and revised agri-environment-climate measures (AECMs) under the 2023 Common Agricultural Policy (CAP) reform.

In this ex-ante appraisal, farmers were presented with a choice between three options for managing grassland: an AECM contract (five-year duration), an eco-scheme contract (one-year duration), or an opt-out, meaning no AECM and no Eco-scheme. The AECM was modelled for grassland management with

action-based and result-based contracts, reflecting the CAP's hybrid structure. Eco-schemes, being less restrictive and shorter-term, were defined as alternatives to AECMs.

The experiment employed a labelled DCE design, with attributes such as compensation level, restrictions, and contract flexibility varying across choice cards. By repeating these hypothetical choices for different attribute combinations, the study captured the preferences and trade-offs farmers make, shedding light on their willingness to participate in voluntary measures and the factors influencing their choices.

This approach provides critical insights into the expected uptake of these measures and their potential economic and environmental impacts, allowing policymakers to refine the design of CAP initiatives to enhance their effectiveness and farmer participation.

Example ex-post evaluation (PATTERN): econometric analysis for energy efficiency policies in the Netherlands

The ex-post evaluation of the Netherlands' Climate Strategy employs econometric response models to analyse the impact of policy measures on energy savings in residential buildings. This ex-post analysis focuses on the effectiveness of two measures, namely the Investment Subsidy for Small Renewable Energy Systems (ISDE) and the National Heat Fund. For this analysis, regression analysis is used, which is a statistical method used to identify and quantify relationships between variables. In the context of this specific case, the relationship between energy savings and key variables such as grant amounts, implementation year, and building characteristics was assessed. The analysis provides insight into policy effectiveness and key drivers of energy savings.

This ex-post evaluation reveals the mixed success of the Netherlands' Climate Strategy policies. Financial incentives like the ISDE and National Heat Fund effectively promote energy efficiency and renewable energy adoption, as shown for example by the increase in implementation of insulation materials over the studied period. However, challenges in sustaining and optimising these impacts remain, as declining trends in the programmes' energy savings over time are demonstrated.

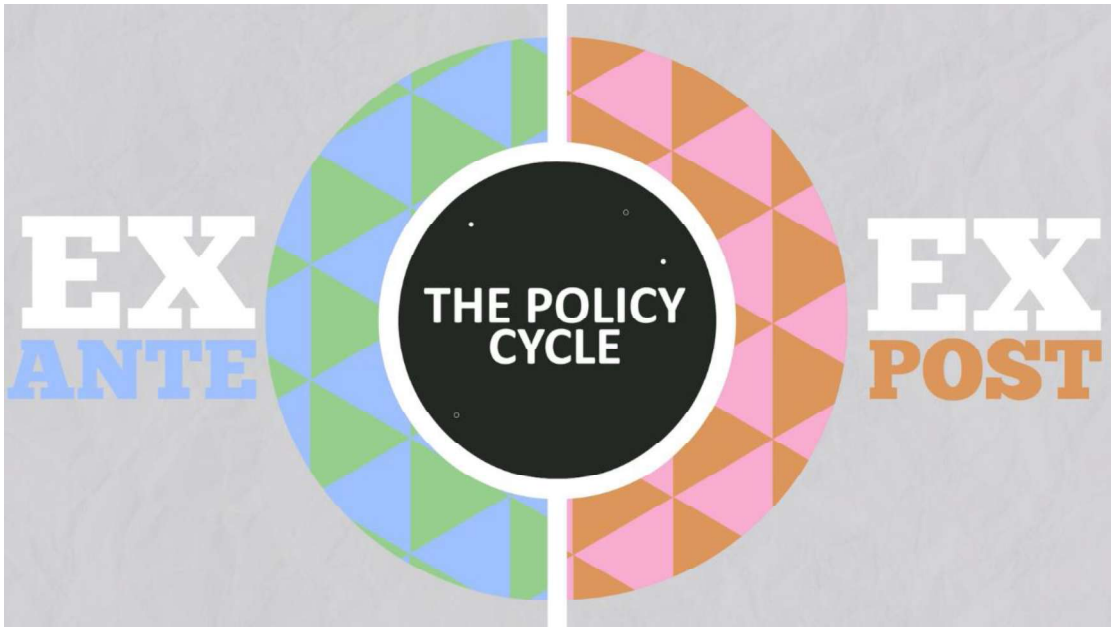
In essence, ex-post and ex-ante evaluations differ in the following basic principles:

1. Purpose: Ex-post evaluation is typically conducted to assess the effectiveness and efficiency of a program or policy, emphasising accountability, while ex-ante evaluation is typically conducted to assess the feasibility and expected impact of a policy, relating more to transparency as key objective.
2. Data availability: Ex-post evaluation relies more on actual data from the implementation of the policy, while ex-ante evaluation is based on projections and assumptions about how the policy or measure will be implemented and what its impact will be.
3. Time frame: Ex-post evaluation is conducted after the policy has been implemented, while ex-ante evaluation is conducted before the implementation.
4. Use of results: Ex-post evaluation results are used to improve the policy and inform future decisions, while ex-ante evaluation results are used to guide the design and implementation of the policy or measures.

1.2 Bridging the looking backward and forward perspective for policy appraisal

As the meta-analysis has demonstrated (PATTERN D1.1, 2023), the practices of ex-ante and ex-post evaluations are relatively detached. **They have historically developed as separate practices, with little interaction between them, due in part to their distinct purposes, contexts, methodologies, and time frames** (Oliveira & Pinho, 2011). Different practitioner and academic communities have treated them in isolation, often working in silos, which has contributed to a lack of coherence between the two approaches (Smismans, 2015). **Despite this disconnect, it is argued that both research communities encounter similar circumstances, regarding their current status as well as the challenges they face, and that it is hence "time to bridge the gap"** (Smismans, 2015). Additionally, strengthening the link between

both practices will contribute to a more efficient, effective and coherent policy cycle. By incorporating insights from the ex-post evaluations into subsequent ex-ante assessments and policy design stages, policy learning is fostered. This process utilises evidence from ex-post evaluations to decide on the desirability of future action, extending beyond project-level learning (Mergaert & Minto, 2015; Smismans, 2015).



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Despite this promising potential, linking or bridging both practices remains uncommon (Frontier Economics, 2016; Mergaert & Minto, 2015; Smismans, 2015). Furthermore, the meta-analysis indicated that the proportion of ex-ante evaluations making use of an available ex-post evaluation is larger than the proportion of ex-post evaluations making use of an available ex-ante appraisal (PATTERN D1.1, 2023). Broadly, the ability of evaluations to contribute meaningfully to policy learning is hindered by procedural, political, and institutional challenges. Institutional challenges comprise for example, the institutional importance attached to evaluation, and turnover of staff. Procedurally, a key issue is the misalignment of timing between ex-post and ex-ante evaluations within the policy cycle, which affects the usability of evaluation findings (Mergaert & Minto, 2015). This timing issue is partly due to the absence of a systematic, cyclical process in regulatory policy, unlike the more structured approach seen in budgetary processes. Additionally, structural mismatches exist between the types of evidence generated through ex-post evaluations and the data required for ex-ante assessments. Other obstacles include the differing priorities of assessments – accountability versus learning – and contrasting expectations regarding which actors should be involved in each assessment. These obstacles complicate efforts to create a more integrated and coherent evaluation framework (Smismans, 2015).

Although links between ex-post and ex-ante evaluations might currently not be particularly strong, there are benefits to gain from bridging those two types of evaluation. With bridging we mean creating links between both practices and using ex-ante appraisal in the ex-post stage, or vice-versa. **When ex-post results are used to inform ex-ante evaluations of future policies, this can help improve the accuracy and reliability of that ex-ante evaluation. As real-world data and experiences are fed into the model instead of assumptions and projections, outputs are likely to be more accurate** (Frontier Economics, 2016). This is also true the other way around, acknowledging the importance of performing an ex-post evaluation might influence choices made at the ex-ante stage. For example, thinking of the data required to assess effectiveness and efficiency in a later stage will facilitate setting up the appropriate monitoring

requirements; another example is the use of results from ex-ante evaluations of policies under consideration to inform the design and implementation processes (Broc et al., 2019).

2. OVERCOMING CHALLENGES FOR BRIDGING DURING POLICY EVALUATION

Several key challenges in bridging ex-ante and ex-post evaluations have been determined in the meta-analysis, which hinder the effective use of evaluation findings in policy development (PATTERN D1.1, 2023). Besides institutional, procedural and political challenges, methodological barriers exist as well. One major challenge is the misalignment in timing between ex-ante and ex-post evaluations, making it difficult for insights from one to inform the other. Additionally, policy designs often change over time, creating discrepancies between the original objectives assessed in ex-ante evaluations and the real-world impacts measured in ex-post assessments. There is also a disconnect in the types of evidence gathered – ex-ante evaluations rely on projections and assumptions, while ex-post evaluations analyse actual outcomes, making direct comparisons challenging. Moreover, inconsistencies in data sources and analysis scales, shifting definitions of baselines and counterfactual scenarios, and variations in evaluation questions make it difficult to establish a cohesive evaluation framework. This chapter explores the challenges policymakers and practitioners face in linking ex-post and ex-ante evaluations, along with recommended solutions. This chapter is divided in three subchapters, elaborating which techniques are most suited to use in which moment of the evaluation process. As this report is supposed to be an easy-to-read and usable document, the evaluation process is divided in three stages: Setting up the evaluation, data collection and monitoring, and conducting the evaluation. For more detailed guidance on how bridging can be applied in each of the eight evaluation steps, refer to D4.3 Guidelines to bridge ex-post and ex-ante for policymakers[2](PATTERN D4.3, 2024).

[2] Available at: https://pattern-heu.eu/wp-content/uploads/2024/12/D4.3_Guidelines.pdf

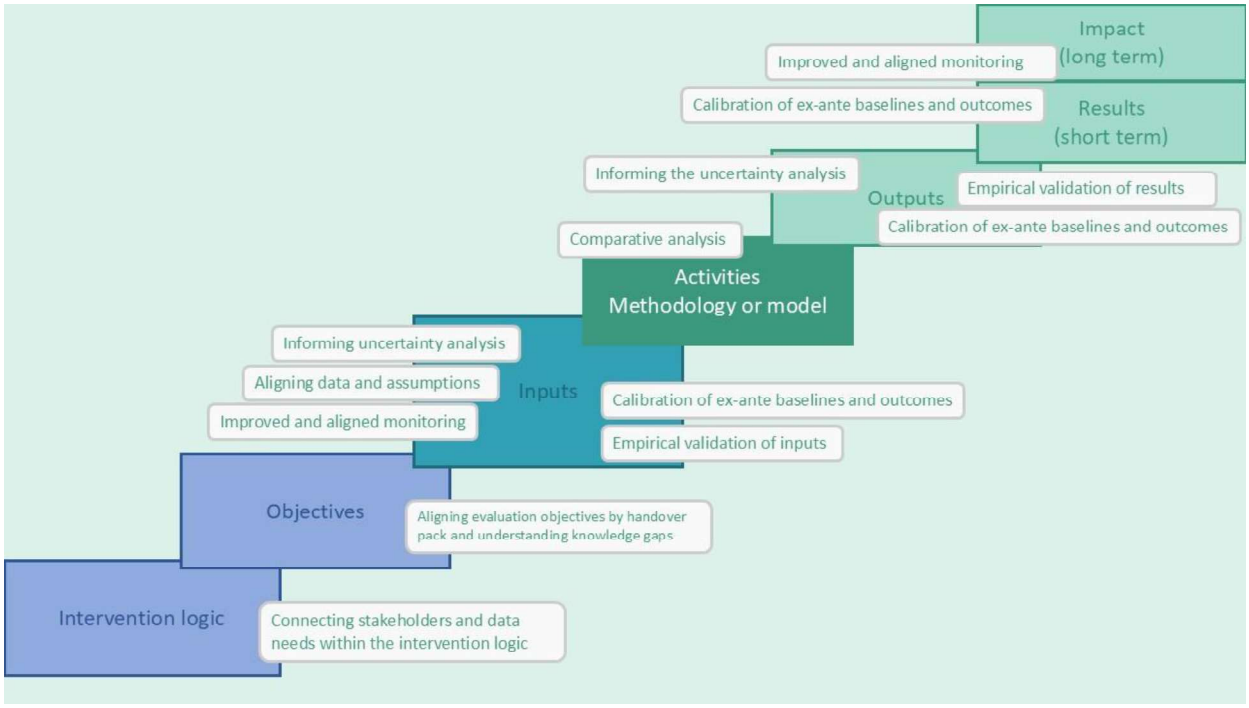

Figure 2: Bridging techniques applied to the different evaluation steps.

2.1 Setting up the evaluation: intervention logic, policy design and its evaluation objectives

There are several challenges in bridging ex-ante and ex-post evaluations when setting up an evaluation. One consists of the **misalignment between evaluation questions and the original policy objectives**, making it difficult to assess whether the intended goals of the policy have been achieved (Frontier Economics, 2016). This issue can be exacerbated when ex-post evaluations occur less frequently than ex-ante assessments, as it becomes more difficult to identify the intended policy objective when numerous ex-ante assessments exist, and documentation practices are not perfect. This disconnect limits the learning potential of ex-post evaluations, ultimately reducing their influence on policy redesign. Additionally, policy design often evolves over time, altering key aspects such as target groups, which further complicates direct comparisons between the two evaluation types. Another issue arises from **differences in the defined baseline scenario**. External factors, such as socio-economic developments or cultural shifts, may not be fully accounted for, leading to significant differences between the counterfactual scenario assumed in ex-ante evaluations and the baseline used in ex-post assessments. These discrepancies make it difficult to accurately compare anticipated outcomes with actual results.

Differences in evaluation scope and data aggregation further hinder comparability between ex-ante and ex-post assessments. Ex-ante evaluations often analyse broad sectoral trends using aggregated datasets, while ex-post evaluations focus on individual policy instruments, relying on highly disaggregated data (Ricardo et al., 2020). For example, while an ex-ante projection for a sector may assess the combined impact of multiple drivers and policy measures on emissions, an ex-post study might isolate the effect of a single intervention, such as a subsidy scheme. Although ex-post evaluations attempt to account for interactions between policies, these linkages are difficult to quantify, increasing the risk of double counting and uncertainty in counterfactual scenario definitions. These methodological inconsistencies, coupled with variations in data sources and analytical scales, make it challenging to directly compare and integrate findings from ex-ante and ex-post evaluations. Bridging ex-post and ex-ante in the early stages of policy design and intervention logic would remedy these issues by **improving accuracy and increasing**

understanding of causality. Additionally, by setting up appropriate data collection and monitoring provisions at the start, bridging enhances the evidence-base and evaluability of the policy at a later stage.

In this early stage of setting up the evaluation, trying to integrate ex-post and ex-ante evaluations does not really consist of applying certain techniques. It is more a matter of adopting a cyclical approach to both policy and evaluation processes and taking on a bridging mindset. Aiming to account for the needs of future assessments will extend the use of the evaluation and the information it encompasses beyond the current task. Two recommendations are formulated here, to provide inspiration on how such a bridging mindset could be implemented.

Recommendation 1: Use the intervention logic to connect stakeholders and data needs

A well-defined intervention logic is an important tool for any evaluation but can also serve as an enabler for bridging ex-ante and ex-post evaluations. It provides a structured framework that outlines how a policy is expected to work, detailing the steps involved, the relevant actors, and their interrelations. Typically presented through a description and diagram, **it maps out the causal mechanisms driving a policy's intended outcomes along the objectives–inputs–outputs–impacts chain**. Various approaches exist for setting up an intervention logic (European Commission, 2021b; European Environment Agency, 2016; HM Treasury, 2020; Ricardo et al., 2020), making it a flexible tool with multiple uses. Importantly, an intervention logic is not static; it should be adapted throughout the policy cycle to reflect real-world changes, incorporating insights from ex-post evaluations to improve future ex-ante assessments. By re-establishing the logic model as the foundation for ex-post evaluations, and vice versa, policymakers can refine their approach and ensure a stronger connection between policy planning and actual results (Williams et al., 2022).

Another important element of the bridging mindset in this stage, is to acknowledge the **vital role of stakeholders.** Engaging a broad range of stakeholders is important when designing the intervention logic but it can be equally useful to test the logic with key stakeholders. This improves the accuracy of ex-post evaluations, enabling a clearer understanding of the causal relationships at play. A well-maintained intervention logic thus **enhances policy learning by ensuring that ex-post evaluations are based on a more precise reconstruction of the original policy design and its intended mechanisms**.

A last way of using the intervention logic to strengthen the link between ex-ante and ex-post evaluations, lies in the early **planning of data collection and monitoring** processes. The intervention logic developed during the ex-ante phase already identifies key data points necessary for assessing the policy's costs and benefits. This framework should guide ongoing monitoring efforts, ensuring that relevant data is systematically gathered and stored, making ex-post evaluations more efficient (PATTERN D1.1, 2023). By embedding evaluation planning within the intervention logic from the start, policymakers can create a continuous feedback loop where ex-post findings inform future ex-ante impact assessments, strengthening evidence-based and adaptive policymaking.

Recommendation 2: Align evaluation objectives and research questions

Adopting a bridging approach at the level of evaluation objectives ensures that research questions remain aligned across assessments, making it easier to measure effectiveness, efficiency, coherence, and relevance. By referencing prior impact assessments and expected outcomes, **evaluation questions can become more specific**—such as determining whether an intervention met its projected effects and identifying the factors influencing its success or failure (Frontier Economics, 2016).

To facilitate alignment between ex-post and ex-ante assessments on the level of evaluation objectives, requires a forward-looking approach. This includes **evidence planning, systematic logging of appraisal versions, and structured information transfer**. During the ex-ante stage, it is crucial to anticipate ex-post evaluation needs by documenting key assumptions, results, and relevant indicators to assess. This means

structuring data in a format typically used in ex-post evaluations, ensuring comparability in sources and scale of analysis. A "**handover pack**", which may include scheme details, behavioural response assumptions, model specifications, and forecasting reports, can facilitate this process and help evaluators identify the correct ex-ante appraisal version for comparison (Frontier Economics, 2016).

Similarly, applying the bridging perspective during the ex-post stage means generating evidence that directly informs future ex-ante appraisals. Aligning ex-post evaluation work with the evidence needs of ex-ante assessments allows evaluators to **pose research questions that address knowledge gaps**, such as identifying key drivers of energy savings, or conditions that limit or enhance policy effectiveness. By ensuring that evaluations systematically address shared knowledge gaps, a broader evidence base can be built, model accuracy can be improved, and the feedback loop between ex-ante planning and ex-post assessment can be strengthened (European Commission, 2021b; HM Treasury, 2020). This structured approach enhances policy learnability, leading to better-informed decision-making and more effective, data-driven interventions.

Example PATTERN case: Decarbonising transport in city of Lappeenranta (Finland)

The city of Lappeenranta, Finland, faces significant challenges in reducing CO_2, NO_x, and fine particle emissions from the transportation sector, which currently accounts for nearly 50% of the city's scope 2 emissions. Committed to becoming carbon neutral and reducing CO_2 emissions by 80% by 2030, the city recognises that existing national and EU policies are insufficient to meet local targets and may also have adverse socio-economic effects at the municipal level. To address these shortcomings, the city has introduced a policy package — a combination of complementary policies and measures — instead of a single intervention, integrating three key pathways: the use of electric vehicles in private mobility, the use of electric vehicles in city transportation and logistics, and the use of biogas in municipal vehicles. The necessary intervention assumptions were described, as well as the congruent indicators.

Bridging in the early evaluation steps, on the level of the intervention logic and objectives, has happened in two ways in the Finnish case. (1) The ex-post analysis identified potential local measures to enhance policy effectiveness in the future, including providing shared cars and expanding EV charging points in city-owned properties, which were subsequently incorporated into the intervention logic developed in frame of the ex-ante assessment. (2) The ex-post evaluation highlighted inequalities in access to EV infrastructure, particularly regarding the availability of charging stations, financial support for installation, and proximity to charging points. To address these disparities, it was decided to focus on measuring equality of electrification of transportation in the subsequent ex-ante analysis. For that purpose, an equity indicator was developed for the ex-ante analysis, ensuring that policies aimed at electrifying transportation also promote accessibility and social equity. Equality was acknowledged as an important policy objective. The ex-post evaluation needs were anticipated by recording this objective, establishing an indicator, and including it in the ex-ante analysis, the next ex-post analysis will be made easier as it can explicitly evaluate this criterion.

2.2 Data collection and monitoring process

The next steps in the evaluation process exists of identifying the data requirements and/or monitoring process. Bridging during these steps presents several challenges. One major issue is the vast amount of information needed to enable meaningful comparisons, which can be difficult to store, access, and manage (Frontier Economics, 2016). The outsourcing of modelling or evaluation work further complicates this, as crucial data may not be systematically archived or made available for future assessments. Inconsistencies in data categorisation pose another challenge – ex-post evaluations may calculate impacts based on consumption, while ex-ante projections often use sectoral or production-based methods (Ricardo et al., 2020). Additionally, ex-post and ex-ante assessment can use different data sources and scales of analysis. Ex-ante appraisals typically use top-down sectoral analysis, while ex-post

evaluations often rely on bottom-up assessments of individual policy instruments, making direct comparisons difficult. Finally, ex-post evaluations often focus on historical data, which may not always capture key variables relevant for future projections (Ricardo et al., 2020). In this step of the evaluation process, **the recommended bridging actions are to: 1) align data inputs and assumptions, and 2) improve and align monitoring**. Applying these bridging techniques will enhance the accuracy and completeness of the evidence base used in policy evaluation, which subsequently improves the reliability and validity of results of these assessments. Aligning data inputs ensures more accurate and complete information on elements as costs, benefits, and technology and policy characteristics, leading to a stronger evidence base for both types of evaluations. Additionally, more accurate assumptions on external factors, such as economic growth, demographic changes, and environmental conditions, support more precise projections and impact assessments. Understanding interactions with other policies allows for a more comprehensive evaluation of policy effectiveness.

Bridging technique 1: Alignment of data inputs and assumptions

To facilitate comparison of policy assessments, it is recommended to align data types used in ex-ante and ex-post evaluations. This action should start **before data collection begins**, as evaluators should identify key variables that accurately measure policy impacts and ensure they are linked to evaluation objectives, research questions, and intervention logic. Using **consistent indicators across evaluations**, such as relying on the same statistical sources or harmonising data collection methods, ensures that findings remain relevant for both ex-ante projections and ex-post assessments. When full alignment is not possible, previous ex-post evaluations can still serve as valuable inputs for new ex-ante analyses. For instance, if an ex-post study on heat pump subsidies provides detailed sectoral data, it can refine future ex-ante projections on energy efficiency. Additionally, when scopes differ, adjustments such as statistical corrections or alternative assumptions should be considered to align ex-post insights with ex-ante forecasts.

How to limit hypothetical bias in stated preference surveys?

Hypothetical bias may occur in stated preference surveys such as discrete choice experiments (Catalogue of Bias Collaboration, et al., 2020). This bias occurs when individuals report unrealistic values to researchers due to the hypothetical nature of the questions asked. The reported hypothetical behaviour may not necessarily be what they would do in reality (Hensher et al., 2015). In practice, literature shows that **hypothetical bias can be reduced in post-survey stage by calibrating the discrete choice model using information from past surveys or studies**. The following are examples of how this is done:

- (Buckell & Hess, 2019) use data from available revealed preference models to calibrate the stated preference model. This approach uses real-world, ex-post data where the actual behaviour and choices of individuals were actually observed. Where revealed preference models are available from previous evaluations, the data can be used to calibrate the scale of utility and the alternative-specific constants of the stated preference model.
- (Loomis, 2011) examines the possibility of applying tailored calibration based on meta-analysis to allow the calibration factor to vary by relevant factors influencing the magnitude of the hypothetical bias. Another suggested method is to use a 'proxy good' for which the hypothetical and actual willingness-to-pay (WTP) is known from past studies. The respondents' mean ratio would then be used to calibrate respondents' hypothetical WTP for the 'public good' in question.

A **structured data collection approach** further enhances alignment by ensuring that methods, indicators, and sources are compatible across evaluations. Using past studies as references can help inform data collection strategies, ensuring that methods proven effective in previous evaluations are applied consistently. It is very important that evaluators **log and document key assumptions, variables, and data versions** systematically to avoid discrepancies caused by evolving policy objectives or multiple appraisals

over time. Creating a handover pack, including scheme details, behavioural assumptions, and forecasting reports, can facilitate information transfer and maintain consistency. Additionally, adopting **validated datasets and standardised methods**, such as using macroeconomic indicators from the same statistical agency, improves long-term comparability. The **timing and frequency of data collection** should also be aligned, for example, by scheduling surveys or monitoring campaigns at regular intervals that fit both ex-ante and ex-post needs. Finally, ensuring transparency and **quality control** through triangulation, validation against previous studies, and systematic literature reviews reduces biases and strengthens the evidence base for future evaluations. By following these steps, policymakers can enhance data consistency, comparability and accuracy.

Example PATTERN Case: alignment of data inputs and assumptions in the agricultural case study in Belgium

The agricultural case study in the PATTERN project considers agri-environment-climate measures (AECMs), a measure under the Common Agricultural Policy (CAP). In Flanders, Belgium, a scheme of government contracts is set up, in which financial incentives are provided to farmers for adopting environmentally friendly practices, with the goal of promoting biodiversity and reducing ecological impacts. To evaluate their effectiveness and guide future policy design, the case study combined **ex-ante and ex-post assessment methods using Discrete Choice Experiments (DCE) and Q methodology**.

The study employed Q methodology as an ex-post assessment tool to capture farmers' perceptions of previous AECMs from past CAP reforms. On the other hand, the DCE was used as an ex-ante tool to gauge farmers' preferences for new AECMs under the most recent CAP reform. Both DCE and Q method are survey-based methodologies. It is hence important to **bridge both evaluations when the survey is designed, and the population sample is decided**. To ensure such alignment, Q statements and DCE attributes were carefully selected to effectively characterise similar elements of the policy. Q statements were mapped to DCE attributes, so each DCE attribute was represented by one or multiple Q statements. For example, a Q statement like "The policy provided a high level of compensation for farmers" was linked to the DCE attribute "compensation level". Moreover, both methods targeted the same population of Flemish farmers who had participated in previous AECMs, ensuring consistency in data collection. Aligning data inputs and assumptions allows to refine policy assumptions, improve the design of new AECMs, and enhance the comparability of findings across different evaluation stages.

Bridging technique 2: Improved and aligned monitoring

Effective policy monitoring is essential for generating reliable data that supports both ex-ante and ex-post evaluations. By designing monitoring systems that align with evaluation objectives, policymakers can create a seamless connection between predicted and observed policy impacts. Also for this bridging technique, early action is encouraged. A **well-structured monitoring plan** should begin by defining ex-post evaluation questions early in the policy process, ensuring that data collection efforts address these queries. Using the intervention logic as a guide, monitoring indicators should be linked to evaluation objectives, enabling a clearer assessment of policy effectiveness. Additionally, past evaluations—especially ex-ante assessments—offer valuable insights into the best monitoring methods, reducing implementation difficulties and improving data consistency. To bridge knowledge gaps, monitoring should also account for variables that are challenging to measure retrospectively, such as cause-effect relationships and counterfactual scenarios, which are often difficult to establish in ex-post evaluations. Timing and duration of monitoring must also be carefully planned, aligning with short-, medium-, and long-term policy outcomes. Where feasible, establishing long-term monitoring systems beyond the lifespan of a policy can enhance the assessment of sustained impacts while generating new evidence for future ex-ante evaluations.

Stakeholder engagement plays a crucial role in ensuring the success of monitoring efforts. Ex-ante assessments can help identify relevant stakeholders responsible for data collection, ensuring a coordinated approach across sectors and governance levels. Involving both ex-ante and ex-post evaluators early on can help embed evaluation needs within the monitoring framework, enhancing data usability. Additionally, **systematic data storage and organisation** improve accessibility for future evaluations. Developing standardised templates ensures that monitoring data is consistently recorded, facilitating its integration across policy cycles. Addressing data confidentiality concerns and ensuring compatibility with evaluation software can further streamline data sharing and reduce ambiguities. Given the complexity of multi-stakeholder monitoring systems, clear protocols and documentation should be established to maintain data quality, timeliness, and completeness. Finally, outlining any **limitations of the collected data** allows evaluators to assess implications for ex-post analysis, improving comparability with ex-ante projections. By adopting these measures, monitoring can serve as a strong bridge between ex-ante predictions and ex-post findings, strengthening the overall reliability and effectiveness of policy evaluations.

Example: Determining the climate impact of the Integrated Energy and Climate Programme (IEKP) and proposing a plan for continuous monitoring (Germany)

This study involves an ex-post evaluation of implemented measures within the German government's Integrated Energy and Climate Programme (IEKP) (Doll et al., 2012). It also sets up a monitoring framework for the comprehensive, regular evaluation of the IEKP measures to enable a periodic comparison of the ex-post evaluation with the ex-ante projections at fixed points in time.

The IEKP consists of two policy packages, which each comprise various regulatory measures, aimed at reducing greenhouse gas emissions in Germany by 40% by the year 2020. Due to the numerous measures involved in the two packages and the associated potential overlapping impacts, a monitoring framework is set up. Its objectives are to better align the scope, questions and approach of the ex-ante and ex-post evaluations and streamline collection of monitoring data across the different measures.

The monitoring tool takes into consideration bundled measures which have overlapping effects, and which require monitoring of energy efficiency indicators through a top-down approach. On the other hand, the effects of individual measures are portrayed through bottom-up indicators. The broad spectrum of considered indicators intends to improve the consistency of results between ex-ante and ex-post evaluations. Since monitoring of the individual measures can be resource- and data-intensive, the study specifies questions which need to be addressed when developing the monitoring plan, such as: Who is responsible for the collection of data? How can the flow of information be ensured for updates? What synergy effects can be achieved with other reporting obligations (projection report, national inventory report, etc.)?

The Excel-based monitoring tool is designed for periodic updates with within a rolling monitoring system. It is structured to regularly examine and update the ex-ante appraisal of measures and gradually transforming it into an ex-post evaluation. This means that the ex-ante projection for a year is overwritten with historical (ex-post) data gathered through monitoring. In this way, the accuracy of the ex-ante results can be improved because the impacts of investments made in a historical year can be taken into account.

2.3 Conducting the evaluation by means of economic appraisal method

The apex in the evaluation process, and the last step discussed here, is carrying out the evaluation using an economic appraisal method. Economic appraisal methods face significant challenges when bridging ex-ante and ex-post evaluations. The complexity of ex-ante models makes it difficult to pinpoint why actual outcomes deviate from forecasts, particularly when external economic factors introduce uncertainty. Conducting ex-post evaluations is often resource-intensive, further complicating efforts to refine predictive models. Additionally, the separation of ex-ante and ex-post assessments into distinct

practitioner groups limits knowledge sharing, preventing ex-ante analysts from incorporating insights that could improve future evaluations. This gap is also reflected in broader academic and policy communities, where ex-post evaluations align more closely with political science and regulatory analysis, while ex-ante assessments focus on economic modelling (Frontier Economics, 2016; Smismans, 2015).

Divergences between ex-ante projections and ex-post findings often stem from key evaluation parameters such as investment costs, economic and population growth, travel demand, discount rates, and policy delays (Kelly et al., 2015). Additionally, studies have shown a systematic overestimation of emission projections due to factors like policy implementation failures, misinterpreted trend expectations, and intrinsic model uncertainties (European Environment Agency, 2015). Furthermore, unpredictable events, such as economic recessions or shifts in energy policy, contribute to these discrepancies. Given these challenges, integrating ex-post insights into ex-ante appraisals is essential for improving model accuracy, ensuring more reliable policy evaluations, and enhancing the overall credibility of economic assessments. Four bridging techniques are recommended: empirical validation, calibration, uncertainty analysis, and comparative analysis. It should be mentioned that the selection of an appropriate economic appraisal method forms an important enabler for bridging across the various stages of the policy cycle. Alternatively, applying the bridging techniques described hereafter can impact the choice of appraisal method.

Bridging technique 3: Empirical validation of results and inputs

The first bridging technique that can be applied when carrying out the evaluation, consists of empirical validation. It is recommended to use validation to measure the level of agreement between estimated (ex-ante) and empirical (ex-post) data, and not to explain causal relationships (Balci, 1998). Hence, validation is not about achieving an exact match between projected and actual values but rather about **assessing the degree of alignment** at different levels, such as parameter validity (matching observed values), pattern validity (aligning trends in results), or distributional validity (comparing statistical characteristics like means and standard deviations) (Carley, 1996). By identifying discrepancies between estimated and actual impacts, validation helps refine uncertainty analyses, improve model calibration, and enhance future projections. Finally, it is a prerequisite for other bridging techniques building on results from this exercise (e.g., calibration and uncertainty analysis).

To conduct empirical validation, a structured approach is needed[3]. First, **selecting relevant variables** is critical, focusing on those that significantly influence policy outcomes, may have data quality concerns, or have been prioritised by stakeholders. Next, **data preparation** ensures comparability by standardising measurement units and adjusting for differences in data sources. A robust validation process should involve **multiple data sets** when possible, reducing the risk of bias from a single dataset. **Descriptive statistics**, such as mean, standard deviation, and median, help summarise differences between ex-ante and ex-post values, while visualisation techniques like scatter plots and **statistical analyses** (e.g., mean absolute error, root mean squared error) quantify the level of agreement. Documenting the validation process is crucial for transparency, ensuring that findings can be replicated and used to refine future ex-ante assessments. Additionally, using **independent third-party validation** can enhance credibility and eliminate biases in the validation process (Balci, 1998).

Example: Evaluating a Dutch subsidy scheme for insulation: dealing with free-riders (the Netherlands)

The article by (Rovers et al., 2022) describes the efforts undertaken to limit free-rider effects in a Dutch subsidy scheme for energy-saving insulation measures in privately owned homes (SEEH). The scheme ran

[3] Detailed guidance on how to conduct empirical validation is provided in D4.3 Guidelines to bridge ex-post and ex-ante for policymakers. Available at: https://pattern-heu.eu/wp-content/uploads/2024/12/D4.3_Guidelines.pdf

from 2016 to 2020 and aimed to reduce CO_2 emissions by encouraging homeowners and homeowner associations (HOA) to install insulation, with up to 20% of costs covered. A key concern addressed in its design and evaluation was minimising the free-rider effect—cases where subsidies are granted to individuals who would have made the investment anyway.

Prior to implementation, an ex-ante evaluation (Tigchelaar et al., 2016) warned that the budget could be quickly exhausted by free-riders, undermining the scheme's additionality. To address this, the scheme included stricter eligibility conditions: homeowners had to install at least two insulation measures, each meeting minimum surface area and thermal resistance standards. The ex-ante analysis, based on detailed monitoring and survey data (e.g., WoON), modelled different subsidy scenarios and estimated that this stricter threshold would lead to approximately 60% additional savings—that is, savings that would not have occurred without the subsidy. This scenario was adopted for the final design of the SEEH scheme.

An ex-post evaluation, including a 2018 survey conducted by the Dutch government's RVO agency, assessed the actual free-rider effect. The results showed that 38% of participants could be considered free-riders, meaning 62% of the energy savings were additional. Based on this, it was estimated that the scheme led to 1.4 petajoules of natural gas savings per year, of which 0.9 petajoules were additional when accounting for free-rider behaviour.

Validation of the ex-ante scenario results by using ex-post data collected through a survey demonstrates the effectiveness of the stricter criteria in limiting free-riders. Data limitations prevented gaining further understanding of the cause-effect relationship; however, this case illustrates how the bridging technique of validation (here: value validation of the free-rider results) could be performed and add value to policy making.

Bridging technique 4: Calibration of ex-ante baselines and outcomes

Calibration builds upon empirical validation as a crucial bridging technique in economic evaluation. Given this relationship, it is unsurprising that calibration offers similar benefits to validation, particularly in enhancing the accuracy of ex-ante assessments by aligning them with empirical ex-post data. While validation establishes an initial empirical foundation for the model, calibration refines this process further by iteratively adjusting input parameters and methodologies to ensure that the model eventually reflects observed outcomes with reasonable tolerance. Calibration of ex-ante assessments can occur at two levels, where (1) the simulated ex-ante results are compared against real ex-post data to calibrate the dependent variable(s); and, (2) the ex-ante relationships, input parameters and assumptions are compared with ex-post data on these cause-effect relationships (including input parameters and assumptions) to analyse the independent variable(s) (Carley, 1996). By integrating real-world data, calibration improves the reliability of economic projections, making it a valuable tool for policy evaluation. Calibration strengthens the alignment between ex-ante projections and ex-post evidence by refining inputs, outputs, and results, ensuring a more accurate representation of policy impacts, as reflected in Figure 2. Additionally, calibration strengthens the cause-effect relationships in policy evaluation, improving the understanding of adoption rates, behavioural effects, and economic elasticities3. It is a bridging technique that ensures economic models account for the complexities of policy implementation, economic conditions, and other exogenous factors.

3The calibration process consists of several key steps[4]. The first step is preparation, where analysts identify which **parameters to adjust and select appropriate datasets for calibration**. Sensitivity analysis is often used to exclude less influential parameters while defining ranges for calibration values based on

[4] For a comprehensive guidance on how to conduct calibration, please refer to D4.3 Guidelines to bridge ex-post and ex-ante for policymakers. Available at: https://pattern-heu.eu/wp-content/uploads/2024/12/D4.3_Guidelines.pdf

previous studies, expert judgment, and literature. The second step is execution, where calibration algorithms, such as least squares, genetic algorithms, or simulated annealing, are applied to **minimise deviations between model predictions and historical data**. The acceptance criterion, determining when calibration achieves a satisfactory fit, can be based on quantitative metrics like root mean square error or qualitative visual inspection of trends. The third step involves assessment and potential revision, where the accuracy of input parameters and assumptions is re-evaluated. If the model does **not achieve an acceptable fit, additional refinements may be made**, such as revising datasets, modifying calibration settings, or consulting experts for validation. The fourth step focuses on integration, where calibrated parameters are incorporated into ex-ante models to **improve future projections**. Finally, the documentation stage ensures that all calibration decisions, assumptions, and methodologies are recorded for transparency and reproducibility.

Example PATTERN Case: Calibration in the aquaculture case study in Norway

Calibration of ex-ante predictions with ex-post observations using Life Cycle Assessment (LCA) to evaluate the environmental impact of sea lice treatments was applied to the Norwegian aquaculture case study in PATTERN. The case follows a structured approach to link past and future environmental assessments, using ex-post analyses (2018-2022) to generate ex-ante predictions (2023-2026). Due to inconsistencies in the Traffic Light System (TLS) regulations, which governs sustainable fish farming practices in Norway, historical treatment trends were used to estimate future treatment applications. This ensured a more realistic alignment between past and future assessments, making the ex-ante analysis more reflective of actual industry trends. The methodology involves defining a consistent system boundary, collecting inventory data on treatment applications and salmon biomass, running life cycle impact assessments with standardised methods, and refining the results by filtering historical inconsistencies.

The process of bridging ex-post and ex-ante evaluations was implemented through multiple steps, ensuring methodological consistency. First, system boundaries and functional units were standardised to allow direct comparability. Inventory data were collected from databases like Ecoinvent and Agribalyse, incorporating factors such as fish mortality, energy use, and material inputs. The ex-ante predictions assumed a shift in treatment types, with a decrease in chemical and biological treatments and an increase in mechanical treatments, following observed historical trends. The same LCA methods and characterisation factors were applied to maintain consistency between ex-post and ex-ante results. Refinement steps involved extending the historical data period and focusing on production zone-specific assessments to improve the reliability of predictions. Interpretation of results emphasised the relative nature of LCA impacts, showing that while the overall ecosystem quality impact increased due to treatment shifts, the per-ton impact of salmon production remained stable. The case underscores the necessity of continuously refining ex-ante predictions with actual data as it becomes available, improving the accuracy of future environmental assessments

Bridging technique 5: Uncertainty analysis informed by ex-post (or ex-ante)

Uncertainty analysis is an essential aspect of ex-ante appraisals, allowing policymakers to understand the limitations of model predictions and improve decision-making. Since ex-ante models rely on assumptions and input parameters that may be uncertain due to, for example, incomplete data or system complexity, assessing these uncertainties helps identify their impact on model outcomes. For instance, by identifying key input parameters, such as costs, benefits, technology evolution, and policy characteristics, and their plausible ranges, the accuracy of baseline assumptions can be improved. Additionally, a better understanding of cause-effect relationships, including behavioural responses and policy adoption rates, strengthens output estimations. This process enhances the robustness of policy forecasts and ensures that decision-makers are aware of potential risks. Incorporating insights from ex-post evaluations can further refine uncertainty analysis by providing empirical data to define parameter ranges more accurately, validate assumptions, and improve overall model reliability. Hence applying uncertainty

analysis as a bridging technique will benefit elements along the entire objectives-inputs-outputs-impacts chain as depicted in Figure 2.

4The first step in uncertainty analysis is to **define its goal**, which could range from assessing model sensitivity and testing policy robustness to improving transparency in decision-making. Ex-post evaluations play a role in this stage by identifying critical cause-effect relationships and highlighting the main sources of uncertainty (Saltelli et al., 2004). Once the objective is clear, it is necessary to **determine which uncertainties to focus on**. Identifying key uncertainties is often guided by literature, expert consultation, ex-post data, and screening techniques such as global sensitivity analysis (GSA) to ensure that only the most influential parameters are considered (Refsgaard et al., 2007; van Dorsser et al., 2018; Walker et al., 2003). Determining **uncertainty ranges and probability distributions** is the third step. Ex-post evaluations can enhance this process by providing empirical insights into uncertainty ranges, such as observed deviations in investment costs or policy implementation delays. When defining these ranges, it is also important to consider potential correlations between parameters to avoid misrepresenting dependencies in the model. Consequently, the **choice of the uncertainty analysis method** depends on the goals of the study, the type of model used, and the level of uncertainty present. Examples are sensitivity analysis, scenario analysis and robustness analysis[5]. Once the uncertainty analysis is performed, its **results must be carefully interpreted** to determine whether refinements are needed. If significant discrepancies arise, it may be necessary to adjust model assumptions, include additional ex-post data, or reconsider which parameters should be prioritised. Finally, documenting the entire process ensures transparency and facilitates future evaluations which helps policymakers assess the robustness of different policy options and enhances the reliability of decision-making.

Bridging technique 6: Comparative analysis

Comparative analysis enhances understanding of the key determinants that shape differences in economic, environmental, and societal effects, by systematically comparing projected policy impacts with actual outcomes. The primary objective of comparative analysis is **not simply to identify deviations from forecasts but to understand the reasons behind them**. It is therefore the most advanced bridging technique, improving key elements along the entire objectives-inputs-outputs-impacts chain, as illustrated in Figure 2. 5 This process allows policymakers and analysts to refine predictive models, improve the accuracy of future ex-ante appraisals, and strengthen the overall reliability of economic evaluations.

5As it forms the most complete bridging technique, several prerequisites must be met before it can be applied. First, the cause-effect relationships of the policy intervention must be well-documented in the ex-post evaluation, starting with a clear intervention logic and a thorough assessment of policy effects. Additionally, the objectives and expected outcomes must be explicitly defined in both the ex-ante and ex-post appraisals to ensure meaningful comparisons. Finally, the data and results from both evaluations must be of high quality – transparent, reliable, and directly relevant to the policy being assessed. Due to these stringent requirements, comparative analysis is only seldomly applied in practice.

Performing a comparative analysis is a process comprising many steps[6]. The first involves classifying the variables used in both ex-ante and ex-post assessments. This process helps identify which data points are

[5] For more detail on bridging by uncertainty analyses, please refer to D4.3 Guidelines to bridge ex-post and ex-ante for policymakers. Available at: https://pattern-heu.eu/wp-content/uploads/2024/12/D4.3_Guidelines.pdf

A comprehensive explanation on how to carry out comparative analysis, illustrated by a case study, can be found in D4.3 Guidelines to bridge ex-post and ex-ante for policymakers. Available at: https://pattern-heu.eu/wp-content/uploads/2024/12/D4.3_Guidelines.pdf

commonly used, which are available but underused, and which are relevant but missing. Identifying these disparities between evaluations helps **pinpoint differing variables** that are crucial in explaining actual policy effects. Once key differences are established, the next step is to conduct the actual comparative analysis. This can be done **by re-running ex-ante models with additional ex-post data** to refine projections **or by applying the original ex-ante dataset in ex-post evaluations** to assess their predictive accuracy. Another approach involves directly comparing datasets and indicators to extract meaningful insights into discrepancies. The chosen method depends on the specific policy context and research objectives, but the aim is to understand how model choices and data availability influence assessment results. By systematically comparing methodologies, analysts can improve policy effectiveness by refining economic models and addressing inconsistencies.

The analysis also seeks to **determine the key factors contributing to differences** between ex-ante and ex-post evaluations. Statistical techniques, such as regression analysis, can be used to identify these determinants while ensuring that correlations among different variables are accounted for. The insights gained help refine ex-ante models, making future assessments more transparent and reliable. Finally, documenting the entire comparative analysis process is essential to ensure transparency and facilitate integration with other evaluation techniques, such as calibration and uncertainty analysis. By clearly outlining the variables analysed, the methodology applied, and the determinants identified, stakeholders can better understand the reliability and accuracy of policy assessments.

Example PATTERN case: comparative analysis in the building sector in Belgium and in the Netherlands

In frame of PATTERN, projections in hindsight were analysed for the Belgian and Dutch buildings sector to apply the comparative analysis bridging technique. This case study evaluates the accuracy of past projections for CO_2 emissions in the Belgian and Dutch buildings sector by comparing them with actual energy balances and emission inventories from 2000 to 2020. The goal is to identify key sources of uncertainty in these projections and understand the factors driving discrepancies. By conducting both quantitative and qualitative analyses, this research examines how well past projections align with real-world data and explores how assumptions about energy use, policy impacts, and socio-economic developments influence forecasting accuracy. These insights are critical for improving future policy planning and enhancing the reliability of projection methodologies.

The case study methodology followed a structured, multi-step approach to compare ex-ante projections with ex-post emissions data, focusing on data collection, historical trend analysis, decomposition analysis, and policy evaluation. Initially, relevant parameters were identified, including greenhouse gas emissions, energy consumption, and socio-economic factors, ensuring consistency across different scenarios. The collected data was verified, interpolated when necessary, and adjusted for factors as weather conditions. Once data was compiled, historical emissions trends from 2000 to 2020 were examined alongside key drivers such as population size, energy efficiency improvements, and changes in energy sources. A decomposition analysis was applied to break down emissions changes into four primary drivers: weather, socio-economic activity, energy intensity, and carbon intensity. Additionally, a detailed policy analysis was conducted by mapping legislative developments at national and EU levels, categorising policies into regulatory, financial, and informational instruments to understand their impact over time.

Findings from this comparative analysis highlighted key discrepancies between projections and actual emissions trends in the residential sector. In general, projections tended to overestimate emissions and final energy consumption, particularly for 2015 and 2020. Over time, deviations between projected and actual values increased, driven primarily by uncertainties in energy intensity assumptions rather than the timing of the projections. The study also found that projections of carbon intensity were relatively accurate, while energy intensity was consistently overestimated, reflecting difficulties in capturing the

full impact of energy efficiency measures. Additionally, demographic parameters such as population size and household numbers were relatively well estimated, while assumptions on weather conditions varied widely across scenarios, limiting comparability. Sudden policy shifts, such as increased insulation efforts in Dutch residential buildings after 2014, also led to significant short-term deviations, underscoring the challenge of accounting for policy-induced behavioural changes in long-term projections.

3. HOW TO INSTITUTIONALISE BRIDGING WITHIN POLICYMAKING PROCESSES?

Similar to the regular evaluation practices, fostering a closer connection between bridging and policymaking can be achieved through institutionalisation. The institutionalisation of bridging ex-post and ex-ante evaluation in policymaking is a systematic process aimed at embedding the evaluation practices into formal government structures and decision-making frameworks (OECD, 2020c). This process enhances the integration of bridging within the policy cycle, ensuring that policy management is guided by evidence-based insights (Lázaro, 2015). Institutionalisation establishes evaluation systems through policies or strategies, promoting systematic assessment, transparency, and policy learning (Jacob et al., 2015). However, challenges persist in achieving a consistent and coordinated approach across government institutions, particularly in aligning frameworks, building human resource capacity, and sustaining political interest in evaluation (OECD, 2020b).

This chapter explores the key dimensions of institutionalisation through three core aspects: institutional arrangements, procedures in policymaking, and capacity building. Institutional arrangements embed evaluation in government through legal provisions and resources, procedural arrangements establish frameworks for systematic evaluation, and capacity building develops the skills and culture needed for effective implementation.

3.1 Institutional arrangements to support bridging in policy evaluation

Example of institutional arrangements to support bridging: EU Better Regulation

The EU's Better Regulation principles have been instrumental in institutionalising evaluation practices across the policy cycle, ensuring that regulatory decisions are evidence-based and systematically assessed. Central to this effort is the 'evaluate first' principle, upheld by the EU Regulatory Scrutiny Board, which mandates that regulatory amendments undergo evaluation before implementation. Compliance with this principle has grown significantly, reaching nearly 90% in 2022 (Gibson & Kenche, 2023). The EU has also pioneered 'back-to-back' evaluations, integrating ex-post assessments into impact analyses, promoting bridging of ex-post and ex-ante evaluations. The EU's commitment to embedding evaluation in its broader regulatory framework is reflected in the transition towards "Better Regulation" emphasising continuous assessment throughout the policy cycle. This shift was further reinforced by transferring evaluation responsibilities from DG Budget to the Commission's Secretariat General, highlighting its strategic importance (Smismans, 2015). Additionally, the provision of Better Regulation Guidelines (European Commission, 2021a) and Toolbox (European Commission, 2021b), has further facilitated evaluation and bridging practices. Through these mechanisms, the EU has fostered an 'evaluation culture,' ensuring that policy interventions are informed by robust scrutiny and systematic review.

Legal Frameworks

One way to look at institutional arrangement is through the lens of regulations (Jacob et al., 2015). Legal frameworks can play a fundamental role in embedding bridging practices within governments by providing a structured and systematic foundation. Many countries have established legal provisions mandating policy evaluation, either ex-post or ex-ante, recognising its importance in evidence-based decision-making (Jacob et al., 2015; Lázaro, 2015; OECD, 2020c, 2020b). However, there is no universal model for designing these frameworks, as countries adopt diverse approaches based on their administrative traditions and governance structures, for example:

- Integrating policy evaluation into the constitutions, reflecting a strong political commitment and ensuring long-term continuity beyond electoral cycles.

- Establishing primary legislation, embedding evaluation within broader public management laws or enacting dedicated policy evaluation acts.
- Secondary legislation, such as ministerial decrees and regulations, is also commonly used to operationalise these legal mandates, providing detailed guidelines on evaluation scope, timing, and quality standards.

While embedding bridging into a constitution may not be appropriate, **primary, and especially secondary legislation** can provide a suitable framework for institutionalising the linking of evaluation practices. For example, a dedicated policy evaluation act could be envisaged, establishing a unified evaluation system across ministries through clarifying each ministry's role in the evaluation process. It could be used to formally mandate evaluations before and/or after policy adoption, and detail requirements for those evaluations, embedding the bridging element (e.g. to use previously conducted evaluations, to consult stakeholders involved in other stages of the policy, etc.). Such provisions could however also be included in budgetary governance frameworks, or more sectoral monitoring and evaluation regulations.

The institutionalisation of evaluation through legal mechanisms must, however, strike a balance between structure and flexibility. While regulations provide essential guidance, overly rigid legal requirements risk bureaucratising evaluation processes, potentially reducing their effectiveness (OECD, 2020c; Smismans, 2015). In some cases, evaluation obligations are embedded in broader regulatory instruments, such as budgetary governance frameworks or national planning laws, without prescribing overly detailed methodologies (Lázaro, 2015). This allows for **adaptability while still reinforcing the importance of bridging**. Additionally, legal frameworks must be supported by adequate resources, technical expertise, and institutional commitment to avoid superficial compliance (Lázaro, 2015; OECD, 2020c). Countries that successfully integrate evaluation into their governance structures often **complement legal mandates with sector-specific evaluation policies, administrative guidelines, and mechanisms for knowledge sharing among government agencies.** Ultimately, the effectiveness of legal frameworks depends not only on their existence but on their capacity to foster a culture of evaluation within government institutions, ensuring that assessment results are systematically used to improve policy outcomes.

Policy Framework

Beyond legal frameworks, policy frameworks also play an important role by providing strategic direction and fostering an evaluation culture across the government (OECD, 2020c). These frameworks can take different forms but to ensure that bridging in evaluation can be conducted systematically and effectively, it is encouraged to clearly **define institutional responsibilities, establish evaluation plans, and outline best practices**. Unlike legal frameworks, which impose regulatory requirements, policy frameworks offer flexibility in structuring processes and integrating them into government operations. Formal legal frameworks do not form a prerequisite for establishing a policy framework; on the contrary, policy frameworks can be designed as standalone mechanisms to enable (bridging of) evaluation. Additionally, policy frameworks can be focused on specific sectors or thematic areas, embedding bridging within targeted policy domains. Integrating bridging within the existing policy framework for evaluation appears to be a practical and effective approach.

Guidelines for bridging practices

A third option in institutionalising evaluation as such and bridging ex-ante and ex-post practices in particular, is the production of guidelines for these activities. They serve as practical tools for policymakers, helping to ensure that bridging can be systematically integrated in their evaluation practices to support their decision-making processes. Providing structured guidance on planning, conducting, managing, and utilising policy evaluations seems a common practice as many countries have established evaluation guidelines to support implementation across government (OECD, 2020b). Similarly

to the policy frameworks, in some cases, guidelines exist independently of legal or policy frameworks, highlighting their significance as standalone instruments for fostering evaluation practices.

Guidelines can address either **the technical quality of evaluations or the good governance of evaluations**, or both. They typically cover key aspects such as designing data collection methods, establishing quality standards, and ensuring stakeholder engagement (OECD, 2020c), as also explained in the **PATTERN D4.3 Guidance on bridging**. They can also address the general planning of evaluation activities, what means are needed depending on the type of evaluation objective, and defining the intervention logic (Broc et al., 2019). As guidelines deal with both process-related aspects as well as content requirements, they are the perfect place to incorporate information about bridging ex-ante and ex-post evaluations. For example, higher-level recommendations can be made regarding adopting a forward-looking mindset, enabling bridging later on because information is clearly and consistently logged. Similarly, guidelines are the place to incorporate very practical information on bridging techniques. Importantly, they help embed bridging of evaluation within routine government operations, supporting the institutionalisation of bridging by ensuring that evaluation practices remain consistent, adaptable, and aligned with policy needs.

PATTERN D4.3 Guidance on bridging ex-post and ex-ante for policymakers

A meta-analysis of current practices indicated a very limited use of ex-ante appraisals by ex-post evaluations or vice versa. This limited application is due to multiple challenges and uncertainties happening throughout the different evaluation steps (PATTERN D1.1, 2023). Nevertheless, bridging ex-post and ex-ante evaluations could lead to more evidence-based and effective policy interventions. Ex-post evaluations can help to improve the accuracy and reliability of ex-ante appraisals, as they will be based on real-world data and experiences rather than assumptions and projections. On the other hand, ex-ante evaluations can inform the design and implementation of a policy, and its ex-post evaluation, to improve its effectiveness and efficiency once it has been implemented (PATTERN D1.1, 2023).

To show how bridging can be applied, and has been applied already, PATTERN developed a guidance document 'Guidelines to bridge ex-post and ex-ante for policymakers' (PATTERN D4.3, 2024). Multiple ways of bridging are described, giving stepwise and illustrated insight into the existing challenges, the improvements resulting from bridging, the methods to use, and when to use these. These elements are described for every step in the evaluation process, ranging from designing the intervention logic to disseminating evaluation findings. Additionally, a second part has been developed from modelers and case perspectives. This part focuses on showing how bridging can be applied by the seven PATTERN economic appraisal methods.

Dedicated evaluation services or institutions

A discussion on institutionalisation of evaluation must consider the role of organisational institutionalisation, i.e. dedicated evaluation services or institutions. These entities integrate evaluation, and related bridging, into policymaking through coordination, a whole-of-government approach, and knowledge sharing. The institutional set-up is often a reflection of the characteristics of the political system they operate in (Jacob et al., 2015; Lázaro, 2015). Typically, it is the central government, often through the Centre of Government (CoG)[7] or the Ministry of Finance, is responsible for steering policy evaluation across ministries and agencies (OECD, 2020c). These central institutions provide strategic direction, set evaluation priorities, and ensure that evaluation findings are systematically integrated into decision-making. Policy evaluation can be structured as either highly centralised or decentralised, with sectoral ministries conducting evaluations and central coordination ensuring quality, timing, consistency,

[7] The Centre of Government is known by various names in various countries. Examples are Chancellery, Cabinet Office, Office of the President, Office of the Government, etc. (OECD, 2020c).

and the bridging. By acting as facilitators, CoG institutions can promote a **collaborative approach to evaluation among different institutions, contribute to policy learning and cultivate a bridging culture** (Jacob et al., 2015). Central evaluation units, such as a National Evaluation Agency, or a Centre of Excellence, or dedicated evaluation personnel, oversee evaluation quality, provide technical guidance, and can disseminate methodologies for ex-ante, mid-term, ex-post evaluations and bridging these.

Some countries, such as the United Kingdom, have successfully integrated evaluation experts—including researchers, economists, and statisticians—into policy and strategy units, ensuring that evaluation findings inform decision-making from policy inception to implementation (Jacob et al., 2015). While no single institutional mechanism guarantees the systematic use of evaluation results, a combination of centralised coordination, methodological support, and decentralised implementation appears to be the most effective approach (Lázaro, 2015). To effectively promote the bridging of evaluations, these institutions and actors must be well-informed about the available approaches and best practices.

Example of dedicated institution promoting bridging: UK's Regulatory Policy Committee

A good example of a dedicated institution advocating better regulation and the use of evidence generated through evaluations, is provided by the UK's Regulatory Policy Committee (RPC). It promotes bridging ex-post and ex-ante evaluations by ensuring that regulatory decisions are informed by robust evidence and analysis throughout the policy cycle. As an independent scrutiny body, the RPC evaluates the quality of impact assessments for proposed regulations and provides external validation of estimated costs and benefits. Additionally, the committee assesses Post-Implementation Reviews (PIRs), which government departments must conduct within five years of implementing regulatory measures. By reviewing whether PIRs provide sufficient evidence to support retaining, revising, or repealing regulations, the RPC ensures that past evaluations meaningfully inform future policy decisions. This systematic approach aligns with best practices by embedding continuous regulatory assessment into the UK's legislative framework. The RPC's independent oversight helps counter optimism bias, promotes regulatory transparency, and enhances the credibility of the government's regulatory framework. Through its scrutiny, guidance, and advisory role, the RPC fosters a culture of evidence-based policymaking, ensuring that ex-post evaluations effectively feed into ex-ante assessments to improve regulatory outcomes (Gibson & Kenche, 2023; Regulatory Policy Committee, n.d.).

Creating a culture of bridging in policy assessment

A last aspect of embedding evaluation practices into governance structures and promoting bridging ex-post and ex-ante approaches of high quality in decision-making, is formed by a strong bridging culture. Fostering a culture of bridging ensures that it becomes an integrated part of an organisation's way of working, rather than a separate or isolated function (HM Treasury, 2020; OECD, 2020b). When evaluation in general, and a bridging mindset in particular, is embedded within an institution's culture, it shifts from being seen as a bureaucratic obligation or a compliance exercise to a core component of good policy practice. Embedding this mindset does not happen by accident—it requires deliberate efforts to promote bridging approaches as a valuable tool for guiding future actions and improving policy outcomes. Heads of departments and policy leaders must champion this perspective by ensuring that evaluative thinking is incorporated from the outset of policy design and that all relevant actors consider how the value of a policy will be established throughout its implementation (HM Treasury, 2020). National policy styles and organisational culture also shape the broader enabling environment, influencing the extent to which evidence and bridging are embraced and integrated into policymaking (Jacob et al., 2015; OECD, 2020c).

3.2 Procedures embedded in policymaking to support bridging

While the theoretical model of the policy cycle as discussed in section 1.1 suggests distinct, sequential stages, in practice, policymaking is often far more dynamic and fluid (Mergaert & Minto, 2015; Smismans, 2015). The notion of a linear, neatly compartmentalised policy process does not always reflect reality;

instead, the policy process involves iterative interactions and interdependencies between various elements (HM Treasury, 2020). This means that integrating bridging ex-post and ex-ante evaluations into the policy cycle requires multiple, almost constant interaction between the two, which can occur at any stage of the process (Broc et al., 2019; HM Treasury, 2020; Oliveira & Pinho, 2011).

Stimulating bridging by fostering a cyclical approach

Ensuring a better link between policymaking and evaluation is one way to promote the use of evaluation outcomes and adopt a bridging mindset. Fostering an evaluation reflex at all stages of the policy cycle makes policymakers and evaluators more aware of future evaluation needs, enabling for example better data collection or aligned monitoring. A first mechanism that can be used is integrating evaluation into the **budgetary cycle** (OECD, 2020c). As expenditure programmes have a clear period of duration, evaluation is more naturally established around a cyclical pattern (Smismans, 2015). A format like a spending review enhances the integration of ex-post and ex-ante evaluations as it not only generates performance evidence on programs and policies but also uses this information to inform budget reallocations in a new cycle (OECD, 2020c). A more direct approach consists of **conducting a Regulatory Impact Assessment** (RIA). RIAs and other cost benefit analyses (CBA) help policymakers systematically analyse the costs and benefits of regulatory and non-regulatory options before making decisions, thereby promoting an evidence-based policy agenda. (Bos & de Swart, 2024) argue that, additionally, a cost benefit analysis should be performed ex-post to learn how the realised costs and benefits differ from the expected costs and benefits, and to be able to improve ex-ante CBA in the future.

Another approach to strengthening bridging of evaluations in regulatory policy is the inclusion of ex-post review requirements, such as sunset clauses, and the obligation to use such information in the subsequent policy design stage (Broc et al., 2019; Lázaro, 2015). Vice versa, formal provisions at a policy's inception or revision to use information from existing ex-post evaluations, promotes bridging of practices (Gibson & Kenche, 2023). The European Union's 'Evaluate First' principle exemplifies this approach by mandating an assessment of past actions before new interventions are introduced, ensuring that evaluation is embedded into strategic planning and ex-post evidence exists for the (re)design of the policy and related ex-ante assessments (Smismans, 2015). Furthermore, ex-post evaluations and ex-ante impact assessments can be conducted 'back-to-back', encouraging the bridging of both practices even more (Gibson & Kenche, 2023). **Including evaluation requirements** is one way to advance the practice of evaluation, and thereby the practice of bridging.

Supportive framework for bridging

A supportive framework is essential for growing the practice of evaluation. As also described in Section 3.1, a facilitating component is the **establishment of evaluation guidelines**, which help ensure both technical quality and good governance. Effective guidelines clarify key aspects such as evaluation objectives, scope, and methodological approaches, ensuring that evaluations are purposeful and relevant (Lázaro, 2015; OECD, 2020c). They are also a possible vehicle to promote bridging of evaluation approaches.

Additionally, an enabling environment can also be forged by less tangible aspects such as **user incentives, organisational culture and internal processes** that influence the way of working. This involves the degree of independence organisations have in allocating resources for evaluations, in making decisions about evaluation topics and the methodologies, and in utilising the evaluation outcomes (HM Treasury, 2020; Lázaro, 2015; OECD, 2020c). Bridging is facilitated when organisations have the means (budget and decision-making powers) to decide which policy to evaluate, select appropriate methods, and involve relevant stakeholders. Key questions arise: Is there a culture of broad stakeholder involvement? Are there processes in place to document changes in policies over time? These elements can render bridging of ex-post and ex-ante assessments either more easy or more difficult.

The last element in this framework conducive of evaluation, constitutes **resource allocation**. Resources comprise budget to conduct the evaluation(s), time to collect data and perform both ex-post and ex-ante analyses but also time to involve implementing staff and set up the required partnerships for a qualitative evaluation. Possible actions to make the resources an enabling factor include adopting a forward-looking perspective. This implies initiating discussions about ex-post evaluation means early-on, when the policy budget is decided, for example. Also, discussing the results of the respective evaluations, the employed methods, and the use of the evidence can instigate bridging. When stakeholders clearly understand how their input will be utilised, their commitment increases, making it easier to involve them across different evaluation stages, for example linking ex-ante stakeholders to ex-post assessments (Broc et al., 2019). Resources form an important part of the planning of evaluations and hence contribute to bridging.

Planning of evaluation in the policy design phase

Effective evaluation planning enhances both the quality and the usability of evaluations (Broc et al., 2019; Lázaro, 2015; OECD, 2020c). As (Mergaert & Minto, 2015) established, the timing of evaluations can pose a barrier to their use in policymaking, thereby hindering bridging. The ex-post and ex-ante processes operate on different timelines, leading to challenges to match the timeframes. To address this, policymakers should anticipate evaluations early in the policy design phase to align with decision-making timelines. It is recommended to **adopt a forward-looking approach** and considering future evaluation needs from the outset, as a way to facilitate bridging of ex-post and ex-ante.

To improve evaluation planning, governments should establish **multi-annual evaluation agendas** that prioritise policies and programs for assessment based on criteria such as strategic relevance, budgetary significance, and evaluability conditions (Lázaro, 2015). These plans should specify which programs will be evaluated, the timelines, the types of evaluations to be conducted (e.g., impact assessment, cost-effectiveness analysis, implementation evaluation), and the allocation of financial and human resources. This presents an important opportunity for bridging ex-post and ex-ante as this could be specified in the evaluation approach, for example.

Additionally, **policies should be designed with evaluation in mind**. This means clearly defining objectives, expected outcomes, and monitoring requirements at the outset. Engaging **evaluation experts** during policy formulation can help identify relevant evaluation approaches and data needs in advance, reducing the risk of inadequate information for future assessments. Setting up dedicated working groups to oversee evaluation planning can further ensure coordination and data accessibility (Broc et al., 2019). Not only planning but also preparing the evaluation during the policy design and implementation is an excellent way to foster bridging.

Communication and collaboration between policymakers, evaluators and practitioners

Effective evaluation requires ongoing communication and collaboration between policymakers, evaluators, and implementing agencies. One major barrier to bridge ex-post and ex-ante assessment is the disconnect between different actors involved in policymaking (Broc et al., 2019). Policymakers, evaluators, and frontline practitioners often operate within separate silos, which "is not conducive to better evaluation practice" (Giorgi, 2017), and hence certainly not for bridging. To address this, **structured coordination mechanisms** should be established. **Liaison meetings, inter-administrative networks, and cross-governmental working groups** can facilitate the exchange of experiences and foster commitment to bridging. Such exchanges may vary in formality, ranging from dedicated services for policy analysis, to focal points for quality evaluation, or steering committees overseeing the evaluation process (Broc et al., 2019; Lázaro, 2015; OECD, 2020c).

Clear **role definitions** also help streamline the evaluation and bridging processes. Assigning **an evaluation coordinator** can improve cooperation between evaluators and policy practitioners, ensuring that evaluations are not perceived as external audits but as integral components of policy development

(Giorgi, 2017). Additionally, the evaluation is facilitated by good organisation and open communication. This can be achieved by identifying and involving the right stakeholders and clarifying the expectations from each party. Additionally, organising open discussions about evaluation objectives, clearly communicating on evaluation expectations, and creating feedback loops, are all practices that help the differing perspectives that can exist between policymakers and practitioners (Broc et al., 2019). This in turn helps to ensure that evaluation findings are actively considered in decision-making.

3.3 Capacity building

Capacity building contributes to the use of evidence within organisations, stimulating evaluation practices, including bridging. Capacity building initiatives need to take into account the specific institutional and procedural elements at play in local policy making. Understanding how the policymaking process looks like and where the opportunities to bridge lie, is important in identifying where capacity needs to be strengthened. Additionally, embedding such initiatives into organisational structures and strategies is important to secure long-term impact (OECD, 2020c). Building capacity can be done in several ways: on the one hand, the policymaker's skills for evaluation and bridging can be trained; on the other hand, the organisational capacity for such activities can be strengthened. Furthermore, facilitating knowledge-sharing on several levels is important, as it secures adequate resources to execute evaluations.

Training and skills development

Training and skills development are essential to equip policymakers with the ability to use evaluation and bridging in their decision making. As behavioural change takes time, capacity building initiatives should be **long-term, participatory, and embedded in professional development frameworks** (OECD, 2020a). Intensive skills training programs can enhance the ability of policy professionals to use evaluations in general and apply bridging techniques in particular. This could be done via trainings for evaluation project managers, or other analytical professions within government and focus on key competencies such as scoping, leading and managing, methods, use and dissemination. Especially **scoping and methods** capabilities offer chances to increase capacity on bridging ex-post and ex-ante evaluations as these comprise constructing an intervention logic, identifying the appropriate evaluation approach, producing proportionate evaluation plans, leveraging monitoring and administrative data, and applying various bridging evaluation methods (HM Treasury, 2020; Lázaro, 2015).

Nevertheless, not every policymaker needs to be an expert on specific bridging approaches. Instead, capacity building initiatives can focus on stimulating a bridging mindset. This way participants will not only learn new skills, but also become motivated to take a more advocating and guiding role on evaluation and bridging in the organisation (OECD, 2020a). Creating a favourable internal culture is the goal of targeted **leadership trainings for senior civil service officials** (Lázaro, 2015; OECD, 2020a). By increasing managers' understanding of the value and process of evaluation (and bridging), this could contribute to fostering an evaluation-friendly environment. By championing the evaluation use and training co-workers, they could bring about the organisational change favourable to bridging. **Mentoring programs** offer another capacity-building approach by providing personalised guidance and hands-on experience in applying evaluation (and bridging) to policy issues (OECD, 2020a).

Organisational tools and processes

As discussed in section 3.1, organisational structures and cultures play an important role in facilitating the use of evidence. Strengthening organisational capacity for evaluation requires embedding evaluation functions within institutional and procedural frameworks and ensuring their sustainability (OECD, 2020a). Developing organisational tools and processes can help integrate bridging into daily decision-making processes and sustain institutional knowledge. These can take the form of evidence strategies, **guidance documents, or toolkits** (OECD, 2020a). Guidance notes can treat general topics related to evidence or

evaluations, for example in an evaluation newsletter, or a dedicated framework agreement. They could however, also go specifically into the topic of bridging evaluation practices and discuss specific methods for bridging, actions that policymakers can take to bridge and case studies to illustrate. **PATTERN deliverable D4.3** (PATTERN D4.3, 2024) is an example of how guidance notes can be written to explain and ultimately encourage bridging practices in policymaking.

Knowledge and data infrastructure

Activities regarding knowledge and data infrastructure comprise providing access to **research portals and knowledge-sharing platforms, and facilitating efficient data storage**, thereby enhancing the accessibility and utility of evaluation findings (OECD, 2020a). It also encompasses improving the current evaluability conditions of policies, by creating (multi-year) evaluation plans, and by making sure that relevant data is available, has good quality and is accessible for use in evaluations (Lázaro, 2015). Ensuring access across policymaking domains, and externally for research purposes, is an important element in building organisational capacity towards evaluation use and adopting a bridging approach.

As previously mentioned, ex-post and ex-ante professionals represent two distinct communities. Additionally, compartmentalisation of policymakers and so-called suppliers of research, along with the misalignment of research timelines and policy cycles further hinders the knowledge transfer (Lázaro, 2015; OECD, 2020c). Building capacity in this regard requires **increasing interaction between various actors in the evaluation process**. Structured initiatives such as interactive forums, seminars, and policy dialogues can foster dialogue between researchers and policymakers, increasing mutual understanding and trust. Ongoing activities such as platforms, communities of practice, formal networks and partnership projects can create sustained opportunities for knowledge exchange. Finally, knowledge brokers can support capacity building for bridging as they serve as intermediaries who support policymakers navigating complex research landscapes and facilitate the transfer of knowledge to the public sector (OECD, 2020a).

Dedicated resources

A last important factor currently constraining evaluation capacity consists of resource limitation. As discussed in section 3.2, the concept of budget is to be interpreted in a broader sense than just financial resources, encompassing personnel and time as well. A lack of dedicated resources leads to less qualitative evaluations, limiting their reliability and impact (Broc et al., 2019; OECD, 2020c). Ensuring adequate budget for evaluation activities can be addressed at two stages. Ideally, resources needed for evaluation are discussed in the policy design phase. It is important that the means needed for carrying out a meaningful ex-post evaluation, are discussed in the ex-ante phase. Alternatively, when there is a more structured approach regarding evaluation, such as evaluation agendas or **evaluation planning**, the allocation of resources will more naturally be a topic to discuss (Lázaro, 2015).

4. WHAT COULD BE LEARNED FROM APPLYING BRIDGING IN PATTERN CASES?

The integration of ex-post and ex-ante economic evaluations through the bridging of Aggregation Model Tool (AMT) and REMES-EU Computable General Equilibrium (CGE) represents an important methodological goal within the PATTERN project. AMT, an Agent-Based Model, captures observed behavioural responses to environmental and climate policies (ex-post), providing a micro-level perspective grounded in empirical data. REMES-EU, in contrast, projects macroeconomic impacts of climate and environmental policies under different policy scenarios (ex-ante). Utilising sectoral and regional data, it operates at a more general, macroeconomic level, projecting long-term impacts on GDP, employment, energy consumption, and emissions. Bridging these two tools requires a **recalibration of sectoral productivity in REMES-EU based on AMT's behavioural insights**, enabling a more coherent and accurate representation of policy impacts.

Methodologically, AMT employs Agent-Based Modelling (ABM), simulating individual behaviours and interactions to observe emergent patterns. It uses micro-level data to model how agents respond to policy interventions and captures heterogeneity within populations, such as farmers adopting green practices at different rates. AMT uses bottom-up data derived from empirical, field-level observations which allows to represent the reality in a more adequate way. ABM's mode of thinking about phenomena at the collective level makes it easier to capture emergent phenomena relative to other modelling techniques and provides a description of the system that is closer to reality. These models assume that agents are heterogeneous, with bounded rationality and dynamic preferences. REMES-EU, in contrast, relies on a Computable General Equilibrium (CGE) modelling framework. It uses mathematical equations to represent the interactions between economic agents and markets in an aggregated way and their cross-sectoral impacts, relying on aggregated macro-economic data, such as national accounts and sectoral productivity parameters. This model simulates adjustments across multiple markets simultaneously, ensuring that resources like labour and capital reallocate optimally in response to policy changes. However, these models assume a representative individual characterised by perfect rationality and static behaviour, which constitutes a limitation (Niamir et al., 2020). To overcome these limitations, we combine the strengths of top-down computable general equilibrium models and bottom-up agent-based models through productivity adjustments which is well-established in economic modelling (Ringler et al., 2016; Willenbockel et al., 2018).

This chapter presents key observations arising from the bridging process, highlighting both methodological challenges and insights gained through the iterative feedback mechanism established between the models. The observations presented here contribute to a deeper understanding of **how micro-level behavioural responses can be effectively integrated into macroeconomic projections to support more robust and reliable policy assessments**. The first section discusses the risk of unidirectional bridging, which could lead to productivity overestimations by attributing output deviations solely to changes in productivity. Subsequent sections illustrate how the bidirectional (called in the literature as “soft-link”) feedback mechanism, implemented to address these issues, enhances model performance by capturing the interplay between productivity shifts and input demand variations. Finally, we outline the limitations encountered during the bridging process and discuss the implications of these findings for future model development and policy evaluation.

4.1 Key observations arising from the bridging AMT and REMES-EU

Observation 1 – Unidirectional bridging might overshoot the evaluation of the productivity changes.

An important aspect of economic growth that is considered exogenous in CGE models is productivity. Productivity plays a crucial role in determining long-term economic performance, influencing output levels, competitiveness, and income distribution. However, in CGE models like REMES-EU, productivity is typically treated as an external parameter rather than an endogenous outcome of economic interactions. This is because productivity changes are often driven by technological progress, institutional factors, and other complex mechanisms that are difficult to model within the CGE framework (Lamperti et al. 2019). Even policies designed to mitigate the effects of climate change can generate economic consequences that are often inadequately captured by traditional economic models. In this case, productivity can be significantly influenced by policy measures or other external shocks. Incorporating the endogenous response of sectoral productivity to specific policies enhances the explanatory power of economic models, allowing for a more comprehensive understanding of intersectoral dynamics and economic interactions. CGE frameworks, rely on predefined productivity parameters, typically sourced from projections or established databases, making it difficult to capture these adaptive effects. Conversely, ex-post analyses from the ABM model assess the realised impact of policies, including potential shifts in sectoral productivity due to adaptative behaviours due to the policy, providing valuable empirical insights that can help refine future modelling approaches (Lamperti et al., 2019).

Linking macroeconomic CGE models with micro-level behaviourally-rich ABMs can operationalise behavioural changes in formal policy analysis and open new synergies between micro and macro approaches (Niamir et al., 2020). In this respect, to integrate specific insights from about sectoral output from AMT into REMES-EU's sectoral activity projections and refine value chain interactions, the **recalibration of productivity in REMES-EU serves as a key mechanism**. By adjusting productivity parameters based on insights derived from AMT, the coherence between ex-post behavioural responses and ex-ante macroeconomic projections can be strengthened. This alignment ensures that REMES-EU's projections reflect observed patterns of adaptation and response captured by AMT, ultimately improving the reliability and relevance of economic impact assessments. The goal set at the beginning of the project was to endogenise the definition of the productivity level for the sectors under consideration for each case study.

Originally, the recalibration was conceived as a unidirectional re-adjustment of the output of the REMES-EU CGE model to match the same growth rate for the output of the sector considered under the case study as the one stemming from AMT, as shown in **¡Error! No se encuentra el origen de la referencia.**Figure 6. The recalibration was planned to be achieved by collecting ex-post results on the activity level of the sector directly impacted by the policy, which would then be used for the redefinition of the productivity parameter in the CGE model for the same sector. This process involved maintaining all shocks applied in the ex-ante analysis to obtain the closest possible approximation of the activity levels observed in the ex-post analysis.

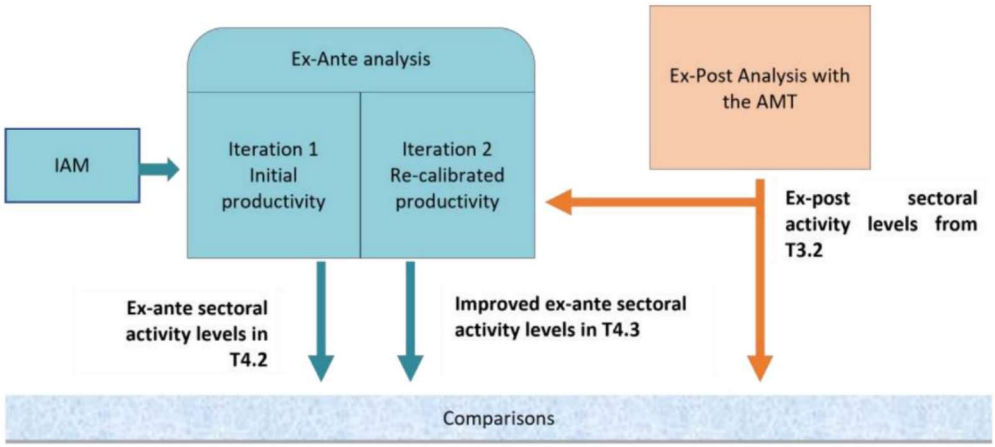

Figure 6: Bridging procedure between the REMES-EU CGE model and AMT considered in the proposal

However, focusing solely on a unidirectional linking — adjusting only productivity — can lead to several drawbacks. There are several reasons: (1) By attributing output differences entirely to productivity changes, there is a risk of misinterpreting the underlying drivers of observed performance. An increase in output might result from higher input utilisation, such as greater labour or capital intensity, rather than an intrinsic gain in efficiency. Ignoring this distinction could lead to distorted productivity estimates. (2) Additionally, forcing the CGE model to reconcile discrepancies between projected and observed output through productivity adjustments alone may cause calibration instability. This approach might stretch productivity parameters beyond plausible ranges, impairing the model's reliability. (3) Lastly, overlooking the feedback effects of input demand adjustments can result in missed secondary effects, such as changes in input prices and marginal costs. Therefore, a **case-study dependent bidirectional linkage**, where input demand changes are fed back from the REMES-EU CGE model into the AMT model was devised to improve the explanatory power of changes in productivity and provide more robust insights into policy impacts.

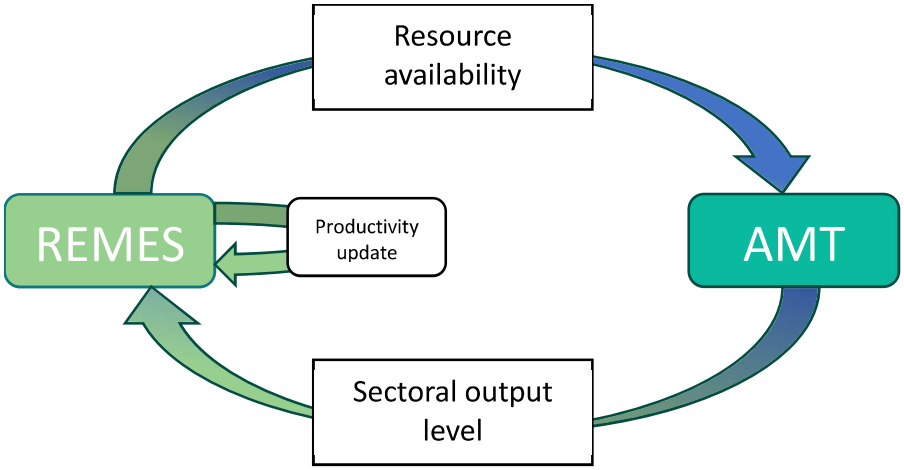

Figure 7: General structure of the bridging procedure implemented in the final stage of the project.

Therefore, to ensure that bridging better captures the interplay between productivity and the production process, the procedure has been revised to involve the exchange of data between the models to create an iterative feedback mechanism. As a general framework, REMES provides economic and environmental information, such as the availability of capital and labour as well as CO_2 emissions trends, which can be generally termed as resource availability because it informs AMT about how much labour and capital will be available for production and how much CO2 will be possible to emit from the sector according to the

environmental constraints considered in REMES, while AMT responds with sector-specific behavioural information, typically in the form of the output level of the sector that is under scrutiny for the specific case-study analyses, as shown in Figure 7.

The bridging between the models is case-specific, and the data exchanged depends on the considered case study. In three of the four case studies, Production acts as a shared indicator facilitating the exchange between the two models while also serving as an output. In such cases, the iterative exchange ensures that ex-ante production outcomes from the REMES-EU model are recalibrated using the production development provided by AMT, thereby enhancing the overall accuracy of the projections. This recalibration involves adjusting productivity levels in REMES for sectors targeted by environmental policies. Such adjustments affect the output of REMES regarding the relative development of labour and capital requirements for the sector in question, which is subsequently fed back to AMT to restart the procedure. The bidirectional linking procedure continues iteratively until the infinite-norm of the difference between consecutive iteration results falls below a predetermined tolerance, which means that each model provides two very similar outputs in two subsequent iterations of the procedure. This iterative approach ensures that while REMES tracks macroeconomic condition changes, AMT's micro-foundational perspective adds granularity by incorporating sector-specific dynamics, such as sales development and resource allocation.

Observation 2 – Productivity tends to decrease as resources are reduced or production patterns are disrupted, while it increases with technology upgrades

The bridging technique described above has been systematically applied to four distinct case studies, each representing a sectoral and regional perspective on sustainability challenges and policy interventions. These include agriculture (Belgium), aquaculture (Norway), transport (Italy), and buildings (Netherlands), reflecting the diversity of environmental and economic dynamics across Europe.

While the overarching goal remained the same across all case studies — harmonising ex-ante and ex-post assessments — the specific parameters exchanged between the Aggregation Model Tool (AMT) and the REMES-EU Computable General Equilibrium (CGE) model were tailored to each sectoral context. These parameters were adjusted to align economic projections with real-world behavioural responses, ensuring that the ex-ante model accounted for empirical structural adjustments observed in the ex-post evaluations. For instance, in the agriculture case study, bridging focused on recalibrating sectoral productivity to account for the impact of Agri-Environment-Climate Measures (AECMs) on land use and economic efficiency. In contrast, the aquaculture case study incorporated policy-induced shifts in environmental regulations, particularly through Norway's Traffic Light System (TLS), which governs sustainable fish farming practices. The transport case study in Italy prioritised the effects of public transport electrification and fleet modernisation on economic competitiveness, whereas the buildings case study in the Netherlands refined its focus on consumer decision-making and adoption rates for energy efficiency measures.

By applying **case-specific parameter adjustments**, the PATTERN project has successfully demonstrated the adaptability of its bridging methodology, ensuring that ex-ante evaluations reflect the dynamic and evolving nature of real-world policy impacts.

AGRICULTURAL CASE IN FLANDERS

The agricultural case study is centered on the evaluation of the macroeconomic and environmental impacts of the Common Agricultural Policy (CAP) in Belgium, with a particular focus on the Flanders region. The primary objective was to investigate how CAP-driven policies promoting sustainable agricultural practices influence sectoral productivity and broader economic dynamics. Specifically, the study assessed the role of Agri-Environment-Climate Measures (AECMs), which provide subsidies to farmers as an incentive to adopt environment-friendly practices.

While ex-ante analyses, such as those conducted using the REMES-EU CGE model, can simulate the macroeconomic impacts of such policies, these models often struggle to capture critical behavioral aspects. For instance, the rate of policy adoption among farmers and the dynamic changes in productivity driven by increasing adoption rates are typically beyond the scope of conventional ex-ante evaluations. To address this gap, the PATTERN project applied a bridging technique to integrate insights from ex-post behavioral observations with ex-ante economic projections.

The bridging process followed a structured, iterative procedure involving two key steps:

1. Data Alignment:
   The initial phase focused on aligning empirical data on sales figures, subsidy distributions, and the percentage of land allocated to AECMs across the AMT and REMES-EU models.
2. Iterative Exchange of Parameters, as shown in Figure 8:
   Subsequently, the models exchanged sector-specific output in an iterative loop:
   - REMES-EU provided AMT with its results related to capital inputs, labour allocations, and CO_2 emissions associated with agricultural activities;
   - AMT supplied REMES-EU with sectoral output figures and the extent of land converted to agro-environmental practices.

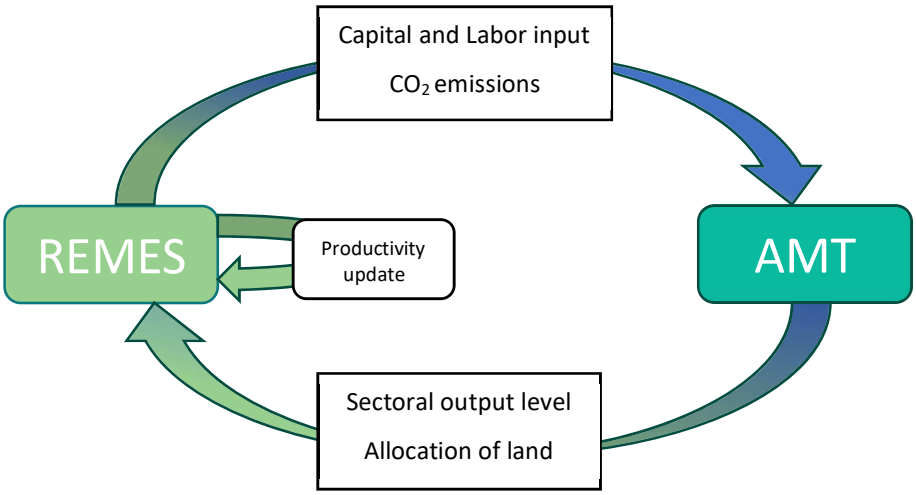

Figure 8: Bridging procedure for the agriculture case study (BE).

This iterative feedback ensured that REMES-EU's ex-ante forecasts incorporated real-world behavioural patterns based on simulated data observed in AMT's ex-post analysis, particularly regarding the adoption rates of AECMs.

The results of the bridging procedure revealed significant variations in terms of the behaviour of productivity depending on the level of subsidies provided to farmers:

- **Higher Productivity with Lower Subsidies:** When subsidy levels were relatively low, productivity remained at the level set for the reference scenario, which was comparatively higher than the one reached with higher subsidies, as farmers predominantly converted less fertile land for environmental purposes, thus maintaining the productivity of prime agricultural areas.
- **Reduced Productivity with Higher Subsidies:** As subsidy levels increased, productivity consistently declined. Higher subsidies incentivised the conversion of more fertile, high-yield land into areas designated for sustainable practices, thereby reducing overall sectoral productivity (sales per working hour) .

The bridging enabled the detection of a negative correlation between the extent of land allocated to sustainable practices and sectoral productivity. As land allocation for AECMs expanded, productive

capacity diminished, particularly when high-yield agricultural land was repurposed for environmental objectives. The bridging approach not only enhanced the predictive reliability of the REMES-EU model but also revealed productivity dynamics associated with land-use changes induced by environmental policy measures. Although this might be considered as an expected phenomenon, the bridging allows quantifying its magnitude.

AQUACULTURE CASE IN NORWAY

The aquaculture case study examines the macroeconomic and environmental implications of Norway's Traffic Light System (TLS), a policy introduced in 2017 to regulate salmon and trout farming through sustainability indicators. The TLS categorises thirteen coastal zones into three color-coded classifications—green, yellow, and red—based on environmental impact assessments. This categorisation directly influences aquaculture productivity by imposing restrictions on production capacity to promote environmental sustainability.

Given the boundaries of the ex-ante models, the primary goals of the study have focused on analysing productivity trends within the Norwegian aquaculture sector, with particular attention to regional variations in order to evaluate the effectiveness of the TLS policy in achieving a balance between economic growth and biodiversity conservation.

As for the agricultural case study, the methodological framework employed in this case study followed a two-step bridging process to integrate data across models:

1. Data Alignment: The initial phase involved harmonising data related to the TLS status across five Norwegian macro-regions (R1–R5) as well as the decrease in production required in zones marked with a red colour.
2. Iterative Exchange of Parameters: An iterative parameter exchange process was conducted between the models, as shown in Figure 9.
   - REMES-Norway supplied data regarding capital and labour input levels;
   - AMT provided regional production output estimates, which were subsequently utilised to recalibrate the productivity parameters within REMES-Norway.

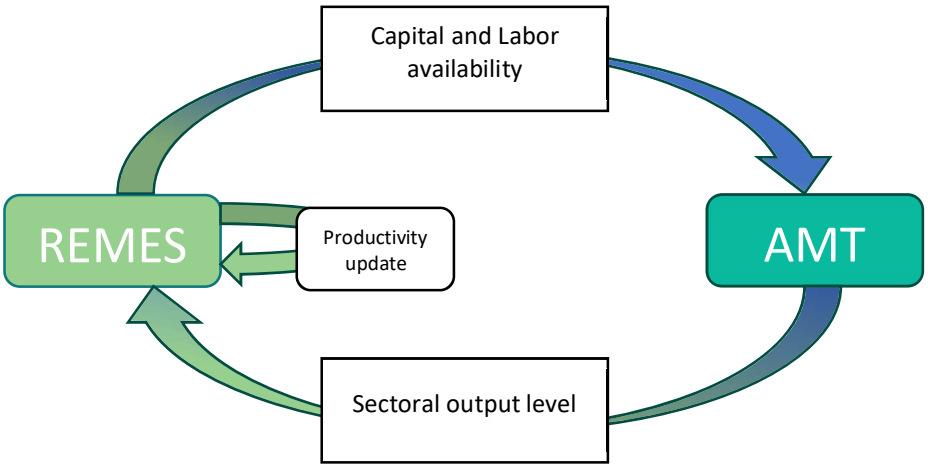

Figure 9: Bridging procedure for the aquaculture case study (NO).

The results of the study revealed that ex-ante simulations conducted prior to TLS implementation consistently overestimated sectoral productivity. Namely, the TLS policy was associated with a decrease in productivity within regions subjected to production restrictions. Nevertheless, under the bridging process, the AMT model projected higher production levels in the absence of TLS compared to REMES-Norway for any group of regions, with regions negatively affected by TLS restrictions exhibiting even

stronger economic declines than the ones projected, **signalling a generalised decrease in productivity led by the TLS**. Conversely, regions that initially demonstrated growth in value-added outputs under ex-ante simulations now show a decline relative to non-TLS scenarios, while regions predicted to experience declines have observed more pronounced reductions.

The observed decline in productivity could be attributed to several interrelated factors. Intermittent production schedules could lead to resource underutilisation, potentially preventing the full utilisation of labour and equipment. This could result in elevated fixed costs and diminished efficiency. Additionally, the periodic halting of production could disrupt biological cycles, particularly fish growth cycles, which could contribute to lower yields, increased mortality rates, and heightened disease susceptibility.

Operational inefficiencies also could play a role, as frequent production stoppages might require additional setup time and maintenance activities, potentially reducing overall operational efficiency. The inability to maintain continuous, high-volume production could further limit economies of scale, restricting the cost advantages typically associated with large-scale operations.

Labor market instability might be another contributing factor. Irregular work schedules could lead to higher workforce turnover, potentially necessitating ongoing retraining efforts and decreasing the average level of workforce experience. Furthermore, inconsistent production levels could disrupt the supply chain, potentially affecting the availability of inputs and market supply. This disruption might cause price volatility and ultimately reduce revenue.

Lastly, the implementation of TLS might incur high compliance costs, as significant administrative and technological expenses could be required without directly contributing to production output. Collectively, these factors could combine to produce a measurable decline in productivity.

TRANSPORT CASE IN ITALY

The transport case study focuses on evaluating the macroeconomic and environmental impacts of the transition of local public transport (LPT) energy mix within the context of regional economic development. The primary objective is to analyse how the bridging process informs the understanding of the transition to a clean transportation sector, including its effects on productivity, spillover impacts, and price and demand dynamics.

As for the previous case the two bridging process is as follows:

1. Data Collection Bridging: The initial phase involved harmonising data related to the output for bus transport across models. This was done by setting the output of the bus transport model as a proportion to the energy consumption of the bus transport and road transport sectors. Namely, the sales for bus transport was set to 7% of the sales for land transport in both models[8].
2. Model Integration Bridging: Following the alignment phase, the models engaged in an iterative process to exchange key parameters until convergence was achieved, as shown in Figure 10:
   - REMES-EU provided AMT with capital and labour availability along with income projections for households;
   - AMT responded with the demand for LPT services in terms of person/km.

[8] ODYSSEE-MURE. (n.d.). *Energy efficiency trends and policies*. Retrieved from https://www.odyssee-mure.eu/publications/efficiency-trends-policies-profiles/italy-country-profile-english.pdf , June 2024.

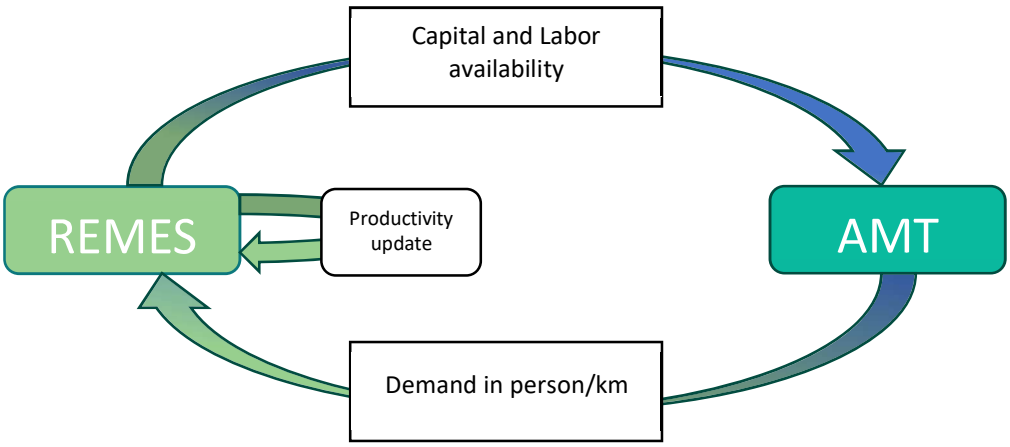

Figure 10: Bridging procedure for the transport case study (IT).

The bridging analysis indicated an increase in value added for land transport, driven by a **rise in sectoral productivity**, shown by an increase in sales and a decrease in prices with the same inputs. The fleet upgrade is expected to generate long-term positive effects by reducing maintenance costs, which in turn lowers service prices and stimulates demand.

The post-bridging analysis presents a more optimistic outlook, suggesting that productivity improvements in the transport sector could lead to more competitive pricing, increased demand for capital and electricity, which becomes the primary fuel by the end of the time horizon, with a reduced dependence on fossil fuels.

BUILDINGS CASE IN THE NETHERLANDS

The buildings case study focuses on evaluating the macroeconomic and environmental impacts of the "Investeringssubsidie Duurzame Energie (ISDE)" policy in the Netherlands. This policy provides subsidies to homeowners, businesses, and institutions to promote renewable energy adoption and improve building energy efficiency. The primary goal was to assess how these subsidies impact the energy consumption patterns, carbon emissions, and broader economic dynamics within the building sector.

Traditional ex-ante models, like REMES-EU, can estimate macroeconomic impacts but often overlook behavioural changes, such as the decision-making processes of individuals when adopting energy-saving measures. To bridge this gap, AMT's outputs about ex-post behavioural insights and REMES-EU's outputs about ex-ante economic projections have been exchanged among the models based on an iterative procedure comprising two main steps:

1. Data Alignment: The initial step involved harmonising data on subsidy rates for the coverage of the building insulation process.
2. Iterative Parameter Exchange: Next, sector-specific data was exchanged in an iterative loop to enhance predictive accuracy:
   - REMES-EU: Provided AMT with insights about income projections;
   - AMT: Supplied REMES-EU with updated estimates of the adoption rate for the measure by the households.

This iterative feedback, displayed in Figure 11, allowed REMES-EU's forecasts to incorporate observed behavioural patterns, particularly concerning the responsiveness of consumers to subsidy schemes. Unlike other cases, in this study, the REMES-EU CGE model did not update the productivity levels of any sector, as the primary focus was on households and their decisions to adopt insulation improvements.

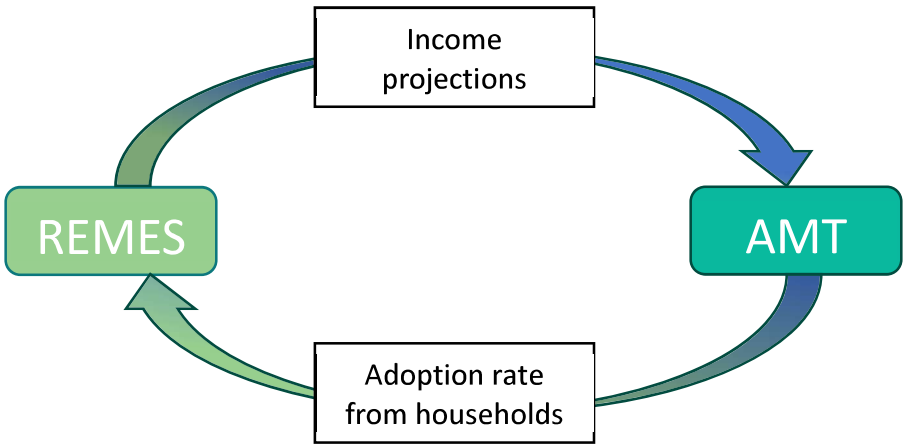

Figure 11 Bridging procedure for the buildings case study (NL).

The results of the analysis underscored a marginally increasing relationship between the coverage rate of the ISDE policy and the demand for construction services. When the coverage rate was set at a lower level, specifically around 30%, the observed demand for insulation services was smaller than what had been projected by the ex-ante analyses. This deviation indicates that the behavioural responses to lower subsidy levels may have been underestimated, particularly regarding the willingness of households to engage in energy-efficient retrofitting under less favourable financial conditions.

Conversely, when the coverage rate was increased to 50%, the demand for insulation services surpassed the expectations of the ex-ante forecasts. This suggests a more pronounced sensitivity of consumers to higher subsidy levels, as the perceived financial benefits more effectively motivated the adoption of energy-saving measures. The positive relationship observed indicates that policy adjustments toward more generous coverage rates could potentially accelerate the transition to improved building energy performance.

Additionally, the analysis revealed that the ripple effects of these changes in demand were largely consistent with the patterns anticipated in the initial ex-ante modelling. The macroeconomic impacts extended beyond the building sector, with positive spillover effects being predominantly concentrated in the services and industrial sectors. These findings highlight the interconnected nature of the economy, where increased activity in the construction sector can stimulate demand in related industries, further amplifying the broader economic benefits of the ISDE policy. The observed sensitivity of demand to subsidy coverage levels and the sectoral spillovers emphasised the importance of considering behavioural dynamics in future policy assessments aimed at promoting energy-efficient building practices.

Looking ahead, **potential improvements** to the approach described above could involve recalibrating productivity parameters while enhancing the bridging procedure by **refining the elasticities of substitution within the ex-ante CGE model**. Adjusting these elasticities would enable the model to more accurately replicate the input demand patterns observed in the ex-post AMT analysis. This refinement acknowledges that increases in output are not solely attributable to intrinsic productivity improvements but may also reflect adjustments in the substitution between labour, capital, and other inputs. By distinguishing between true efficiency gains and shifts in factor utilisation, this approach ensures that the iterative feedback mechanism more effectively captures the complex interplay between micro-level behavioural responses and macroeconomic dynamics. Such advancements could provide a more comprehensive understanding of the long-term impacts of energy policy interventions on the economy, supporting more effective and targeted policy design. This process would, however, necessitate more sophisticated techniques for data calibration to ensure behavioural consistency among the common sectors and agents modelled across the two models. It would involve replacing simpler, yet effective, methods like the bisection method with Newton-based techniques for parameter updates in the ex-ante

model. Such an adjustment, however, introduces challenges related to computational efficiency, as the ex-ante model would need to be solved at each iteration of the selected method, thereby requiring the development of customised solution techniques.

4.2 Limitations and challenges

The bridging procedure between REMES and AMT has been successfully established by addressing a series of challenges along the way. In this section, some of the main challenges and limitations encountered during this process are presented.

The main problem encountered during the bridging process in all cases was the inconsistency in the step size settings between the two models, so that the two-way feedback loops were conducted in a different way than expected. Bidirectional feedback loops are key to capturing the dynamics of the economic system. In the original concept, the two-way feedback loop works as follows: the CGE model updates the data for each step, exports it to the AMT model, which updates it based on the data provided by the CGE and exports the next year's data to the CGE, and the above process is carried out year by year until the simulation is completed for all time periods. However, there is a gap between the actual implementation and the expected way: CGE model - export data of all time periods with a step size of 5 years at one time; AMT model - linearly split the 5-year data provided by CGE into data with a step size of 1 year, update its own data, and then export the data of all time periods and feed them back to CGE. Although this implementation is able to complete the exchange of data, there is a significant difference between this way and the original iterative concept of year-by-year iteration. Inconsistency in time steps, namely the mismatch between CGE's 5-year step and AMT's 1-year step may affect the dynamic interaction effect of the model, and linear splitting error (i.e., the linear splitting of 5 years' data into 1 year's data may introduce an error, which can't accurately reflect the dynamics of the year-by-year change).

Another shortcoming is the limited parameter transfer from AMT to CGE. The **AMT model is designed with a specific focus on particular scenarios, which means it has a narrow scope in terms of parameter transfer**. This limitation arises because the model is tailored to specific contexts and may not account for a broader range of variables or scenarios. To provide more comprehensive parameter feedback to the CGE model, a more flexible and adaptable framework would be required. This could involve expanding the parameter range to include factors such as environmental variables, economic shocks, or policy changes, allowing for dynamic interactions between the two models and more robust data exchange. AMT models are highly dependent on high-quality, fine-grained enterprise data. Geographers and regional scientists have developed spatial microsimulation methods to address the problem of unavailability of individual data. These methods generate virtual populations that are highly consistent with the characteristics of the real population by combining census data or survey data for small regions. Such methods not only provide refined data support for policy formulation but also provide important analytical tools for regional economic and social studies. However, research on businesses and other subjects (such as household-based units) is still limited. The specific approach depends on the research subject. Taking Italy as an example, census data can be directly used to generate individual-level information such as population counts, income, and education levels. However, the situation in the agricultural sector is different: not all agricultural workers' data are included in business databases. Unlike the Italian case, especially when spatial factors are considered, the relationship between agricultural workers and business entities cannot be simply derived from the normal distribution in census data to generate individual-level data. In addition, there are significant challenges in obtaining fine-grained subsidy information and combining it with personal data due to data protection regulations and privacy concerns. This data limitation not only affects the accuracy of micro-simulations, but also constrains the comprehensiveness of policy analysis, especially when assessing the impact of subsidy policies on different subjects.

Behavioural inconsistencies in the two models are also one of the main reasons for difficulties in the articulation process. Specifically, the AMT model usually focuses on individual behaviour at the micro level, such as the production decisions of farmers or the behaviour of residents applying for insulation measures, while the CGE model focuses on economic equilibrium and intersectoral interactions at the macro level. Hereto, the inconsistencies between the two models in terms of behavioural assumptions, time scales, feedback mechanisms, and data requirements are the main reasons for the difficulties in the convergence process. These inconsistencies are especially obvious in specific cases, which directly affect the assessment of policy effects and the accuracy of simulation results. Therefore, potential improvements to the current approach could focus on improving access to granular data to enable more precise sectoral analysis, while expanding the collection of AMT-related behavioural data, such as individual choices, preference shifts and policy responsiveness. Strengthening the bridging process could also include incorporating experimental studies or survey-based evidence to enrich micro-level behavioural parameters. In addition, the use of machine learning or Bayesian methods for data imputation could improve the predictive capabilities of AMT.

5. POLICY RECOMMENDATIONS FOR BRIDGING

The following recommendations aim to enhance the systematic integration of ex-post and ex-ante evaluations within EU, national, and local policymaking. These recommendations address bridging techniques during the evaluation cycle, institutional arrangements, evaluation procedures, and capacity-building efforts to ensure evidence-based policymaking. The recommendations below are numbered for clarity, nevertheless, these numbers do not indicate any form of priority.

1.	**Align Policy Objectives and Evaluation Questions –** Yet in the policy design process, clearly define and align evaluation objectives across both ex-ante and ex-post assessments to ensure that policy outcomes can be measured effectively and consistently over time.
2.	**Handover Pack –** Develop a unified monitoring framework with standardised indicators and data categories, enabling consistency and comparability across evaluations and policy cycles; and this already during policy design. A "handover pack", which may include scheme details, behavioural response assumptions, model specifications, and forecasting reports, can facilitate this process.
3.	**Synchronise Evaluation Timing –** Align the scheduling of evaluations with policy cycles and budgetary reviews, ensuring that ex-post findings are available in time to inform upcoming ex-ante assessments.
4.	**Stakeholder Engagement and the Intervention Logic**– Engage a wide range of stakeholders, including policymakers, experts, and practitioners, throughout the evaluation process to guarantee diverse data input and increase the relevance and acceptance of findings. Involving stakeholders from the ex-ante appraisal helps reconstruct original assumptions, planned activities, and external factors, leading to a more accurate assessment of causal relationships.
5.	**Alignment of Data Inputs and Assumptions –** Standardise data types and sources across ex-post and ex-ante evaluations, ensuring consistency by using common indicators and aligning data collection methodologies to enhance comparability.
6.	**Improved and Aligned Monitoring –** Develop integrated monitoring systems that collect relevant data for both ex-ante and ex-post evaluations, supporting a continuous feedback loop for more accurate assessments. A well-structured monitoring plan should begin by defining ex-post evaluation questions early in the policy process. Past evaluations—especially ex-ante assessments—offer valuable insights into the best monitoring methods, reducing implementation difficulties and improving data consistency.
7.	**Empirical Validation of Results and Inputs –** Use empirical data from ex-post evaluations to validate assumptions and parameters in ex-ante models, improving the credibility and accuracy of policy forecasts.
8.	**Calibration of Ex-Ante Baselines and outcomes –** Adjust input parameters and methodologies in ex-ante models based on observed outcomes from ex-post evaluations to enhance predictive accuracy and better reflect real-world dynamics. It is a bridging technique that ensures economic models account for the complexities of policy implementation, economic conditions, and other exogenous factors.
9.	**Uncertainty Analysis Informed by Ex-Post Data –** Incorporating insights from ex-post evaluations can further refine uncertainty analysis by providing empirical data to define parameter ranges more accurately, validate assumptions, and improve overall model reliability.

10.	**Comparative Analysis –** Systematically compare projected policy outcomes with actual results from ex-post evaluations to refine future models and improve predictive capabilities.
11.	**Institutional Coordination –** Establish dedicated evaluation bodies or units across government agencies, similar to the UK's Regulatory Policy Committee (RPC), to ensure better coordination and integration. Furthermore, institutionalise multi-annual evaluation plans to align policy cycles with systematic ex-post reviews and use findings to refine future policy interventions.
12.	**Regulation to Mandate Bridging -** Encourage the incorporation of formal review clauses in policy regulations that mandate a connection between ex-ante and ex-post evaluations, ensuring that impact assessments include structured follow-up evaluations. ☛ *The **EU Better Regulation Principle** constitutes a good example of incorporating evaluation into institutional arrangements. Ways to further encourage bridging of ex-post and ex-ante could be to formalise the bridging principle within the EU Better Regulation agenda by incorporating **explicit requirements in the Better Regulation Guidelines and Toolbox** to systematically connect ex-post findings to ex-ante appraisals. Connected to this is a possible expanded role of the EU Regulatory Scrutiny Board (RSB) to oversee how ex-post evaluations inform new regulations, ensuring that findings from past policies directly shape impact assessments.* ☛ *Similarly, the **Governance Regulation (EU) 2018/1999** requires Member States to report both ex-post and ex-ante assessments of their policies and measures in achieving their Green Deal objectives. However, as highlighted in the Meta-analysis D1.1 (PATTERN D1.1, 2023) on existing initiatives, bridging practices are rarely applied, and ex-post evaluations are seldom reported. Emphasising the benefits of integrating **bridging practices within the framework of the Governance Regulation could incentivise** more consistent ex-post evaluations.*
13.	**Procedural Frameworks –** Establish structured review procedures and embed bridging into policy cycles, linking evaluations directly with budgetary and policy-making processes. This includes incorporating regular evaluation checkpoints within the policy timeline, ensuring that both ex-ante and ex-post evaluations are performed systematically, and aligned with budgetary reviews and legislative revisions.
14.	**Capacity Building Programs –** Investing in training programs that focus on bridging techniques and fostering a culture of continuous learning among policymakers and evaluators is essential. Capacity-building efforts should also include technical training on data analysis, monitoring methodologies, and evaluation best practices to strengthen institutional expertise.
15.	**Knowledge Exchange Platforms –** Create platforms for regular interaction between ex-ante and ex-post evaluators to facilitate the exchange of insights, experiences, and best practices. This could include Liaison meetings, inter-administrative networks, and cross-governmental working groups that foster the exchange of insights and lessons learned increasing mutual understanding and trust.
16.	**Clear Guidelines for Bridging –** Develop and disseminate clear guidelines and frameworks that outline practical steps for systematically incorporating ex-post findings into future ex-ante assessments, such as the **PATTERN D4.3 BRIDGING GUIDANCE**.
17.	**Resource Allocation –** Allocate sufficient resources, including funding, staff, and technical expertise, to support continuous monitoring and systematic integration of evaluations across policy cycles.

18. **Having a champion for evaluation –** Heads of departments and senior policymakers should champion the integration of ex-post and ex-ante evaluations, ensuring that evaluation results are systematically used in policy decision-making.

By addressing these challenges through clear objectives, harmonised data systems, aligned evaluation timing, institutional and procedural support, policymakers can create a robust framework for bridging ex-post and ex-ante evaluations. These recommendations aim to enhance the effectiveness and relevance of policy evaluations, contributing to more evidence-based policymaking.

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The PATTERN project aims to improve practitioners' capacity for decision making on climate and environmental policies by developing a One-Stop Shop for the economic appraisal of policies and measures. With this One-Stop Shop and its different components, PATTERN will provide decision-makers, stakeholders, and the public with more realistic ability to systematically assess the options and their consequences. It will provide a basis for improving (i) methodologies, techniques and models for conducting economic appraisal of climate and environmental policies (ii) the broader policy evaluation framework and practices currently used in European countries and their regions and (iii) tailored analysis and engagement strategies structures for participation and co-creation with relevant stakeholders and key actors to enhance operational capacities of economic appraisal methods and improve the impact of European policies on climate and environment.

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