Sustainable Blue Economy Partnership

Advancing knowledge exchange at the marine science-policy interface

An assessment of current tools and strategies

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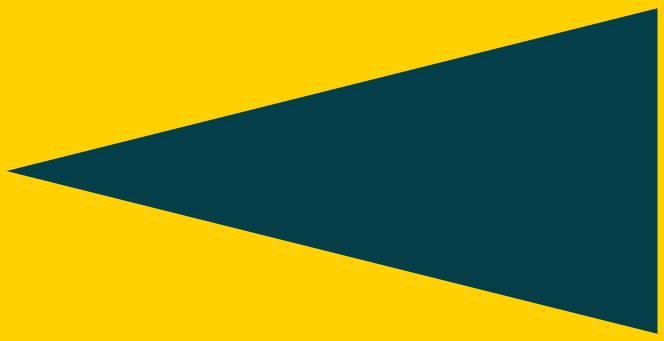

Preface

Today, marine ecosystems across the globe are under mounting pressure from climate change and biodiversity loss to pollution and the unsustainable use of ocean resources. In this context, the need for timely, effective, and science-informed policy has never been more urgent.

This report, commissioned by the Sustainable Blue Economy Partnership (SBEP), explores how to enhance knowledge transfer and valorisation at the marine science-policy interface. It does so at a pivotal moment in the ocean's history. At the third United Nations Ocean Conference to Support the Implementation of Sustainable Development Goal 14 (Nice, 9–13 June 2025), the European Union adopted the 'European Oceans Pact' - a transformative political initiative establishing a cross-sectoral framework for ocean governance. The Pact commits to ensure that European seas and the ocean remain healthy, resilient, and productive, while supporting a sustainable blue economy grounded in strong and innovative marine research. It also serves as a call to action to strengthen transnational cooperation and advance innovative ocean governance for long-term sustainability (EC 2025).

In addition, we are currently in the midst of the United Nations Decade of Ocean Science for Sustainable Development (2021–2030), a global initiative which mobilises efforts to boost and transform ocean science into actionable knowledge. In parallel, the EU Mission Restore our Ocean and Waters by 2030 seeks to protect and restore the health of our ocean and waters through collaborative research and innovation, citizen engagement and blue investments.

These initiatives are supported in its efforts by SBEP, a pan-European partnership of 74 partner institutions from 30 countries and the European Commission (EC) that serves as a key implementation mechanism for the EU Mission Restore our Ocean and Waters and UN Sustainable Development Goal 14. SBEP pools investments, aligns national and EU priorities, and fosters collaboration among stakeholders working on key marine topics such as digital ocean technologies, marine spatial planning, sustainable blue bioresources, and multi-use marine infrastructures.

These key initiatives echo the European Commission's call through its Guiding Principles for Knowledge Valorisation to embed science more deeply into decision making processes and ensure that inclusive, transparent knowledge serves societal, economic and ecological objectives. A clear call to action, as too much of our marine knowledge still fails to reach decision making arenas in a usable form, despite some limited progress. Fragmented institutional mandates, diverging science-policy timelines, disciplinary silos, and poor communication continue to hinder effective science-policy engagement.

This report addresses these challenges and presents practical insights into effective knowledge transfer and how to maximise policy impact. It draws on both the literature – including insights from the EU's Joint Research Centre, the Better Regulation Toolbox, and recent EU-level valorisation strategies (see **1.2 Policy frameworks in support of evidence-informed policy making and knowledge valorisation in the EU**) – and the Flanders Marine Institute's (VLIZ) experience as an internationally networked marine science institute with a long tradition in knowledge brokering. The report is structured into four major chapters:

Chapter 1. Science-policy knowledge exchange – A literature-based exploration of past and present science-policy knowledge exchange practices, drawing inspiration from the behavioural science point of view. This section also includes a review of science-policy knowledge exchange in the marine context.

Chapter 2. The value of knowledge brokering for marine science-policy exchange – A deep dive into the concept of knowledge brokering, currently the most applied and successful concept for effective knowledge exchange between marine sciences and policy.

Chapter 3. Citizen science and knowledge coproduction - two emerging pathways for more integrative and inclusive policy making – As Europe moves towards more open, participatory evidence-based governance, citizen science and knowledge coproduction take the lead in facilitating major societal and environmental progress.

Chapter 4. Toolbox for marine science-policy exchange: a systematic screening of different approaches. Developed as a user-oriented guide that helps marine scientists communicate their research effectively to achieve policy impact. It discusses various communication formats, explaining what they are, when to use them, and their respective advantages and constraints.

At the core of this report lies a call for more dynamic, context-sensitive, and trust-based forms of science-policy interaction: from coproducing knowledge with stakeholders to investing in dedicated knowledge brokers and boundary organisations or looking at citizens to complement institutionalised science. However, the conclusions and recommendations of this report are not set in stone. The complexity and scale of the marine system and its governance means that science-policy exchange cannot rely on 'one-size-fits-all' solutions. This complexity and the dynamic nature of science-policy contexts also preclude the use of a fixed, chronological decision tree to determine which knowledge transfer format to apply in a

given situation. The way knowledge reaches policy is highly context-dependent, shaped both by the research side (e.g., whether the research is linked to ongoing policy processes and what phase they are in) and the policy side (e.g., whether there was a targeted question from policy, confidentiality). It requires careful assessment of the situation to determine the most suitable format, or combination of formats, as part of a strategic communication plan. Therefore, this report should be viewed as an objective reflection of lessons learned and a compass for what lies ahead. It is written to invite policy makers, researchers, and intermediaries to build and sustain meaningful, resilient science-policy partnerships, relying on trust and with the shared aim of working towards a better stewardship of our seas and ocean we all depend on.

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Chapter 3. Citizen science and knowledge coproduction - two emerging pathways for more integrative and inclusive policy making

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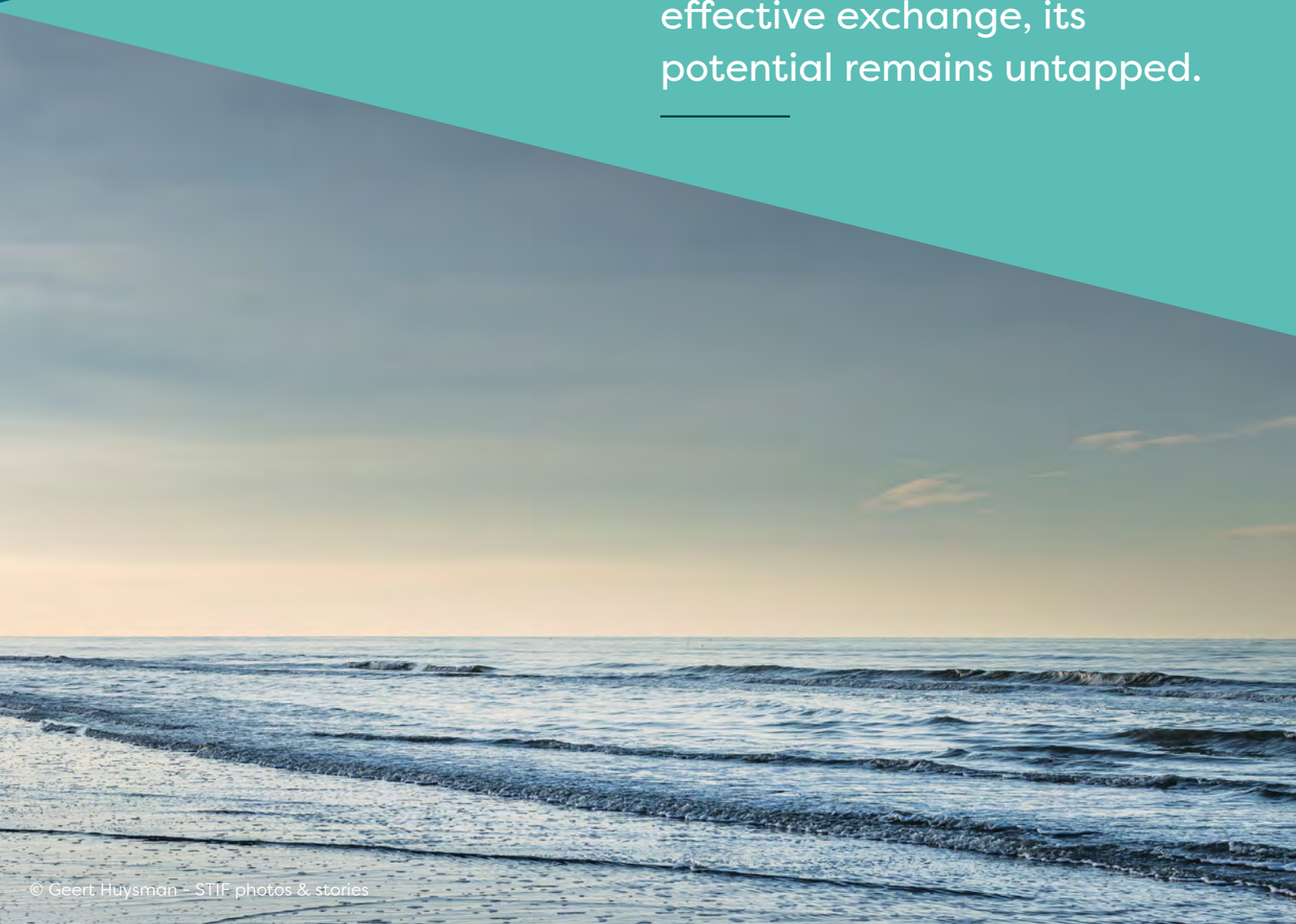
References

Science is vital for tackling major challenges, but without effective exchange, its potential remains untapped.



Chapter 1

Science-policy knowledge exchange

1.1 Science in policy

Science is the backbone to effectively address the major challenges of our time, like climate change, the green and digital transition, virus outbreaks, chronic diseases, developments in artificial intelligence, etc. (EC 2020).

Scientific knowledge, broadly defined, is a vital asset in policy making. It supports every stage of the process by shaping public and political discourse, identifying knowledge gaps and policy challenges, and guiding the design, implementation, evaluation, and comparison of policy measures based on their effectiveness and impact (COM (2022) 391, The British Academy 2024). A robust evidence base and science-policy exchange fosters critical deliberation and helps mitigate unintended consequences. As such, scientific evidence is particularly useful for tackling complex "wicked problems" (see **1.5 Additional insights from a behavioural science perspective**) and disputable issues (Bednarek et al. 2018, Head 2019, Mair et al. 2019, EC 2020, COM (2022) 391). Moreover, scientific evidence suggests that policies with less scientific input are more prone to unforeseen side effects and are less likely to effectively address underlying challenges (COM (2022) 391).

However, effectively integrating the best available science into decision making remains a major challenge, particularly when taking the multiple actors, institutions, knowledge types, jurisdictions, political processes, and social concerns into account. Knowledge transfer requires translating scientific insights into formats that are accessible, tailored to users' needs and directly applicable to policy development. In addition, to be useful, scientific knowledge must be delivered in ways that are clear, concise, relevant and aligned with concrete policy demands (discussed in detail in **1.3 Effective science-policy knowledge exchange**) (Cvitanovic et al. 2015, Mair et al. 2019, Cooke et al. 2020, COM (2022) 391).

According to a broad survey (2020) by the EU's Joint Research Center[1] (JRC), 63%[2] of the respondents believe that scientific knowledge is insufficiently synthesised, translated and formatted for policy makers to easily use. This disconnect contributes to a persistent gap between the vast body of high-quality scientific research – the EU is a global leader in scientific output producing about 18,1% if all high-quality scientific publications (SRIP 2024) – and the relatively limited number of innovative or practical applications derived from it (van Vught 2009, van de Burgwal et al. 2019, EC 2020). Bridging this gap requires improved mechanisms for knowledge transfer and for knowledge valorisation, i.e. the process of transforming knowledge into products, services, or processes that create economic or societal value (Hladschenko 2016, van de Burgwal et al. 2019, EC 2020).

1.2 Policy frameworks in support of evidence-informed policy making and knowledge valorisation in the EU

The EU has a long tradition of embedding evidence-informed[3] decision making at the center of its policy making approach, the so called 'science for policy philosophy' (S4P). This commitment was first formalised back in 2000 in the Lisbon Strategy (Rodriguez et al. 2010), which laid the foundation for future EU knowledge valorisation policy. The Strategy's objective was to make Europe "the most competitive and dynamic knowledge-based economy in the world by 2010", a.o. through investing in better policies, research, innovation, and knowledge transfer.

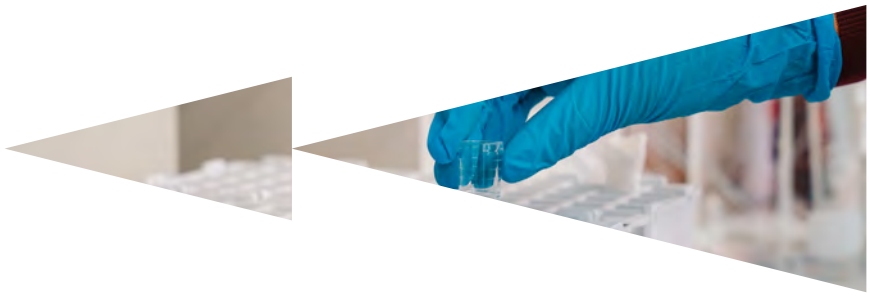
Building on this, the Better Regulation Communication (COM (2002) 278) established an overarching framework for evidence-informed policy making at the EU level. It emphasised the necessity of gathering robust evidence before implementing policies. Since then, the Better Regulation approach has been continuously expanded and refined through subsequent

[1] The EU's Joint Research Center (JRC) provides independent, evidence-based knowledge and science, supporting better EU policies to positively impact society. They play a key role at multiple stages of the EU policy cycle and contribute to the overall objectives of Horizon Europe.

[2] Based on the results of the JRC and DG for Research and Innovation (DG-RTD) workshop 'How to support and connect policy making in the EU and Member States', along with a survey of nearly 500 experts in the science-policy interface. These were conducted in the framework of the JRC's Science-for-Policy Ecosystems project (2020-2022), which maps the science-for-policy structures, processes, and networks within EU Member States.

[3] Evidence-informed policy making refers to an approach to policy making that aims at informing policy deliberations and decisions with the best available evidence. Evidence in general refers to "data, information, and knowledge from multiple sources, including quantitative data such as statistics and measurements, qualitative data such as opinions, stakeholder input, conclusions of evaluations, as well as scientific and expert advice" (EC Better Regulation Toolbox and Guidelines).

EU excels in scientific output but faces valorisation barriers.



communications and guidelines, culminating in the development of the "Better Regulation Toolbox" (COM (2019) 178, EC Better Regulation Toolbox and Guidelines)[4]. The toolbox provides a stepwise approach to evidence-informed policy making consisting of: (i) understanding the policy problem; (ii) mapping available expertise; (iii) collecting evidence; (iv) analysing evidence; (v) interpretation of evidence; and (vi) presentation of evidence. For each step, further structured guidelines, tools, and resources are listed (EC Better Regulation Toolbox and Guidelines, COM (2022) 391). The overarching goal is to maximise the use of the EU's scientific and technological knowledge and enhance the effective transfer of research and innovation (R&I) results to society and industry. The Better Regulation framework hence integrated impact assessments and evaluations, as well as stakeholder consultation processes as a standard practice into EU policy making. The "evaluate first" principle exemplifies this approach, ensuring that policy initiatives begin and end with thorough analyses of policy problems and their impacts, before revising or introducing new legislation. The Better Regulation framework hence fosters a systematic, transparent and inclusive approach of science, ensuring that expert knowledge is mobilised and integrated into policy making. Better regulation consequently contributes to public trust and accountability of evidence use in policy making (see **1.7 Credibility of science and policy**).

1.2.1 The COVID-19 pandemic and the path towards a new knowledge valorisation strategy

Back in 2020 the COVID-19 pandemic[5] underscored the urgent need to accelerate the valorisation of research and innovation within the EU (EC 2020, The British Academy 2024). The health crisis clearly demonstrated that a swift and efficient transfer of knowledge is critical for progress and societal

[4] To improve knowledge valorisation at the EU-level DG R&I organises Mutual Learning Exercises (MLEs). In a previous edition this S4P initiative addressed the five key aspects of knowledge valorisation (EC 2024).

[5] The fight against coronavirus (2019-2022) has unequivocally demonstrated the crucial role of science in informing policy as research results and scientific knowledge were instrumental in containing the pandemic. The COVID 19-pandemic provided the litmus test for the quality of science and highlighted the need for interdisciplinary science and its synthesis, the importance of communicating uncertainty (Hyland-Wood et al. 2021), the value of boundary organisations facilitating knowledge translation and multidisciplinary collaboration (Vindrola-Padros et al. 2021) and the consequences of dealing with misinformation (Islam et al. 2020).

wellbeing and that the way in which research results are valorised can greatly influence our lives. The crisis exemplified the major challenges concerning the translation[6], transfer or brokering[7] and valorisation of scientific knowledge in policy making (EC 2020, SWD (2022) 346), The British Academy 2024). In addition, the pandemic revealed disparities in how Member States approached and utilised scientific advice, leading to inconsistencies in communication and policy responses (COM (2021) 380, SWD (2022) 346, The British Academy 2024).

A first answer to these challenges was communicated in the 2020 Communication on "A new ERA for Research and Innovation" (COM (2020) 628). This communication underscored the need to improve knowledge valorisation to address societal challenges and drive the green and digital transitions of Europe. This renewed ERA framework emphasised the importance of translating R&I results into tangible benefits for society. It promotes inter-sectoral mobility, impact assessment, knowledge valorisation, open science, international cooperation and science diplomacy while also supporting the EU missions under Horizon Europe. It strives towards more interconnected R&I ecosystems, with a strengthened link between policy making and the scientific community.

As part of the ERA Communication, the EC launched the Knowledge Valorisation Platform[8] in 2021.

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[6] Knowledge translation tries to increase the understanding of knowledge across disciplines or professional boundaries. In practice it concerns elucidating and packaging insights for other audiences than the group that produced the information (Head 2010).

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[7] Knowledge brokering focuses on harnessing the diverse insights of professions and academic disciplines around key problems and facilitate understanding and action (Head 2010) (see **Chapter 2**). It is a broader concept than dissemination and/or translation, which involves making knowledge and results known and accessible.

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[8] The Compendium for Coast and Sea of the Flanders Marine Institute is a recognised good practice example of this platform.

Towards holistic science-informed decision making.

This platform seeks to build a pan-European community[9] of stakeholders committed to translating research results into sustainable products and solutions that generate economic, environmental, and social benefits, as well as improved policy making. Designed as a digital collaboration forum, it aims to facilitate cross-border cooperation, enabling stakeholders to exchange best practices, share knowledge, and leverage expertise to accelerate the uptake of research outcomes for the benefit of society and the economy.

The call for greater coordination of knowledge transfer and knowledge valorisation in the EU was repeated in (COM (2021) 380), drawing early lessons from the COVID-19 pandemic. This communication reinforced the call to action to accelerate bridging the gap between, science and policy making.

In response to the above, and motivated by the evolving societal and economic challenges, the EU developed a new extensive valorisation strategy, introducing a new set of guiding principles on knowledge valorisation that acknowledge the crucial role of various stakeholders, including citizens and public authorities (SWD (2022) 346). This approach was formalised in the European Commission's proposal for guiding principles on knowledge valorisation (COM (2022) 391), which calls on policy makers and stakeholders to "strengthen the structures, processes, and practices in the use of research results and scientific knowledge for designing and implementing public policy." In general, it is designed to facilitate innovative ways to deliver new responses to the major contemporary challenges by drawing on research and scientific knowledge to maximise the impact of the EU's research and innovation investments. It advocates for a move towards a more holistic approach to science-informed decision making, ensuring that research findings are effectively leveraged to support the development of trusted and effective policy solutions. Informing policy with research findings, so that different policy options can be better accessed to support decision making is therefore just one of the multiple ways the EU Valorisation Policy works. The document explicitly states that: "the diversity of knowledge valorisation channels

[9] To support the community building, The European Commission's Directorate-General for Research & Innovation has been running an awareness raising campaign (2023-ongoing) on knowledge valorisation to disseminate the latest policy developments and to demonstrate how research and innovation results can be better transformed into societal and economic benefits.

Human factors influence informed decision making.

and tools should be reflected to address sustainability, social and policy innovation and encourage multidisciplinary collaborations that go beyond technological areas involving disciplines such as social sciences, the humanities, the arts and tacit knowledge, e.g., looking at the interlinkages between social and environmental or economic and environmental policies". This new strategy hence recognises the importance of all players involved, including citizens and public authorities to support knowledge valorisation in the EU (COM (2022) 391, SWD (2022) 346). It also intends to provide a common framework for national, regional, and local policy makers to maximise the impact of R&I investments. Since 2022 the guiding principles were supported by several codes of practice.

To support this new valorisation strategy, the EC has produced a review identifying and analysing the main channels to promote the uptake of R&I results and underlying the gaps to be filled for each channel to enhance knowledge diffusion and uptake (COM (2022) 391). In **Chapter 4**, various knowledge exchange formats are described and evaluated for their effectiveness of achieving policy impact in a certain context.

1.3 Effective science-policy knowledge exchange

Humans are not purely rational beings and therefore it is important to learn from behavioural sciences, social sciences and humanities to get an insight into the policy making process (Head 2010, Mercier & Sperber 2011, Bruine de Bruin & Bostrom 2013, Cairney & Kwiatkowski 2017, Marshall et al. 2017, Cairney 2018, Mair et al. 2019, Cairney & Oliver 2020, Ettinger et al. 2025). This

includes examining the influence of emotions, values, narratives, interests, concerns, contexts, and social relationships on science-policy exchange and decision making (Mair et al. 2019).

As a basic principle, knowledge producers should be aware that purely stating the facts is ineffective when communicating with policy makers (Cairney & Kwiatkowski 2017). Instead, framing and storytelling are key elements to draw attention to an issue and shape the narrative. Framing and storytelling (see box) can determine the understanding of an issue and prompt policy makers to gather further evidence (Cairney & Kwiatkowski 2017, Mair et al. 2019, CEF 2025).

In one of their earlier studies from 2017 on how to effectively communicate with policy makers Cairney & Kwiatkowski propose a three-step approach:

- Understand the audience, synthesise evidence concisely to minimise cognitive burden and frame conclusions rather than assume data will speak for itself;
- Identify the right moment to engage with policy makers;
- Actively participate in the policy making process, build legitimacy and trust, and try to view issues from the policy makers' perspective.

In two follow-up studies the recommendations, dilemmas and uncertainties of engaging in science-policy exchange are explored in more detail (Oliver & Carney 2019, Cairney & Oliver 2020). Based on an extensive literature study the researchers come up with a set of basic recommendations for scientist willing to reach policy makers:

- Do high **quality research** and provide it in a way that is policy-relevant, accessible but accurate and timely. Use sound research methods, with systematic reviews and develop an evidence-synthesis for policy makers (see also Topp et al. 2018);
- Engage in **effective dissemination** using a range of outputs such as policy briefs, social media, and other accessible formats and provide clear summaries of problems and potential solutions. Relying solely on policy briefs or dialogues is often insufficient (Ettinger et al. 2025).
- **Communication should be adapted** to generalist audiences: avoid jargon without oversimplifying, use clear and definitive language, and be transparent about uncertainty and complexity (Marshall & Cvitanovic 2017, Karcher et al. 2022). Framing also plays a critical role, as it can determine whether your message is heard or ignored (Mair et al. 2019).
- **Understand the policy making process** and accept that evidence-based policy making does not fully reflect the political process. The political landscape is dynamic and science communicators should learn what, when, where and who to influence (Marshall & Cvitanovic 2017). In addition, policy rarely changes at a quick pace and research is unlikely to provide a ready-for-duty policy proposal. Moreover, policy makers are human beings with their own career concerns and modus operandi (Lloyd 2016).
- **Build trust and develop good relationships** with the policy maker through routine and authentic, thoughtful interactions that focus on listening and learning (Boaz et al. 2018, Topp et al. 2018). Having trusted and longer-term networks gives researchers better access to influence policy as they benefit from more credibility

within the policy arena. However, this requires a major time-investment and skills from the researcher that often don't get valued (Boaz et al. 2018);

- Decide if you want to **act as an honest broker or issue advocate** (Pielke 2007). Honest brokers provide honest, clear and timely evidence to the policy maker. They remain neutral and shape the debate by a science-based framing of the solution and issues. While issue advocates indicate a preferred course of action and recommend specific policy options based on their research or beliefs. The boundary between the two can be difficult for policy makers to discern as they tend to value candid judgements and opinions from people they trust, rather than new or an excess of research (see also **1.5 Additional insights from a behavioural science perspective – The knowledge-deficit model**);
- **Be entrepreneurial** - or use someone who is. Scientist are advised to be brave, persuasive, comfortable in policy environments, flexible, persistent, patient, pragmatic, available, media savvy, etc. Mastering all these abilities can be beyond the abilities of every scientist, hence relying on knowledge brokers – professionals in science-policy knowledge exchange – can provide a means for scientist to communicate their research results without them having to worry about their people skills or the potential impact on their core activities (Marshall & Cvitanovic 2017);

Knowledge exchange demands a context-sensitive and strategic approach.

- To be effective, scientific evidence should not only correct gaps and misconceptions in stakeholders' knowledge but also **build on their existing beliefs** and preferred language (Bruine de Bruin & Bostrom 2013, see **1.5 Additional insights from a behavioural science perspective – Bounded rationality**). Scientists should also **be reflective** on their engagement activities.

These findings were echoed during the EU Joint Research Centre (JRC) workshop *"How to support and connect policymaking in the EU and Member States"* (2022). Together with insights from a *science-for-policy* survey of nearly 500 experts working at the science-policy interface, as well as by recent analyses by practitioners and researchers, three main challenges in building a robust science-policy ecosystem were identified (see also SWD (2022) 346):

- Strengthening connections and relationships between scientists and public administrations;
- Enhancing the professional competencies[10] of both researchers and policy makers in research-informed decision making;
- Ensuring good governance when integrating science into policy through transparent, participatory, and anticipatory processes.

Diving deeper into best practices for effective science-policy knowledge transfer and impact – Ettinger et al. (2025) investigated 139 studies about strategies for communicating complex issues like climate change with policy makers and identified several good practice approaches (Ettinger et al. 2025).

Among the most frequently mentioned strategies were: tailoring messages to the target audience, providing accessible, relevant, concise, and timely evidence, and building coalitions and trusted relationships (see also Mair et al. 2019, Oliver & Carney 2019, Cooke et al. 2020).

The most recommended practice was adapting research communication to policy makers' needs: framing findings in ways that align with their values and concerns, selecting appropriate messengers, media, and settings, and addressing the core questions: what does the policy maker already know? What additional information is needed to support informed decision making (Bruine de Bruin & Bostrom 2013)? In doing so researchers must ensure that their findings are effectively

[10] The EC has several initiatives to enable professionals to perform effectively at the science-policy interface (COM (2022) 391) (see also **1.2 Policy frameworks in support of evidence-informed policy making and knowledge valorisation in the EU**).

summarised to highlight their implications for practitioners and decision makers (Head 2010) and be mindful that excessive information can lead to decision avoidance, again underscoring the importance of strategic communication (see **1.5 Additional insights from a behavioural science perspective – The knowledge-deficit model**). In addition, researchers must consider using several media to effectively convey their message (Grorud-Colvert et al. 2010, Oliver & Carney 2019). Another major recommendation by Ettinger et al. (2025) is to engage in coalitions, which enhances message repetition, expand reach, and diversify messengers.

The review by Ettinger et al. (2025) further outlines several additional recommendations for effectively engaging policy makers and conveying scientific evidence:

- Select the appropriate messenger (experts, influential figures, policy makers), medium, and setting and have them purpose driven - what works in one context may not be effective in another (Grorud-Colvert et al. 2010, Head 2010);
- Carefully curate the information to be included providing a comprehensive yet concise evidence package;
- Employ a clear, concise, and, when appropriate, narrative-based communication style to enhance relatability;
- Target dissemination efforts across a broad spectrum of stakeholders and tailor information to their needs;
- Engage in direct dialogues with policy makers and incorporate expert testimonials;
- Ensure the timing and frequency of communication align with policy making processes;
- Understand the policy making environment and identify potential leverage points;
- Involve policy makers in the research process by seeking their input on research questions;
- Utilising a diverse range of communication tactics and channels to target a diverse audience.

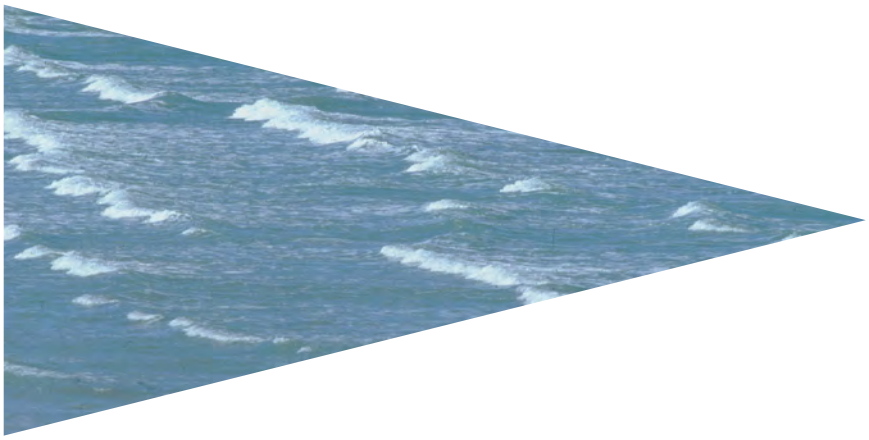
While the above recommendations may seem general or self-evident, substantial uncertainties persist (see below) regarding how to implement effective knowledge exchange in practice. Empirical guidance remains limited on how to engage with the complexities of policy making such as producing evidence syntheses, managing expert communities, coproducing research and policy with diverse stakeholders, and providing both scientific advice and actionable policy recommendations. Ideally, researchers should account for how policy makers simplify their world, but in doing so risk to be misunderstood (Mao 2021, Abbas 2024, CEF 2025).

At the very core of science-policy exchange lies the question if and how far scientist are willing to go to have their science heard by policy and the willingness of policy makers to engage in evidence-based decision making (Mair et al. 2019, Oliver & Carney 2019). For an in-depth discussion on the major dilemmas scientist face in policy engagement and pitfalls, see Oliver & Carney (2019).

A two-way exercise between science and policy.

Despite the unquestionable value of science, it remains important to keep in mind that scientific knowledge is just one of many forms of knowledge that inform policy making and influence the public debate (Bruine de Bruin & Bostrom 2013, Cairney & Oliver 2020, COM (2022) 391). Policy today is shaped by a diverse range of sources (individuals, science, institutions with a policy link, lobbyists, grey literature, public opinion, etc.) and values, with science playing an essential but not exclusive role. It's hence a matter of framing the scientific insights to make them policy relevant and as such demand the attention of the policy makers (Topp et al. 2018, Mair et al. 2019).

While politicians should not rely solely on science to justify their decisions, they must clearly explain the evidence that informed their choices and acknowledge what was excluded. This is essential, as evidence can be misunderstood, misused, cherry-picked, or entirely omitted from the decision making process (Mair et al. 2019, COM (2022) 391, SWD (2022) 346). Consequently, effective communication of evidence by both science and policy is essential for bridging the gap between science, policy, and the public perception.



Research shows that when society is exposed to a diverse and nuanced presentation of evidence, confidence in science and science-based policy making tends to increase (EC 2022, Horvath & Mabett 2022, The British Academy 2024). Hence, by adopting a more inclusive and transparent approach to evidence communication, policy makers can foster greater public trust and enable more informed and balanced decision making (COM (2022) 391, SWD (2022) 346, The British Academy 2024) (see also **1.7 Credibility of science and policy**). However, this strategy can create tension, especially on polarised and complex issues such as climate change, which involve strong stakeholder interests and have significant societal implications The British Academy 2024, Ettinger et al. 2025). In essence, it's about finding the right balance for evidence in policy making (Mair et al. 2019).

1.4 Effective knowledge exchange at the marine science-policy interface

Review analyses of knowledge exchange (KE) at the marine science-policy interface conclude that enhancing collaboration between science and policy actors is essential for translating marine scientific knowledge into effective action (Cvitanovic et al. 2015, 2016, Buxton et al. 2021, Karcher et al. 2021, 2022, 2024). Over the past decade numerous approaches to improving KE at the interface of marine science and decision making have been

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practiced (see **Chapter 4**). While the value of knowledge exchange (KE) is increasingly acknowledged, significant barriers still affect the effective integration of marine science into policy and practice (Cvitanovic et al. 2015, Addison et al. 2018, Karcher et al. 2022, Karcher et al. 2022b, Karcher et al. 2024).

In one of the earlier reviews of scientific literature on improving knowledge exchange[11] in marine resource management, Cvitanovic et al. (2015) emphasised the need to better understand the enabling factors for effective knowledge exchange and to develop improved methods for evaluating its outcomes and impact.

Their findings identified the limited accessibility[12] of scientific knowledge and institutional constraints[13] (e.g., a lack of organisational support for engagement activities, insufficient time for researchers to conduct engagement activities, a lack of funding to support engagement activities, inadequate measures for science impact, etc.) as significant barriers that restrict meaningful interaction between scientists and policy makers. Another key challenge was the lack of guidance on how to adapt knowledge exchange strategies to specific contexts as traditionally, knowledge transfer was approached as simply trying to make research results understandable to diverse audiences through a single format.

The researchers identified four key strategies to improve effective knowledge exchange at the marine science-policy interface: knowledge coproduction, the use of knowledge brokers, the establishment of dedicated boundary organisations[14] and embedding researchers in government agencies. In addition, they point to the need for more insight into the specific expertise and skill required for successful knowledge exchange practices and the necessity to investigate the potential of social media and web platforms to communicate scientific findings to policy makers.

Cvitanovic et al. (2015) also argued that effective knowledge transfer typically goes beyond the traditional linear model, where scientists are the sole knowledge-providers and policy makers the passive recipients and that instead a more bidirectional way of communicating is preferred. Bidirectional engagement mechanisms today are central to the UN Decade of Ocean Science for Sustainable Development, a global initiative which seeks to strengthen marine science-policy connections and promote science-informed marine policy through inclusive and participatory approaches.

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[11] Described in Cvitanovic et al. (2015) and accordingly applied by the studies of Karcher et al. (2021, 2022, 2024) as the interchange of knowledge between scientific producers and research users, encompassing all activities and facets of knowledge production, sharing, storage, mobilisation and use.

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[12] This included the on average long time (years) between data collection and publishing.

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[13] Likewise, decision makers face a range of institutional barriers that prevent knowledge exchange activities from occurring, as well as leading them to feel disempowered to act or take action (Cvitanovic et al. 2015).

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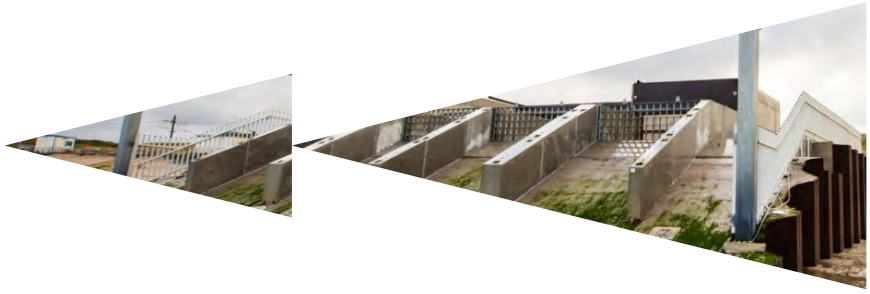
[14] Some reflections on what is considered boundary spanning activities are given in Bednarek et al. 2018.

Building on the insights of Cvitanovic et al. (2015), Karcher et al. (2022) analysed[15] 25 success stories where marine research contributed successfully to evidence-informed decision making, offering additional insights into how to improve knowledge exchange at the marine science-policy interface. Their analyses show that a diversity of approaches are used for knowledge exchange, from consultative engagement to knowledge coproduction. The majority of the success stories - projects with a high or guaranteed policy impact - were projects initiated by policy demand, donors, local communities or boundary organisations (see also Steger et al. 2021). Relatedly, working with established advisory bodies or governmental agencies was highly beneficial for successful KE.

Success[16] was found to be enabled by a combination of different factors relating to the actors involved, the processes applied, institutional support, the context and timing (figure 1). A key takeaway to generate impact was the importance of involving different actors and fostering constructive relationships among the involved stakeholders. Karcher et al. (2022) point to the importance of having good interpersonal skills, institutionalising knowledge exchange – for instance through knowledge brokers or boundary organisation specialised in connecting science with policy (see also Cvitanovic et al. 2015 and **Chapter 2**) – and the development and implementation of broader research impact metrics.



The most frequently described approach for successful knowledge exchange was interactive knowledge exchange, also known as knowledge coproduction, encompassing practices such as co-designing, co-creating, co-writing, and co-evaluating (see also Karcher et al. 2024 and **Chapter 3**). These strategies have in common that they increase political receptiveness and research uptake by being very context-specific, pluralistic, goal-oriented, highly interactive benefiting from different iterative exchanges allowing for reflection and adaptation between science-policy actors (Hegger & Dieperink 2015, Norström 2020) (see also **Chapter 4**).

[15] The analyses were conducted based on the following questions: (i) what initiated the project/initiative, what were its goals?; (ii) which approaches to knowledge exchange were used?; (iii) what outcomes and impacts were achieved; (iv) what were the enablers of successful knowledge exchange and (v) what lessons can be drawn from improved knowledge exchange at the marine science-policy interface.

[16] Success in the study of Karcher et al. (2022) was defined as: "knowledge becoming accessible, understandable, shared and used, enabled by good knowledge exchange products, processes and social outcomes, etc. with the potential to contribute to changes inpolicy and demonstrable societal impact".

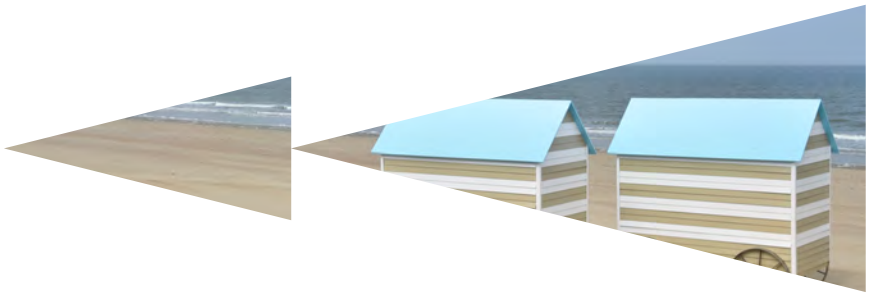
However, such interactive modes of engagement often fall outside the traditional scope or ambition of many researchers and are rarely integrated into standard research planning. This highlights a broader need to professionalise and diversify training programmes in order to strengthen specific interpersonal or 'soft' skills essential to understanding each other's operating context and hence increase collaborative science-policy work (e.g., EU COST actions, Karcher et al. 2022).

Another key success factor was the involvement of several other societal actors and knowledge types beyond the science or policy domain. Connecting different scientific disciplines, like for instance social sciences gave useful insights on what types of policy instruments affect ocean professionals and underlines the need for strong collaboration across scientific disciplines (Karcher et al. 2022). This demonstrates the importance of early and meaningful engagement with diverse actors and knowledge types, including local knowledge, which have already shown to enhance the legitimacy and effectiveness of decision making, management, and conservation outcomes (IOC UNESCO 2009, Hegger et al. 2012, Dawson et al. 2021, Karcher et al. 2024).

From a broader perspective, Karcher et al. (2022) found that the most consistently identified enablers of successful knowledge exchange were people-related factors, at both the individual level (e.g., diversity, skills, commitment) and the organisational or process level. Understanding the expertise, motivations and limitations of the involved actors is thus highly important for effective KE (see also Cvitanovic et al. 2016, Marshall et al. 2017). At the individual level, success was often associated with the presence of skilled and committed actors, including so called "champions", facilitators, and effective leaders (Karcher et al. 2022, 2024). At the process level, practical collaboration, inclusive participation, equity, clearly defined goals, and continuity were identified as key enablers.

Figure 1. Schematic overview from Karcher et al. (2022) of the different factors that enabled successful knowledge exchange in the 25 case studies analysed within this study.

Trust is key for effective science-policy knowledge transfer.



Above findings underline the vital role of credibility and long-term relationships between scientists and policy makers (Karcher et al. 2022, 2022b; see also **1.7 Credibility of science and policy**). As trustworthiness is both fragile and dynamic, effective knowledge exchange hence relies on the continuous nurturing of interpersonal connections, including trust-building, developing close relationships, and regular face-to-face interaction (Lacey et al. 2017). Using the International Council for the Exploration of the Sea (ICES) as a case study, Cvitanovic et al. (2021) outline strategies for strengthening and managing trust, including ensuring transparency, demonstrating independence and expertise, and maintaining regular interactions. Hence, the above insights prove that knowledge exchange mechanisms should not only consider or rely on the value of the knowledge in se, but also consider behaviours, attitudes and skills to effectively guide evidence-informed decision making (Karcher et al. 2024).

Additionally, Karcher et al. (2022, 2022b) addresses the importance of funding mechanisms in supporting targeted impact planning, recognising the substantial time and resources required for meaningful knowledge exchange, and helping to establish the necessary enabling conditions for effective knowledge exchange, namely having the right people, skills, and processes in place. To that end, research and funding organisations are recommended to embed knowledge exchange into their core missions, allocate dedicated roles and resources, and acknowledge its value through initiatives such as cross-learning programmes and transdisciplinary collaborations

(e.g., EU COST Actions). At present, the responsibility of justifying knowledge exchange efforts still rests predominantly on both researchers and practitioners, again pointing to the need for structural support (see also Karcher et al. 2022b for a more detailed discussion on the aspect of the cost of knowledge exchange at the interface of science and policy).

Karcher et al. (2022) concluded that working at the science-policy interface in a structured and systematic way, through credible and proofed processes of generating, organising, sharing, and debating knowledge, significantly increases the impact of knowledge exchange, particularly when supported by advisory bodies, boundary organisations, and NGOs (see **Chapter 2**). For the full overview of the different types of enablers and why they were considered successful, the lessons learnt and the recommendations to others, see Karcher et al. (2022).

Ten years after the analysis of Cvitanovic et al. (2015) and as a follow-up to Karcher et al. (2022), Karcher et al. (2024)[17] conducted another review on the progress and the needs to improve knowledge exchange at the marine science-policy interface. Based on a review of 60 recent academic articles on science-policy exchange, the analysis shows a growing recognition of the value and impact of knowledge exchange on both policy and individuals, with increasing attention to interpersonal and procedural enablers. The researchers observed that knowledge coproduction and boundary organisations are increasingly becoming mainstream with established strategies, research networks and engaged funders coordinating and facilitating science-policy exchange also playing an increasing role.

Knowledge coproduction and boundary organisations appeared to be the most applied concepts for knowledge exchange but approaches often overlap or are combined (Karcher et al. 2021, 2022, 2024 and **Chapter 2 and 3**). Remarkably, the reviewed studies rarely motivated their decision to adopt a specific knowledge exchange approach. As Cvitanovic et al. (2015) previously observed, despite some advances, there remains an insufficient understanding of how to match knowledge exchange strategies to different contexts (see **Chapter 4**). As a result we have only a limited understanding of the comparative effectiveness of available KE approaches in coastal and ocean governance. However, some progress in this field is being made (see above and Karcher et al. 2022, 2022b).

While it is clear progress is made on effective knowledge transfer at the marine science-policy interface, Karcher et al. (2024) conclude that more research is needed on inclusivity, institutionalisation of KE in research agendas and government agencies, the know-how on exchange-strategy selection and the efficiency of knowledge exchange approaches to effectively support evidence-informed ocean and coastal governance. One of the recommendations to improve science-policy engagement is to put greater focus on the needs of practitioners in boundary organisations, government agencies, advisory bodies, etc. through formalised mechanisms.

[17] They assessed: (i) the strategies applied and emerging for improving KE; (ii) the rationale for using a specific KE strategy within a specific context; (iii) what enabled KE to be effective; (iv) what was achieved through KE; (v) what were the measures to evaluate KE.

These efforts can build on existing global initiatives such as the UN Decade of Ocean Science for Sustainable Development that strengthen connections between science and decision making.

For the full list of the ten recommended research needs to improve knowledge exchange between marine research and policy makers, see Karcher et al. (2024).

To summarise, over the past decade numerous approaches to improving knowledge exchange at the interface of marine science and decision making have been developed, tested and refined but despite better insights - mostly stemming from social sciences - there remains a gap in understanding which strategy to follow within a certain context. Knowledge coproduction (Hegger & Dieperink 2015, Norström et al. 2020, Chambers et al. 2022) and the utilisation of knowledge brokers (Karcher et al. 2022, 2024) or boundary organisations (Bednarek et al. 2018, Cvitanovic et al. 2018, Karcher et al. 2022, 2024) have so far proven to be particularly effective in liaising science to policy (see in detail in **Chapter 2 and 3**). Despite clear progress in science-policy interactions, significant barriers on both sides remain. These include challenges within the decision making process itself, such as the limited time or expertise of policy makers to access and interpret scientific information (see **1.5 Additional insights from a behavioural science perspective – Bouned rationality**) as well as cultural divides between science and policy communities, institutional disincentives (e.g., the "publish or perish" culture), and insufficient resources in terms of time, funding, and capacity for researchers to engage in impactful knowledge exchange (Cvitanovic et al. 2015, 2016; Rose et al. 2018, Walsh et al. 2019, Karcher 2022a, 2022b, 2024).

For more detailed insights on how to effectively engage in science-policy knowledge transfer and its common challenges within a marine context, see e.g., Cvitanovic et al. (2015, 2016), Karcher et al. (2022, 2024).

1.5 Additional insights from a behavioural science perspective

Bounded rationality

The concept of *bounded rationality* describes the cognitive limitations of policy makers as human beings. Unlike the ideal of *comprehensive rationality*, which assumes decision makers can process all relevant information objectively, bounded rationality acknowledges that policy makers operate under significant constraints. They simply lack the time, resources, and cognitive capacity to consider all available information, evaluate every possible solution, or anticipate the full consequences of their actions (Cairney & Kwiatkowski 2017, Cairney & Oliver 2020, Stanovich et al. 2021).

As a result, policy making is not a purely rational process. Policy makers cannot fully separate values from facts, consistently rank their preferences, or analyse the policy context comprehensively (Cairney & Kwiatkowski 2017, Cairney & Oliver 2020, Stanovich et al. 2021). Instead, they rely on heuristics and cognitive shortcuts to process large amounts of information quickly. This necessity means that decision making is shaped by both 'rational' and 'irrational' processes, with choices often made under conditions of uncertainty and without full awareness of all relevant factors Cairney & Kwiatkowski 2017, Cairney & Oliver 2020).

Evidence quantity does not necessarily increase likelihood of uptake.

This reality has important implications for the interaction between research and policy. Researchers transferring knowledge to policy makers must recognise that also science itself is not entirely value-neutral. Policy-relevant research too is influenced by subjective choices - from the framing of research questions to the criteria used to assess policy impact. Individual perceptions, judgments, and behaviours, including those of scientists, are shaped by biases, values, and identities (Head 2019, Mair et al. 2019, Stanovich et al. 2021).

Ultimately, policy makers must often act without complete information and uncertainty about long-term consequences. This does not imply irrationality but rather reflects the inherent constraints of decision making in complex and dynamic policy environments. Expecting policy makers to adhere to unrealistic standards of rationality hence overlooks the practical realities of contemporary governance and decision making.

The knowledge-deficit model

According to social scientist, the *knowledge-deficit model* – the assumption that simply providing more scientific evidence will lead to problem-solving and *comprehensive rationality* in decision making is fundamentally flawed (Crow & Jones 2018, Cairney & Oliver 2020, The British Academy 2024). Instead of accumulating evidence in the hope of persuading policy makers, science communicators should align their strategies with the way policy makers process information, which is through *cognitive shortcuts* (Cairney & Oliver 2020, The British Academy 2024). Policy makers need 'computationally cheap' information and tend to disregard almost all evidence when making decisive choices (Gigerenzer 2001). An overload of evidence can also lead to decision avoidance (Bruine de Bruin & Bostrom 2013).

Therefore, rather than prioritising an expansion of the volume of scientific insights, effective science communication should focus on framing research evidence in a way that reduces ambiguity[18]. Policy makers seek to reduce ambiguity, by adopting a simplified definition or picture of a complex problem and reduce uncertainty by gathering information relevant to that definition. The key for science is to narrow ambiguity and limit the attention to a small set of solutions. If science wins the 'framing battle', policy makers are more likely to demand more scientific evidence on the issue they're facing and its solution (Cairney & Kwiatkowski 2017, Cairney & Oliver 2020).

[18] Ambiguity generally describes disagreement on how to interpret the world and the many ways in which we can describe an issue as a policy problem (Cairney & Oliver 2020).

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The value of storytelling

In a time when misinformation spreads rapidly and the world faces complex global challenges, the importance of science communication cannot be overstated. Yet, scientific findings are often too complex for non-experts, creating a delicate balance between ensuring accuracy and avoiding oversimplification. Those involved in science communication—whether researchers, scientific institutions, or other actors—carry the responsibility of making scientific knowledge accessible. They must engage with the public and policy makers to foster broader support and drive impact. Achieving this requires a commitment to transparency, collaboration, and compelling storytelling.

Storytelling is the preferred way of people giving meaning to how they see the world – an image that fit with who they think they are and what they know (Crow & Jones 2018). Storytelling is a way to convey complex messages with empathy and clarity, two elements that have proven to be fundamental to building trust in science and policy. It comes down to building a narrative that connects with peoples experience's and emotions, making the science more engaging, relatable and memorable. By using real-world examples, personal stories, and compelling visuals, storytelling can help researchers in making their work more accessible, relevant, trustworthy - and therefore more impactful. It is thus a powerful way for researchers to engage with people and having their research shared, discussed and applied and by doing so increasing its value (Mair et al. 2019).

The value of storytelling.

Wicked problems

In the real world, the understanding of issues and problems can often be hotly contested, with a divergence of viewpoints and recommended policy pathways. This usually arises for two main reasons. The first is the fragmentation of perspectives and social understandings, associated with competing value preferences, different occupations, social roles, organisational contexts and knowledge disciplines. The second reason is the inherently complex and multi-layered nature of many important problems that attract our attention (Head 2010). Many of these problems arise from multiple causes and are interconnected. They are called "wicked problems" (e.g., climate change, the covid-crisis, the energy transition, poverty, child traficking, etc.) (Head 2019). It is important for all stakeholders involved to recognise the limits of science to solve these fundamentally political and complex "wicked" issues[19]. This fragmentation of perspectives and the issue of wicked problems require an inclusive and transparent approach to scientific knowledge and policy action (Head 2010, 2019, SWD (2022) 346).

In summary, several best practices can be drawn from the above-mentioned behavioural-social science perspective, such as the need to combine analytical rigor with deliberative argumentation, recognising the influence of biases and values on knowledge production and utilisation, fostering mutual trust between scientists and policy makers, acknowledging that no single institutional model for science advice fits all political and sectoral contexts, and embracing the plurality of legitimate perspectives and insights. In reality, influencing policy remains a specialist, time-consuming activity without ever guarantees of success (Lloyd 2016).

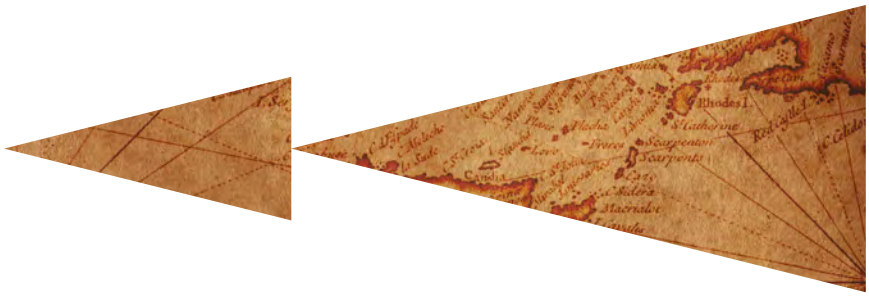
1.6 Credibility of science and policy

Policy making today takes place within a complex global political landscape that is increasingly challenged by polarisation, disinformation, misinformation, and authoritarianism (Mair et al. 2019). Consequently, trust in both government and science cannot be taken for granted, as these two domains are inherently interconnected (Cairney & Kwiatkowski 2017, Mair et al. 2019, COM (2022) 391). Research has shown that declining trust in the political system often extends[20] to science, further complicating evidence-based policy making (Mair et al. 2019, SWD (2022) 346, The British Academy 2024) as the ability of policy makers to leverage scientific insights diminishes when citizens lack confidence in science or worse - perceive it as irrelevant to policy. This in turn leads to less evidence-based policy outcomes (The British Academy 2024) which is particularly concerning given the current global decline in trust in politicians and political institutions (IPSOS 2022, Duffy et al. 2023).

[19] This limitation is the main reason why the EC recommends Member States to use the term evidence-informed policy, rather than (scientific) evidence based policy when making and communicating policy (SWD (2022) 346).

[20] Confidence or trust in science is grounded in the capacity of science to produce truth claims that are validated by the perceived rigour of the scientific process, validation through peer-review, its political independence and the competence of scientist, whereas confidence in policy makers is based on their motivations, competence and conduct to deliver democratically mandated policy (The British Academy 2024).

Scientists as a group are among the most trusted in society (Mair et al. 2019). Its trustworthiness depends on expertise, honesty and shared interests and values (Mair et al. 2019). Public trust in science for policy is essential to make informed political choices and for strengthening the accountability of public policy decisions (Mair et al. 2019, SWD (2022) 346, The British Academy 2024). However, fostering this trust requires clear frameworks that manage expectations and define responsibilities between scientists and policy makers. Both scientists and policy makers can enhance their credibility by ensuring that policies are well-informed by the most reliable and widely accepted facts and sources of information available (SWD (2022) 346, The British Academy 2024). This can be achieved by the researcher, and to a certain extent by the government, by promoting the accessibility and transparency of science and by fostering a sense of ownership. Furthermore, explicitly valuing and integrating diverse disciplinary perspectives can improve the uptake of scientific findings (COM (2022) 391, The British Academy 2024). This approach is more effective than simply providing more



evidence to change public opinion (see **1.5 Additional insights from a behavioural science perspective – The knowledge-deficit model**). Such efforts must always be conducted in a way that safeguards the integrity and independence of the scientific process (Gluckman et al. 2021, SWD (2022) 346, The British Academy 2024), as this is a prerequisite to maintain trust in both science and policy. Ensuring transparency through independent expert panels, publicly accessible reports, and clear communication from scientific advisor helps protect this independence (The British Academy 2024). In the case of transferring knowledge on sensitive or contested issues where public trust is low, researchers and knowledge brokers are advised to ensure sensitivity to different perspectives and nuances when communicating findings.

In practice, this may require including appropriate expertise in public perspectives and public engagement.

Another key factor in building trust from a politicians' perspective is to clearly communicate the potential scientific limitations in terms of the amount of information, the uncertainties associated with the data, or a lack of scientific consensus on certain policy options (Oliver & Pearce 2023). However, it is also the responsibility of policy makers to explain how they will address these limitations and take full accountability for their decisions (The British Academy 2024).

Interdisciplinary scientific evidence can lend significant political weight to policy decisions (De Pryck & Hulme 2023, IPCC). However, one has to be mindful as the invocation of different scientific fields and findings can

consolidate divergent positions and stifle the political debate (The British Academy 2024). At the same time, if policy makers engage in selective mobilisation of scientific knowledge, the credibility of the scientific evidence itself may be called into question (The British Academy 2024).

Ultimately, maintaining trust in science and policy requires a balanced approach, one that acknowledges uncertainties, fosters transparency, and upholds the independence of science while ensuring that policy makers take responsibility for their choices. This is a challenge that requires further effort to connect science with policy makers, citizens and other stakeholders.

1.7 How to define impact?

With the increasing understanding in how to engage in impactful science-policy knowledge exchange (see above), comes the increasing desire to measure and characterise the impact of science on policy and society or the effectiveness of knowledge exchange (Fazey et al. 2014, Cvitanovic et al. 2015, Karcher et al. 2024).

Today, many scientists intent to influence policy or management through their research, yet few can report cases where this is actually achieved or incorporate measures to evidence success (Cvitanovic et al. 2015, Evans & Cvitanovic 2018, Oliver & Carney 2019, Karcher et al. 2021). Moreover, the majority of advice given to academics on how to create impact is not based on empirical evidence or on literature on policy making and evidence use (Oliver & Carney 2019).

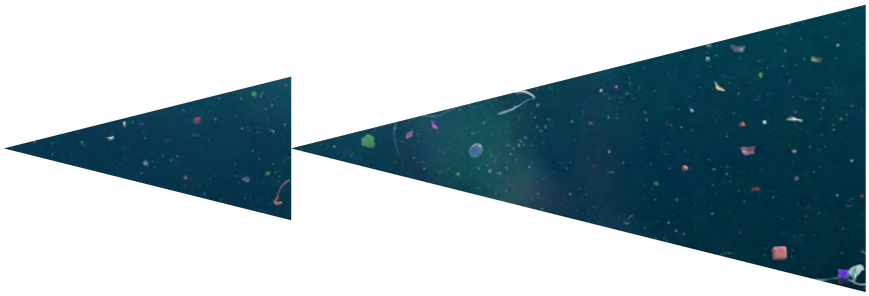
Hence, establishing reliable metrics for evaluating knowledge exchange in the marine science-policy interface has become an increasingly recognised research priority (Cvitanovic et al. 2015, Reed et al. 2021, Karcher et al. 2024). However, objectively quantifying the policy impact of research by a (universal) set of indicators might not be feasible or effective given the diverse objectives and contexts of knowledge exchange that work across different modalities. Moreover, creating impact or simply defining successful[21] knowledge exchange is inherently difficult and thus to measure[22] or evaluate (Reed et al. 2014, 2021, Karcher et al. 2021, 2024). Because science-policy exchanges are typically non-linear, the potential impact is often indirect and therefore again challenging to quantify.

The dimensions of impact are also highly diverse (Wyborn et al. 2019, Reed et al. 2021) and success or impact can come in diverse forms (Cooke et al. 2020, Cvitanovic et al. 2021, Karcher et al. 2021). Impact can broadly be described as "changes in awareness, knowledge and understanding, ideas, attitudes and perceptions, and policy and practice" (Morton 2015). It can span individuals, groups, organisations, societies, and ecosystems. However, what constitutes successful knowledge

[21] In the study of Karcher et al. (2021) success in science-policy interactions is addressed by the following questions: i) what goals, desired outcomes and statements of success are articulated for KE-processes?; (ii) what positive outcomes are claimed as success?; (iii) what types of evidence are used to decide if KE was successful; (iv) which practical methods are used for the evaluations?

[22] Interviews and surveys were the most commonly applied strategies for evaluating science-policy interactions and knowledge exchange in the context of environmental management (Karcher et al. 2021).

Impact has many dimensions.



exchange or research impact is always context-specific and is a matter of the perceptions of intended beneficiaries and those of potentially disadvantaged parties (Cooke et al. 2020, Cvitanovic et al. 2021, Reed et al. 2021). Impact can manifest as less tangible social outcomes[23], products, or changes in processes, but it may also involve conceptual shifts (Karcher et al. 2021, 2024, Edler et al. 2022). Impact can also be defined by a combination of metrics, for instance knowledge brokering strategies often use metrics that are process related (e.g., the number of meetings), output related (number of policy informing briefs), or outcome related (policy changes, changes in understanding) (Scarlett et al. 2020).

Measures to evaluate[24] the effectiveness of knowledge exchange are predominantly qualitative as these metrics are deemed to be better suited to capture the nuances, complexity and contextual variability inherent to knowledge exchange processes (Reed et al. 2018, Cooke et al. 2020, Norström et al. 2020, Karcher et al. 2022, 2024). However, measuring complex, intangible elements – how do you measure trust or integrity? – remains a persistent challenge. More abstract changes like increased awareness of science among policy makers, improved understanding of each other's needs, greater mutual interest and engagement, or enhanced

[23] Some examples are: a changed mindset, improved understanding, altered behaviour, strengthened relationships or resolved conflicts.

[24] A comprehensive evaluation of research impact is given in Reed et al. (2021).

interpersonal and professional skill sets can also be considered meaningful forms of impact (Karcher et al. 2024). Beyond the development of reliable metrics, other challenges include how to practically conduct assessments and how to align the expectations and intended outcomes of the parties involved (Jagannathan et al. 2020, Karcher et al. 2021). Research has already shown that the perception of success or impact may differ between what scientific studies aim for and what is eventually recognised as successful knowledge exchange (Cooke et al. 2020, Karcher et al. 2021)[25].

Moreover, it is important to recognise that knowledge exchange is just one of many factors contributing to shaping policy (see **1.3 Effective science-policy knowledge exchange**). Hence, it will be hard to discern the extent of the causality of changed policy by knowledge exchange mechanisms. Nevertheless, in their review of successful cases of knowledge exchange at the marine science-policy interface, Karcher et al. (2022) demonstrate that working at the science-policy interface in an organised manner e.g., through advisory bodies, boundary organisations, or NGOs can significantly enhance knowledge exchange success (see **Chapter 2**). Cooke et al. (2020) reviewed various strategies for achieving and measuring success in science-policy engagement and concluded that there is no single pathway, but flexibility is essential. Key factors that enhance effective knowledge exchange include using multiple communication channels, working within coproduction frameworks, training early-career scientists in applied partnership science, and acknowledging limitations. They identified five core strategies for strong science-policy partnerships: be transparent about uncertainties, invest in training future scientists, safeguard research integrity, maintain regular two-way communication with stakeholders, and stay responsive to partner needs.

Ultimately, the degree to which decisions are evidence-based depends on the willingness of the political landscape to engage with scientific knowledge. Furthermore, the perceived impact and effectiveness of knowledge transfer are inherently perspective-dependent, varying between knowledge producers, policy makers, and the public (de Jong et al. 2016, Gluckman et al. 2021).

[25] According to the review study of Karcher et al. (2021) successful knowledge exchange was considered based on its usability, policy or societal impact and social outcomes.

Specialised knowledge exchange is beneficial for effective science uptake into policy.

Chapter 2

The value of knowledge brokering for marine science-policy exchange

2.1 What is it?

Knowledge brokering is the professional translation and communication of scientific knowledge into understandable and useable information for policy makers or other stakeholders. It is conducted by specialist knowledge brokers, boundary organisations engaged in science-policy exchange, and other intermediaries (BIBS)[26]. This practice is grounded in a deep understanding of the differing perspectives, cultures, and languages of both the policy and scientific communities, with the aim of fostering effective, bidirectional engagement (Boswell 2018, Gluckman et al. 2021).

In practical terms, it requires identifying and responding to the specific information needs of policy makers, while ensuring that the knowledge produced by scientists is communicated in a form and language that aligns with these needs. Knowledge brokering thus happens at the interface between researchers and decision makers with the aim of presenting evidence in a way that informs and broadens policy options without steering the policy development process itself (honest brokering). Brokerage at the science-policy interface can generally be defined by the following attributes (statements from Gluckman et al. 2021):

- It ensures alignment between the needs and/or request of the policy community (or other audience) and provide an evidence-synthesis;

[26] For more insight into the definition of brokers, intermediaries and boundary spanners (BIBS) see Neal et al. (2022). In general, although overlap exists, intermediaries tend to focus on knowledge dissemination, while boundary spanners are more occupied with building relationships with brokers performing multiple functions like capacity building, relationship building and knowledge dissemination.

- It ensures that any evidence-synthesis is robust, transdisciplinary, and has had appropriate expert inputs;
- It ensures that the policy community or other targeted stakeholders have a robust understanding of the implications of the evidence offered;
- Where appropriate, advice is provided in the form of options rather than making specific recommendations;
- Where policy advice is required, it is provided in a manner that minimises the biases and values of those providing advice, and the advice is self-reflexive in that it communicates its own limitations and any unavoidable bias;
- It does not attempt to take a role other than informing in the policy making process.

2.2 Approach

In practice, knowledge brokering is preceded by a phase of unbiased, neutral and pluralistic evidence gathering and synthesis to widen and optimise the choices of the decision maker (Gluckman et al. 2021). This evidentiary synthesis on its own tends to have little direct impact on policy (Mair et al. 2019, Cairney & Oliver 2020, Karcher et al. 2022), the brokerage – the effective transmission of the evidence synthesis is key. As a core principle, effective knowledge brokering should engage a range of stakeholders in the gathering of information, but most definitely in the provision of knowledge and the formulation of options. The brokerage itself should be based on trust, integrity and transparency.

The authoritative evidence-synthesis of the knowledge broker should entail a thorough and systematic integration of knowledge across multiple disciplines and viewpoints, presented in a clear and accessible manner that outlines both what is known and what remains uncertain. It must also communicate the degrees of uncertainty and relevant limitations (Cairney & Oliver 2020, Gluckman et al. 2021, The British Academy 2024). Achieving this effectively requires transdisciplinary expertise both in terms of understanding and skills, since good knowledge brokering can be a valuable asset in navigating the complex interplay between sound scientific evidence, normative claims, and value-based positions that policy makers have to deal with on a daily basis. Recognising the contribution of the social sciences is therefore critical within science advisory ecosystems engaging in knowledge brokering (discussed in detail in **Chapter 1**).

For a more in-depth description of the different core values on how to conduct (honest) knowledge brokering, see Gluckman et al. (2021).

The case for boundary organisations:

Bridging the science-policy gap is increasingly vital to addressing complex societal challenges (Bednarek et al. 2018, COM (2022) 391, Neal et al. 2022, Ettinger et al. 2025). Effective responses require multidisciplinary expertise, coherent strategies, and trusted relationships between science and policy actors (COM (2022) 391). Therefore, science-informed decision making is increasingly becoming a collaborative and social process, underpinned by supportive institutions, structured interaction, and a scientific culture that values policy engagement (JRC, Karcher et al. 2022).

Boundary organisations prove to be a crucial mechanism in linking science to policy in a more comprehensive and inclusive knowledge exchange process. Specialised in connecting knowledge production with its valorisation at multiple levels, they play a key role in supporting evidence-informed decision making (Bednarek et al. 2018, Karcher et al. 2021, 2022).

Examples such as knowledge transfer offices, incubators, and science parks provide platforms for researchers and innovators to valorise knowledge, ideas, products, and services (COM (2022) 391). By serving as contact points for stakeholders engaging with policy, these organisations improve the conditions for impactful knowledge exchange (Cvitanovic et al. 2018, COM (2022) 391). Their common services – networking, mentoring, coaching, and best practice dissemination – further enhance the valorisation and uptake of research.

Like knowledge brokers or intermediaries, boundary organisations (which often employ the former) thus foster communication and collaboration across diverse stakeholder networks (Cvitanovic et al. 2015, Neal et al. 2022). Through extensive social network development, they stimulate knowledge flows and facilitate knowledge coproduction – one of the most effective strategies for advancing knowledge exchange (Karcher et al. 2022 and **Chapter 3**).

The case of boundary organisations.

2.3 Why?

Due to the complexities of effective knowledge exchange (see **1.3 Effective science-policy knowledge exchange)**, there is a trend to more systemic knowledge brokering. Moreover, the dissemination process from scientific research to policy makers can be slow and leaky (relevant research might remain unnoticed) as it often takes years for research to be published, synthesised and translated into recommendations for policy or other stakeholders (Green et al. 2009). Researchers also in most cases don't have the time, expertise, willingness, structures or funding to engage in science-policy exchanges (Cvitanovic et al. 2016). Additionally, researchers struggle or often fail to include, or identify policy maker perspectives into their research, often leading to less relevant research findings (Cvitanovic et al. 2016, Neal et al. 2017). On top of that, a lack of interaction between researchers and policy makers also hinder efforts to implement evidence-based policy or practices (Neal et al. 2022). Knowledge brokers acting as honest brokers also have the capacity to enhance the trustworthiness of science and government (Mair et al. 2019).

2.4 When?

Knowledge brokering by BIBS can a.o. assist in (JRC project, Gluckman et al. 2021, Neal et al. 2022, Oliver et al. 2022, Karcher et al. 2021, 2022, 2023, SWD (2022) 346):

- Disseminating, translating, synthesising, and communicating research for policy;
- Managing different requests for scientific evidence and facilitating access to research results;
- Training researchers and policy makers in evidence-informed decision making and science communication;
- Building partnerships and fostering collaboration among a network of stakeholders;
- Recognising and rewarding policy impact;
- Establishing processes and dedicated roles for science in policy engagement.

In Scarlett et al. (2020)[27] 174 indicators are presented to evaluate knowledge transfer infrastructure and capacity building which can be used or adapted by organisational knowledge brokers in their monitoring and evaluation work.

2.5 Evaluation[28]

Advantages

- Offering scientists a way to get their results to policy makers without distracting from their core scientific activities (Cvitanovic et al. 2016, de Jong et al. 2016, Marshall & Cvitanovic 2017, van de Burgwal et al. 2019);
- Boundary spanning professionals are better skilled and thus more efficient in transferring science to policy (Bednarek et al. 2018);
- Avoids competition between scientists to reach policy makers, which reduces the possibility of an uneven reach of science, hence offering an equal path for science to policy (Oliver & Carney 2019);
- Without effective brokerage mechanisms, critical topics or perspectives may fail to gain sufficient attention. Scientists are not always capable to advance key issues onto the policy agenda, while policy makers tend to prioritise immediate concerns at the expense of longer-term risks. Brokerage mechanisms can play a key role in bridging this gap by systematically bringing emerging and relevant scientific knowledge

into policy discussions, thereby opening new policy windows strengthening both short-term responsiveness and long-term resilience. Hence, effective science brokerage is not only crucial for responding to urgent policy issues, it also supports long-term strategic decision making (Bednarek et al. 2018);

- A trusted knowledge broker is able to communicate about what information is and is not reliable – enhancing the trustworthiness of science and government, which is of particular importance in the current post-truth era and its impact on democracy, policy making, public understanding and attitudes (Gluckman 2018, Mair et al. 2019);
- Knowledge brokers are trained to carefully evaluate the quantity and quality of available evidence and take care of ensuring that all the relevant knowledge and knowledge gaps are identified and closed where possible;

- Knowledge brokers are experts in defining the common linguistic framework between the researcher and the policy maker;
- The knowledge broker can assist by reporting on the degrees of evidential support to help the policy maker consider the consequences in accepting or rejecting the evidence;
- Brokers are well placed to evaluate the level of scientific consensus and provide the appropriate interpretation to divergent views;
- Brokers are able to inform policy makers on the to be expected positive or negative spillover effects of different policy options;
- Brokers are able to demonstrate good scientific judgement – a proper consideration of the quality (e.g., vague assumptions, incomplete or incorrect scientific approach, missing information, etc.) and nature of the evidence are essential skills to identify bad science and misinformation that may reach policy;

[27] This review is set within the context of health research.

[28] The listed advantages and disadvantages are possible examples and their likelihood depends on the quality of the coproduction process.

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- Knowledge brokers can assist in building a case for certain scientific insights with the policy community;
- Knowledge brokers are able to recognise the purpose of the policy request (e.g., informing vs. advising vs. evaluation) and subsequently tailor the advice to the evidence need;
- Knowledge brokers are experienced in working with policy makers and as such help ensure the appropriate questions are asked;
- Knowledge brokers have a broad skillset to perform different functions conducive for effective knowledge exchange like: disseminating, translating, synthesising and communicating research for policy, managing requests for evidence, facilitating access to research, training researchers and decision makers for evidence-informed policy making, building partnerships, rewarding policy impact and creating processes and opportunities for science-policy exchange (Gluckman et al. 2021, Neal et al. 2022, Karcher et al. 2022, SWD 2022 346);
- Knowledge brokers are trained in what nonexperts know and need to know to make more informed decisions (Bruine de Bruin & Bostrom 2013);

Considerations and constraints

- It is hard to navigate in policy dynamics and balancing the information asymmetry between science providers and users;
- Transparency on the authority of knowledge (the reason why certain scientific evidence is gathered and synthesised) and the inclusion of social sciences still need to be improved (Gluckman et al. 2021);
- Is the brokering conducted as an honest broker (offering non-directional scientific support) or as an issue advocate (usually the case for scientific bodies pursuing a specific agenda) (Pielke 2007, Gluckman et al. 2021)?;
- Without political interest, the uptake of science in policy will be very unlikely (Gluckman et al. 2021).

2.6 Best practice examples

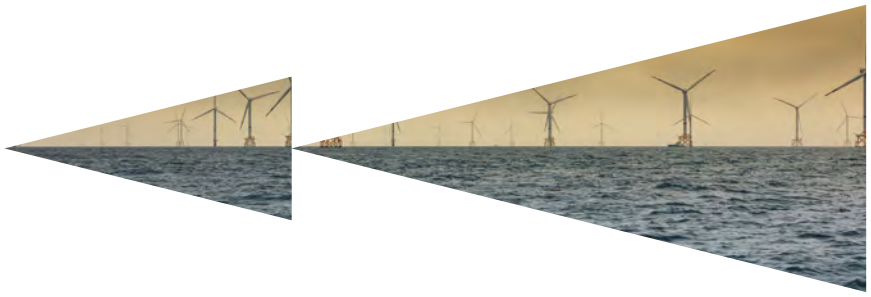
Policy and Innovation division of Flanders Marine Institute (VLIZ)

The Policy and Innovation division of VLIZ provides marine knowledge valorisation to science, companies (within the context of Blue Economy) and policy. The division actively invests in the development of a scientific knowledge base and the detection of knowledge gaps and innovation needs, with a view to scientifically underpin the policy for the coast and sea, and to enhance the marine innovation capacity in Flanders and beyond. With a view to marine science valorisation, the division acts as a Marine Knowledge Transfer Office between the marine research community, policy makers and marine and maritime industry.

European Marine Board (EMB)

The European Marine Board (EMB) is a strategic, pan-European forum for advancing marine research and technology, providing foresight, policy analysis, and clear recommendations to European institutions and national governments. As an independent, EMB bridges the

Professionally matching science with policy.



science-policy gap through a variety of approaches, including identifying scientific challenges and opportunities, fostering collaboration among marine research stakeholders, and expressing a unified vision for European marine research priorities. With a reputation for delivering high-quality science-policy advice, EMB facilitates the transfer of cutting-edge scientific knowledge into the policy-making process, engaging a broad network of experts and stakeholders across Europe and internationally. Since its establishment in 1995, EMB has been instrumental in shaping marine research policy, with its activities influencing funding mechanisms and driving capacity building for the future. non-governmental advisory body, EMB plays a crucial role in transferring knowledge between the scientific community and decision makers, reinforcing Europe's leadership in marine science.

Exploration of novel engagement opportunities to tackle societal challenges.

Chapter 3

Citizen science and knowledge coproduction - two emerging pathways for more integrative and inclusive policy making

3a. Citizen Science

Europe, through its Green Deal (COM (2019) 640), is committed to engaging local communities and citizens in fulfilling its research and innovation agenda (see also **1.2 Policy frameworks in support of evidence-informed policy making and knowledge valorisation in the EU**). The EC recognises the potential of citizen engagement as a valuable form of evidence to help achieve its environmental objectives and the United Nations Sustainable Development Goals (UN SDGs) (EC 2018). Creating opportunities for cocreation with citizens is seen as essential for driving the societal transformations required (EC 2022) as connecting citizens with science and policy making increases trust and support for both science and policy and results in more balanced policies. Citizen science is actively supported by the European Environment Agency as a credible and impactful approach to environmental data collection, governance, and protection (Haklay 2015, Rubio-Iglesias et al. 2020).

3a.1 What is it?

Citizen science is a flexible concept, depending on the situation or the discipline and has been given many definitions (Haklay 2015). In its review paper on Citizen science for environmental policy, the European Commission considers citizen science as the non-professional involvement of volunteers in the scientific process, whether in the data collection phase or in other phases of the research (EC 2018). In other descriptions, the non-formal scientific training requirement is mentioned (Bonney et al. 2014).

The European Citizen Science Association (ESCA)[29] underlined ten good practice principles to describe citizen science projects (ESCA 2015):

- Citizen science projects actively involve citizens in scientific endeavour that generates new knowledge or understanding. Citizens may act as contributors, collaborators, or as project leaders and have a meaningful role in the project.
- Citizen science projects have a genuine science outcome. For example, answering a research question or informing conservation action, management decisions or environmental policy.
- Both professional scientists and the citizen scientists benefit from taking part. Benefits may include the publication of research outputs, learning opportunities, personal enjoyment, social benefits, satisfaction through contributing to scientific evidence e.g., to address local, national and international issues, and through that, the potential to influence policy.
- Citizen scientists may, if they wish, participate in multiple stages of the scientific process. This may include developing research questions, designing the method, gathering and analysing data, and communicating the results.

[29] The European Citizen Science Association (ECSA) is a membership organisation with the aim to increase the democratisation of science, encourage the growth of citizen science in Europe, and support the participation of the general public in research processes – across the natural sciences, social sciences, humanities, and the arts.

Reduces the gap in understanding between citizens, science, and policy.

- Citizen scientists receive feedback from the project. For example, how their data is being used and what the research, policy or societal outcomes are.
- Citizen science is considered a research approach like any other, with limitations and biases that should be considered and controlled for. However, unlike traditional research approaches, citizen science provides opportunity for greater public engagement and democratisation of science.
- Citizen science project data and meta-data are made publicly available and where possible, results are published in an open access format. Data sharing may occur during or after the project, unless there are security or privacy concerns that prevent this.
- Citizen scientists are acknowledged in project results and publications.
- Citizen science programmes are evaluated for their scientific output, data quality, participant experience and wider societal or policy impact.

- The leaders of citizen science projects take into consideration legal and ethical issues surrounding copyright, intellectual property, data sharing agreements, confidentiality, attribution, and the environmental impact of any activities.

Enabled by the digital transformation, citizens are increasingly playing a key role in contributing to scientific knowledge and data (JRC-Citizen Science for EU Policies, Hyder et al. 2015, EC 2018). They are increasingly recognised as a valuable source of information for statistical reporting and authoritative environmental monitoring, including tracking progress towards the UN Sustainable Development Goals (UN SDGs) (Fritz et al. 2019, Fraisl et al. 2020). Despite its growing potential, a common perception persists that citizen science data are of lower quality than data collected through traditional, science-led approaches. As a result, some argue that such data should only be used when no other sources are available.

As citizen science is in essence a tool for data collection, effective knowledge transfer isn't guaranteed and its receptiveness depends on the used transfer strategy and political interest (Hyder et al. 2015). Policy makers often face challenges in integrating citizen science into formal processes due to concerns about data quality - specifically in terms of accuracy, spatial and temporal resolution, robustness, documentation, and accessibility (Thiel et al. 2014, Hyder et al. 2015, EC 2018).

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However, studies have demonstrated that data collected by volunteers, even those without formal training, can produce results comparable to those obtained by professional scientists (Adriaens et al. 2021, Meschini et al. 2021). The reliability of such data is strongly influenced by the level of training, guidance, and experience provided to participants (Crall et al. 2010, Gillet et al. 2012, Brown & Williams 2019, Meschini et al. 2021).

From a scientific perspective, there are additional reservations. Researchers must be prepared to engage with volunteers and when doing so ensure adherence to robust and repeatable protocols, maintain scientific objectivity, and guarantee data accessibility. Hence, they need to clearly demonstrate the added value of citizen involvement in their projects. Ensuring scientific credibility and policy relevance requires rigorous quality assurance procedures throughout the process, including validation, verification, and management of observer bias (Hyder et al. 2015, EC 2018). In the marine realm, citizen science projects are on a steep increase (Thiel et al. 2014), with a focus on coastal, mass participation projects (Roy et al. 2012) like for instance ('De Grote Schelpenteldag', Coastsnap).

At the same time, citizens themselves may be hesitant to participate in data collection efforts aimed at informing policy. For many, ease of participation, enjoyment, and a sense of personal benefit are critical motivators. Without these, there is a risk of disengagement or detachment from the project, which may undermine data quality and reliability (Hyder et al. 2015).

3a.2 Approach

There are many ways citizens can engage in citizen science, an integrative overview and discussion of the various techniques is given in Haklay (2015)[30]. Data collection can be either active (e.g., collecting and counting seashells) or passive (e.g., GPS signals from diving equipment, sensors, etc.) (Hyder et al. 2015). A common approach in environmental monitoring is by mobilising citizens to help collect data, the 'contributory approach'. There's also the 'participatory mapping approach' in which citizens are equipped with tools and receive some training to assist in data collection (Hyder et al. 2015).

[30] Passive Sensing, Volunteer Computing, Volunteer Thinking, Environmental and Ecological Observation, Participatory Sensing and Civic/Community science.

◂ 3a.3 Why?

- When the public is actively involved in the creation of science and not merely receiving results, it helps mitigate the perception of traditional hierarchies of knowledge between scientists and society at large. In other words, incorporating citizen science can enhance public perceptions of scientific research as competent, informative, locally relevant, and trustworthy. Qualities that are critical, as trust is the number one factor influencing citizens' compliance with policy (Horvath & Mabett 2022);
- By making research more inclusive and accessible a more collaborative and informed society can be achieved;
- Raises awareness of the value of science and evidence-based decision making on issues that matter to citizens (EC 2018);
- A deliberate design with clear and actionable outcomes of a citizen science can be a useful tool to lobby for local or national policy change (Shirk et al. 2012);
- Citizens can help deliver evidence that could not have been achieved by scientists alone (Hyder et al. 2015);
- By engaging, educating and empowering citizens, management strategies benefit from improved community support and the overall reputation of the project increases (Dickinson et al. 2012, Hyder et al. 2015).

◂ 3a.4 When?

Currently, there is no consistent or strategic rationale guiding the development of policy-relevant citizen science. Projects are usually initiated in response to practical needs, such as gaps in existing data, challenges in collecting data through conventional means, the influence of similar initiatives by peer organisations, or the availability of knowledgeable local volunteers.

While citizen science can be perceived as confrontational when used by communities to challenge local developments or industry, it also holds the potential to elevate public discourse. Because science is widely regarded as objective and trustworthy, citizen science can help shift debates from opinion to evidence, enhancing transparency and trust in environmental decision making. Although risks such as data misinterpretation remain, well-designed and carefully managed citizen science initiatives can contribute to more informed and democratic policy outcomes or at least foster constructive dialogue between the involved stakeholders (Haklay 2015, EC 2018, Fritz et al. 2022, Horvath & Mabett 2022).

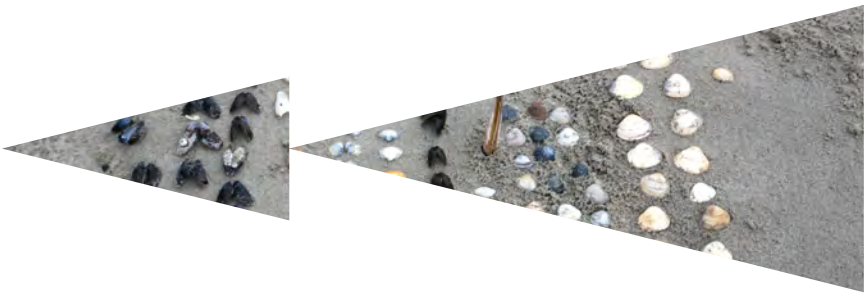
Citizen science, when correctly applied, can add value to the scientific evidence base and assist in developing large data sets that would be more complex or costly to obtain through other means. However, it should always be considered as supplementary and part of an integrated, overall scientific scheme as some tasks are simply not amenable to volunteers (use of specialist equipment, inaccessible or dangerous locations, importance of frequency of reporting, etc.) (Hyder et al. 2015).

For a detailed explanation on how to maximise the potential of citizen science, stimulate citizen science and its policy uptake in environmental policies, see EC (2018).

3a.5 Evaluation

Advantages

- The development of novel, socially and culturally accepted technologies like the internet and mobile apps allows anyone - regardless of literacy, education, or location - to participate in citizen science and feel empowered to act on issues that concern them (ECSAnVis-project, Newman et al. 2012, Hyder et al. 2015);
- Increases public awareness on local to global issues (EC 2018);
- The inclusion of citizens results in more responsible, fair and inclusive research (EC 2018);
- Increases the positive attitude towards policy as citizens view authorities using science generally as competent, fair, transparent, and trustworthy (Horvath & Mabett 2022);
- The possibility to collect substantial amounts of data at an appropriate scale to investigate large-scale environmental issues (Dickinson et al. 2012);



- Citizens can be key drivers in initiating behavioural change and, as such, play an important role in tackling major global challenges (Fritz et al. 2022);
- Citizen science allows for rapid problem identification and solutions, particularly in the early detection of diseases, invasive species, pests, etc.;
- Citizen science offers a wider evidence base to policy makers by providing new or complementary evidence (EC 2018);
- Citizen science is in most cases a cost-effective way of obtaining (and sometimes processing) data (Hyder et al. 2015);
- The application of citizen science often goes in tandem with open access data and data sharing policies (EC 2018);
- A large variety of research can be conducted through citizen science (Roy et al. 2012);
- Citizen science makes research more inclusive and easier to access, helping to build a more informed and collaborative society. By showing people how their contributions influence decisions, it also strengthens democracy and transparency (EC 2018);
- Citizen science might create new communities of interest (EC 2018);

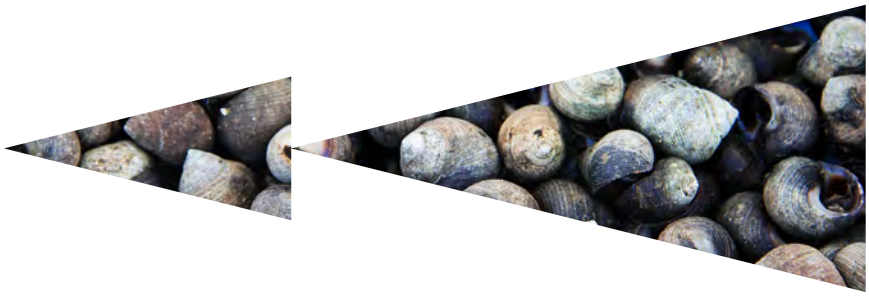
[31] The listed advantages and disadvantages are possible examples and their likelihood depends on the quality of the coproduction process.

- Citizen science can contribute to the scientific knowledge base, but only if outputs from citizen science projects are scientifically checked and evaluated (Hyder et al. 2015);
- Gives citizens the opportunity to contribute meaningfully to science and policy, empowering them to address local problems and even become drivers of change (EC 2018);
- The addition of local knowledge is likely to benefit data quality (Danielsen et al. 2009);
- Citizen science as a form of reliable data collection is supported by influential entities such as the European Commission (EU 2014, EC 2018, 2022) and the European Environment Agency (EEA) (Rubio-Iglesias et al. 2020);
- Citizen science can lead to a more applied and relevant research agenda (EC 2018);
- Increases community support for political decisions (Danielsen et al. 2009, Chandler et al. 2012, Hyder et al. 2015);
- By understanding citizens' needs and expectations, more societally relevant policies can be developed (EC 2018);
- Citizen science has the potential to be used as an early warning tool to detect environmental changes (EU 2014, Hyder et al. 2015, ESCA 2016);
- Citizen science can help uncover new issues or scale up existing data, contributing to gap-filling knowledge (EC 2018).

Considerations and constraints

- Debate on the quality of data gathered by untrained citizens, although mechanisms exist to reduce this uncertainty (Fritz et al. 2022);
- Scientists need to figure out how to best use citizen science to deliver policy-relevant evidence (Roy et al. 2012, EC 2018);
- Ensuring the right balance between easy engagement and maintaining sufficient data quality can be challenging for scientists (EC 2018);
- A lot of citizen science projects are NGO-led, which can make a continuous scientific follow-up challenging (EC 2018);
- The sharing of local and indigenous knowledge can inadvertently lead to the release of sensitive information, e.g., the revealing of the location of endangered species (Haklay 2015);
- At the individual level, privacy concerns must be addressed - particularly when participants collect or share data from their homes (Haklay 2015);
- Uptake of knowledge gathered by citizens by policy makers is often limited (Hyder et al. 2015);
- Citizen science without a clear overarching coordinating mechanisms (e.g., alien species observations by non-affiliated voluntary experts) often results in personal data not being available to the public (Verleye et al. submitted);
- Potentially difficult to incentivise people and once engaged rely on a sustained engagement as monitoring fatigue is a common threat (EC 2018, Fritz et al. 2022);

Complementary to conventional science.



- One has to be mindful of legal and ethical issues when handling with personal data or conducting voluntary work (Regulation EU 2016 /679, EC 2018, Berti Suman & Pierce 2018, Hansen et al. 2021);
- Knowledge derived from citizen science or traditional local knowledge can be difficult to analyse and incorporate in scientific reporting and policy making, hence requiring proficiency in and the application of sound interdisciplinary approaches (Hyder et al. 2015);
- Not all citizen science projects are suited or intend to produce policy-relevant evidence (Hyder et al. 2015, Zooniverse, Shirk et al. 2012, Roy et al. 2012);
- The inherently difficult or complex workings of science and policy, can make citizen fear that their participation is too technical or too distant to leverage engagement (EC 2018);
- Citizen science isn't universally embraced by the academic community (Hyder et al. 2015);
- No control over data manipulation if citizens don't objectively contribute to data collection.

3a.6 Best-practice examples

The EU-citizen science platform (ECS)

ECS is a database of the EU's citizen science projects, resources, organisations, platforms and users. It strives to create a globally connected, inclusive, and strong community of citizen scientists to drive societal change in Europe. Having knowledge and

data open to the public, allowing people to engage in research without restricted access to the data is its key principle.

SciStarter

An online platform that brings together citizen science projects from various networks and its participants.

Horizon 2020 MICS-project (2019-2022)

The MICS-project (Measuring the Impact of Citizen Science) developed a platform of tools to measure costs and benefits of citizen science from project conception to realisation. The impacts of citizen science are being measured by metrics and indicators on the following domains: (1) Society: impact on society and individuals as well as collective values and understanding; (2) Economy: implications for entrepreneurial activity, and economic benefits derived from data; (3) Environment: impact on the bio-chemical-physical environment, e.g., on the quality or quantity of specific natural resources or ecosystems; (4) Science: impact on the scientific process as well as research more broadly, and the scientific system; (5) Governance: impact on the processes and institutions through which decisions are made.

Marine recreational fisheries (VLIZ/ILVO, 2015-present)

This project collaborates with the Belgian recreational sea fishing community who actively contributes to the data collection. The data, provided to the researchers through a personal logbook and interviews, is key to assess the sector's size, fishing effort, catches, and socio-economic impact, which in turn can complement stock assessments and contribute to the evaluation of the ecological and socio-economic effects of policy decisions targeted at the fishing sector.

Beach observation network SeaWatch-B

Citizen science initiative using a participatory approach in which citizens receive training and tools to conduct beach surveys in Flanders. SeaWatch-B is supported by VLIZ and the Flemish contribution to LifeWatch - a European research infrastructure under the ESFRI framework, dedicated to the study of biodiversity and ecosystems.

3b Knowledge coproduction

3b.1 What is it?

Knowledge coproduction has received many definitions (Wyborn et al. 2019, Norström et al. 2020). In a broad sense, it refers to a framework to integrate different perspectives and knowledge into decision making (Wyborn et al. 2019). Knowledge coproduction assumes that the relationships between science, policy and practice are complex, multi-pathway and nonlinear.

Three widely accepted definitions and which are often referred to in environmental science studies are the following:

- Hegger et al. (2012): "A process of knowledge production where several actors, usually from different fields, cooperate directly in the exchange, production and application of knowledge, usually at the science-policy interface".
- Wyborn et al. (2019): "Knowledge coproduction processes iteratively unite ways of knowing and acting – leading to mutual reinforcement and recriprocal transformation of societal outcomes. It involves multiple participants (scientists, policy makers, civil society, etc.) to produce multiple outcomes".
- Norström et al. (2020): "Knowledge coproduction processes are iterative and collaborative processes involving diverse types of expertise, knowledge and actors to produce context-specific knowledge and pathways toward a sustainable future".

3b.2 Approach

Knowledge coproduction is part of an evolving set of participatory and transdisciplinary research approaches that reject the notion that scientists alone should define research questions and deliver knowledge to society (Norström et al. 2020). However, unless politicians are actively participating in the coproduction process, the output of the process still requires some form of knowledge transfer to influence policy.

Knowledge coproduction strategies tend to enhance political receptiveness and research uptake by being: context-specific, pluralistic, goal-oriented, highly interactive benefiting from different iterative exchanges allowing for reflection and adaptation among science-policy actors (figure 2) (Hegger & Dieperink 2015, Norström et al. 2020). Ferguson et al. (2022) identified three process-based factors that increase the likelihood of successful knowledge coproduction: (i) the maturity of relationships within a collaboration; (ii) the level of context-knowledge present in the group; (iii) the intensity of the engagement efforts during the project. The researchers highlight open dialogue and equal, shared power as key principles. In a balanced power-relationship every contribution must be valued and each participant should have an equal opportunity to contribute (Reed et al. 2018).

Knowledge coproduction techniques often consist of iterative elements that allow for reflection and improvement between knowledge exchange actors which helps ensure that specific needs are incorporated into the knowledge production phase to make the results more policy-oriented (Sander 2018). Learning and reflexivity are important elements in coproduction (Norström 2020).

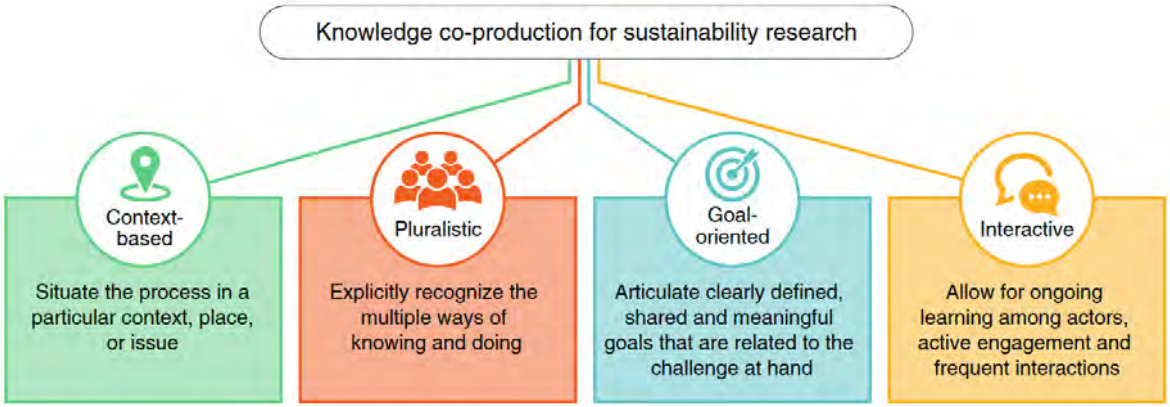


Figure 2. Principles for knowledge coproduction in sustainability research. High-quality knowledge coproduction should be context-based, goals-oriented and interactive (from Norström et al. 2020).

It is proven that information shared at the beginning of the deliberative process and repeated is more salient and perceived as more credible (van Swol et al. 2007).

A key asset of knowledge coproduction is the more inclusive approach compared to the more conventional (linear) way of science-policy exchange. When done properly, it should account for all the interactions between knowledge producers and knowledge users. Therefore, knowledge coproduction requires the design of a tailormade strategy that creates the best possible conditions for collaboration between the different actors, something which requires specific individual and process skills (Molinengo et al. 2021). When designing a collaborative framework some important elements need to be taken into account:

- The process to evaluate and select, stakeholders, process viewpoint and knowledge should be transparent (Wyborn et al. 2019);
- Make sure that when selecting your stakeholders that the group is representative of society or has a holistic view on the topic of interest and allow for a meaningful and inclusive dialogue (Wyborn et al. 2019);
- Power dynamics – some voices or communities will try to have a stronger voice, hence one should make sure all input is equally valued and there's equity between participants (Chambers et al. 2022);
- Capacity of the participants, the frequency and duration of the participative process need to be within the possibilities of the stakeholders (Reed et al. 2018);
- Avoid discussing or addressing philosophical differences on what actors belief what exists or is real or how they produce and value their knowledge. Instead focus on pragmatic collaboration putting mutual respect, trust and shared goals central (Wyborn et al. 2019);

- Provide transparency on how different knowledge claims and perceptions of evidence are reconciled and be accountable (Wyborn et al. 2019);
- Create an environment of psychological safety to stimulate the sharing of critical information, ideas questions and dissenting opinions (Mair et al. 2019);
- The length and frequency of the engagement need to match the goals of the process, recognising that outcomes are highly scale-dependent over space and time (Reed et al. 2018);
- Take the time to understand the local context to determine the appropriate type of engagement approach and adapt the design to the context (Reed et al. 2018).

For a deeper discussion on the intricacies of knowledge coproduction and desired skills, see Wyborn et al. (2019) and Molinengo et al. (2021).

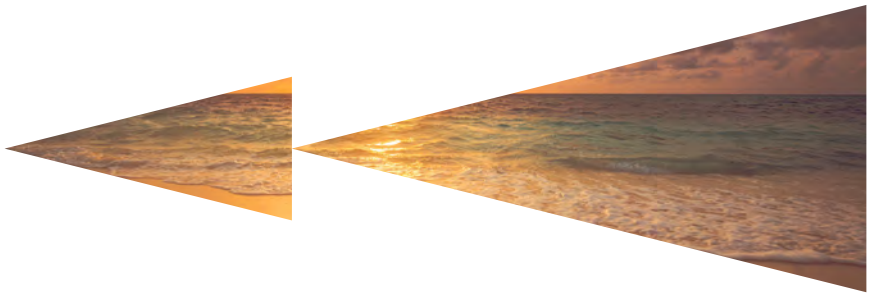
3b.3 Why?

People systematically overestimate their understanding of concepts. The individual human reasoning capacity is limited and subject to confirmation bias and motivated reasoning (see 1.5 Additional insights from a behavioural science perspective). Collective thinking can overcome individual bias and significantly improve the quality of the outcome when collaborative processes are carefully designed (Mercier & Sperber 2011, Mair et al. 2019).

In addition, today there's a growing international belief within science and policy that shifting towards knowledge coproduction will enable science to influence a greater impact on contemporary sustainability challenges than more traditional scientific approaches (Norström et al. 2020). Hence, knowledge coproduction is expected to play a significant part in the global sustainable transformation (Hegger & Dieperink 2015, Wyborn et al. 2019, Norström et al. 2020, Chambers et al. 2022). Evidence that collaborative knowledge- and action making processes lead to more societally relevant research resulting in achieving fair, creative and lasting transformations are growing (Hegger et al. 2012, Hegger & Dieperink 2015, Bennet et al. 2019, Diaz et al. 2019, Pereira et al. 2019, Wyborn et al. 2019, Karcher et al. 2022).

Also, knowledge coproduction – guided by the principle of meaningful inclusivity - inclusivity beyond actors from research and management – can increase the

Requires sustained and transparent engagement.



legitimacy and accountability of the produced knowledge (Wyborn et al. 2019, Chambers et al. 2022). Inclusive science-policy engagement can also contribute to societal transitions and build trust in decision making by empowering local governance and fostering institutional reorganisation (Wyborn et al. 2019).

However, on the downside, coproduction practices have been criticised for insufficiently addressing conflicts, power dynamics, and underlying structural issues (Jagannathan et al. 2020). In addition, the local context and openness of the stakeholders involved play a critical role in the uptake of research in policy making (Goldman & Pabari 2021); therefore, interactive engagement must also be understood as a matter of participation norms and values (Reed et al. 2018). Guidance on navigating such challenges is provided by Chambers et al. (2022).

3b.4 When?

Science-informed decision making requires researchers and policy stakeholders to engage. It is only in recent years that direct and iterative engagement has become a central strategy for fostering political responsiveness, promoting research uptake, and addressing multifaceted environmental and societal challenges (Wyborn et al. 2019, Norström et al. 2020, Ferguson et al. 2022, Karcher et al. 2022, 2024). So too for achieving evidence-informed decision making in ocean and coastal governance (Cvitanovic et al. 2015, Nguyen et al. 2019, Karcher et al. 2022, 2024).

Knowledge coproduction may be pursued to enhance the legitimacy of research outcomes, to ensure the implementation of scientific knowledge in society, or in recognition of the limits of scientific expertise and the value of complementary perspectives (van der Hel 2016). However, some critics argue that coproduction is too focused on local contexts. They question the effort unless its output can be generalised and used widely. Instead, they propose what they consider "co-assessment" - evaluating situations together locally, but without necessarily generating new, broadly useful knowledge (Sutherland et al. 2017, Wyborn et al. 2019).

3b.5 Evaluation[32]

Advantages

- A very effective knowledge-exchange format for generating policy impact and improve the outcome of the decision making process (Cvitanovic et al. 2015, Hegger & Dieperink 2015, Reed et al. 2018, Nguyen et al. 2019, Norström et al. 2020, Chambers et al. 2022, Karcher et al. 2022, 2024);
- Coproduction can rearrange conventional relationships between knowledge and power, science and society, state and citizens (Wyborn et al. 2019);
- Encourages reflexivity through inclusion of different actors, interests and understandings (Hegger & Dieperink 2015, Wyborn et al. 2019);
- A higher accountability and credibility of coproduction outcomes (Hegger & Dieperink 2015, Reed et al. 2018, Wyborn et al. 2019);
- Coproduction fosters collaborative understanding, which can ease tensions, build trust, and enhance commitment to project goals and long-term decision making (Reed et al. 2018);
- Socially engaged research helps researchers to achieve desired societal and scientific outcomes;
- Increases the societal relevance of research (Hegger et al. 2012, Hegger & Dieperink 2015);
- Collaboration produces more actionable science (Nguyen et al. 2019);
- Enhanced sense of ownership of non-scientific stakeholders results in a higher inclusion of environmental and social values (Blue Balance project);
- Can strengthen the role of local communities by building trust, ensuring accountability and consent, and promoting the revitalisation of cultural identities, traditional knowledge, and practices (Hill et al. 2020);
- An interdisciplinary and/or transdisciplinary way of generating new knowledge (Knapp et al. 2019, Ferguson et al. 2022);
- Contributes to a broader empirical knowledge base (Hegger & Dieperink 2015).

Considerations and constraints

- Bottom-up transformation processes can lead to friction with established authorities (Avelino & Rotmans 2009, Lam et al. 2020);
- Researchers must surrender control over research agenda (Oliver & Cairney 2019);
- In some occasions the scientific interests might be unfulfilled (Wyborn et al. 2019);
- Despite growing success and international support, the development of guiding definitions, and frameworks to assess the quality and success of knowledge coproduction don't follow at the same pace resulting in highly diverse definitions, conceptualisations and implementations of the concept (Norström et al. 2020);
- Blurring lines between sectors comes with the risk of diluted accountability (Bovaird et al. 2007, Oliver et al. 2019, Williams et al. 2020);

The listed advantages and disadvantages are possible examples and their likelihood depends on the quality of the coproduction process.

Effective, but requires specific professional skills.

- The threat of unequal access to power, generating knowledge that primarily serves the interests of those already in power can entrench dominant narratives, reinforcing the influence of policy elites or actors with the resources and capacity to engage, while sidelining individuals and communities with fewer means or differing viewpoints (Goldman et al. 2018);
- The promise of ameliorating complex problems and having positive impact is sometimes contested (Oliver et al. 2019);
- Requires specific professional skills at the individual and the process level and implementation can be difficult (Cvitanovic et al. 2015, Reed et al. 2018, Wyborn et al. 2019, Chambers et al. 2021, Chambers et al. 2022);
- Unequal power dynamics – strong voices or the scientific community might take-up a privileged role in coproduction processes (Knapp et al. 2019, Chambers et al. 2021, Chambers et al. 2022);
- When stakeholder and public engagement fails to deliver on expected outcomes, this can ignite latent conflicts, turning a conflict of interests into much deeper and more intractable issues, which may escalate into alienation and distrust (Reed et al. 2018);
- Existing frameworks often focus on how particular practices can help achieve intended aims, hence likely influencing decisions towards specific (social-ecological) outcomes (Djenontin & Meadow 2018);
- Many researchers still have to deal with incentive structures that primarily reward disciplinary science that does not engage with society. At the same time, many scientists work within organisations that do not incentivise critical reflection, ongoing learning and revision of actions (Norström et al. 2020);
- Knowledge coproduction might be lengthy and complex, costing valuable time and resource, possibly making researchers reluctant to engage in knowledge coproduction (Cvitanovic et al. 2015);
- Knowledge coproduction requires a lot of time and effort but is often not sufficiently planned or budgeted for (Karcher et al. 2022b);
- Although well-meant, people can voice an opinion or provide recommendations which aren't supported by empirical evidence (Oliver & Carney 2019);

- Knowledge coproduction can be a lengthy process and as such isn't always suitable to provide short-term policy advice;
- It is important to carefully consider the people you want to engage in knowledge coproduction to reduce the chances of bias, ensure a comprehensive understanding and avoid gaps in information (Hegger et al. 2012);
- Risk of reputational damage for participants or organisations by accusations of bias, partisanship or partiality (Cairney & Oliver 2020);
- Needs clear goals and strategic coordination to reduce the risk of gathering noise (Oliver et al. 2022);
- Participants in engagement activities might not share the same aim (Oliver et al. 2022);
- To fulfill its transformative mandate responsibly and transparently, continuous reflection and purposeful development of process expertise are required (Molinengo et al. 2021).

3b.6 Best practice examples

BLUE BALANCE project (2022-2025) (VLAIO)

BLUE BALANCE aims to increase public engagement and participation in the sustainable transition of the Flemish coastal region. The project is set on developing a social license to operate sustainable (economic) activities. BLUE BALANCE focuses in particular on bringing residents and tourists of the Flemish coastal region into dialogue with local industrial stakeholders and policy makers. To achieve this goal, the project partners are using a multidisciplinary approach that includes social psychology, marine and maritime sciences, archaeology, and media and communication sciences.

Think Tank North Sea:

The Think Tank North Sea, a bottom-up initiative, was established in response to the 2017 North Sea Vision 2050 process, in which three thematic working groups consisting of stakeholders from the quadruple helix (policy, industry, science, society) laid the foundation for developing broadly supported, long-term visions guiding the future use of the Belgian North Sea (BNS) by 2050. In 2019, two new working groups were launched: 'Working with Nature' and 'Living with Climate Change'. Both vision reports formulated recommendations and key principles that stakeholders can consider in their current operations, helping to ensure a sustainable future for the BNS. The findings and recommendations of these two groups have been captured in concise vision documents.

No one-size-fits-all: Effective knowledge exchange begins with selecting the right format for the right context.

Chapter 4

Toolbox for marine science-policy knowledge exchange: a systematic screening of different approaches

4.1 Introduction

Bridging the gap between scientific knowledge and policy action remains a critical yet complex task, particularly in the marine and maritime domains where scientific findings must navigate a landscape shaped by political timelines, sectoral interests, and dynamic socio-ecological systems. However, tackling the major challenges facing the seas and ocean requires accessible scientific knowledge that can be integrated into the decision making process. But a critical gap remains in the understanding of the comparative effectiveness of the available concepts, strategies and activities that can be used to facilitate effective knowledge exchange in relation to coastal and ocean governance (Karcher et al. 2024). Additionally, many science-policy engagement mechanisms remain poorly described, insufficiently specified or evaluated, or are simply unfamiliar to marine scientists, resulting in less effective knowledge exchange, wasted resources, and potentially suboptimal policy outcomes (Mair et al. 2019, Karcher et al. 2022, Oliver et al. 2022).

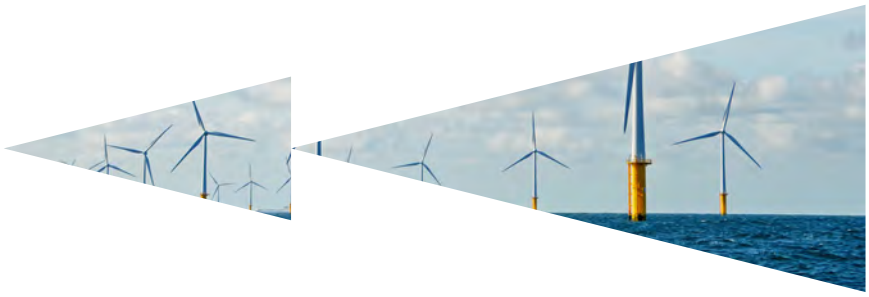
The identification of the most appropriate or suitable knowledge exchange format in a certain occasion or context remains far from straightforward (Cvitanovic et al. 2015, Oliver et al. 2022, Karcher et al. 2022, 2024) and must take into consideration a number of transversal challenges. Key among these challenges is the need to deal with scientific uncertainty and complexity, especially when communicating concisely to time-constrained audiences such as ministers or press. The handling of sensitive or politically delicate information also demands careful consideration, to avoid oversimplification or

Contextualisation is key: to who, what, how and when.

misrepresentation. Moreover, the pursuit of objectivity in science-policy exchanges remains a central concern, i.e. how can information be presented as policy-relevant without becoming prescriptive?

A further complication lies in assessing the 'impact' of science-policy interactions. Impact is not always directly visible or measurable. Is knowledge exchange successful if information reaches policy makers but is not acted upon, or only partially taken up, after weighing it against other interests and sources of information? Does awareness alone constitute impact? These questions reveal the layered nature of influence and the difficulty of establishing causal links between knowledge exchange and decision making.

Underlying this complexity is the fact that policy is not a monolithic entity. Rather, it comprises a diversity of actors, layers, and perspectives – from civil servants and technical experts to ministerial advisers and cabinet members – each operating under distinct constraints and expectations. Effective knowledge exchange must therefore take into account when, how, and what information



is needed, as well as to whom within the policy ecosystem it should be directed. In addition, consideration should be given to how the scientific input aligns with the broader policy cycle: is the information provided in response to a direct request, as part of a policy evaluation, as evidence to inform preparatory processes, or in a more proactive manner in the absence of an explicit policy demand?

In response to the growing call for a more conceptual understanding and practical guidance on which formats and processes offer the greatest return on knowledge exchange investment across varying contexts (Karcher et al. 2022; Oliver et al. 2022; Kaufman and Boxshall 2023), this chapter explores a range of knowledge exchange formats that can be deployed to strengthen the connection between science and policy, and to more effectively inform stakeholders in the marine and maritime sectors, including the blue economy. In doing so, this chapter also responds to the European Commission's Communication on the Guiding principles for knowledge valorisation (COM (2022) 391; see also **1.2 Policy frameworks in support of evidence-informed policy making and knowledge valorisation in the EU**), which calls for benchmarking successful initiatives, ecosystems, and organisations to develop shared concepts and incentives that guide the assessment and implementation of knowledge valorisation processes. The chapter is a science and expert-based effort to provide marine scientists with a user-oriented guide that helps them communicate their research effectively and achieve policy impact. It systematically discusses

various communication formats, explaining what they are, when to use them, and lists their respective main advantages and constraints. To make these formats more tangible and visually accessible, each is accompanied by concrete examples. These examples are based partly on formats used by VLIZ in its role as a knowledge broker towards policy and science communicator, as well as on examples from other organisations in both marine and non-marine contexts.

This chapter explores a range of knowledge exchange formats that can be deployed to strengthen the connection between science and policy, and to more effectively inform stakeholders in the marine and maritime sectors.

Note that this chapter does not offer a universal blueprint, but rather a contextualised overview of the available tools. By examining different formats and their respective strengths and limitations, it aims to guide researchers, intermediaries, and policy makers in making informed choices tailored to the situation at hand.

It should be noted that broad systemic concepts such as 'open data' and 'open access' publications, while not discussed here as standalone knowledge exchange formats, play an essential overarching role in enabling and supporting the accessibility, transparency, and dissemination of scientific information across the science-policy interface.

4.2 Choosing the most appropriate science-policy information exchange format

When choosing for a particular format to convey scientific knowledge to policy actors, several key questions should be considered. Who is the targeted audience? Is there a pressing deadline or time-sensitive decision at stake? How much time and capacity is needed to develop the output? What is the primary goal, simply informing, or actively supporting action? And finally, is the process internal or co-creative?

Who is the targeted audience?

Policy or professional stakeholders

Broad or non-specialist audience

What is the primary goal?

Advice (action oriented)

Informing (knowledge exchange)

Are there deadlines for active knowledge exchange?

Hard deadlines

Soft deadlines

Not applicable

How much time and effort are required?

Very high

High

Moderate

Low

Not applicable

Process characteristics?

Co-creative (external input)

Internal

Not applicable

	Targeted to policy or professional stakeholders	Broad audience
Knowledge-compiling document	v	
Indicator report	v	
Self-initiated policy informing brief	v	
Question-driven policy informing brief	v	
Question-driven targeted information/ advice note	v	
Position paper	v	
Peer-reviewed scientific publication	v	
Scientific white paper	v	
Guideline document	v	
Code of conduct	v	
Infographic	v	v
Digital knowledge platform	v	
Digital GIS platform	v	
Digital indicator platform	v	
Public consultation	v	
Audiovisual information transfer	(v)	v
Social media	v (e.g., LinkedIn)	v (e.g., Facebook, ...)
E-learning module	v	
In-person stakeholder engagement framework	v	
Expert judgement	v	
Face-to-face interview	v	
Living lab	v	
Cross-sectoral exchange programmes and science-policy internships	v	
Science-art collaboration		v
Targeted e-mail campaign	v	v
Artificial intelligence platform		v (passive info flow)

Overview of science-policy information exchange formats in relation to their targeted audience.

	Advice	Informing
Knowledge-compiling document		v
Indicator report		v
Self-initiated policy informing brief		v
Question-driven policy informing brief		v
Question-driven targeted information/ advice note	v	v
Position paper	v	v
Peer-reviewed scientific publication		v
Scientific white paper		v
Guideline document	v	v
Code of conduct		v
Infographic		v
Digital knowledge platform		v
Digital GIS platform		v
Digital indicator platform		v
Public consultation		v
Audiovisual information transfer		v
Social media		v
E-learning module		v
In-person stakeholder engagement framework	v	v
Expert judgement	v	v
Face-to-face interview	v	v
Living lab	v	v
Cross-sectoral exchange programmes and science-policy internships		v
Science-art collaboration		v
Targeted e-mail campaign		v
Artificial intelligence platform		v

Overview of science-policy information exchange formats in relation to their primary goal.

	Hard deadline	Soft deadline	No deadline or not applicable
Knowledge-compiling document		v	
Indicator report		v	
Self-initiated policy informing brief		v	
Question-driven policy informing brief	v		
Question-driven targeted information/ advice note	v		
Position paper		v	
Peer-reviewed scientific publication		v	
Scientific white paper			v
Guideline document			v
Code of conduct			v
Infographic			v
Digital knowledge platform		v	
Digital GIS platform		v	
Digital indicator platform		v	
Public consultation	v		
Audiovisual information transfer			v
Social media		v	
E-learning module			v
In-person stakeholder engagement framework	v		
Expert judgement	v		
Face-to-face interview	v		
Living lab	v		
Cross-sectoral exchange programmes and science-policy internships			v
Science-art collaboration		v	v
Targeted e-mail campaign		v	
Artificial intelligence platform			v

Overview of science-policy information exchange formats in relation to their time sensitivity or deadline constraints.

	Very high	High	Moderate	Low	None
Knowledge-compiling document	v				
Indicator report	v				
Self-initiated policy informing brief		v			
Question-driven policy informing brief		v			
Question-driven targeted information/ advice note			v		
Position paper	v				
Peer-reviewed scientific publication	v				
Scientific white paper		v			
Guideline document		v			
Code of conduct		v			
Infographic			v		
Digital knowledge platform	v				
Digital GIS platform	v				
Digital indicator platform	v				
Public consultation			v		
Audiovisual information transfer	v	v	v		
Social media				v	
E-learning module	v				
In-person stakeholder engagement framework			v		
Expert judgement				v	
Face-to-face interview				v	
Living lab		v			
Cross-sectoral exchange programmes and science-policy internships		v			
Science-art collaboration			v		
Targeted e-mail campaign				v	
Artificial intelligence platform					v

Overview of science-policy information exchange formats in relation to their time and capacity needs.

	Co-creative	Internal	Not applicable
Knowledge-compiling document	v		
Indicator report	v		
Self-initiated policy informing brief	v	v	
Question-driven policy informing brief	v	v	
Question-driven targeted information/ advice note	v	v	
Position paper	v		
Peer-reviewed scientific publication	v	v	
Scientific white paper	v	v	
Guideline document	v		
Code of conduct	v		
Infographic	v	v	
Digital knowledge platform	v		
Digital GIS platform	v		
Digital indicator platform	v		
Public consultation		v	
Audiovisual information transfer	v	v	
Social media		v	
E-learning module	v	v	
In-person stakeholder engagement framework	v		
Expert judgement		v	
Face-to-face interview	v	v	
Living lab	v		
Cross-sectoral exchange programmes and science-policy internships	v		
Science-art collaboration	v		
Targeted e-mail campaign		v	
Artificial intelligence platform			v

Overview of science-policy information exchange formats in relation to their process characteristics.

Knowledge-compiling document

Goal

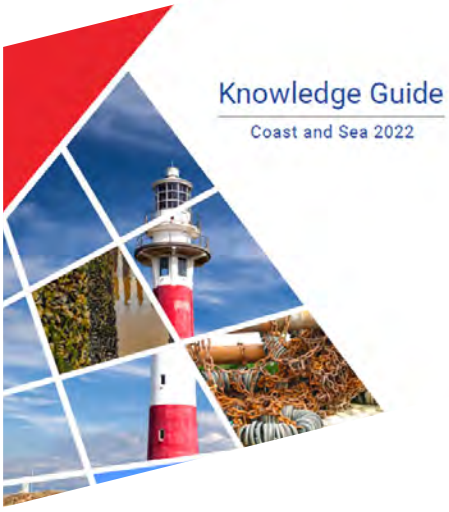
Knowledge-compiling documents support professional stakeholders – including researchers, academics, policy makers, and industry representatives – in navigating the vast and unstructured landscape of information. They serve as a knowledge hub, integrating diverse types of information into a comprehensive, accessible, and thematically structured overview. While not exhaustive, they usually serve to introduce readers to the core concepts of the topic and act as a referral document guiding its users towards more detailed information, datasets, and publications. To enhance accessibility, these documents must be well-structured, allowing users to find key information quickly. A consistent thematic and narrative structure ensures clarity and usability. In some cases, the documents can also be split or presented in the form of individual thematic factsheets.

To facilitate their referencing function, interactive digital versions can be provided, incorporating hyperlinks for direct access to source information. In addition, websites allow for greater interactivity and the use of targeted key words, which significantly enhances the overall searchability and enables users to find relevant information more efficiently.

Knowledge-compiling documents should be objective and neutral, free from judgment, and developed in collaboration with a range of experts. By actively involving diverse stakeholders in the development process the relevance, credibility, and acceptance of the final product increases.

When to use

Knowledge-compiling documents aren't tailored to address specific policy questions. Instead, their strength lies in providing policy makers with a holistic and balanced overview of scientifically substantiated knowledge to support evidence-based decision making.



Holistic and balanced overview of knowledge.

Advantages

→ Integrates fragmented information into a clear, structured overview;

→ Provides a consolidated basis for science-based policy development;

→ Builds credibility through participatory or peer-reviewed development process;

→ Makes complex science accessible and usable;

→ Connects sectors and knowledge cultures;

→ Can act as a catalyst for knowledge sharing and knowledge development;

→ Improves access and searchability of key information;

→ Can act as reference or educational tools for new marine experts or policy makers;

→ Neutral and fact-based approach makes them broadly accepted and fosters trust among stakeholders.

Considerations and constraints

→ Requires significant time, funding, capacity and coordination;

→ Not action-oriented, the impact depends on whether end-users actively consult them;

→ Risk of becoming outdated quickly, especially in fast evolving scientific fields;

→ May lack detail or spatial nuance for effective decision making;

→ Risk of limited policy uptake unless further translated into policy briefs, stakeholder workshops, etc.;

→ Risk of misuse and cherry-picking by policy makers ignoring inconvenient evidence;

→ May underrepresent local or non-academic knowledge.

Example

Knowledge guide Compendium for Coast and Sea

The Knowledge Guide Compendium for Coast and Sea is a comprehensive knowledge resource – both as a knowledge compiling document and online platform (see further) – designed to structure and synthesise scientifically validated and up-to-date information relevant to the marine and maritime domain with a focus on the Belgian North Sea, the Scheldt estuary and the Belgian coastal zone. Its primary objective is to support policy makers, researchers, industry professionals, and other professional stakeholders by providing an accessible and thematically organised overview of the diverse aspects of the different user functions of the Belgian North Sea and coastal zone.

Given the multidisciplinarity and multisectorality of human activities in a marine context, the Compendium adopts an integrated approach, encompassing environmental and ecological insights as well as socio-cultural, economic, and institutional dimensions of the marine system. By offering easy access to the fragmented and disperse marine/maritime scientific knowledge the Compendium for Coast and Sea serves as a user-friendly gateway to expert insights.

Dauwe, S.; Verleye, T.; Pirlet, H.; Martens, C.; Sandra, M.; De Raedemaecker, F.; Devriese, L; Lescrauwaet, A.-K.; Depoorter, M.; Moulaert, I.; Mees, J. (Ed.) (2022). Knowledge Guide Coast and Sea 2022 - Compendium for Coast and Sea. Flanders Marine Institute (VLIZ): Ostend. 267 pp. https://dx.doi.org/10.48470/25

Indicator report

Goal

These documents provide a structured and accessible overview of scientifically validated information and numbers. Like knowledge-compiling documents, they are descriptive by nature and do not provide value judgments on their content. However, while knowledge-compiling documents aggregate a broad range of data and sources, these reports specifically focus on describing developments and identifying trends within a clearly defined thematic framework. The publication may cover multiple topics within a given context, but it can also concentrate on a single theme and explore it in greater depth.

Serving as neutral documents, they provide data and indicators accompanied with factual context, but without evaluation or targeted policy-driven recommendations.

When to use

The primary function of indicator reports is to translate data and factual information into insight, often using accessible visual formats (graphs, graphics, etc.). In doing so, they are very suitable to identify and monitor specific phenomena and trends. Indicator reports do not necessarily directly address specific policy questions. Instead, their role is rather informative, providing policy makers with scientifically substantiated knowledge to support decision making.

Advantages

→ Suitable to monitor progress towards policy goals;

→ Supports evidence-based decision making by visualising contextualised data to assist policy makers in understanding trends, emerging risks, etc.;

→ Tracking trends allow for adaptive management;

→ Supports awareness raising by visualising complex data in an accessible way;

→ Stimulates factual dialogue between stakeholders;

→ Benchmarking allows to compare states and trends across countries or regions;

→ Acts as a valued foundation for scientific reviews or synthesis reports (IPBES, IPCC) by linking empirical trends to systemic drivers or management responses.

Considerations and constraints

→ Requires significant time, funding, capacity and coordination to develop and maintain;

Focus on identifying and monitoring specific trends.

→ Not action-oriented, the impact depends on whether end-users actively consult them;

→ Risk of becoming outdated quickly, especially in fast evolving scientific fields;

→ Risk for ineffective policy responses due to lack of background knowledge to interpret indicators correctly;

→ Updates are time consuming, hence they are less adequate to capture fast-changing developments requiring urgent decisions;

→ The choice of indicators usually depends on data availability, political agendas or institutional priorities, risking to marginalise less quantifiable, but potentially equally important issues;

→ The development of relevant indicators requires input from different stakeholders (science, policy, local expert knowledge, etc.), increasing the workload.

Examples

Indicator report Marine Research and Innovation

This periodic report offers a comprehensive insight into the Belgian marine research landscape. It monitors developments across various aspects of the Belgian marine science landscape using a replicable and standardised methodology. It zooms in on trends related to research capacity, research disciplines, output, (international) collaborations, project funding and the availability and use of large research infrastructures.

KustINzicht 2025

KustINzicht 2025 is a joint publication of VLIZ and Streekhuis Kust of the Province of West Flanders. It is developed as a region-specific knowledge guide, providing policy makers and stakeholders with objective data, maps, and information on developments and processes relevant to the Belgian coastal zone. It covers key local themes such as the unbalanced demography, the specific economic profile and a natural environment under pressure from human activities and climate change. The geographical focus makes it directly applicable for highlighting challenges and opportunities to local administrations.

Pirlet, H.; Dauwe, S.; Verleye, T.; Lescrauwaet, A.-K.; Lust, H.; Bouchti, Z.; Verreet, G.; Janssen, C.; Mertens, T.; Mees, J. (2023). Indicator report Marine research and innovation 2023. Compendium for Coast and Sea. Flanders Marine Institute (VLIZ): Ostend. 61 pp. https://dx.doi.org/10.48470/70

Dauwe, S.; Verleye, T.; Depoorter, M.; Maelfait, H.; Pirlet, H.; Lonneville, B.; Mees, J. (2025). KustINzicht 2025. Compendium for Coast and Sea. Vlaams Instituut voor de Zee (VLIZ): Oostende. ISBN 9789464206326. 219 pp. https://dx.doi.org/10.48470/98

Self-initiated policy informing brief

Goal

A self-initiated policy-informing brief (SIPIB) refers to a document proactively created by an organisation, scientist, or knowledge broker to inform policy makers or guide the political discourse, without being directly requested or commissioned by an authority or policy maker. A SIPIB supports evidence-informed decision making by providing timely, credible and relevant information to the policy maker. This type of brief is typically developed to raise awareness on emerging issues, highlight gaps in existing knowledge, or introduce new topics which aren't yet on the political agenda or need to be reframed. It aims to provide evidence-based insights, trends, or recommendations on a clearly defined topic, with the goal of supporting policy makers in their decision making process and encouraging dialogue between scientists, policy makers and other stakeholders. The content of a SIPIB provides a clear and accessible summary of the most current scientific knowledge, incorporating objective data, information, and evidence. These briefs are also made publicly available to ensure that the information reaches a broader audience, contributing to greater transparency and knowledge sharing which ultimately build trust and improve impact.

When to use

A SIPIB is best used when an organisation wants to raise awareness of new or pressing issues that have not yet been addressed in policy, or when gaps in existing knowledge are identified that require attention. In such cases, targeted, objective, and evidence-based insights on a particular policy-relevant subject can be shared directly with relevant policy makers. This can occur at any time, but is likely to be more effective when aligned with ongoing policy processes, such as policy development, evaluations, or regulatory reviews.

Advantages

→ Supports proactive policy and long-term thinking by highlighting emerging issues, risks, or opportunities;

→ Allows scientist to respond to current events, or urgent concerns without a political request;

→ Sharpens the skills of scientist to communicate and frame their research for political purposes;

→ Provides a low-barrier format for communicating scientific evidence to policy;

→ Flexible and can be issued strategically to coincide with ongoing policy processes.

Focus on awareness raising and highlighting knowledge gaps.

Considerations and constraints

→ Resource intensive process while not officially commissioned by a policy body, due to which the uptake of the research findings may be low;

→ Impact largely depends on the credibility of the issuing organisation, the strategic quality of communication, and the presence of established relationships or alignment with ongoing policy processes;

→ Scientists often lack the time, support, or skills to develop effective policy briefs, which additionally draw them away from their core research work;

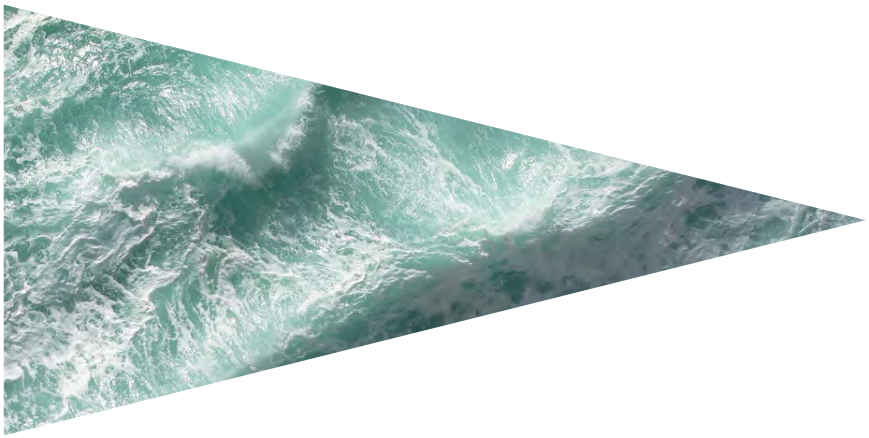
→ The self-initiated character may increase the risk of framing bias or agenda-driven messaging;

→ Risk of oversimplification due to their concise nature.

Examples

SIPIB on marine carbon accounting

Dauwe et al. (2023) provides a scientific review of the topic of marine carbon accounting. It discusses the current approach of the relevant environmental-economic accounting frameworks and touches upon the associated challenges and opportunities linked to marine carbon accounting. It also elaborates on the role that the ICOS Oceans Network can play in this emerging and rapidly developing field and seeks to demonstrate how the VLIZ-ICOS Oceans partnership can be at the core of an effective European marine climate strategy and sustainable regional development.



SIPIB on marine citizen science

van Hee et al. (2020) thoroughly reviews and analyses 127 marine citizen science projects in the North Sea area, and formulates recommendations for policy makers.

Dauwe, S.; Pirlet, H.; Gkritzalis, T.; Landschützer, P. (2023). The opportunities and challenges of marine carbon accounting - a case study for the North Sea shelf ecosystem and the potential value of the ICOS Oceans Network. VLIZ Beleidsinformerende Nota's, 2023_01. Flanders Marine Institute (VLIZ): Ostend. 34 pp. https://dx.doi.org/10.48470/34

van Hee, F.M.; Seldenrath, A.; Seys, J. (2020). Policy Informing Brief: Marine citizen science in the North Sea area and what policy makers can learn from it. VLIZ Beleidsinformerende Nota's, 2020_007. Vlaams Instituut voor de Zee (VLIZ)/Van Hall Larenstein: Oostende/Leeuwarden. ISBN 9789464206029. 35 pp.

Question-driven policy informing brief

Goal

A question-driven policy informing brief (QDPIB) is a document developed to address specific questions or issues that are of immediate concern to policy makers. The clearly defined question or raised issue can come from various angles, including inquiries from the minister or their cabinet, governors, government services at different policy levels, policy advisors, etc.

Unlike self-initiated policy-informing briefs (SIPIBs), which are proactively developed to provide general insights or raise awareness about broader or emerging issues, QDPIBs have a narrower scope because they are created in response to a direct need for information or clarification on a specific topic, often arising from ongoing policy discussions, consultations, societal pressure, or debates. Because they are question-driven, they usually are time-bound and have a higher impact potential compared to SIPIBs.

These briefs are designed to provide policy makers with objective, accurate, and actionable insights. The emphasis lies on clarity, reliability, and relevance and less on drawing a broad picture. They offer a targeted analysis on a certain topic, typically combining background information, key findings, trade-offs and uncertainty, and implications for policy. As such, QDPIBs can help bridge the gap between complex scientific data and practical policy solutions and be a valuable medium to facilitate informed decision making and effective policy implementation. In general, unless otherwise specified by the requester, QDPIBs are made publicly available.

When to use

The use of a QDPIB depends on whether a specific question or issue has been raised by a policy maker to you or your organisation. These briefs are typically requested when policy makers seek focused evidence-based clarifications on a particular subject, often in the context of ongoing policy discussions, debates, or decision making processes. The expectations of the requester on confidentiality, intended use and level of detail required for the information will influence the decision to create a QDPIB or a more concise and confidential question-driven targeted information/advice note (QDTIAN).

Targeted approach, created in response to a direct need for information.

Advantages

→ Directly relevant, action-oriented and demand-driven, increasing the likelihood of targeted information uptake and use by the policy maker;

→ Because of the question, QDPIBs offer a more focused objective synthesis of relevant scientific knowledge;

→ Responding to policy needs, QDPIBs can be effective in building trust and relationships among scientists and policy makers opening long-term knowledge exchange pathways;

→ Contributes directly to better informed, more accountable decisions.

Considerations and constraints

→ Often developed under time constraints, which, under certain circumstances may limit the ability to conduct in-depth research;

→ Unless linked to a funded assignment, this format often requires organisations to mobilise internal capacity quickly without dedicated resources;

→ Because the brief focuses on a specific question from the policy maker, there is often little room to look at the bigger picture or long-term issues;

→ Scientists that are less connected to policy networks risk to be overlooked.

Examples

Risk assessment of proposed exemption shipping routes under the Ballast Water Management Convention

As part of the Belgian exemption procedure under the Ballast Water Management Convention (Regulation A-4), the Belgian federal government (FPS Mobility and Transport) asked VLIZ to conduct an initial database-based analysis of species distributions in selected ports. Using the HELCOM/OSPAR binary risk assessment method, this QDPIB reviews all shipping routes to Belgian ports proposed for exemption and identifies potential risks of introducing invasive species.

National approach to the phase-out of lead use in angling

This QDPIB, commissioned by the Belgian federal government (FPS Public Health – Marine Environment Division), assesses the feasibility of phasing out lead in recreational angling. The report is framed within the ongoing European REACH process, which aims to ban the sale and production of lead fishing weights. It reviews lead-related policies, health and environmental impacts, lead loss, available alternatives, their feasibility, and offers policy recommendations.

Saelens, P.; Verleye, T. (2015). Initial risk assessment under Regulation A-4 of the Ballast Water Management Convention for Belgium using the joint HELCOM/OSPAR Harmonised Procedure. VLIZ Beleidsinformerende Nota's, 2015_002. Flanders Marine Institute (VLIZ): Oostende. ISBN 978-94-920432-0-7. 88 pp.

Verleye, T.J.; Dauwe, S. (2021). Policy Information Brief: Scientific basis for a national approach to the phase-out of lead use in angling. VLIZ Beleidsinformerende Nota's, 2021_05. Vlaams Instituut voor de Zee (VLIZ): Oostende. 46 pp. https://dx.doi.org/10.48470/5

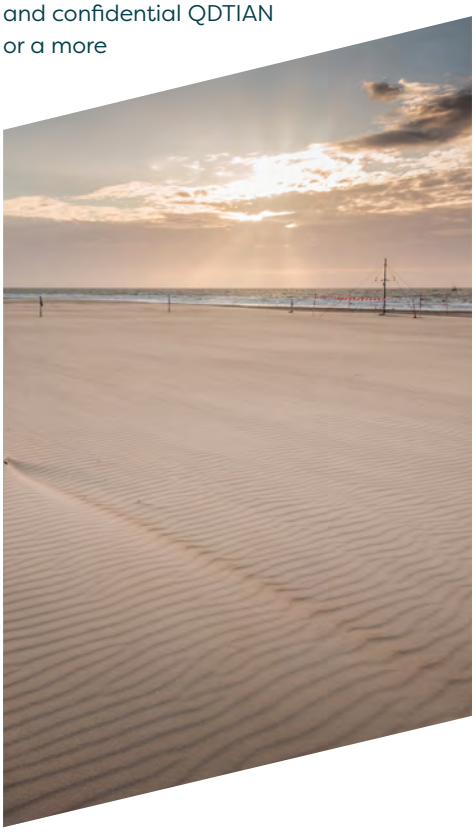
Question-driven targeted information/advice note

Goal

A question-driven targeted information/advice note (QDTIAN) is a more concise document compared to a question-driven policy-informing brief (QDPIB), focusing on providing targeted advice or specific information related to a policy question. These notes are typically shorter (one or maximum a few pages) and offer direct, actionable insights to allow pragmatic evidence-based policy making. The requesters can be ministers and their cabinets, as well as governors, government services, and parliamentary staff. These notes primarily target higher levels of policy. QDTIANs are often highly time-sensitive, created to respond quickly to urgent questions within ongoing policy processes or to supply the necessary scientific background and insights for national or international policy discussions. Unlike QDPIBs, QDTIANs are typically intended for specific policy stakeholder and are not made publicly available.

When to use

These notes are developed when a clear and specific policy question has been asked. They are typically requested when policy makers urgently seek evidence, clarifications, or need actionable insights on a particular subject, often in the context of ongoing policy discussions, debates, public concern, media attention, etc. The expectations of the requester on confidentiality, timing, intended use and level of detail required for the information will influence the decision to create a concise and confidential QDTIAN or a more



Confidential, targeted advice or actionable information in response to a policy question.

comprehensive and publicly available QDPIB. The impact of QDTIAN is generally high.

Advantages

→ Fast response to urgent and targeted policy needs;

→ High likelihood of being read, understood and used in decision making;

→ Tailored to specific policy makers' needs;

→ Focused and actionable;

→ Builds trust and credibility;

→ Effective knowledge-exchange format, it doesn't provide excessive information to the policy maker (see **1.5 Additional insights from a behavioural science perspective: the knowledge-deficit model**).

Considerations and constraints

→ This format requires organisations to mobilise internal capacity quickly;

→ Short deadlines and the concise format may limit the inclusion of nuances, uncertainty and broader scientific context;

→ The opportunity to produce a QDTIAN depends on established relationships and direct requests from decision makers;

→ The policy maker is responsible for clearly and comprehensively stating his/her question in order to get relevant scientific advice.

Examples

Confidential documents

Position paper

Goal

Position papers are strategic documents articulating an organisation's position, or a shared position across a community, on specific topics that are of central importance to the field. They are typically created in the context of ongoing debates, consultations, or policy developments, advocating for particular policy recommendations or actions in policy or research. Position papers are comprehensive, well-structured documents that build a narrative on evidence, policy implications, and desired outcomes. In essence, they use scientific evidence to frame an issue and propose solutions based on a specific perspective on how the issue should be understood and addressed. Although they present evidence, reasoning, and references to justify the organisation's position and proposed recommendations, they also can reflect/represent the values of a certain community or organisation. While scientific research provides the foundation, position papers often aim to engage with current societal issues, public concerns, and the needs of various stakeholders. This requires balancing scientific insights with the practical implications of policy, as well as public and political perspectives.

Position papers are typically written by prominent advisory bodies or boundary organisations. These organisations usually build a network of topic-specific experts from various member organisations to ensure the position paper is well-supported and thoroughly substantiated. This collaborative approach enforces the statements and recommendations and increases the potential impact of the paper. Depending on the nature and practices of the organisation issuing them, position papers can vary significantly in length and level of detail.

When to use

Position papers are documents that are intended to influence a policy process such as the development of new legislation, public consultations, and the development of policy agendas. They can voice the support or concerns of a group of individuals or an organisation to policy makers when they feel the need to influence policy. By communicating in an organised way and acting as a coalition, the aim is to strengthen the likelihood and degree of political impact.

Advantages

→ Allows for a clear communication of a science-based position on a complex issue;

Evidence-based policy advice on key issues, integrating science and society.

→ Strategic and long-term influence allow to proactively shape public and policy debates and research agendas;

→ Enhanced credibility due to diverse input and interdisciplinary validation, as these papers are often developed by expert working groups or advisory bodies;

→ Builds networks, fostering mutual understanding and trust;

→ Represents the shared position of an organisation or a group of stakeholders;

→ Flexibility in scope and detail, allowing organisations to tailor the length and complexity to fit the intended audience, from high-level overviews to in-depth analyses.

Considerations and constraints

→ The need for consensus-building and expert consultation is a resource and time-intensive process;

→ The strategic nature and longer development time make position papers less ideal for responding quickly to emerging policy questions;

→ The effectiveness and impact largely depend on the reputation of the issuing organisation and contributors of the position paper;

→ If the tone of the position paper or the statements are made in a way that the space for compromise or dialogue is perceived too limited by the policy maker, the willingness to take these statements into account may be negatively impacted;

→ The voicing of a certain position may lead opposing stakeholders to question scientific integrity or neutrality.

Examples

European Marine Board (EMB) position papers

Position papers provide in-depth analysis of a certain scientific topic that include an overview of the current state-of-the-art based on existing literature and policy-relevant recommendations. EMB position papers are typically around 100 pages long and structured around four to eight main chapters. They are authored by members of EMB Working Groups and are peer-reviewed by a minimum of two external reviewers and are subject to internal review by EMB member organisations.

World Health Organization (WHO) position papers

In accordance with its mandate to provide guidance to member states on health policy matters, WHO publishes vaccine position papers providing global vaccine and immunisation recommendations for diseases that have an international public health impact. The papers summarise essential background information on the respective diseases and vaccines, and conclude with the current WHO position concerning their use in the global context. The papers are designed for use by national public health officials and immunisation programme managers. They may also be of interest to international funding agencies, the vaccine manufacturing industry, the medical community, and the scientific media.

https://www.marineboard.eu/publications/position-paper

https://www.who.int/teams/immunization-vaccines-and-biologicals/policies/position-papers

Peer-reviewed scientific publication

Goal

Peer-reviewed scientific publications are a cornerstone of scientific progress. They serve as a platform for researchers to share their findings with the scientific community and to discuss the methodologies used in detail. The thorough expert evaluation within the peer-review process ensures that the scientific rigour and methods are applied to the highest standards. This process strengthens the credibility and reliability of published research.

While these publications were traditionally restricted behind paywalls, accessible only to subscribed partners at significant costs, recent years have seen a shift towards open-access publishing. This transition has improved the visibility of scientific knowledge, making research findings more accessible beyond the academic world. However, these publications often use specialised terminology, requiring prior knowledge of the topic and a certain familiarity with science/scientific papers to fully grasp the nuances. As a result, scientific articles may not always be easily comprehensible to those unfamiliar with the field.

When to use

In the context of policy support, peer-reviewed scientific publications often are the primary source of information that leads to evidence-based policy making, providing rigorously validated insights on a wide range of topics. However, despite increased accessibility (open-access), scientific publications are often technical, extensive, and not directly aligned with specific policy questions. In addition, while peer-reviewed publications provide the foundational knowledge for science-policy interactions, policy makers rarely have the time or expertise to extract relevant insights from the vast body of scientific literature. Instead, they rely more on structured, synthesised information that is tailored to their specific needs. In this way, rather than serving as a direct component of the information flow between science and policy, peer-reviewed scientific publications act as the primary source of scientific knowledge for the development of question-driven policy-informing briefs (QDPIBs), self-initiated policy-informing briefs (SIPIBs), or question-driven targeted information/advice notes (QDTIANs). These formats are better suited to bridge the science-policy gap by selecting, interpreting, and summarising relevant scientific findings into concise, policy-relevant messages.

Provide foundational knowledge, but often too technical and not aligned with policy needs.

Advantages

→ The peer-reviewed process ensures maximal scientific credibility and rigor, hence policy makers can trust its insights and conclusions;

→ The methods, data, information and assumptions used to reach new insights are clearly stated in the paper, ensuring maximum transparency;

→ Are generally the go-to information source to draft more accessible policy relevant products like policy briefs, advisory reports, etc.;

→ The first source to get to know new scientific insights.

Considerations and constraints

→ Sometimes difficult to access due to paywalls or membership procedures;

→ Written in technical language making them hard to understand by policy makers without a good scientific background;

→ Publishing peer-reviewed papers is a time-consuming process, which may make them less suitable to respond to urgent or highly rapidly evolving policy questions;

→ Designed to answer research question and not to inform policy directly;

→ Their impact usually depends on intermediaries like knowledge brokers or science communicators.

Examples

Academic publishers

https://www.frontiersin.org/

https://www.elsevier.com/

https://www.science.org/

Scientific white paper

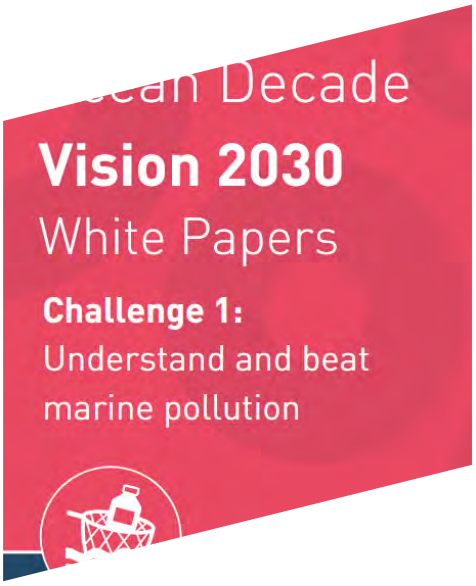
Goal

Scientific white papers are strategic documents with a forward-looking element. Like position papers and to a degree policy briefs, they outline the state of scientific knowledge, highlight emerging issues, try to address knowledge gaps and define research or policy priorities. White papers on the contrary, are more practical in nature, aimed at providing scientific or expert-validated solutions or informing decision making in policy or industry on a particular topic. They are never reactive but always contain a vision for the future.

White papers are usually self-initiated by organisations, think tanks, or research institutions (or industry – i.e. commercial white papers to promote a product or service) to share knowledge and communicate innovation in an effective way, serving as a bridge between scientific research and practical applications. While white papers typically do not undergo the same rigorous peer-review process as scientific papers, they are often reviewed internally by experts or stakeholders within the organisation or field of interest to ensure credibility.

When to use

White papers are often intended for a non-academic audience, including policy makers, industry, or the public, and provide evidence-based insights in an accessible way to inform decision making and influence policy or industry practices. Scientific white papers are used when the goal is to communicate scientific findings or recommendations clearly, concise, and accessible, often to guide public policy, inform about emerging risks and opportunities, shape future research directions, or highlight key challenges and solutions in science.



Expert-driven, future-focused guidance to inform policy or industry decisions.

Advantages

→ More accessible than peer-reviewed papers;

→ No peer-review process, hence faster to develop and update than peer-reviewed articles;

→ High credibility due to engagement of networks and expert validation;

→ Can have significant impact on policy;

→ Designed to directly inform policy makers and provide actionable recommendations.

Considerations and constraints

→ The production of white papers can be a time and resource consuming activity;

→ Reach depends on how well the organisation or stakeholder group is networked with policy and the effectiveness of the communication strategy.

Examples

Springer Nature white papers

https://www.springernature.com/gp/open-science/about/whitepapers

Ocean Decade Vision 2030 white papers

https://oceandecade.org/publications/ocean-decade-vision-2030-white-papers/

European Space Agency (ESA) white papers

https://www.esa.int/Science_Exploration/Human_and_Robotic_Exploration/Research/The_SciSpacE_White_Papers

Guideline document

IUCN Guidelines for the Prevention of Biodiversity Loss Caused by Alien Invasive Species

Goal

Guideline documents are structured, evidence-based resources that provide practical and standardised recommendations, best practices, or procedures to support decision making in specific fields. They are developed based on scientific research, expert consensus, and stakeholder input and are widely used in policy, regulatory frameworks, and scientific disciplines to ensure consistency, quality, and compliance with established norms. Such documents are published by various organisations, including international organisations (e.g., International Maritime Organization - IMO, International Union for Conservation of Nature - IUCN), scientific associations (e.g., International Council for the Exploration of the Sea - ICES), science-policy interface organisations (e.g., Joint Research Centre - JRC, European Environmental Agency - EEA) and government agencies (e.g., European Commission - EC).

Unlike policy-informing briefs (SIPIBs, QDPIBs) or position papers, guideline documents take a more technical approach, focusing less on advocating a particular viewpoint and more on offering a structured framework (recommendations, protocols, procedures) for action based on existing knowledge. While they are typically advisory rather than mandatory, guideline documents can strongly influence policy and practice, shaping how regulations, research methodologies, and industry standards are applied.

When to use

Guideline documents are developed when there is a need for evidence-based practical (methodological) recommendations to assist decision making, and ensure best practices are implemented in a specific field.

Advantages

→ Can provide best-practice instructions (including standardisation) on the implementation of scientific and policy insights;

→ The translation of complex, multidisciplinary knowledge into actionable guidelines;

→ Can provide a benchmark/tool to assess compliance or evaluating performance.

Evidence-based, practical frameworks to standardise and support decision making.

Considerations and constraints

→ Less responsive to progressive insights if not regularly reviewed, however, once formalised may not allow for much flexibility;

→ Well thought-trough guidelines require a time-consuming, well-coordinated effort;

→ Guidelines risk to insufficiently account for the local context.

Examples

IMO – Biofouling Guidelines

The IMO Biofouling Guidelines aim to minimise the transfer of invasive aquatic species by addressing biofouling on ships and other marine structures. They provide best practices for the management of biofouling through design, maintenance, and cleaning. The goal is to protect marine ecosystems while maintaining vessel performance and safety.

https://www.imo.org/en/OurWork/Environment/Pages/Biofouling.aspx

IUCN – Guidelines for prevention of biodiversity loss caused by alien invasive species

The IUCN Guidelines aim to prevent biodiversity loss by reducing the introduction and spread of invasive alien species. They provide a framework for risk assessment, early detection, rapid response, and long-term management. The focus is on safeguarding ecosystems, native species, and ecological integrity.

https://portals.iucn.org/library/efiles/documents/Rep-2000-052.pdf

ICES – Guidelines

ICES Technical Guidelines offer practical, standardised methods and protocols to support marine data collection, monitoring, and assessment activities. They cover a wide range of topics, from survey design and sampling techniques to data processing and quality assurance, ensuring consistency and scientific rigor across marine research and advisory work.

https://www.ices.dk/advice/Pages/technical_guidelines.aspx

Code of conduct

Goal

Codes of conduct are formal documents that define ethical principles, standards of behaviour, and best practices for collaboration, communication, and the use of data and information. They are intended for individuals, stakeholder groups, projects, or organisations operating within a specific field or sector, and aim to ensure adherence to commonly accepted values and professional standards.

In some cases, they also serve as a self-regulatory tool for professional communities, reducing the need for direct regulatory intervention. In parallel to guideline documents, codes of conducts are developed by various organisations, including international organisations (e.g., International Union for Conservation of Nature – IUCN, Food and Agriculture Organization of the United Nations - FAO), scientific associations (e.g., International Council for the Exploration of the Sea - ICES), science-policy interface organisations (e.g., Joint Research Centre - JRC), government agencies (e.g., European Commission - EC) and universities. Those documents are often binding for members of a specific organisation or institution and may have legal or disciplinary consequences if violated.

When to use

Codes of conduct are primarily an ethical and procedural document, and therefore are not typically considered a direct science-policy medium. However, they indirectly support the science-policy process by setting standards for how scientists and policy makers interact and collaborate. In general, they should be used when multiple actors with differing norms and expectations are working together (e.g., science, policy, industry, civil society) or in situations where there are potential power imbalances or risks of misconduct, as they help establish a common understanding of acceptable behaviour and prevent conflict. Adhering to the principles of a code of conduct, is essential to

Ethical standards to encourage responsible collaboration across sectors.

build trust and credibility in science-policy exchanges.

Advantages

→ As a sign of professionalism, transparency and integrity, code of conducts help to build trust among scientists and policy makers;

→ They define the boundaries of what scientists can and cannot do;

→ Encourages inclusive, respectful and equitable knowledge exchange;

→ Encourages consistency and professionalism in how evidence is presented and discussed.

Considerations and constraints

→ Strict code of conducts may discourage creativity, informality or avoid having sensitive conversations;

→ Can introduce unnecessary procedural complexity and become a box-ticking exercise;

→ Can be too generic or be too specific;

→ Unless supported by a strong institutional mandate, code of conducts may be unenforceable, reducing its effectiveness.

Examples

ICES – Code of ethics and professional conduct

The code provides guidance on good scientific practice, identifying and handling actual, potential, or perceived conflicts of interest, defines the standard for behaviour of participants in ICES activities, and sets the responsibilities of those contributing, including environmental responsibilities.

FAO – Code of conduct for responsible fisheries

The code aims to establish international principles for responsible fisheries, covering biological, technological, economic, social, and environmental aspects. It supports the development of national and international policies, legal frameworks, and cooperative efforts to ensure sustainable fisheries management and conservation. Additionally, it promotes food security, fair trade, ecosystem protection, and high standards of conduct within the fisheries sector.

EC – The European code of conduct for research integrity

The code provides a framework for responsible research practices across Europe. It outlines key principles, such as reliability, honesty, respect, and accountability, and offers guidance on good research conduct, data management, publication, and collaborative work. It serves as a reference for researchers, institutions, and funding bodies to promote integrity and prevent misconduct in all stages of the research process.

https://www.ices.dk/about-ICES/how-we-work/Pages/Code-of-conduct.aspx

https://www.fao.org/4/v9878e/v9878e00.htm

https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/european-code-of-conduct-for-research-integrity_horizon_en.pdf

Infographic

Goal

Infographics are visual representations of information, data, or knowledge that simplify complex content, presenting it in a clear, concise, and engaging manner. They are usually linked to more detailed knowledge documents, such as knowledge-compiling documents, policy briefs, scientific papers, etc. Their primary role in the science-policy process is to quickly highlight core data, trends, and developments, enabling policy makers to quickly grasp essential insights. Additionally, infographics should encourage readers to explore the accompanying documents for more comprehensive and nuanced information. Ideally, infographics should also include critical elements, such as challenges, risks, and uncertainties, that require further consideration in the policy process. By doing so, infographics contribute to a more informed and balanced policy dialogue, bridging the gap between scientific evidence and practical policy making.

When to use

Infographics are most effective when there is a need to visually summarise complex information in a format that is engaging and easy-to-understand. They should be used in situations where quick comprehension of key data, trends, or relationships is important, especially for busy decision makers or a broader audience. They are designed to help reinforce the take-home messages.

Advantages

→ Clear visuals foster shared understanding of complex issues across disciplines and sectors;

→ Complements policy briefs, presentations or other written or spoken specialist content;

→ Helps to quickly draw attention to the key message(s);

→ Reduces cognitive load and improves long-term retention of information;

→ Appealing to visually oriented policy makers with limited time;

→ Makes data more actionable, encouraging evidence-informed decision making;

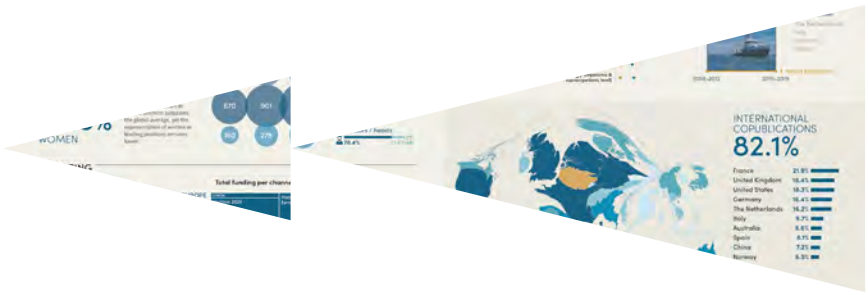
→ Good format for digital dissemination (social media, newsletters, reports, etc.);

→ Stakeholders can interact with the visual story behind written documents.

Considerations and constraints

→ Poorly designed infographics can be misleading;

Translation of complex data into clear visuals, guiding quick insight while linking to deeper sources.



→ Not a substitute for full explanations;

→ No or limited room for nuances or the communication of uncertainty;

→ Design requires specific visual communication skills and resources;

→ The visual framing (scale, color, symbols, positioning, etc.) can influence interpretation;

→ Effectiveness varies by audience.

◄ Examples

VLIZ – Marine Research and Innovation 2023

The infographic offers a comprehensive mapping of the Belgian marine research landscape. It focuses on trends related to research capacity (number of research groups and researchers), output (bibliometrics), (international) collaborations, and funding for research and innovation projects.

VLIZ – KustINzicht 2025

The infographic covers key local themes with respect to the Belgian coastal zone, such as the economy, population, climate, environment, and tourism, with a particular emphasis on identifying and presenting trends within these areas.

https://www.vliz.be/sites/vliz.be/files/2023-11/2023-11-IndicatorReport_infographic.pdf (accompanying document: https://www.vliz.be/en/imis?module=ref&refid=368316)

https://www.vliz.be/testerep/sites/vliz.be.testerep/files/2025-02/2025-02-infografiek-KustINzicht_final.pdf (accompanying document: https://vliz.be/nl/imis?module=ref&refid=405586)

Digital knowledge platform

Goal

Digital knowledge platforms are online repositories designed to centralise, structure, and disseminate scientific knowledge in an accessible and interactive manner. They serve as long-term knowledge hubs that compile and contextualise scientific findings, making them available to a broad (professional) audience, including policy makers, researchers, and stakeholders. Unlike static documents, these platforms often incorporate interactive features such as data visualisation, search functionalities, and direct links to related studies or datasets.

An optional extension is the integration of knowledge graphs, i.e. structured networks that map relationships between key concepts, indicators, policies, and experts. When combined with AI-driven chatbots, this allows users to explore complex scientific content through intuitive, conversational interfaces. In this way, knowledge can be offered in a pre-digested and personalised format, tailored to the user's specific questions or information needs. Digital knowledge platforms support dialogue between science and policy and evidence-informed decision making by facilitating access to and the sharing of scientific insights on a specific or broader topic within a single, comprehensive platform.

When to use

Digital knowledge platforms are especially valuable as centralised reference points for evidence-based decision making and for helping policy makers and stakeholders to quickly find the relevant evidence or tools (graphs, expert contact details, maps, etc.). Their nature as a multifunctional repository makes them particularly relevant for multisectoral or cross-border collaboration which is why they are often used in international agreements or missions like the UN Decade of Ocean Science for Sustainable Development.

A long-term knowledge hub that compiles and contextualises scientific findings

Usually, digital knowledge exchange platforms are frequently updated, which makes them particularly useful in data-intensive and fast-moving science-policy domains (marine spatial planning, environmental monitoring, climate change, etc.). They can thus act as living repositories and interaction spaces that enable dialogue and knowledge co-production.

Moreover, digital knowledge platforms are particularly useful when long-term access to structured, validated, and contextualised scientific knowledge is required. Unlike question-driven policy informing briefs (QDPIBs) or question-driven targeted information/advice notes (QDTIANs), which address immediate questions, these platforms provide information that remains relevant over extended periods.

Advantages

→ Centralises knowledge and data in one place;

→ Available 24/7 for stakeholders all over the world;

→ Can visualise trends and relationships through dashboards and maps (see also 'digital GIS platform' and 'digital indicator platform');

→ Transparent instrument for evidence-informed decision making.

Considerations and constraints

→ Requires a lot of time and resources to develop and keep up-to-date;

→ If not regularly updated they can quickly become outdated;

→ Prone to information overload, reducing its overall applicability.

Example

Compendium for Coast and Sea

The digital knowledge platform Compendium for Coast and Sea is a comprehensive knowledge resource designed to structure and synthesise scientifically validated and up-to-date information relevant to the marine and maritime domain with a focus on the Belgian North Sea, the Scheldt estuary and the Belgian coastal zone. Its primary objective is to support policy makers, researchers, industry professionals, and other professional stakeholders by providing an accessible and thematically organised overview of the diverse aspects of the different user functions of the Belgian North Sea and coastal zone.

Given the multidisciplinarity and multisectorality of human activities in a marine context, the Compendium adopts an integrated approach, encompassing environmental and ecological insights as well as socio-cultural, economic, and institutional dimensions of the marine system. By offering easy access to the fragmented and disperse marine/maritime scientific knowledge the Compendium for Coast and Sea serves as a user-friendly gateway to expert insights.

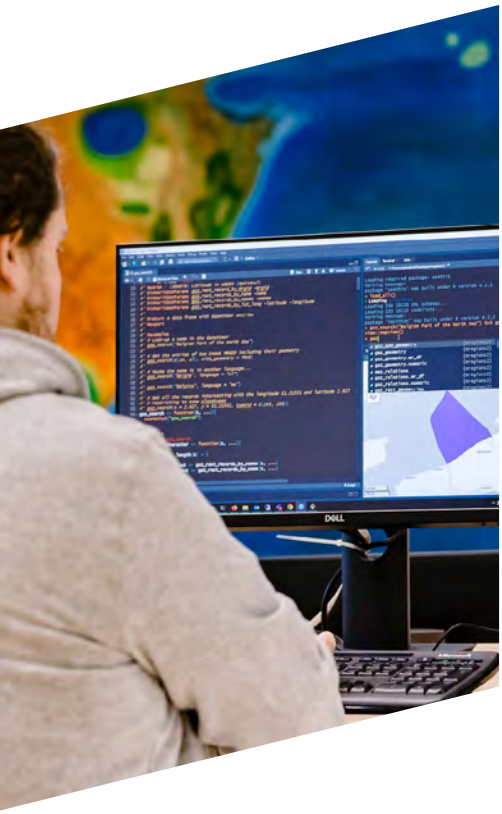
World Bank Group - Climate Change Knowledge Portal

The portal offers an online platform for accessing and analysing comprehensive data on climate change and development. Part of the functionalities can also be categorised under 'digital indicator platforms'.

www.compendiumcoastandsea.be

https://climateknowledgeportal.worldbank.org/

Digital GIS platform



Goal

Digital GIS platforms are interactive geospatial tools designed to visualise, analyse, and communicate spatial data relevant to science and policy. They offer map-based interfaces that allow users to explore geographic patterns and trends in environmental, ecological, and socio-economic data. These platforms help translate often complex datasets into actionable insights by integrating layers of information and providing filtering functionalities. GIS platforms are valuable tools for both communication and analysis, supporting scenario exploration for decision making.

When to use

Digital GIS platforms are particularly effective when spatial context is essential for interpreting scientific information or for informing policy actions. They are ideal for applications such as environmental monitoring, marine spatial planning, biodiversity assessments, spatial impact analysis, and the exploration of spatial patterns in socio-economic variables. These platforms enable users to interact with data visually and geographically, making them accessible to both technical and non-technical audiences. They are especially useful for ongoing projects or policies that rely on regularly updated spatial data.

Advantages

→ Provides policy makers with spatial insight, helping to visualise and understand patterns like coastal erosions, sea level rise, marine spatial planning, distribution of pollutants, etc.;

→ Combining several layers facilitates the integration of multidisciplinary data and hence stimulates an integrated policy approach;

→ Visualising different knowledge types promotes cross-sectoral discussions and collaboration;

→ Many platforms present open-access data, promoting the visibility of science and increasing trust in science;

→ Useful for tracking the effectiveness of policy measures (pollution mitigation, marine protected areas);

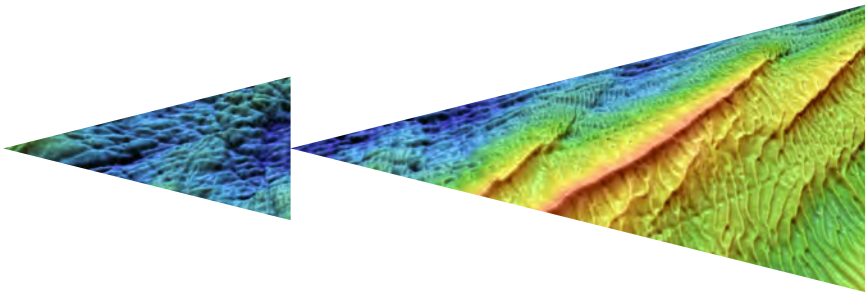
→ Can support monitoring and reporting obligations;

→ Maps are powerful visuals with a lot of communication potential.

Considerations and constraints

→ Quality depends on the amount and size of the data gaps and the

Visualisation, analysis and communication of spatial data relevant to policy.



availability of high-resolution up-to-date data;

→ The usefulness of GIS platforms is reduced when different data sources use incompatible formats, making it harder to compare data and reach a shared understanding;

→ When GIS platforms are developed using only the most readily accessible data, without evaluating more appropriate or reliable datasets, they risk conveying a false sense of objectivity or certainty;

→ Long-term hosting, updating and governance requires clear arrangements and consistent resources.

Examples

Coastal Portal

The Coastal Portal ('Kustportaal') is a geoportal offering visualisations of spatial data of the Belgian coastal zone and the Belgian North Sea. It provides a wide range of ready-made maps and allows users to custom make their own maps through an interactive geoviewer. It also functions as a referral portal to a vast range of information, figures and data on the Belgian North Sea and coastal zone.

European Atlas of the Seas

This digital GIS platform provides spatial information, data and maps on Europe's marine environment. It covers a wide range of topics, such as the environment, tourism, energy, aquaculture, fishing, etc. The platform is designed for researchers, professionals, students, or anyone wishing to explore the European seas.

https://www.kustportaal.be/en

https://ec.europa.eu/maritimeaffairs/atlas/maritime_atlas/

Digital indicator platform

Goal

Digital indicator platforms are designed to present structured, quantitative information through a set of key indicators that track changes and trends over time. As such, these platforms offer policy makers a concise and evidence-based overview of developments within a specific area and enable users to quickly grasp the status, evolution, and potential gaps or risks related to policy objectives.

When to use

Digital indicator platforms are particularly useful when monitoring progress towards policy targets or assessing the state of a system through standardised metrics. They are effective tools for high-level reporting, strategic planning, communication, and decision support. While essentially offering a one-way information flow, many platforms allow for interactivity in the form of user-driven filtering, downloading data, etc. When multidisciplinary in nature, indicator platforms can promote mutual understanding and foster dialogue among sectors such as fisheries, conservation, transport and energy. In addition, indicators are a useful tool to communicate marine science to decision makers, journalists, citizens and other stakeholders.

Advantages

→ A useful way of translating complex scientific findings into policy-relevant insights;

→ Offers a common reference point between disciplines and stakeholders and as such stimulate interdisciplinary dialogue;

→ Standardised indicators support evidence-based policy and enable the monitoring and evaluation of policy-related developments over time.

Considerations and constraints

→ Maintaining and updating digital indicator platforms requires sustained effort and resources;

Tracking progress or system status using standardised metrics.

→ Gaps in data availability or time lags between data collection and platform updates may undermine the platform's usefulness for real-time decision making;

→ Policy makers may consult indicator platforms without consulting researchers or explore underlying knowledge, risking misinterpretation;

→ Indicators may conceal local variation and uncertainty;

→ Indicators that are hard to measure may be excluded despite their potential relevance, hence there's a risk of bias in the choice of indicators.

◄ Examples

OSPAR Quality Status Report (QSR) 2023

The QSR 2023 uses indicators to assess the status and trends in the condition of the North-East Atlantic.

European Environment Agency (EEA) – Seas and Coast Indicator Platform

A marine indicator platform to monitor the state and pressures on European seas, as well as track progress towards environmental policies and targets. Indicators are developed for topics such as tracking non-indigenous marine species, hazarduous pollutants, sea level rise, status of fish and shellfish stocks, etc.

European Commission – EU Blue Economy in depth analytical tool

This platform reports Blue Economy indicators.

Ocean Health Index (OHI)

A framework for assessing ocean health based on the sustainable provisioning of benefits and services people expect from healthy oceans, such as food, cultural and social value, and jobs. The OHI framework can be tailored to different spatial scales and accommodate a range of contexts and values.

Wavelinks – dashboard

Platform that maps the research and innovation landscape of the Mission Ocean, fosters collaborations between projects and reinforces links between academia, industry and society. Their mission is to ensure that valuable insights and discoveries no longer remain isolated but instead become catalysts for innovation and progress.

https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/

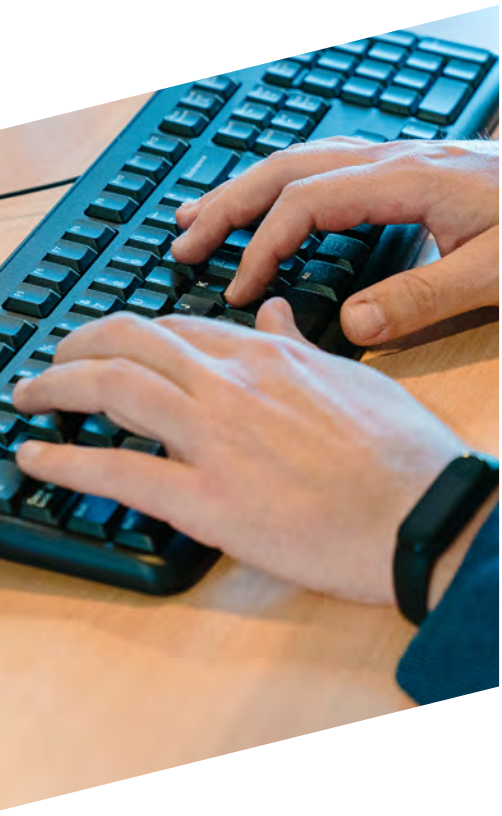
https://www.eea.europa.eu/en/analysis/indicators

https://blue-economy-observatory.ec.europa.eu/depth-analytical-tool_en

https://oceanhealthindex.org/

https://wavelinks.eu/dashboard

Public consultation



Goal

Public consultations (here referring to 'online surveys') are formal mechanisms through which policy makers actively gather input from individuals, organisations, and experts in the context of regulatory reviews, policy evaluations, or the development of new initiatives. While the flow of information is primarily one-way – from science to policy – the content provided is highly policy-relevant because the consultations are framed by targeted questions that directly reflect the information needs of policy makers. Policy makers may use public consultations for multiple purposes. First and foremost, they offer an efficient way to access expert insights and local knowledge. In addition, public consultations help identify and address concerns early in the process, increase the likelihood of broad public acceptance, improve the chances of effective implementation, and enhance the transparency and accountability of the policy process. Public consultations are therefore structured opportunities that directly contribute to evidence-informed and socially accepted policy making.

When to use

Public consultations can be a legal or procedural requirement (e.g., public consultations under the Marine Strategy Framework Directive (Directive 2008/56/EC) or be solely voluntary to enhance legitimacy. Professional stakeholders (scientists, organisations, industry) may be invited to contribute based on their specific expertise, but anyone can proactively engage by identifying and responding to open consultation processes via dedicated online platforms where open policy processes are published and regularly updated. Contributing to public consultations allows you to provide targeted knowledge that aligns with the needs and timing of specific policy initiatives.

Public consultations are primarily used to gather feedback on important or contested issues, such as the development of a new marine spatial plan, the revision of major marine policies (e.g., Common Fisheries Policy), the authorisation of major marine or coastal infrastructure projects (e.g., coastal climate adaptation infrastructure projects), etc. As such, they serve as a key tool for inclusive, transparent, and evidence-based decision making.

Advantages

→ Structured opportunity to gather expert or local knowledge;

→ Contributes to improved evidence-based policy making,

Targeted questions that directly reflect the information needs of policy makers.

identifying concerns and potential drawbacks, increasing the likelihood of effective implementation, and enhancing social acceptance.

Considerations and constraints

→ The intention of gathering external opinions must be genuine instead of just a box-ticking exercise;

→ A time- and resource-intensive process for policy makers, as it requires processing, weighing, and responding to input;

→ When public consultations lack clear framing or are guided by ill-suited questions, they risk generating inadequate input, which can undermine the quality and suitability of resulting policies;

→ Power imbalances can remain unchecked – less strong voices risk to remain unheard.

Examples

European Commission – 'Have your say' portal

A platform where the European Commission gathers feedback on new policy initiatives and evaluations. Each consultation clearly states its objective, the target audience, and the rationale behind the request for input.

Public consultation on Belgium's Marine Strategy

Every six years, a public consultation is organised as part of the updated national marine environment strategy (cf. Directive 2008/56/EC). The report provides an overview of the current environmental state of the Belgian North Sea and offers insight into the revised environmental targets required to achieve Good Environmental Status.

Public consultation on the Common Fisheries Policy (CFP) Regulation

This consultation, combined with other analyses and studies, will inform the evaluation of the CFP Regulation's performance in achieving its objectives, as well as its economic impact, and its relevance in light of emerging needs. In the end, a summary report of the consultations will be published by the European Commission.

Global Ocean Science Report (GOSR)

The Global Ocean Science Report provides a comprehensive overview of the state of ocean science worldwide. It details who is involved, where research activities take place, and how it is carried out. It serves as a vital reference for policy makers, researchers, and other stakeholders aiming to monitor advancement towards the UN 2030 Agenda's Sustainable Development Goals, with particular emphasis on target 14.a, which focuses on scientific knowledge, research capabilities, and the transfer of marine technology. The global community is given the online facility to submit and update data on the GOSR portal and consult data to regularly assess progress on the efficiency and impact of policies to develop ocean science capacity. Regular editions of the report are informed by large-scale national surveys.

https://ec.europa.eu/info/law/better-regulation/have-your-say_en

https://www.health.belgium.be/nl/openbare-raadpleging-over-de-mariene-strategie-voor-de-belgische-mariene-wateren

https://oceans-and-fisheries.ec.europa.eu/news/commission-opens-public-consultation-common-fisheries-policy-regulation-2025-01-27_en

https://www.unesco.org/en/articles/global-ocean-science-report

Audiovisual information transfer

Goal

Audiovisual information formats, such as videos, animations, radio, podcasts, etc. aim to translate scientific knowledge or perspectives into accessible and often engaging content. Their primary goal is to enhance understanding, increase visibility, and foster (emotional) engagement with scientific insights relevant to policy. These formats are particularly effective in communicating complex ideas through storytelling. They help broaden the reach of scientific messages beyond traditional expert audiences and can contribute to awareness-raising, capacity-building, or public support. The latter is also highly relevant within the policy context, as policy decisions are not based solely on scientific evidence, but also take into account the level of societal acceptance and support (see **1.3 Effective science-policy knowledge exchange**).

Despite their strengths, these formats also face challenges. The oversaturation of (digital) media has made it increasingly difficult for platforms to reach, capture and retain attention, especially in the absence of clear targeting or strategic promotion. The target audience you have in mind – and the alignment with its needs – is crucial, but this means that a particular approach may be less suitable or even ineffective for other audiences. Today, it's easier than ever to make and distribute audiovisual content but ensuring visibility and meaningful policy impact often requires strategic deployment and a certain level of professionalism. In addition, for audiovisual content to make a meaningful contribution to evidence-informed decision making, they should be accompanied by dialogue, data access, and background information. Also, the informal nature of certain media formats can sometimes affect their perceived credibility in formal policy settings, unless they are clearly endorsed by reputable institutions or persons.

When to use

While audiovisual formats are particularly effective for explaining complex or abstract topics through visual and narrative means, they are equally valuable for raising awareness and fostering engagement around issues of significant societal relevance, regardless of their complexity. They are valuable tools for reaching and engaging experts as well as non-expert audiences. Audiovisual formats can be used to raise awareness (e.g., the spread and harmful impact of marine litter), mobilise action (warnings), communicate important research results (accelerating sea level rise, biodiversity loss, fishing pressure), make policy implications visible (bottom trawling, deep sea mining, MPAs), etc. These formats are complementary to written materials, helping to diversify communication strategies and extend reach. However, they are less appropriate for detailed, highly technical content that requires regular updates, unless they are embedded within a dynamic platform or part of an ongoing series.

Advantages

→ Can make complex science accessible and understandable to a wider audience;

→ Often emotionally compelling, capturing the attention of the audience;

→ Visual and auditory information is often better remembered;

→ Inclusive way of communicating as people from different background and varied literacy levels can be reached;

→ Can be widely shared and reused;

→ Can make the invisible (sea level rise, ocean acidification, ocean currents, etc.) visible;

→ Multiple audiovisual formats at the disposal of the research communicator.

Translating scientific knowledge or perspectives into accessible and engaging content.

Considerations and constraints

→ Scientific nuances can be lost at the expense of clarity and emotional connection;

→ High-quality formats and content require a lot of time, money and expertise;

→ Usually there's no interaction between messenger and receiver, hence no opportunity for input or dialogue;

→ Visuals can strongly influence perceptions when wrongly framed;

→ Uncertain reach, it's difficult to stand out in the mass;

→ Popularity of different formats are prone to – sometimes quickly – evolving cultural trends.

Examples

Outreach videos

4Ocean cleans the ocean and coastlines while aiming to stop plastic pollution by influencing change in consumption habits, using their YouTube channel to inform and raise public awareness.

Documentaries

In 'Ocean' (2025), David Attenborough explores the planet's undersea habitats, revealing the greatest age of ocean discovery and emphasising the ocean's vital importance while exposing its problems and highlighting opportunities for marine life recovery.

Animations

The animation of UNEP on Blue Carbon introduces how coastal blue carbon ecosystems capture carbon and make an important contribution to reducing the atmospheric carbon levels.

Virtual/augmented reality

The NOAA sea level rise viewer is an interactive geoviewer allowing visitors to visualise community-level impacts from coastal flooding or sea level rise.

Podcasts

The Oceancast series (Spotify series) are an initiative of the Flemish Commission for UNESCO, diving into marine research and innovation and their role in sustainable development.

The Ocean Decade podcasts (IOC-UNESCO) aim to support Ocean Decade activities and stimulate ocean knowledge sharing.

https://www.youtube.com/@4Ocean

https://www.imdb.com/title/tt33022710/?ref_=nv_sr_srsg_0_tt_8_nm_0_in_0_q_ocean

https://www.unep.org/news-and-stories/video/blue-carbon

https://coast.noaa.gov/slr/

https://open.spotify.com/show/7h9hjbHlO4XPvxOYNP928K

https://oceandecade.org/podcasts/

Social media

Goal

Social media encompasses a wide range of platforms that promote the creation and exchange of user-generated content. Mainstream platforms as Facebook, Instagram, TikTok, X (formerly Twitter), LinkedIn, blogs, etc. can be used to share and disseminate scientific information and to build societal support for policy-relevant topics. They enable real-time engagement with target audiences and allow scientific insights to be communicated in an accessible, visually appealing, and often interactive way.

To be effective, a clear strategy is needed to determine what type of information is communicated on which platform, depending on the nature of the content and the intended audience. For example, LinkedIn is more suited to target professional stakeholders, while platforms like Instagram or TikTok may be more effective for reaching younger or broader publics through creative visuals and storytelling. Collaborations with influential individuals or (niche) influencers can further amplify the reach through informal networks, significantly enhancing the spread and impact of messages.

However, there are also challenges. The huge volume of content on social media makes it difficult to capture and maintain attention without a clear strategy and consistent presence. Additionally, visibility is often subject to platform algorithms, which can unpredictably influence who sees what. Moreover, the credibility of information shared through these channels is frequently questioned, particularly when it is not clearly associated with trusted sources or reputable institutions.

When to use

Social media is particularly effective when the goal is to communicate quickly and broadly about current or policy-relevant scientific topics, or when aiming to foster dialogue, public engagement, or societal support. These platforms are valuable tools in science communication, in the first place towards wide or non-expert audiences. They are ideal for teaser content, project updates, announcements, or sharing ‘audiovisual content’ (e.g., videos) and ‘infographics’.

They are less suited for conveying highly technical or detailed content unless this is broken down into digestible formats and supported by visuals or storytelling. For maximum impact, social media should be integrated into a broader communication strategy with clear objectives, target audience segmentation, and monitoring of

Accessible, visual, and timely communication to inform and involve diverse audiences.

reach and engagement. However, awareness, digital literacy, and mindful engagement are crucial for maximising benefits and minimising harms.

Advantages

→ New opportunities to reach people in an unmediated and targeted way;

→ Considerable potential to start and steer scientific or political debates;

→ Quick and realtime communication to a large number of people;

→ Social media facilitates professional connections, career development, and access to educational resources. Platforms like LinkedIn have expanded global professional networks and fostered knowledge sharing;

→ Can raise awareness and mobilise communities around important causes;

→ Enables users to maintain relationships, expand social networks, and stay connected even when physically apart.

Considerations and constraints

→ Social media platforms can easily influence the public opinion;

→ Control, information assessment and verification – key components of credibility – become the responsibility of the media consumer;

→ Credibility can be falsely determined by the number of likes or share;

→ Algorithms are designed to reinforce narratives and preferences, creating filter bubbles playing into the tendency of people to believe what they want to believe regardless of contradicting evidence, hindering critical knowledge construction;

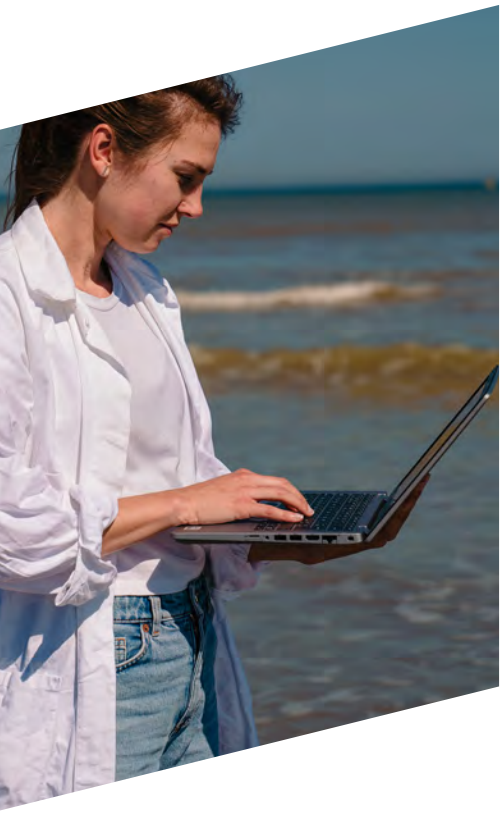
→ Attention-grabbing algorithms can put emphasis on false claims or opinions;

→ Tends to expose users to more polarised political content.

Examples

Social media accounts of numerous (scientific) institutions and organisations

E-learning module



Goal

E-learning modules are digital educational tools. They exist in various forms, ranging from passive/basic one-way information transfer (e.g., online reading material, pre-recorded videos, slides) to interactive formats (e.g., scenario-based e-learning, quizzes, gamified e-learning). They primarily aim to provide new knowledge and improve understanding of (complex) scientific topics among interested stakeholders (both experts and non-experts) by making scientific insights more accessible. In the context of science-to-policy knowledge exchange, they can bridge knowledge gaps between policy actors and the scientific community. However, rather than focusing on the immediate communication of research insights or good practices, these modules tend to offer thematic or conceptual training. E-learning also contributes to broader capacity-building initiatives such as the Blue Skills agenda, which seeks to equip professionals with the knowledge and skills needed to support sustainable blue economies. In this sense, e-learning can be a strategic tool to strengthen science-based policy making, particularly when integrated with other training and communication efforts.

When to use

E-learning modules are most relevant for knowledge exchange that doesn't require in-person engagement. They can serve as tools to introduce concepts, frameworks or methodologies (e.g., nature-based solutions, ecosystem management, multi-use of marine space), facilitate quick learning, and contribute to long-term capacity building.

They are also relevant in the context of general education (foundational knowledge) and awareness-raising. However, they are less appropriate for communicating specific, time-sensitive research findings, influencing urgent policy decisions, or addressing complex, context-dependent challenges. Therefore, e-learning ideally is used as a complementary tool together with more targeted or interactive knowledge exchange formats.

Advantages

→ Reach a broad audience without the need for in-person engagement;

→ Provide consistent, qualitative information;

→ Accessible and flexible, as people can often choose when and where to use e-learning modules;

→ Can be updated and reused depending on context or project;

→ Often the possibility to track progress and engagement.

Conceptual training rather than focusing on direct communication of scientific insights.

Considerations and constraints

→ Users can be hard to motivate to complete modules without rewarding or incentives;

→ Predominantly a one-way communication tool rather than a mutual learning exercise;

→ Users need to have access to digital infrastructure and have a certain degree of digital proficiency;

→ Less opportunity for dialogue, co-production or adaptation to user needs;

→ Mainly a tool for foundational knowledge exchange, not for communicating specific, time-sensitive research findings;

→ If e-learning content is shared informally and not part of an official course, it can be hard to reach the right audience and may get lost in the large amount of information people receive every day.

Examples

Gamified e-learning

Testerep – New Beginnings: Developed in the context of the Testerep project, which aims to gain a more detailed understanding of the evolution of a part of the Flemish coastal landscape over the past 5,000 years. The game is inspired by the people of the fifteenth and sixteenth centuries that had to battle against the water during a series of storm surges. The player is challenged to survive for 30 days while constructing a thriving city, fortifying buildings with dikes, and combatting the water.

VLIZ Digital Experience Lab – Uncertain Tides: By using science-based artistic interpretations of the interplay between climate change and biodiversity, the Flanders Marine Institute (VLIZ) aims to raise awareness about the vital role of oceans in climate systems and the importance of marine biodiversity. The Digital Experience Lab consists of two rooms. In the first room visitors can adjust the atmospheric CO_2 concentration and experience its consequences through a videowall. In the second room generative AI creates an immersive experience allowing visitors to experience how a changing climate disrupts the marine ecosystem.

Reading material

VDAB – Logistiek (Logistics) - Zeevervoer basis (Maritime transport basics): The VDAB (Flemish Employment and Vocational Training Service) is the public employment service of Flanders. Its main objective is to help people find employment, to support employers in their search for suitable candidates and to organise a wide range of training opportunities. This particular course is designed to provide participants with basic knowledge of maritime transport. It is an online course that is available 24/7, and participants can consult an online coach if they have any questions.

Pre-recorded videos

NOC Southampton – Ocean Science in Action: This initiative aims to build a unique collection of open access online educational and capacity development video resources dedicated to the innovative marine technologies and how they are used to tackle the challenges of sustainable management of marine ecosystems.

https://www.therookies.co/entries/20989 (Testerep)

https://www.vliz.be/nl/news/nieuw-zeebelevingslab-dompelt-bezoekers-onder-klimaat-en-biodiversiteitsonderzoek

https://www.vdab.be/opleidingen/(aanbod/O-AMI-800814/cursus/C-AMI-164092/Logistiek---Zeevervoer-basis-online

https://noc.ac.uk/education/educational-resources/ocean-science-action

In-person stakeholder engagement framework

Goal

This format refers to in-person interactions that bring together specific groups of stakeholders (policy makers, scientists, industry actors, or civil society representatives) for structured dialogue, joint problem-solving, or advice formulation. Depending on the format and purpose, these meetings can take the shape of co-creation workshops, expert roundtables, advisory board meetings, thematic working groups/networks, or strategic vision development in think tanks. Post-event documentation plays a key role in translating the results into actionable outputs.

Unlike webinars, these physical meetings allow for deeper engagement, more nuanced discussion, and stronger relationship-building. The latter is of primordial importance and is considered as one of the three main challenges in building a robust science-policy ecosystem (see **1.6 Credibility of science and policy**). These formats are particularly suited for co-creation processes, multi-stakeholder deliberations, and consensus-building, where mutual trust and informal exchanges play a key role. When embedded in long-term structures, such as advisory boards or thematic networks, these settings can also institutionalise science-policy dialogue and ensure continuity in knowledge exchange and relationship building over time.

When to use

These formats are especially effective when the goal goes beyond information dissemination and includes agenda setting, joint interpretation of evidence, scenario planning, or policy co-development and evaluation. They are most suitable in the mid- to late stages of policy processes when knowledge needs to be translated into decisions, or when diverse perspectives must be brought together to interpret complex or contested issues, especially where legitimacy, inclusiveness and transparency are critical to the outcome. A clear definition of the expected goal and target audience is crucial when organising such events.

Advantages

→ In-person formats foster mutual understanding and trust;

→ Engaged stakeholders are more likely to support and implement outcomes;

→ Ideal settings for collaborative interpretation of scientific evidence and co-development of policy options;

→ Institutionalised networks act as long-time structured science-policy interfaces;

→ Allows real-time feedback, clarifications and negotiations, resulting in a tailored approach

Allow for deeper engagement, more nuanced discussions, and mutual trust.

that suits the stage and needs of a given policy process.

Considerations and constraints

→ Depending on the format, the organisation might require significant investment of time, effort and funding, making them less feasible for quick or frequent exchanges;

→ Risk of a power imbalance due to personalities who dominate the conversation;

→ Challenging to clearly capture discussions and summarise them into useful documents;

→ Harder to reach a broader and diverse audience compared to some digital formats;

→ Repeated engagement without clear impact can reduce willingness and effort of stakeholders to participate in in-person interactions.

Examples

Institutionalised thematic networks

ICES Working Groups: Expert groups addressing specific scientific, technical, or policy-relevant questions related to marine ecosystems, fisheries, and ocean science. They bring together scientists from member countries to collaboratively analyse data, develop advice, and produce reports to inform marine management and policy. These groups are central to ICES' role in providing evidence-based advice to national and international bodies, including the EU and regional sea conventions.

Think Tanks

Think Tank North Sea: A bottom-up initiative, established in response to the 2017 North Sea Vision 2050 process, in which three thematic working groups laid the foundation for developing broadly supported, long-term visions guiding the future use of the Belgian North Sea by 2050. In 2019, two working groups were launched: 'Working with Nature' and 'Living with Climate Change'. Both vision reports formulated recommendations and key principles that stakeholders can consider in their current operations, helping to ensure a sustainable future for the Belgian North Sea. The findings and recommendations of these two groups have been captured in concise vision documents.

https://www.ices.dk/community/groups/Pages/default.aspx

https://www.thinktanknorthsea.be/

Expert judgement

Goal

Experts play a pivotal role as intermediaries in the translation of scientific knowledge into policy. Their role is not to make policy decisions themselves, but to coordinate and synthesise scientific input from various sources. Their core task lies in clarifying evidence-informed policy options, e.g., clearly communicating what is known, what remains uncertain, and how different courses of action are supported (or not) by the available scientific evidence. Besides serving as a source of substantive expertise, they also act as translators of complex findings to policy-relevant insights.

In case scientific evidence is limited, incomplete, or still evolving, experts often provide the best available knowledge to support decision making. Their judgment – grounded in experience, contextual understanding, and a broad view of the scientific landscape – offers added value beyond raw data analysis. Moreover, experts can provide an additional layer of validation to scientific findings that are politically sensitive or open to differing interpretations. A strong relationship of trust between experts and policy makers is crucial in this regard, as it forms the foundation for open communication, mutual understanding, and the effective integration of scientific input into the policy process (see **1.3 Effective science-policy knowledge exchange**).

When to use

Involving experts is most effective when it is timely and targeted. Especially in situations involving urgent or highly specific policy questions – such as in crises, permitting procedures, or regulatory decisions – experts can provide frontline information directly aligned with policy makers' needs. At the same time, it is essential that policy makers know in advance whom they can approach for reliable advice. This requires proactive coordination and the development of trusted networks in which relevant expertise is visible and accessible. Ideally, experts are not only consulted on an ad hoc basis but are structurally involved in policy preparation and strategic foresight (see also 'In-person stakeholder engagement framework'). This fosters a continuum in which scientific knowledge, via expert engagement, is durably embedded in policy processes, rather than applied reactively.

Acting as translators of complex findings to policy-relevant insights.

Advantages

→ Experts provide up-to-date, credible and peer-reviewed knowledge that strengthens the evidence base;

→ Experts can interpret complex scientific data within a broader societal context, making it more relevant and actionable for policy;

→ Expert judgement can offer reasoned guidance when there's no scientific consensus or data is lacking;

→ Experts are free to voice their opinion or disagreement on previously accepted or proven statements;

→ Scientific advisors have a valuable role to play to advice government on so called post-normal science;

→ Experts can identify emerging issues and long-term risks, providing anticipatory input for proactive policy development;

→ By offering a broader range of interpretation of scientific finding, the overall credibility of evidence-based policy can increase;

→ Can give a face to science towards the general public and government, which can increase public and political trust in policy decisions;

→ The identification of an expert who can rapidly source, process, and communicate scientifically sound and authoritative advice can be especially effective in crisis situations.

Considerations and constraints

→ Dissent among experts may reduce the authority of scientifically sound advice;

→ Experts might adapt their advice when they feel vulnerable or fear personal consequences of providing advice to government;

→ Particularly in the fields of civil protection and risk assessment – such as catastrophe prediction or public health advice – scientists, and by extension science itself, risk losing credibility when their forecasts prove inaccurate or insufficient;

→ Without following an inclusive or multidisciplinary approach, there's an increased risk of narrowed perspective on issues;

→ Scientific integrity and policy independence needs to be preserved to protect the credibility of both;

→ Some experts may not fully understand the policy context, leading to unrealistic recommendations.

Face-to-face interview

Goal

Face-to-face interviews or meetings are a qualitative research and engagement method that involves in-depth, one-on-one conversations between a knowledge seeker – such as a policy officer, researcher, or consultant – and an expert in a specific field. These interviews can be structured, semi-structured, or unstructured depending on the objective, but they always aim to extract contextual and/or operational knowledge that may not be publicly available or documented. Expert interviews are especially valuable in complex policy areas where knowledge is fragmented, contested, or rapidly evolving. They serve both as a method of data collection and as a knowledge transfer mechanism, bridging scientific expertise and policy needs by enabling direct communication and trust-building. In many cases, they are used not only to obtain facts but also to understand perspectives, interpretations, and priorities within a given policy field.

When to use

Face-to-face interviews or meetings are particularly useful in the early phases of the policy process, such as agenda setting, problem definition, or scoping studies. They are also appropriate when a policy issue is sensitive, complex or underexplored, and when insights from highly specialised and trusted experts are needed to inform decision making. This method is well-suited to contexts where undiscovered or undisclosed knowledge – such as the experience of implementing marine monitoring programmes or managing stakeholder conflicts in coastal zones – is critical. Furthermore, they can be used iteratively throughout a policy cycle to validate assumptions, refine options, or assess feasibility.

From the perspective of the scientific expert, participation in such interviews is typically by invitation, but may also be initiated

Extraction of contextual and operational knowledge that is not publicly available.

proactively when their expertise is relevant to an ongoing policy discussion or emerging issue. Engaging in these exchanges offers an opportunity to contribute to evidence-informed policy making and fosters mutual understanding between science and policy.

Advantages

→ Encourages co-creation and shared ownership of knowledge and solutions;

→ Promotes real-world experiences in policy contexts;

→ Enhances stakeholder learning and trust;

→ Enables exploration of sensitive, local or experiential knowledge that is not documented;

→ Provides depth, nuance and a context-specific understanding;

→ People might be more willing to share their thoughts openly compared to impersonal surveys, workshops or written responses;

→ Can be used as a final cross-check of information, uncover blind spots and ensure maximum policy relevance.

Considerations and constraints

→ Risk of biased input due to a limited or non-representative sample;

→ Risk of interviewer bias in both question phrasing and interpretation of responses;

→ Difficult to standardise across multiple interviews, affecting comparability;

→ Hard to externally validate the insights of the interviewee;

→ Data quality highly dependent on the interviewer's skill and experience.

Examples

Defining Good Environmental Status (GES) for the national implementation of the Marine Strategy Framework Directive (MSFD)

Face-to-face interviews were conducted by different member states to gather expert opinion on how to interpret GES indicators and how to operationalise them.

Marine Spatial Planning (MSP) - input for the Belgian position regarding a planned offshore wind farm in French waters

France plans to build an offshore wind park in front of Dunkirk (Parc éolien en Mer de Dunkerque), near the Belgian coastal town of De Panne. Because of concerns about the social, ecological and economic impact of the location for the wind park for Belgium, interviews were held with stakeholders from government, industry (fisheries, shipping, offshore wind) and NGOs to gain a better insight into sector-specific needs, conflicts and concerns.

Living lab

Goal

Living labs are participatory platforms for innovation and experimentation that operate in real-world settings and involve a diverse group of stakeholders, including researchers, policy makers, local communities, industry representatives, and civil society actors. Originating from the field of innovation studies, living labs have increasingly been applied in policy contexts to enable co-creation of knowledge, shared problem-solving, test and evaluate solutions, and iterative policy design. Unlike traditional research settings, living labs emphasise real-time feedback, collaborative learning and reflexivity, and adaptive processes, making them especially suitable for tackling complex and systemic challenges such as climate change impacts on coastal regions, marine spatial conflicts, or sustainable fisheries management. Their strength lies in fostering long-term engagement, trust, and innovation through practical experimentation embedded in the socio-ecological context of marine governance.

When to use

Living labs are best used in policy processes where complex, interdependent issues must be addressed collaboratively and where solutions cannot be fully designed or tested within traditional institutional silos. They are particularly appropriate when stakeholder engagement is essential to the legitimacy, acceptance, or success of a policy intervention. Living labs can play a key role when testing innovations, piloting governance frameworks, fostering collaboration across sectors, or exploring land-sea interactions under real-world constraints. Their iterative and flexible nature makes them well-suited for adaptive policy cycles and for contexts where learning, feedback, and stakeholder involvement are critical for long-term implementation.

Advantages

→ Encourages action-oriented co-production and shared ownership of knowledge and solutions;

→ Promotes real-world experimentation and context-sensitive solutions in policy contexts;

→ Bridges gaps between research, innovation, and practice;

→ Enables continuous feedback loops for adaptive policy development;

→ Increases legitimacy and social acceptance of policy;

→ Can empower local communities and include non-traditional knowledge in evidence-informed policy making;

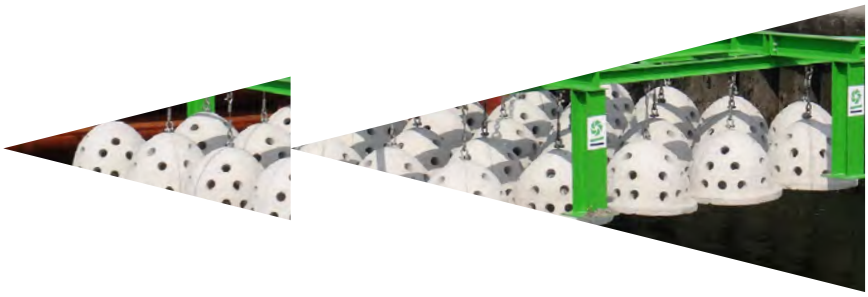
→ Encourages long-term stakeholder commitment and network building.

Considerations and constraints

→ Heavy on time, coordination, and funding needs;

→ Requires sustained engagement, which can be difficult to maintain over long periods;

Participatory platform for innovation and experimentation in a real-world setting.



→ Risk of stakeholder dominance or marginalisation;

→ Difficult to scale findings beyond the local context due to place-specific dynamics;

→ Outcomes can be difficult to measure and evaluate rigorously, making them potentially difficult to integrate into decision making;

→ Requires a high degree of institutional flexibility, which may conflict with rigid policy cycles.

Examples

DuneFront project

The project aims to enhance coastal protection in wich 'demonstrator sites' play a crucial role. One of the sites, the Living Lab Raversijde, serves as a pilot site for evaluating dune-in-front-of-a-dike as a hybrid nature-based solution. The site provides marram grass planting in various configurations and concentrations to manipulate aeolian sand transport dynamics.

Treasure project

This Interreg project (2023-2026) investigates how the plastic outflow from rivers into the North Sea can be reduced. The core of the project consists of living labs at different river-sea interfaces. Each region implements a combination of policy, data collection, awareness, and removal activities to develop robust, practice-based solutions to reduce riverine waste that can be used across the North Sea region.

https://dunefront.eu/demostrator-sites

https://www.interregnorthsea.eu/treasure

Cross-sectoral exchange programmes and science-policy internships

Goal

Exchange programmes and internships can be strong instruments to bridge the gap between scientific research and policy. Their primary goal is to foster mutual understanding, knowledge transfer, and collaboration between academic institutions, research bodies and policy. By embedding scientists within policy environments – or conversely, bringing policy makers into research settings – these initiatives cultivate shared language, enhance contextual awareness, and promote the co-creation of solutions to complex societal challenges. Ultimately, the aim is to strengthen the science-policy interface by equipping participants with practical insights, cross-sectoral networks, and an appreciation of the institutional dynamics that shape both evidence production and decision making.

When to use

Exchange opportunities and internships are most effective when timed to align with critical phases in the policy or research cycle, such as during the formulation of new policy agendas, the implementation of research findings, or the design of interdisciplinary programmes. They are particularly effective when there is a clear need to build trust, translate knowledge into action, or enhance the relevance and uptake of scientific outputs. They are most effective when guided by clear expectations, mutual objectives, institutional support, and a commitment to two-way learning. In doing so, they become catalytic tools for capacity-building, innovation, and sustained collaboration at the science-policy nexus.

Advantages

→ Helps to overcome stereotypes and misconceptions by gaining a close insight into the values, work cultures and constraints of the other sector;

→ Policy makers learn about the scientific method, its strengths and weaknesses and can become more appreciative of scientific evidence;

→ Sustained interaction makes scientists aware of actual policy needs, which can lead to aligned research agendas to political priorities, improving the uptake and impact of scientific knowledge;

→ The co-creative environment can stimulate more innovative, creative solutions resulting in more robust policy solutions;

→ Increases adaptability by developing skills and knowledge in areas scientists and policy makers would normally not be accustomed to;

Mutual understanding, knowledge transfer and collaboration are key.

→ Enables faster dialogue, a more direct transfer of scientific knowledge towards policy and a quicker identification of knowledge gaps.

Considerations and constraints

→ New collaborations need time to build trust;

→ Differences in communication and work styles can lead to misunderstandings;

→ Requires time, coordination, and sustained institutional support, without which networks may remain weak and outcomes personal rather than institutionalised;

→ Programmes are often too short for deep learning or lasting impact, especially when such initiatives are not imbedded into a broader engagement strategy;

→ Lack of genuine commitment risks making exchanges symbolic rather than impactful;

→ Unequal access to exchange or internship opportunities due to financial, institutional or geographic barriers may reinforce disparities;

→ Success depends on strong mentorship across science and policy.

Examples

EU4Ocean Coalition – Young Advocates and the Youth4Ocean Forum

The Youth4Ocean Forum is a European platform for people between the ages of 16 and 30 to connect with like-minded people and experts and share ideas on how to shape a future healthy ocean. Members of the Youth4Ocean Forum can submit their projects and apply for EU accreditation and become an EU Young Ocean Advocate. As a Young Ocean Advocate, they will have the opportunity to present their project at key European events, engage with mentors, scientists, and decision makers, and play an active role in driving positive change for the ocean.

Science meets Parliament

This initiative, a type of 'pairing scheme', connects twenty scientists with an equal number of Belgian parliamentarians. The aim is to immerse researchers in the heart of policy making for a day, allowing them to attend committee meetings and understand the legislative process from within. In return, the parliamentarians later visit the scientists' workplaces to learn how academic research is conducted. The overarching goal is to build a bridge between science and policy, enabling societal challenges to be addressed with well-founded, evidence-based insights.

VOKA summer internships

During a Voka (Flemish Network of Enterprises) summer internship, a politician spends half a day working on-site at a company. This initiative aims to strengthen the connection between the political sphere and the business community. In parliament, politicians handle dossiers that have a direct impact on enterprises. By experiencing the workplace first-hand, these policy issues come to life. The summer internships offer a unique opportunity for dialogue and the exchange of ideas.

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https://maritime-forum.ec.europa.eu/theme/ocean-literacy-and-blue-skills/ocean-literacy/youth4ocean-forum_en

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https://www.sciencemeetsparliament.be/

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https://www.voka.be/zomerstages

Science-art collaboration

Goal

Science-art collaborations integrate scientific knowledge with artistic expression, ranging from visual arts and installations to performances, films, animations and interactive exhibits. These partnerships are increasingly recognised for their value in crossing disciplinary boundaries and opening new spaces for knowledge exchange. Their goal is to present complex scientific issues in engaging, accessible, and often emotional or thought-provoking ways. Rather than relying on traditional, one-way communication models that aim to correct public 'knowledge deficits', such collaborations explore participatory and transdisciplinary approaches. Creative, low-threshold formats attract diverse audiences and foster dialogue, expanding the reach and relevance of science communication. By combining different scientific disciplines with artistic practices, these collaborations offer alternative entry points to understanding science, appealing not only to reason, but also to the senses and imagination.

While not intended as direct tools for delivering technical policy recommendations, science-art collaborations contribute to shaping the broader societal context in which policy decisions are made. By creating space for reflection and dialogue, those collaborations help build the cultural and societal readiness needed for policy change. This is significant, as policy makers are influenced not only by expert input, but also by public perception, cultural narratives, and social values.

When to use

Science-art collaborations are particularly effective when the goal is to raise awareness among non-expert audiences or provoke reflection on complex issues, inspire curiosity and emotional connection or bring invisible challenges (marine biodiversity loss, ocean health, climate change) into public and policy consciousness. They work best in early-stage policy processes (e.g., agenda-setting, vision development) or in parallel outreach and education efforts. They can also be used to support exhibitions tied to key events (e.g., science-policy conferences, cultural festivals).

Advantages

→ Mutual learning and expanded perspectives;

→ Accessible and inclusive formats;

→ Public engagement and creative, participatory formats attract diverse audiences and

Present science in an engaging, accessible, emotional or thought-provoking way.

fosters dialogue, moving beyond traditional science communication models;

→ Breaking hierarchies between scientists, artists, policy makers and public;

→ Transdisciplinary innovation by fostering new formats and methods of collaboration.

Considerations and constraints

→ Risk for asymmetric participation and expectations (scientists often have limited availability), resulting in underutilised collaborative potential;

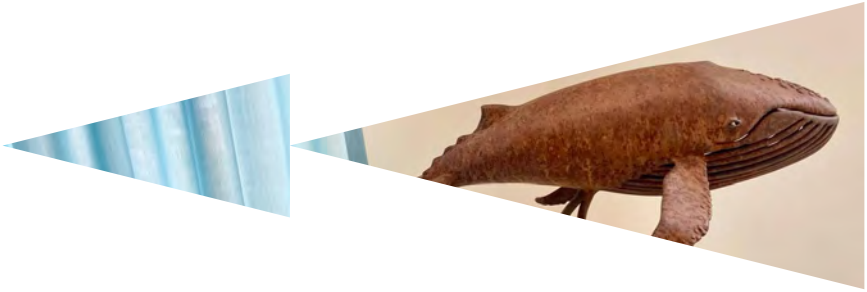
→ Differences in working methods between scientists (structured, slower timelines) and artists (work more spontaneously);

→ Hierarchical perception between different scientific disciplines and artists.

Example

ArthropoScenes

AnthropoScenes connects theatre and science, putting water in the spotlight. On stages in Berlin and markets in Brandenburg, artists and researchers experiment with different audiences to debate and develop sustainable water futures. The aim is open dialogues across all corners of the region and integrate these conversations, stories and ideas into further artistic and scientific works.



European Marine Board (EMB) - EMBracing the Ocean programme

The programme provides grants for creative individuals/groups from a wide-range of disciplines to engage in a two-way co-creation of artwork in collaboration with ocean scientists. The aim is to raise ocean awareness, inspire sustainable behaviour, and offer new perspectives to science.

Studiotopia

Through Studiotopia, artists and scientists from diverse backgrounds collaborate on projects that illuminate the complexities of the Symbiocene, a concept that envisions a future where humanity lives in harmony with the Earth and all its inhabitants, fostering mutual flourishing and interconnectedness. From exploring biodiversity hotspots to investigating sustainable technologies, each endeavor offers a unique perspective on our relationship with the natural world.

https://www.anthroposcenes.de/ourwork

https://www.marineboard.eu/open-calls

https://www.bozar.be/en/studiotopia

Targeted email campaign

Goal

Targeted email communication refers to the strategic use of email (e.g., digital newsletters), to share relevant, timely, and specific scientific information in a short and focused format with particular audiences such as policy makers, stakeholders, or the general public. The aim is to provide content that is adapted to the recipient's interests, needs, or level of knowledge. By using tailored and targeted messaging, periodic email communication avoids information overload and fosters a more sustained engagement with scientific developments, policy-relevant insights, or collaborative opportunities, on the condition that recipients have agreed to receive these emails. In addition, targeted emails can facilitate further interaction (e.g., inviting recipients to participate in webinars, surveys, consultations, co-creation workshops, etc.).

When to use

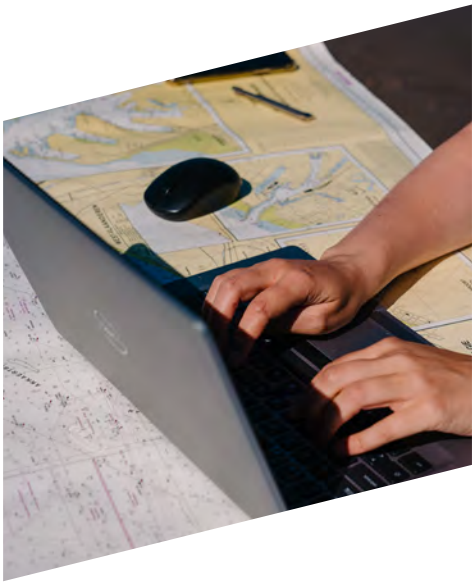
Targeted email communication is particularly effective in situations where the goal is to share specific outputs or calls to action, such as the release of new datasets, new research results, project updates, communication with existing networks, helping to ensure continuity and sustained engagement over time. It is a relatively low-threshold way of transferring information with a potentially large reach.

Advantages

→ Tailors messages to stakeholders, increasing uptake and action;

→ Enables direct and efficient delivery of targeted content at low cost and effort, without relying on external media or events;

→ Supports long-term engagement, which can be monitored based on click rates.



Smart email communication keeps stakeholders informed, engaged, and connected.

Considerations and constraints

- Avoid information fatigue;
- Too generic or too technical messages may become less effective;
- Reach limited to subscribers;
- Maintaining and safely storing a personal contact list;
- Can be easily overlooked;
- No or limited opportunities for dialogue.

Examples

Testerep Magazine

Digital news channel of the Flanders Marine Institute (VLIZ), offering a monthly newsletter for registered subscribers. Aimed at a broad audience it shares updates on VLIZ activities, as well as news from marine research and policy communities in Flanders. The magazine also highlights other coastal and marine knowledge and innovation initiatives.

Blue Cluster newsletter

Regularly published digital newsletters for a subscribed audience, focusing on relevant developments, events, and projects related to the blue economy and marine innovation. These newsletters aim to inform and engage stakeholders across industry, research, and policy by highlighting opportunities, partnerships, and advancements that support sustainable growth in the marine and maritime sectors.

https://www.vliz.be/testerep/nl/over-testerep-magazine

https://www.bluecluster.be/webform/newsletter

Artificial intelligence platform

Goal

Artificial intelligence (AI) platforms (e.g., ChatGPT, Perplexity, Gemini, etc.) are emerging digital tools that support the generation, processing, and dissemination of knowledge. They are particularly effective at rapidly scanning, synthesising, and contextualising large volumes of information from diverse sources. AI platforms can deliver customised content in response to stakeholder queries, making them valuable for matching scientific evidence with policy questions and vice versa. They help bridge disciplinary boundaries by translating complex information into more accessible formats for different audiences.

In addition to assisting in the generation and processing of information, AI platforms can also support participatory processes, scenario modelling, analyse trends to understand policy priorities or concerns, identify key actors and relationships, etc.

When to use

AI platforms are particularly useful to quickly generate and synthesise large volumes of information or data. It can also help identify patterns and connections in multidisciplinary or multisectoral contexts, such as marine sciences or the Blue Economy. Their ability to deliver customised knowledge in accessible formats makes them a strong asset, particularly in contexts with limited human capacity or time pressure. However, their role has to be seen as complementary and not as a replacement for human expertise, deliberation, human relationships and trust-building exchanges that are key for effective science-policy engagement.

Advantages

→ Rapid synthesis of large volumes of (scientific and policy) information or data;

→ Customised outputs tailored to specific needs or questions;

→ Accessible, no need for specialised jargon;

→ Connects multidisciplinary and multisectoral knowledge;

→ Support in context with limited time or human resources;

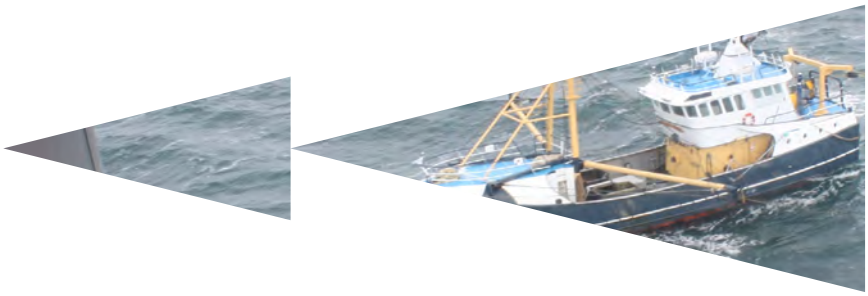
→ Data analysis and visualisation capabilities;

→ Can assist in stakeholder and network mapping.

Considerations and constraints

→ Generated content is susceptible to factual errors and should be thoroughly evaluated for accuracy, objectivity and appropriateness;

Deliver customised content in response to stakeholder queries



→ Functions as a black box, resulting in transparency and accountability issues;

→ No situational awareness with very limited context sensitivity;

→ Over-reliance may weaken human judgement and critical dialogue;

→ No human interaction, deliberation or trust-building.

Examples

ChatGPT (OpenAI)

ChatGPT is a conversational AI platform. It is useful for translating complex information into accessible formats and generating tailored content for diverse stakeholders.

Perplexity

Perplexity is an AI-powered research assistant that provides direct, sourced answers to user questions. It excels at rapidly compiling information from trusted sources, making it helpful for quick evidence searches.

Gemini (Google DeepMind)

Gemini is a multimodal AI capable of interpreting text, images, and other inputs. It can support data analysis, generate summaries, and help visualise complex systems and as such can assist in areas like ecosystem modelling or stakeholder mapping.

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https://chatgpt.com/

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https://www.perplexity.ai/

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https://gemini.google.com/

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