Understanding political learning by scientific experts: A case of EU climate policy

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Abstract

Research often explores the role of scientific expertise in policymaking from an externalized perspective, mostly focusing on how policymakers use and abuse scientific expertise through political learning. However, very little is known about political learning by scientific experts. What strategies do they use to maintain and advance their access to, and influence on policymaking? Using process tracing, we illustrate how scientific experts' access to policymaking is challenged as a policy issue develops. We explore how this nudges scientific experts to engage in political learning and employ political advocacy strategies to enhance science's role in policy making, corresponding to evolving political opportunity structures. We empirically trace this using the case of EU climate policy development between 1990 and 2022. We identify three main sets of advocacy strategies used by scientific experts: Narrative and semantic (policy issue-oriented), Socialization (Actors-oriented), and Governance (systems and structures-oriented). In doing so, this article illustrates the political actorness and agency of scientific experts and provides a supplementary understanding to the role of science in public policy and policy change, not only as a function of policymaker's instrumentalization of science, but also as a function of how scientific experts actively advocate for science's role in public policy.

1. Introduction

Policy learning has been increasingly recognized as a key driver for the formulation of policy across a wide range of policy domains, especially in complex and critical issues such as climate and environmental policy, public health policy, and crisis governance, among others. Here, policy learning can be understood as a deliberate, problem-oriented process by which policy actors seek and process policy issue-related information and knowledge, aiming to update understandings and beliefs and formulate solutions. This can result in changes of policy beliefs, instruments, policy positions, or how they are advocated (Zaki, Wayenberg, & George, 2022). The increase in complex, highly politicized and contested policy problems, and growing accountability pressures, created impetus for evidence-based policymaking, thus emphasizing a particular strand of policy learning, that is epistemic policy learning, i.e., learning from experts. This is a process by which policy actors learn about policy problems from groups of (often scientific) experts with authoritative claims to subject matter knowledge and access to policymaking.

Among different policy domains, environmental policymaking, especially within the European Union (EU), is perhaps one of the most vibrant spheres for policy learning. There, we have seen policy learning, particularly from experts, substantively shape policy, driving changes in both overarching policy paradigms, and policy instruments (e.g., Challies et al., 2017; Dupont, Rosamond et al., 2023; Koch & Lindenthal, 2011). Within the EU and beyond, in the realms of environmental policymaking and across other policy domains, epistemic policy learning research predominantly approaches the role of expertise from an externalized perspective. Either as sources of information, knowledge, and evidence-based ideation, as "teachers" with varying degrees of influence over policymaking (e.g., Dupont, Rosamond et al., 2023), or as objects of political

utilization where expert knowledge is used by political actors to substantiate their policy positions, or solve technical problems (e.g., Boswell, 2008)[1].

However, despite the importance of experts' contributions to policymaking, research on scientific experts as "learners" has been relatively scarce. This is especially the case regarding experts' learning about the non-technical or political aspects of policy, and their political actorness and agency. We know surprisingly little about the political maneuvers employed by experts to defend, maintain, or enhance the advocacy of expertise or its access to policymaking. These maneuvers can be understood as outcomes of political learning processes by which actors update their understandings of how to better advocate their policy positions, agendas, and enhance their political viability, becoming more "savvy" political advocates. This becomes particularly important given the politicization of critical policy issues such as the environment and climate, migration, and public health, among others. An issue that has increased the instrumentalization of science and affected scientific experts' access to – and role in – policymaking (See Dupont, Rosamond et al., 2023).

We delve into largely unchartered territory in the nexus of epistemic and political learning, guided by the question: *what political advocacy strategies do scientific experts pursue to enhance their access to, and influence on, policymaking?* We operationalize political advocacy strategies as deliberate approaches aiming to advance policy positions on the political agenda (see Bennet & Howlett, 1992), based on political learning as updates of knowledge and information regarding evolving political contexts within a specific policy domain (see Zaki, Wayenberg & George, 2022).

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[1] In this article, we use experts to indicate 'scientific experts' unless otherwise stated.

We use an exploratory case study design. This allows us to create preliminary accounts and categorizations of relatively under-researched phenomena, serving as basis for future hypothesis generation and testing (see Pierre & de Fine Licht, 2019). First, drawing on policy learning literature, we establish the context for political learning by scientific experts, using process tracing (See Kay & Baker, 2015; Beach, Schäfer, & Smeets, 2019). We theorize a three-phase process that depicts how expert's access to – and influence on – policymaking is challenged over three phases of policy issue evolution. Then, we elaborate how this can trigger political advocacy maneuvers by scientific experts in response to political opportunity structures changes over time. Using instrumental case selection, we empirically trace the most prominent political advocacy strategies used by scientific experts across three phases of the European Union's climate policy development between the 1990s, when the EU began to engage in climate policy development, and 2022, when our data gathering phase was completed. We dedicate special attention to political learning by experts in the European Environment Agency (EEA). Being an independent expert/knowledge agency that is formally embedded in the EU's political and policy system, our focus on the EEA gives us unique insights into the interplay between expertise and politics. We source our data from 32 semi-structured interviews conducted between 2010 and 2022, with senior policy officials and experts, covering their years of experience of European climate policy from 1990 onwards. We also leverage 21 hours of in-person ethnographic observations of the scientific committee meetings of the EEA and three agency events where scientific experts, politicians and policymakers convened in 2022. Our analysis is supported by documents including communications, reports, and publications by the European Commission, the EEA, the IPCC, among others.

This article makes three main contributions. Theoretically, we expand understandings of how political and epistemic learning takes place by integrating the political dimension into two

learning processes often viewed dichotomously, either with political opportunism on the political learner's side or epistemic puritanism on the expert's side (see Dunlop, 2014). We thus re-align epistemic policy learning processes with the ontological position where learning and politics are foundationally inseparable across different types of learning processes (Hall, 1993). Second, we provide a clearer understanding of how, when, and why scientific expertise is (or is not) integrated into the policymaking process. By highlighting that scientific experts engage in political learning, and the political advocacy strategies they use, we establish the political agency and actorness of scientific experts. This helps add another explanatory dimension to the multilevel learning process whereby policy change is not only a linear function of the use of scientific expertise by policymakers, but also the manner and extent to which scientific experts learn about politics and the advocacy of their scientific positions. Furthermore, we offer a novel account of political learning within a new context: a process rarely researched within the EU context, especially not with a focus on experts as learners. This also allows us to develop context-specific theoretical understandings of the relationship between experts and policymaking within the complex EU architecture. These contributions are particularly important when the climate policy context is politicized, throwing into doubt the role of experts and their ability to leverage that expertise, and challenging policy analysis aiming to decipher the dynamics and role of experts' contribution to policymaking and policy change.

This article is structured as follows: In section two, we review the literature on the nexus of political and epistemic policy learning, outline our theoretical expectations, and establish the plausibility of political learning by scientific experts. In section three, we explain our methodological framework. This is followed by our case analysis in section four, discussion of findings and concluding remarks in section six.

2. Political learning by scientific experts

2.1 A review of scholarship

Research sheds light on how scientific experts contribute to policymaking, mainly through a lens of evidence provision. Epistemic policy learning contributes to varying outcomes, from the technical calibration of policy instruments or favoring certain policy designs (e.g., Baekkeskov & Öberg, 2016), to scientifically endorsing certain technical solutions (e.g., Zito, 2001; Kamkhaji & Radaelli, 2017), or facilitating paradigmatic shifts (e.g., Zaki, Pattyn & Wayenberg, 2023).

The role of experts is often explored from an externalized position, predominantly focusing on how scientific expertise is 'picked up' by policy actors, where scientific experts are teachers (e.g., Kiendrébéogo et al., 2020). This has given us important insights into how policy and politics interface with scientific expertise, mostly from a utilitarian perspective, i.e., how expertise is used by policymakers and politicians (e.g., Dunlop, 2014; Boswell, 2008). This view of expertise is consistent across the micro, meso, and macro levels. On the microfoundational level, research explores how policy actors integrate lessons from scientific expertise into solution identification through different heuristics (Beach, Schäfer, & Smeets, 2019; Beach & Smeets, 2022). At the meso level, research explores how epistemic policy learning is leveraged by organizations and institutions, contributing to the identification and adoption of certain policy options (Dunlop, 2017; Bell & Feng, 2019). At the macro level, we see how policy systems leverage epistemic policy learning to identify solutions, legitimate or substantiate policy positions (Boswell, 2008; Adler & Haas, 2009).

The extent to which these different pathways for epistemic policy learning affect policymaking is often shaped by several factors, chief of which is the access afforded to experts, or demand for expertise (Dunlop & Radaelli, 2013; Löblová, 2017). Another set of factors include

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the institutional setup of expert structures such as advisory boards and scientific committees, their power dynamics, and governance of learning processes (Zaki & Wayenberg, 2023; Zaki, 2023). Overall, this literature discusses how scientific expertise is integrated in policymaking across different levels, through positioning experts as teachers with varying degrees of influence (see Haas, 1992; Dunlop & Radaelli, 2013). Yet, the political advocacy exercised by scientific experts is rarely accounted for or recognized. In other words, the political actorness and agency of scientific experts is often implicit or absent.

Second, the political learning perspective offers a similar image. Political learning explores how policy actors become shrewder advocates of their policy positions and increase the political viability or "uptake" of their preferences. Effective political learning enables actors to favorably "package" policy innovations and ideas (Bennett & Howlett, 1992; Mallinson & Hannah, 2020). It is a compelling lens to explain policy change. Some argue that political learning is a precondition of policy change (Biegelbauer, 2016). Hence, political learning is associated with important outcomes, such as democratic consolidation, paradigm shifts, and adjustment of political and advocacy strategies. It also shapes how policy actors instrumentalize scientific expertise to serve their policy agendas. This mainly depends on factors like policy issue salience and the political contestation surrounding learning (Trein & Vagionaki, 2022).

Yet, as with research on epistemic policy learning, political learning research rarely (if ever) focuses on scientific experts as learners. It focuses on politicians, political parties and, occasionally, on citizens (e.g., Fleming, 2014). Political learning scholarship has paid remarkably less attention to whether scientific experts engage in such processes and what political advocacy strategies they use to advance their policy positions within increasingly contested policy settings.

2.2 Theorizing political learning by scientific experts

To explore the political learning strategies used by scientific experts, it is first necessary to establish why scientific experts would engage in political learning to begin with, and why they would employ different political advocacy strategies. We posit that different political learning strategies are employed by scientific experts in response to expertise displacement, i.e., unfavorable shifts in or threats to experts' access to policymaking as the policymaking context evolves. Evolving conditions present changing opportunity structures for the political advocacy of scientific expertise, so that actors need to continuously adjust their political advocacy strategies (Hess, 2019). To explain this context, drawing on literature, we construct a three-phase process that provides a macro-level view of how experts' influence on policymaking becomes varyingly challenged. We empirically verify this process and trace different political learning strategies employed under evolving contextual conditions. This process starts when different actors (e.g., politicians, advocacy coalitions, industry players, publics) perceive increases in issue salience due to scientific knowledge production and influence on policymaking, followed by *increasing politicization*, and *changes in policy subsystem governance*.

To theorize and explore this process, we use process tracing. Process tracing is considered a potent supplement for qualitative case designs, as it allows us to conduct theoretically informed in-depth explorations of mechanisms leading to certain outcomes (Kay & Baker, 2015). The process is first theorized (Constructed) and unpacked, and then the phenomena of concern are empirically traced through analysis (for examples, see Löblová, 2017; Beach, Schäfer, & Smeets, 2019). This serves two objectives. First, it guards against false positive or Type I errors, which is a common pitfall in trying to identify policy learning. These errors can include identifying learning-like phenomena (such as behavioral or policy changes), that might be an outcome of

stochastic or random changes in political advocacy strategies, rather than genuine deliberate learning processes. This valuable feature of process tracing methods helps us more reliably reject the no-learning hypothesis (Radaelli, 2009). Second, by theorizing this process and empirically tracing evolving political opportunity structures, we are better positioned to provide explanatory insights for the use of different political learning strategies as our process of central concern (see Beach & Smeets, 2022).

2.3 A process of expertise displacement

Initially, epistemic policy learning is employed as a primary learning mode to address complex technical issues where there are actors who are highly certified (recognized) as problem solvers. Those experts become endorsed by governing actors, thus positioned as credible sources of learning and solution formulation. Conversely, at this stage, non-expert policy actors (learners such as policymakers or other subsystem actors) have little control over learning means and outcomes. Thus, experts can be somewhat uncontested with strong access and high influence on policymaking (Dunlop & Radaelli, 2013). Under these conditions, policy issues remain relatively un-politicized, with limited public attention, and with other actors either not possessing sufficient capacity, or interest in disputing expertise (e.g., Dupont, Rosamond et al., 2023). Even in crisis conditions where policy issues receive public attention, during the initial learning phase where issues are still highly complex or "ambiguous", politicization remains fairly low and experts' access to, and influence on, policy remains relatively undisputed. During this phase, we can see a "science drives policy" relationship, whereby policies formulated and implemented in the public sphere are mainly driven by scientific expertise (see Zaki, Pattyn & Wayenberg, 2023). Strong and relatively undisputed scientific influence on policymaking contributes to swift policy formulation and the development of solution-oriented, domain-specific policies.

Scientifically driven policies gradually have implications for different societal segments, thus increasing issue recognition and pulling more stakeholders into the policy arena (see Zaki, Pattyn & Wayenberg, 2023). These new actors (e.g., other high-level policymakers, politicians, the general public) have increasing access to policy knowledge produced by scientific experts, thus accumulating more ammunition to enter the policy debate (Dunlop, 2017)[2]. Increasing issue recognition, and the entry of multiple new stakeholders into the policy debate can nudge policymakers to employ other modes of learning that do not necessarily allow for high influence of scientific experts, such as, learning through reflexivity, socialization or bargaining, rather than engaging with experts (see Dunlop, James & Radaelli, 2017).

With higher policy issue salience, and with the entry of new stakeholders with multiple (often competing) interests, advocacy coalitions aiming to advance different policy agendas are formed within a policy subsystem (e.g., Möck, 2021). Here, policy issues become more prone to politicization, and thus contestation, as policy issues become highly salient on the agendas of political actors (e.g., government officials, political parties). Politicization is driven by increasing public recognition and pressure (Dupont, Rosamond et al., 2023). The existence of different actors representing a wide range of interests surrounding a politicized issue contributes to evolutions in policy issue formulation aiming to capture its multidimensionality and mediate conflicting interests, usually involving reflexive process of social learning. This often results in the adjustment of policy issue formulation and policy paradigms (see Zaki, Pattyn & Wayenberg, 2023). In this discursive social learning processes, moving from one policy paradigm to another, scientific experts' influence on policymaking can be further challenged, particularly given the politically contested nature of such transitions (Hall, 1993; Blyth, 2013). These conditions further limit the

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[2] This is regardless of the quality of the new entrants learning about the policy problem.

authority and control of epistemic groups over policymaking and enable more bargaining-oriented or reflexive learning (Dunlop & Radaelli, 2013; Dunlop, James & Radaelli, 2016), especially as updated issue formulations commonly induce changes in what expertise can be considered relevant (Zaki & Wayenberg, 2021). Put together, this undermines expert-driven knowledge exchange (Radaelli, 1999).

The third phase of this process involves changes in a subsystem's governance architecture. Due to the entry of new actors, politicization, and policy issue evolution, the policy subsystem population increases, and thus its governance architecture changes. Changes in institutional structures appear. We have seen this in the creation of new multidisciplinary advisory groups to address the COVID-19 crisis or new agencies and directorates in the case of climate change governance. This adjusts knowledge exchange architectures and affects the access configuration of pre-existing epistemic groups to policymaking (e.g., Dupont, Rosamond et al., 2023; Candel, Princen, & Biesbroek, 2021). Figure 1 provides an overview of this process.

In sum, different factors affect the openness to expertise integration in policymaking, particularly as policy issues become contested over time. These changes offer different political opportunity structures. The concept of political opportunity structure denotes differential access to advocacy opportunities (Merton, 1995). Fundamentally, political opportunity structures represent the relative openness of a certain political system, where existing social and institutional conditions can enable or constrain mobilization and how policy positions are advocated (Teräväinen, 2010). In this context, the existence and coagulation of different actor constellations with specific interests and value systems, and changes in institutional architectures influence available political opportunity structures (e.g., see Möck, 2021). Different types of political opportunity structures exist, for example according to Leifeld & Schneider (2012): Discursive (pertinent to framing),

relational (pertinent to establishing networks and alliances and communication), and institutional (more structural and governance oriented). Research shows that policy advocates adjust their political advocacy strategies to respond to changes in opportunity structures (Hess, 2019). Accordingly, emerging political advocacy strategies can also be geared towards these types of political opportunity structures, i.e., focusing on networking and alliance building, communication, and framing, or adjusting structural and institutional aspects.
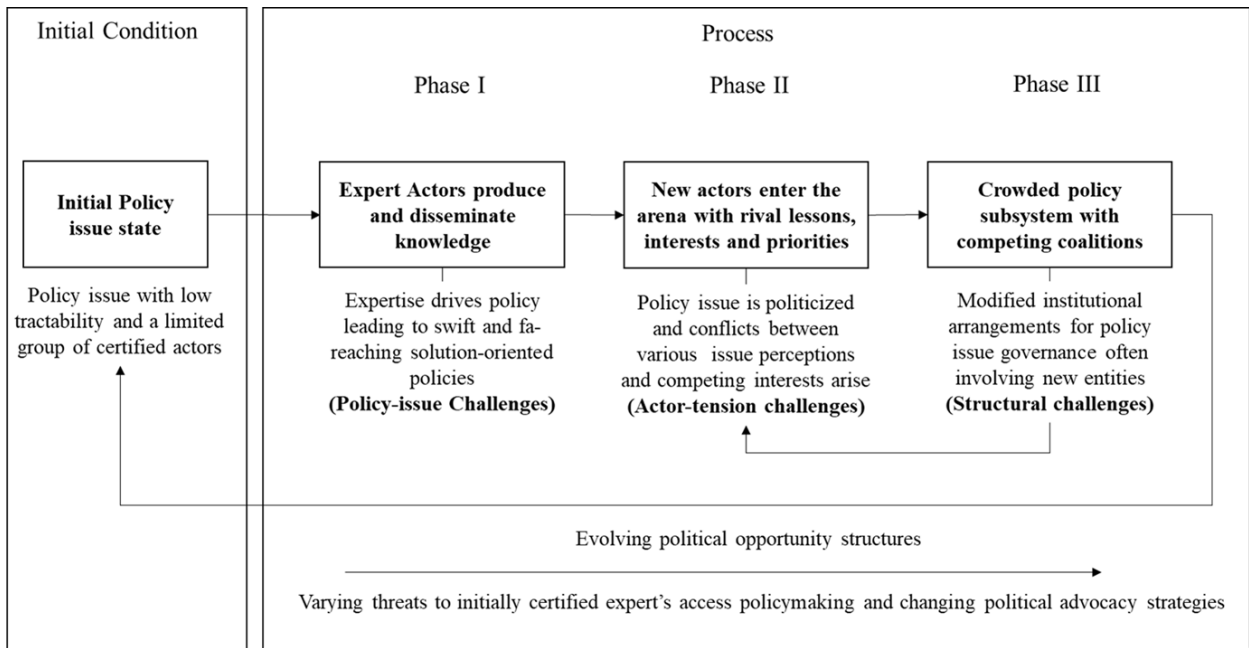

Figure 1: A process of expertise displacement

Before proceeding, important caveats are warranted regarding the above-described process. First, the process is not strictly linear. Policy learning processes, increasing issue salience, the entry of new actors, politicization, and changes to governance structures are non-linear, and are iterative as depicted in figure 1, i.e., they often do not occur abruptly in single instances as binary events (see Radaelli, 2009; Löblová, 2017; Zaki, Wayenberg & George, 2022). Second, actors likely do not enter the policy arena only as a result of increasing issue salience or increasing access to knowledge, other factors from different theoretical perspectives certainly exist. However,

we focus on some of the most observable factors that are most relevant to the authority of epistemic policy learning in policymaking (see Dunlop & Radaelli, 2013; Dunlop, 2017; Zaki, Pattyn & Wayenberg, 2023). Thus, the above depiction is not intended to be a fully linear, comprehensive model, rather it offers a macro-level analytical view for the general trends of expertise displacement over time. Hence, this process should be understood as an Archimedean device that takes a macro-level view to help understand the context surrounding expertise displacement.

Now with these conditions established, the last theoretical pillar is why would we expect epistemic communities to be proactive actors and engage in political learning and employ political advocacy strategies to enhance access to policymaking?

Research shows that experts respond to reduced access to policymaking. These responses aim at reclaiming or protecting expert jurisdictions and influence (Gieryn, 1983), and at maintaining the core tenets of epistemic policy learning: access to policymakers (Haas, 1992), and epistemic authority (Dunlop, 2017). For example, they can engage in "boundary work", i.e., processes aiming to establish favorable distinctions and boundaries that regulate interactions between experts and the systems in which they are embedded. This can include epistemic-based reframing of roles, relevance, issues in which experts are engaged, or undermining the relevance and rigor of perceived domain "intruders" (e.g., Chreim, Langley, & Reay, 2016). Scientific experts can also frame the debate as one of science versus non-science (Gieryn, 1983). These responses and constructed boundaries are not static, but evolve over time, in response to contextual variations and politicization.

Defending the role of scientific experts in policy is not apolitical, especially given the increasing politicization of science (Saarela, 2019). Epistemic communities can also engage in bargaining or coalition building, similar to other non-expert actors (Haas, 1992; Löblová, 2017),

which all entail aspects of political maneuvering. Preliminary empirical observations support this view: when expertise was gradually drowned out by increasing contestation and politicization during the COVID-19 crisis, we observed scientific experts engaging in political advocacy, lobbying, and alliance building (Zaki & Wayenberg, 2021). This comports with the theoretical view that epistemic communities are likely to attempt to influence policymaking through providing robust expertise and advice and can resort to political maneuvers when there is limited appetite for scientific evidence in policy (see for example Dunlop, 2000).

3. Methodological Framework

Case design and selection

We adopt an exploratory case design. With few previous theoretical accounts, exploratory cases aim at creating preliminary accounts of under-researched phenomena. While theory-informed, such cases can be used to create typological groupings, categorize, and contextualize phenomena. They serve as a basis for future theory building, hypothesis generation and testing (e.g., Pierre & de Fine Licht, 2019; Pijnenburg, 1998). As such, an exploratory case design is highly suitable for our research question aiming to identify political learning strategies.

Our case selection strategy is instrumental, aiming to identify empirical cases well-suited for exploring the phenomenon of interest. To explore political learning by scientific experts, we focus on EU climate policy in the period between 1990 and 2022. Here, case selection is based on our theorization of why political learning by scientific experts would occur in a certain context. In this case, we have: climate change as a complex policy issue where expertise plays an important role amidst increasing politicization (Dupont, 2019; Dupont, Rosamond et al., 2023), within a multistakeholder institutional setting of the EU, where policy learning, negotiation, lobbying, and advocacy are often observed (Zito, 2009; Challies et al., 2017), and governance and advisory

structures dynamically adjusted (see Candel, Princen, & Biesbroek, 2021). This increases the likelihood of observing genuine political learning phenomena and to trace our theorized mechanism. By scientific experts, we refer to a group of scientific experts with authoritative claims to policy knowledge and access to policy. These actors demonstrate shared sets of normative and principled beliefs, causal beliefs about climate change, its causes and impact, notions of validity of knowledge, and a policy enterprise (see Haas, 1992; Löblová, 2017). We specifically focus on political learning by experts at the European Environmental Agency (EEA), an independent agency of the European Union which plays a key role in providing data and scientific knowledge on environmental affairs and climate change within the EU political system. The EEA is a European agency of experts, sitting between the scientific and policy communities. Its role in EU climate policymaking has evolved into one of bridging the scientific and policy communities, providing robust data and analysis also in the policy monitoring and evaluation phases. This makes the EEA a fairly unique knowledge agency in EU climate policymaking.

We also use insights from national level scientific experts, policymakers, and European Commission (EC) staff to triangulate our empirical observations.

Case Structure, analysis, and data

Being a theory-informed exploratory case, our proposed process leads us to a longitudinal layout. We structure our case into three loose, consequent eras where we can observe changes in climate change's issue salience, increasing politicization, and new governance structures being introduced 1990-2006, 2006-2015, 2015-2022 (Dupont, Rosamond et al., 2023). This allows us to trace and analyze political learning strategies over time and account for the influence of contextual conditions (for example see Löblová, 2017; Beach & Smeets, 2022). Thus, this is a case-centric, historically specific process tracing design that aims at explaining outcomes in a particular case

and serves to develop insights for future hypothesis generation and testing (Kay & Baker, 2015). The reasonable, theoretically informed assumption here is that with varying levels of issue salience, politicization, and changes in subsystem governance structures we can observe various political advocacy strategies in response to changing political opportunity structures.

Our data is sourced from 32 semi-structured interviews with experts and senior officials from EU institutions (the European Commission, European Parliament and from permanent representations of member states to the EU) and from the European Environment Agency. Interviews were conducted between 2010 and 2022, covering the interviewees' years of experience dating back to the 1990s. We also leverage data from 21 hours of in-person ethnographic observations of the agency's scientific experts' group, and policy official meetings[3]. Given the long duration of our analysis, we must acknowledge issues of recall bias and the potential for memories to fade, particularly when reporting learning. While this cannot be completely avoided, we mitigate this by supporting our analysis and triangulating findings with official documents from EU agencies, scientific reports, and published literature. Interviews and observations were transcribed and fully anonymized. Furthermore, our analysis of over a 30-year period allows us to uniquely account for the long time required for learning to take place (see Radaelli, 2009). Table 1 offers an operationalization of our main variables and phenomena of interest within our analysis.

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[3] Ethnographic (participatory) observations were used as a supplementary channel for data collection, particularly concerning recent developments in EU Climate policy.

Key variables of interest	Indicators and operationalization
Occurrence of Learning	▪ Critical reflection on priors and acquired knowledge (Rietig & Perkins, 2017). ▪ Circulation and consumption of policy-issue related information and knowledge among target expert actors (Zaki, Wayenberg & George, 2022).
Political learning strategies	▪ Deliberate and coherent actor approaches aiming to advance political advocacy of policy positions (Bennet & Howlett, 1992), based on knowledge and information regarding evolving policy contexts (see Zaki, Wayenberg & George, 2022). This is based on changes or explicit affirmation of tactics and strategies relating to political goals and processes, concurrent better understanding of these (Biegelbauer, 2016).

Table 1: Operationalization of key phenomena and outcomes

For analysis, we follow a systematic process. First, we reject the "no-learning" null-hypothesis (i.e., dismissing that observed phenomena are learning-like behaviors that do not constitute genuine learning based on critical reflections) by ensuring the occurrence of learning at the background level. This helps us limit the effects of social desirability bias, and over-inclusion of learning-like confounding phenomena. Then, we trace processes of political learning through observing changes (i.e., moving from a baseline state to another) in strategies aimed at better political positioning and access to policymaking. Data coding categories were abductively developed, guided by the operationalization in table 1. We code for mentions of political considerations and their influence on advocacy of expertise. Thus, we maintained openness to data, and a close connection to our theorized process. Analysis was done by the two authors and findings were compared and integrated.

Given the longitudinal nature of analysis, we first situate the EEA as our primary learner. The EEA's specific, institutionalized role at the science-policy interface in the EU makes it a particularly interesting focus of our analysis. Then, we structure our analysis over three phases of political learning based on changes in policy issue politicization over the period between 1990-

2022. In the discussion, we synthesize the political advocacy strategies employed by scientific experts, and their contexts.

4. Political learning by scientific experts in EU climate policy

Positioning the primary learner: The European Environment Agency

The EEA was established in 1994. Its main mandate is to provide reliable data and knowledge on the state and outlook of the European environment (Council of the EC, 1990; European Environmental Agency, 2022). The Agency's establishment came in recognition of the pressing importance of environmental issues and the need for data-driven environmental policymaking within the EU (Waterton & Wynne, 1996; Schout, 1999; Zito, 2009).

However, while this need was evident, the context was contested. Different stakeholders argued over the Agency's "reach". There were conflicts over whether establishing a new agency would constitute an encroachment into existing EU agencies' or institutions' scope or missions (INT-11; INT-13[4]). This was of particular concern for the European Commission (Zito, 2009), and especially the Directorate General for Environment (DG ENV) whose scope was argued to be overlapping (see Jevnaker & Saerbeck, 2019). Eventually, the EEA was established as legally autonomous, and was mandated to maintain close ties with EU institutions.

The Agency's main interlocutor became the Commission's DG ENV (Egeberg et al., 2014). DG ENV spearheads the Commission's environmental policy efforts across environmental policy integration, biodiversity, and natural resources, with climate change also being part of its mandate until DG Climate Action (CLIMA) was created in 2010 (Candel, Princen, & Biesbroek, 2021; Koch & Lindenthal, 2011). Tensions over jurisdictions between DGs within the EC have also long

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[4] INT: Interview data

existed, and these sometimes spilled over into the relationship with the EEA. DGs have competed over administrative turf, core competencies and resources, particularly given the creation of DG CLIMA. The context of the learning processes within the Commission has often been seen as politically charged. Relationships between the EEA and Commission partners (and between internal Commission units) often involve intricate processes of maneuvering overlapping often conflicting boundaries. These issues are often resolved through informal rather than formal coordination (see Jevnaker & Saerbeck, 2019; INT-10; INT-11; INT-13).

The Agency also has several multistakeholder relationships with high level political actors such as the European Parliament, Council of the EU, and other EU institutions, as well as governments and environmental agencies in member countries (European Union, 2023). Since its establishment, the Agency has therefore been at the center of high-level political networks in a dynamic policy context.

With our primary political learner positioned, next we trace different political advocacy strategies employed across three main phases of EU climate policy development with increasing levels of politicization[5]. Across each phase, we reflect on our 20 theorized process as the backdrop of political learning and political advocacy strategies. There, we rely on both literature and the responses from our interviewees.

Evolution of the EU Climate policy: The backdrop of political learning

EU climate policy has evolved since the 1990s to include greenhouse gas (GHG) emission reduction targets and a broad set of policies across a range of sectors. By first agreeing upon GHG emission reduction targets and then negotiating and adopting implementing policy measures, EU

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[5] Time periods are indicative

climate policy has expanded from a focus on mainly renewable energy and energy efficiency, in the 1990s, to creating an Emissions Trading System (ETS) in the 2000s covering emissions from large industrial installations to policies covering emissions in the land-use sector and forestry in the 2010s. This gradually evolved towards a more comprehensive approach under the European Green Deal in 2019 laying out the policy framework to achieve climate neutrality by 2050 (Dupont, Moore et al., 2023). Policies tackling embedded emissions in products entering the EU single market, and measures to respond to social impacts of a transition to climate neutrality were agreed in the 2020s. In Table 2, we provide a selection of some of the measures that have been adopted over time. This table is intended as a guide that outlines part of the policy timelines and issues that are highlighted later in our analysis of political learning strategies by EEA experts.

Congruent with our theorized process, we trace two intertwined evolutions of the climate issue that led to the displacement of expertise and the need for experts to engage in political learning. First, the increasing salience of climate change, as the (understanding of the) climate issue evolved from a predominantly technical and scientific issue to a societally complex and wicked issue, with wide consequences of policy action and inaction, meant that scientific experts were displaced as new actors and interests raised their voices in the policymaking sphere. Second, the evolution of climate change politicization further hampered the smooth uptake of scientific expertise in the EU.

First, the perceived ease of responding to the climate challenge has evolved. While climate change itself has long been an established fact of science, policymakers in Europe only began working on the issue in earnest in the 1990s, in line with the global processes under the United Nations Framework Convention on Climate Change (UNFCCC), which was adopted in 1992. In the 1990s, climate change was perceived as an environmental issue, with a plausible, scientific,

and technical solution (reducing the emissions of greenhouse gases) (INT-1). Scientific expertise, especially from the Intergovernmental Panel on Climate Change (IPCC), which published its first scientific assessment report in 1990, and its second in 1995, was relied upon. Such sources, were considered "non-negotiable" as expressed by one of our interviewees who worked in the European Commission in the 1990s:

"we would simply say, well that's what the scientists, this is what the intergovernmental panel on climate change, which is the authoritative international group of scientists working on the topic, tell us. And who are we to doubt that if hundreds of scientists produce a report?" "From our point of view, we stoically upheld the scientist views" (INT-1).

But it was not long before the 'wicked' nature of the climate issue became apparent (Head & Alford, 2015; Levin et al., 2012). The scale and scope of the action required, across multiple levels of governance and involving multiple sectors of society meant that, by the mid-2000s, resolving the issue seemed ever more complex (INT-4, INT-14, INT-15). This was not only a matter of technical solutions. The multidimensionality of the issue and scope of action required brought in a strong societal component. This was fueled by an increasing amount of scientific knowledge about climate circulating in the public sphere. This complexity has remained a feature of climate policy, leading to a multitude of interests, voices and actors involved in EU climate policymaking, sometimes drowning out the established scientific expertise (Dupont, Rosamond et al., 2023; Gullberg, 2008; Kirchhoff, Lemos, & Dessai, 2013; INT-6).

Second, along with increasing societal complexity, we also see politicization of the climate issue, again from around the mid-2000s (Dupont, 2019; Dupont, Rosamond et al., 2023; Kuzemko et al., 2016; Paterson et al., 2022). Contestation around both inadequate climate policy action, as evidenced by the repeated IPCC reports, and contestation around the policy choices ensured high

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levels of political prioritization for the climate issue in the EU and (varying degrees of) polarization of the issue and of the policy choices. Literature highlights that the years following the financial and economic crises of the late 2000s (from around 2009-2015) were particularly challenging for advancing climate policy given the politicized context, also displacing scientific expertise (Dupont, Rosamond et al., 2023; Skovgaard, 2014), which was a sentiment shared by many interviewees (INT-1, 3-6, 9-16). For example, agreement on the 2011 roadmap to set the EU on the path to decarbonization was blocked by Poland (Dupont & Oberthür, 2015; European Commission, 2011; Skovgaard, 2014).

With the adoption of the Paris Agreement in 2015, there was renewed commitment to tackling climate change globally. In the EU, this meant that policies advanced, including the adoption of the European Green Deal in 2019 – an overarching policy framework to achieve climate neutrality in the EU by 2050 (European Commission, 2019). Interestingly, although the issue remained politicized at this time, prioritization spurred policy action rather than delaying or diluting action via polarization (Dupont, Rosamond et al., 2023; Paterson et al., 2022).

EU goal	Status	Selection of implementing policy measures
Stabilize CO₂ emissions by 2000	Achieved	- Voluntary measures for renewable energy (ALTENER) - Voluntary measures for energy efficiency (SAVE) - Failed proposal on CO_2 tax
Reduce GHG emissions by 8% over 2008-2012 compared to 1990 levels	Achieved	2001 Directive on renewable electricity 2002 Energy performance of buildings Directive 2003 Directive establishing the GHG Emissions Trading System
Reduce GHG emissions by 20% by 2020 compared to 1990 levels	Achieved	2009 Renewable energy Directive 2009 Revised ETS Directive 2009 Regulation on CO_2 emissions from cars 2010 Revised energy performance of buildings Directive 2012 Energy efficiency Directive
Reduce GHG emissions by 40% by 2030 compared to 1990 levels	Target updated in 2021	2018 Renewable energy Directive 2018 Governance Regulation 2018 Regulation on emissions from land use, land-use change, and forestry 2018 Energy efficiency Directive 2018 Emissions Trading Directive
Reduce GHG emissions by 55% by 2030 compared to 1990 levels	More efforts required	2021 European Climate Law "Fit for 55" package negotiated in 2021-2023 including: 2023 Energy efficiency Directive 2023 Renewable energy Directive 2023 ETS Directive 2023 Regulation on CO_2 emissions from cars and vans 2023 Regulation on land use, land-use change, and forestry 2023 Regulation establishing a social climate fund 2023 Regulation establishing a carbon border adjustment mechanism

Table 2: Overview of EU goals and a selection of some implementing policy measures

Sources: Dupont, Moore et al., 2023; EEA, 2019, 2023; Oberthür & von Homeyer, 2023

This situation also reveals the challenges of politicization: while an issue like climate change may benefit from a certain degree of politicization, to keep political attention and to ensure policy action (Paterson et al., 2022), politicized contexts are challenging for the uptake of scientific expertise in policymaking (Radaelli, 1999). In the next section, we zoom in more on the role and political learning of scientific experts over three, loosely defined phases of EU climate policy development. The phases are derived not from an assessment of the (accuracy of) uptake and translation of scientific expertise into policy, but from an initial assessment of the shifting role of scientific experts in a context of politicized policymaking.

Phase one: Genesis and laying the foundations (1990s-mid-2000s)

During this phase, climate change was largely seen as a scientific and technical issue. Politicization of the issue was only beginning, as the issue became prioritized and more salient (Dupont, Rosamond et al., 2023; Dupont, Moore et al., 2023). Targets were agreed on the reduction of GHG emissions, followed by the development of implementing policy measures on renewables, energy efficiency, and markets or pricing measures, with the policy mix expanding and evolving over time (Knodt & Schoenefeld, 2020; Oberthür & von Homeyer, 2023; see Table 2). The EU's primary focus was to support the goal of limiting global temperature increase to two degrees Celsius (European Commission, 2007).

From our interviews, we learn that there was hardly any perceived need for political learning by experts in this phase. With little in-house knowledge, Commission officials, in particular, relied on available scientific knowledge. One Commission official mentioned that the publication of the IPCC's scientific reports were *'important occasions'* that would allow the Commission to *'confirm our policy'*, and to impose *'difficult decisions on other sectors'* (INT-1),

overcoming (potential) political challenges. Another interviewee clearly highlighted that they were '*at the stage of learning… we wanted the best expertise'* (INT-2), particularly when it came to the new ETS policy measure, first proposed in 2001 (Oberthür & von Homeyer, 2023; Wettestad, 2005). They further highlighted: "*to be very, very frank, there was no expertise within the Commission. We had to go outside, and we did*." The Commission sought studies from external organizations: "*over these let's say five years of the development of the ETS we did a series of consultancy studies, which were increasingly valuable*" (INT-2). These studies formed the basis of the design of the ETS that kicked off its first pilot phase from 2005 to 2007.

Although scientific expertise was required, policymakers had limited contact with scientists themselves (INT-1). Policymakers relied on published reports and articles or called for specific studies. Building on scientific literature and reports became further institutionalized in the Commission when the impact assessment procedure was adopted as a standard procedure for policymaking in 2002 (European Commission, 2002; INT-1).

The EEA focused in this phase on capacity-building inside the Agency. Having been officially established in 1994, it began work mainly as a data provider on environmental and climate issues, meaning that it needed to ensure core tasks such as monitoring, data gathering and analysis, and data quality control. But as EU climate policy expanded, the EEA's role started to evolve, with the Agency becoming more involved in policy assessment and evaluation work. One interviewee, who worked at the EEA from 2000 until 2016 and witnessed much of this evolution, highlighted that this eventually led to the EEA becoming '*more connected and integrated with EU policymaking procedures'* (INT-15), but that the role of assessor and knowledge provider was not as easy as the role of data provider. Another interviewee, who had worked at the EEA since the

mid-1990s, highlighted how in this phase, the EEA was itself still learning how to play its data provider role, while the demands for the knowledge provider role increased (INT-5).

The policy learning processes in this phase can therefore be characterized as predominantly instrumental and technical among both policymakers in the Commission and experts in the EEA. The focus was on developing policy instruments to achieve emissions reduction objectives. This first phase is therefore a time of limited political learning for experts. Rather, the EEA was focused on improving its capacities in monitoring, data collection and analysis, data quality control, and also in assessment and evaluation. Hence, congruent to our theorized process, during this phase, the need for political learning was rather limited. The policy subsystem was sparsely populated, with limited politicization, and scientific expertise was mentioned in policymaking. This left room for the EEA to increase the amount and quality of core data tasks and develop its core competencies as a '*data provider'*, while the knowledge and assessment work took more time to develop (INT-3; INT-4; INT-5).

Phase two: challenges to expertise and incremental policy expansion (mid-2000s-2015)

In this phase, we see the gradual process of expertise displacement. Public attention to climate change grew and scientific knowledge was accessible (e.g., IPCC, 2007). We observe high-level political officials prioritizing climate policy. By 2007, climate change was regularly discussed at meetings of prime ministers and presidents (Dupont, 2019). By 2009, the EU had adopted its target to reduce GHG emissions by 20% by 2020, compared to 1990 levels, and a suite of policy measures to achieve that target (see Table 2).

Given the far-reaching societal and economic implications of tabled climate policies, politicization of the issue became quite high, especially in the wake of the financial and economic crises at from 2008 onwards (Skovgaard, 2014). Climate policy was politically salient but also

increasingly contested (Dupont, Rosamond et al., 2023). There was considerable contestation around targets and policy choices. This emerged with growing recognition of the destabilizing implications of both climate action and inaction for existing social, political, and economic systems (Knutti, 2019), spurring contestations between subsystem actors across multiple levels. For example, at member state level, contestation manifested around balancing economic growth and climate policy requirements, with Poland at this time contesting the EU's proposed long-term goal of decarbonization (Dupont & Oberthür, 2015). Contestation was also evident through the entry of new lobbying actors such as trade unions and industry associations into the debate, leveraging varying interpretations of existing scientific knowledge (and uncertainty) (e.g., Brulle & Downie, 2022). This included industry actors lobbying both against stringent caps on emissions (Markussen & Svendsen, 2005), and in support of such regulations (Gullberg, 2013). Thus, here we see climate change becoming formulated as a complex, socially embedded issue. It became an issue for a wider range of political actors, and no longer only a technical issue for climate experts or just ministries of the environment. EU policymakers started adopting other policy learning approaches beyond primarily learning from experts, ones more focused on bargaining, political negotiations, and reflexivity (e.g., Vogler, 2009). The increasing systemic and social complexity of the climate issue, and entry of new actors with various contested interests also contributed to new structures emerging within the EU institutional architecture, such as the establishment of DG CLIMA in 2010 to develop EU climate policy, facilitate international negotiations around climate policy and streamline relationships with a range of public and private actors (Rietig & Perkins, 2017; Candel, Princen, & Biesbroek, 2021). This is in addition to the emergence of several transnational policy networks influencing policy development (e.g., Rashchupkina, 2015; Adelle, Jordan, & Benson, 2015).

In such an evolving, crowded, and contested space, scientific and expert voices were sometimes drowned out, or even not always welcome (Dupont et al., 2018; INT-1). Consistently, during this phase of high politicization, and in the wider context of increased complexity of the climate issue and several overlapping crises (Burns & Tobin, 2018), scientific expertise in general, and the expanding knowledge and scientific expertise of the EEA, was far less sought after, and sometimes outright unwelcome in policymaking circles. EEA experts viewed the politicization of climate change during this time as a barrier: "*the [process of target-setting] in the European Council ... doesn't leave much room for science"; "on the mitigation side, my feeling is that it's so politicized that there's not much room for science*" (INT-3). Other interviewees highlighted how challenging it was to provide knowledge or critical assessment of EU policy instruments, citing the ETS as an example, which was redesigned to ensure fewer free allowances were distributed: "*we did think that there was greater stringency and the value of the allowances suggested there was much greater scarcity, and then the economic crisis hit*" (INT-2). The ETS revision was implemented in an economic crisis that led to a crash in prices, which almost eliminated any price incentive to reduce emissions in industry that the ETS was trying to create. But, under the ETS "*there was no adjustment possible, we hadn't designed it that way*", as a Commission official acknowledged (INT-2). The ETS was "*technical and at the same time very political*" and, EEA experts noted that they had to be *"careful"* in providing their knowledge and assessments because expert "*policy interference is not so welcome*" when it came to the ETS (INT-4). This is also clear in the comment by a Commission official that criticism of the ETS was hard to take, "*I took it personally*" (INT-2), illustrating that there was hardly a constructive feedback relationship between expert analysis of the ETS and policymakers.

In several ways, there was friction and resistance between the EEA and key EU institutional partners and member states (INT-11). One interviewee highlighted how assessments and studies from the EEA would receive "*pushback*" in this phase, especially around the "*framing*" of their reports, both from Commission policymakers and from member state governments. The EEA had to deal with "*upset ministers… asking that the messages [of our reports] be made more nuanced*" (INT-15). Difficulties for expertise integration also existed inside member states, where the means for expertise to enter policy were sometimes limited by established research budgets that don't "*provide the flexibility that modern society needs*" (INT-6).

We find evidence of an uptick in political learning by EEA scientific experts who implemented different strategies to enhance their access to policymaking circles. First, experts emphasized new framings of the policy issue. Climate change was advocated as a "*cross-cutting issue*" that no longer required siloed and methodical "*build up [of] scientific expertise*", as in the first phase, which could be categorized as a time to "*learn by doing*" and to avoid "*paralysis by analysis*" (INT-3). Another strategy was relational, where experts emphasized that "*it's building trust… with the Commission to know exactly what [our] limits are*", and that it's a "*choice to make whether we want ... to make some noise… with potential consequences*" (INT-4). Other experts adopted relational strategies at national level by directly reaching out to ministers, noting that "*sometimes they listen, sometimes they don't*" (INT-6). This highlighted the challenge of expertise competing for attention from policymakers who are "*literally flooded by materials*" from multiple actors (INT-6). On a governance level, the EEA adjusted its scientific governance structures by bringing in policy, politics, and governance scientists in a bid to better enhance understanding of, integration with, and access to policymaking (INT-11; ETN-1[6]). In addition, Prof. Hans

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[6] ETN: Ethnographic observations of meeting and proceedings

Bruyninckx, a political scientist, who was appointed as Executive Director of the Agency in 2012, can be credited with steering the evolution of the Agency from data provider to fully-fledged knowledge-provider, populated with experts engaged in political learning (INT-5; INT-11). Altogether, we find evidence of deliberate reflections and learning by which experts in the EEA made informed decisions about "when" and "how" to enter climate policy discussions. This was against the background of increased acknowledgement of the complexity of climate policy, while its politicization in the EU formed a barrier to the uptake of expertise (Radaelli, 1999).

Phase three: new momentum towards climate neutrality (2015-2022)

In this phase, more consensus developed around climate change being a complex and systemic issue, with more interests entering the policymaking processes. There is high prioritization and politicization of the issue, with the acknowledgement of the need for climate action less contested, although choices of policy measures still faced contestation.

With the adoption of the Paris Agreement at the climate negotiations in 2015 (aiming to limit global average temperature increase to less than two degrees Celsius, and as close to 1.5 degrees Celsius as possible), a new momentum seemed possible. The EU did not immediately respond with new targets or policy measures (European Commission, 2018; Rietig & Dupont, 2021; Kulovesi & Oberthuer, 2020). But the politicization of climate change seemed to spur policy action (Paterson et al., 2022): there were climate protests and more public support for climate action, political agreement was reached in the European Council to aim for climate neutrality by 2050, and a new European Parliament and European Commission President took office in 2019.

President Ursula von der Leyen's Commission published the European Green Deal (EGD) weeks after she took office. It aims to achieve climate neutrality in the EU by 2050 (European Commission, 2019). It is an overarching, systemic policy strategy, that connects climate action to

multiple sectors. The EGD's agenda represents a shift that is largely disruptive of several established socio-economic models (Schunz, 2022; INT-11; INT-12), involving substantive lifestyle changes. These changes are contested, especially as the EGD's implementation unfolds amidst a context of successive crises, including COVID-19 and the Russian invasion of Ukraine (Bäckstrand, 2022; Dupont et al., 2020; Kuzemko et al., 2022; Oberthür & von Homeyer, 2023; see Table 2). With the 2021 European Climate Law setting the EU's 2030 and 2050 goals into law (see Table 2), the European Scientific Advisory Board on Climate Change was also established, with the EEA identified as the agency to host its secretariat – an extension to changes in the subsystem governance architecture, particularly focused on knowledge exchange processes[7].

Both policymakers and EEA experts highlighted an atmosphere of open knowledge exchange (Dupont, Rosamond et al., 2023; INT-9; INT-10; INT-13; INT-14). The needed expertise was far more multidisciplinary, and the EEA had spent years developing its internal capacity to be able to provide that expertise, or to connect to the relevant knowledge communities (INT-14). EEA experts noted that their work formed an important foundation for the EGD (EEA, 2019; INT-11; INT-12; INT-13; INT-14). Policymakers in the Commission highlighted the importance of bridging multiple sectors and filling gaps, not only in data, but also in knowledge around the systemic connections with and between climate mitigation and adaptation measures. This included themes such as *"sustainable finance", "risk", "vulnerability", "humanitarian assistance", "rural development", "cohesion", "just transition", "research programmes", and "agricultural reform"* (INT-7; INT-8). This systemic view of the climate challenge altered the relationship between science and policy, and between EU policymakers and the EEA (INT-11). Policymakers

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[7] The Board began its operations in 2022, just as our data analysis for this project was ending, meaning that it does not feature in our analysis, and neither is it referenced in our interview data.

needed to recognise their lack of capacity in making connections. This is partly because the EGD "*came as a surprise*" for several policymakers (INT-9; INT-10) and partly because there was an insufficient build-up of relevant expertise within the policy system: "*especially on climate adaptation, we have fewer adaptation experts than for mitigation*" (INT-7). Hence, the understanding of the systemic and interconnected nature of climate change – an understanding highlighted by the EEA in several reports, including its 2015 State and Outlook of the Environment report (EEA, 2016) – revealed the knowledge gaps in policymaking circles.

Our analysis shows several ways in which EEA experts engaged in political learning to counter challenging politicized contexts (such as during COVID-19) and ensure their expertise entered the policymaking discussions. The main objective was to support and drive the systemic change agenda (INT-11) and carve out a place for evidence-based policy decisions. The bulk of the learning activities were centered on developing better understandings of the inner workings of the political system, and how it interacts with knowledge in an attempt to enhance the uptake of scientific expertise (INT-11). First, EEA experts engaged with multiple stakeholders with influence over agenda-setting, including Commission policymakers from DGs beyond DG environment and members of the European Parliament, (beyond the *"usual suspects"*, INT-11). Such engagement took different forms, from personal one-on-one relationships to orientation sessions, workshops, and symposia (INT-12; INT-13; INT-14). The entry of multiple new stakeholders also gave the opportunity to avoid or circumvent exclusive interactions with political actors who constituted roadblocks (INT-11). Engagement focused on explaining the logic of sustainability transitions and acting as "*facilitators of knowledge*" (INT-11).

Second, EEA experts were careful to adapt narratives and terminologies that were consistent with high-level political directions, especially from the Commission. One interviewee described

this as a form of semantic adoption saying, "*we took the language and we started to use it ... you need to connect to their language"* and the need to *"agree on the narratives*" (INT-11; INT-12). This involved internal orientations within expert groups on policy subsystems, governance, and contemporary policy problems terminologies (ETN-2). Together, these strategies aimed to ensure that experts integrate "*science in a knowledge system and a knowledge architecture that is specialized in speaking to policymakers*" (INT-11).

5. Discussion

We set out to explore the political advocacy strategies of scientific experts in response to varying challenges to their access to and influence on policymaking. We theorized a process by which experts' authority in policymaking is challenged, spurring political learning as a response to evolving political opportunity structures. This process involves the swift development of highly influential policies driven by relatively undisputed scientific experts' access to policymaking. This contributes to increasing issue salience, and recognition, non-exclusively helping new actors enter the policy subsystem, increasing politicization and contestation, and changes in policy subsystem governance architecture. We empirically traced this process and its contribution to political advocacy strategies employed by scientific experts within the case of climate policy in the EU between 1990 and 2022, focusing particularly on political learning among experts in the EEA. Then, we established a theoretically guided backdrop to contextualize these political advocacy strategies.

Our analysis shows that political learning by scientific experts varies. During phases where the process of expertise displacement was prominent (particularly between 2006 and 2015, see Dupont, Rosamond et al., 2023), experts had to engage in intensified political learning, developing and employing political advocacy strategies to maintain their access to policymaking. As the

policy issue and subsystem configuration evolved in the third phase of EU climate policy development (between circa 2015 and 2022), contestation remained high, yet there was renewed momentum for a new and more ambitious paradigm of climate policymaking. Political learning also continued, leading to refinements in political advocacy strategies. Along these two phases where expertise displacement took place, political advocacy strategies evolved to respond to changing political opportunity structures. This is line with the theoretically established understanding of political advocacy approaches adapting to changes in institutional and contextual conditions that affect actors' access to policymaking (see Teräväinen, 2010; Hess, 2019).

Identified political advocacy strategies

We find a range of political advocacy strategies at multiple levels. At the individual level, scientific experts cultivate personal relationships, trust, and alliance building with different policy actors. At the organizational level, political learning enabled expert groups/agencies such as the EEA to introduce changes to governance structures aiming to develop better understandings of, and connections with, a continuously evolving policy subsystem. This is in addition to developing more suitable policy-issue narratives. Drawing on our operationalization and analysis, we identify three main types of strategies manifesting as outcomes of political learning. Consistent with policy learning theory, these strategies could be positioned across key elements of the policy learning process as defined by Zaki, Wayenberg & George (2022): *Narrative and semantic strategies* (concerning policy issues), *Socialization strategies* (concerning policy actors), and *Governance strategies* (concerning systems and structures) as shown in Table 3.

Observed political advocacy strategies	Emerging political advocacy strategies across phases of EU climate policy development		
	Phase I Between c. 1990 to 2006	Phase II Between c. 2006 and 2015	Phase III Between c. 2015 and 2022
Narrative and semantic strategies (Policy issue oriented)	▪ No observable political learning processes given the high technical specificity of the climate policy domain, relatively low salience, and limited politicization of the policy issue. ▪ Learning was predominantly technical and instrumental both within policymaking and expert circles.	▪ Advocating new framings of climate change as a cross-cutting societal challenge requiring multidisciplinary expertise and reframing the role of science therein.	▪ Adopting framings and terminologies consistent with high-level political directions, especially from the Commission. This aimed to integrate science in a knowledge system and a knowledge architecture that is specialized in speaking to policymakers.
Socialization Strategies (Actors oriented)		▪ Relational strategies of individual alliance and trust building within the EC. ▪ Direct interactions and advocacy with ministers at member state levels.	▪ More structured alliance building with a broader set of partners and networks at the agenda-setting level including the additional DGs within the EC, European Parliament, Council, and policy networks. ▪ Leveraging the presence of new subsystem actors to circumvent political actors constituting roadblocks to expertise in policymaking. ▪ Adopting the role of "facilitators" by socializing knowledge on climate change across different actor networks.
Governance strategies (Systems and Structures oriented)		▪ Developing understandings of the governance architecture and the cost benefits of challenging policy. ▪ Adjusting governance structures of expert agencies by bringing in political science and governance scientists to better interface with policymaking. ▪ Developing core capacities for the expert agency to act as a fully-fledged knowledge provider.	▪ Adjusting the structure of the agency to ensure interdisciplinary expertise is represented to develop more systematic connections between different policy domains in a manner fitting high-level political narratives.

Table 3: Political Advocacy strategies by scientific experts

The use of these strategies was not mutually exclusive. Rather, strategy mixes were employed simultaneously to address different challenges. Table 3 shows emerging political advocacy strategies across phases of EU climate policy development. This does not mean that strategies employed in phase two are not employed in phase three. Rather, existing strategies remained in place, with new ones being added as the context evolved across different phases.

Our empirical tracing of the process of expertise displacement indicates that these strategies correspond to evolving political opportunity structures, namely the constitutional structure of the subsystem, the configuration of actors and their influence, and public opinion interest (Hess, 2019). For example, during phase two, where pathways for political advocacy were still relatively limited for scientific expertise, we see that political maneuvers included personal (individual) alliance building. This is in addition to forms of "selective mutism" by scientific experts, in other words knowing when to make noise, and calculating the costs and benefits of pushback on specific issues. This enabled scientific experts to focus on higher priority debates. During phase three, we see political opportunity structures evolving, given changes in institutional architecture, configuration of subsystem actors, and a more open atmosphere for science in climate policy, opening the substantial space for three forms of opportunity structures outlined by Leifeld & Schneider (2012): discursive, relational, and institutional. With more influential actors entering the subsystem, and public opinion being strongly in favor of decisive climate action, political advocacy maneuvers took more explicit and outward-facing forms. This translated into activities such as organizing seminars and workshops, systematic agendas for structured alliance building with other actors and (new) partners, including the European Parliament, Council, among others (responding to relational opportunity structures). Furthermore, framing the climate issue to address the general public and other interested actors could prompt mobilization and facilitate more

effective science-policy interactions (responding to discursive opportunity structures). The EEA also engaged in developing competencies as a science-policy interface powerhouse to meet the increasing appetite of the institutional architecture for science-driven climate policy (responding to institutional opportunity structures). While our analysis establishes political learning by scientific experts, we find no instances where experts compromised scientific evidence. Rather they often facilitated the expression and integration of knowledge by better understanding the specific political system or employing more suitable narratives to facilitate more effective science-policy interactions, as one of our interviewees said, "*we do not play political politics, we play policy politics*" (INT-11).

What do these findings imply for theory and practice? Theoretically, there are two main contributions. First, existing models of the science-policy interface have offered groundbreaking insights on how science is instrumentalized by salient political actors. Our findings complement this view by illustrating the active political agency and actorness of scientific experts. This extends existing research by adding an explanatory layer to science's role in policy. To understand the role and dynamics of how scientific expertise influences policymaking, future research needs to consider how scientific experts adapt and pursue access to policymaking under different conditions. This offers a more comprehensive baseline for understanding the relationship between policy learning and policy change by shedding light on scientific experts as active agents, rather than only on the features of the scientific content they produce, and policymaker's demands. Second, these findings offer novel explanatory insights to the epistemic communities literature, particularly concerning whether, why, and how do scientific experts engage in political advocacy. The theorised and traced process of expertise displacement explains the conditions under which scientific experts proactively employ political maneuovers to engage in policymaking.

Empirically, in addition to shedding light on unexplored phenomena, this analysis adds a novel and real-life perspective to the processes of science integration in policymaking within the EU context, where importance is placed on evidence-based policyamking, in an era where policy issues and expertise are often politicized. Practically, this points scientific expert communities' attention to the importance of active political advocacy of science, and outlines several key strategies. Furthermore, it also points policymakers' attention to a novel perspective of a process that creates roadblocks for the integration of scientific expertise in policymaking.

6. Concluding reflections

What have we learned about political learning by scientific experts, and their political advocacy strategies in the context of increasing politicization? First, our analysis finds evidence of scientific experts engaging in political learning processes. We identified three categories of political advocacy strategies: Narrative and semantic strategies (oriented towards policy issues), Socialization strategies (oriented towards ecosystem actors), and Governance strategies (oriented towards systems and structures). However, four caveats are warranted. First, while these findings offer substantive insights into political learning processes, we do not claim that this is an exhaustive stocktaking exercise of all political advocacy strategies. This also does not imply that other types or varieties of policy learning, such as social or instrumental learning, were muted. Second, this account is not normative. We do not assess the validity, success, or scientific impact of the political learning strategies employed. Third, while politicization seems like a reasonable trigger or moderator for this type of political learning, we do not claim that no other factors exist, or that our findings are necessarily generalizable to all domains. Furthermore, our account may not necessarily apply to other policy domains within the EU or beyond. It is possible that research in other policy domains or governance settings can yield other strategies or explanatory factors.

Future research can build on our findings in several ways. First, research could expand upon our exploratory case by examining other scientific actors in the EU climate policy context. This can also be extended to explore national-level dynamics across different political contexts to identify how different politico-administrative traditions and arrangements affect the political advocacy strategies employed by scientific experts in different countries. Second, research could explore political learning by scientific experts in other policy areas with varying subsystem and policy issue characteristics, such as different levels of politicization, and issue-complexity. A third avenue to explore is the multilevel dynamics of this type of political learning, such as investigating connections between these scientific experts' political advocacy strategies at the supranational, national and subnational levels, and whether these dynamics overlap. Finally, building on these findings, future research can develop grounded theoretical models of how political learning processes take place within expert communities.

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