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Political strategies for climate and environmental solutions

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Many of the barriers to progress in addressing environmental problems, such as climate change, are political. We argue that politics should not be seen only as a constraint but be recognized as a target of intervention to advance environmental solutions. We use the example of climate change to illustrate how insight into politics can help policymakers craft strategies to address three gaps: the ambition gap, the implementation gap and the international action gap. Focusing on politically effective choices that are feasible today and have the potential to ease political barriers to future policy action can broaden the solution space.

As science advances solutions to environmental problems such as climate change, biodiversity loss and transboundary pollution, politics is increasingly a limiting factor. Powerful actors that stand to lose from sustainability transitions often stall or block policy progress[1]. These dynamics suggest a greater need to understand and apply effective political strategies in sustainability transitions.

To make politics part of the solution, we need politically effective choices: policies and political strategies that are both feasible today and able to reduce political barriers to future policy action. Politically effective strategies that, for instance, mobilize public and interest group support will expand the range of ways society can deploy technologies and reduce environmental harms. These strategies can help increase the number of jurisdictions taking action or expand the range of mitigation options. Politics, like technology, then becomes a lever for tackling environmental challenges in its own right. Focusing on the case of climate change, we review recent climate politics scholarship to show how policy and political interventions can help bridge three notable gaps: the ambition gap, the implementation gap and the international action gap.

First, the ambition gap refers to national targets and policies falling short of actions required to achieve scientific consensus goals. Organized political opposition to climate policy proposals can partially explain this gap. Designing policy to address the origins of opposition can mobilize support. In the case of climate change, the ambition gap is the difference between greenhouse gas (GHG) emissions trends implied by announced policies and the consensus trajectories that scientists project will reduce the chances of catastrophic climate change.

Second, the implementation gap results from the failure of adopted domestic policies to achieve their stated climate targets. This gap encompasses a policy's failure to maintain political support, for instance, due to leadership turnover in political cycles or backlash from adversely affected groups. Policy and institutional design can support policy durability. The implementation gap also covers incomplete policy implementation (that is, turning policies on the books into technological and behavioural change) due to a lack of bureaucratic capacity or knowledge, and incentive problems.

Third, the international action gap describes the shortfall of effective global action to address climate change. Narrowing this gap includes approaches to deepening commitments by climate leader countries and to broadening commitments beyond them. As climate policy action is interdependent, climate leaders can lower the barriers for follower countries and other actors such as subnational jurisdictions and businesses to expand climate action.

Our contribution is twofold. We review the ways policy and political strategies help overcome these three gaps. We then lay out a research agenda to surface politically effective choices that have high feasibility of adoption and high potential to reduce barriers to future policy action.

Ambition gap

The ambition necessary to tackle sustainability challenges is rarely enshrined in national policy[2]. We visualize the ambition gap in the case of climate policy in Fig. 1. Although countries' 2030 climate pledges achieve progress relative to business-as-usual GHG emissions levels, their aggregate impact would deliver reductions that fall far short of the emissions cuts that scientists believe are necessary to limit catastrophic climate change.

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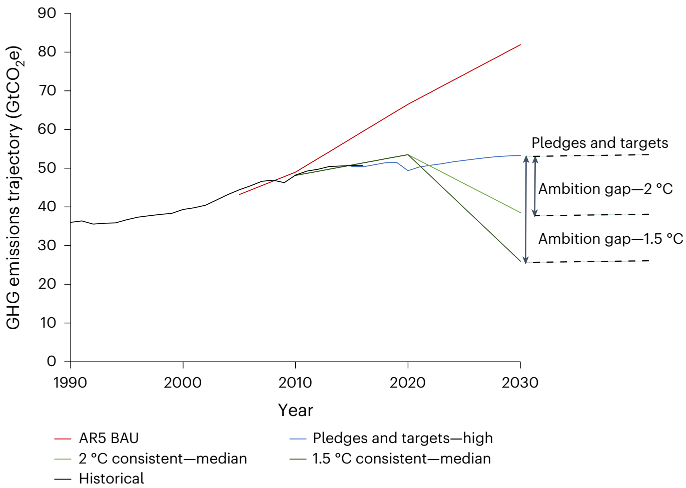

Fig. 1 | Climate policy ambition of countries falls short of action needed to avoid dangerous climate change. The ambition gap is the difference between a GHG emissions trajectory consistent with announced pledges and targets (blue line) and trajectories projected to be consistent with limiting global temperature rise to 2 °C (light green line) or 1.5 °C (dark green line) above pre-industrial levels. The ambition gap is assessed based on 2030 emissions reduction pledges under the Paris Agreement, in which the stated objective is to limit warming to 1.5 °C. The red line shows the business-as-usual (BAU) emissions trajectory as project by the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (AR5). Data from ref. 96.

Scholars of climate politics argue that climate politics are distributive politics: the political battle over who reaps benefits or bears costs from climate policy and climate change outcomes[3,4]. Climate policy and climate change affect individuals and organizations differently depending on the assets they hold[4]. For example, concentrated economic interests contributing to GHG emissions tend to face climate policy costs (for example, firms/labour in fossil fuel and manufacturing industries)[5–8], whereas economic actors making mitigation-related investments can benefit from climate policy (for example, firms/labour in clean energy industries)[9,10]. The prospective policy losers have long organized both overt and covert opposition to climate policy[11], thus often preventing greater policy ambition.

The policies that economics deems most cost-effective often exhibit low political feasibility: policies such as carbon pricing tend to be cost-effective precisely because they impose highly visible costs on powerful polluters to change emitting behaviour in ways that cost least on aggregate, but many concentrate on high emitters (for example, coal mining), while spreading the benefits of climate mitigation diffusely across society, leaving few champions. Such policies have generated political backlash, often resulting in failure of policy adoption, rescinding policy, or policy ambition not ratcheting up over time[12,13].

Designing politically feasible policy

Climate politics research also reveals which interventions are likely to mitigate opposition and mobilize political support for climate action.

A first set of designs centres on policies with concentrated benefits but diffuse costs, as illustrated in the case of US climate policy in Box 1. In the universe of climate policy, particularly clean energy policies, including subsidies, tax rebates, and deployment and performance standards, tend to offer concentrated benefits, while simultaneously spreading the costs across a diffuse set of affected parties, such as taxpayers or electricity rate-payers[14]. With costs more diffuse and less visible, these technology-specific policies have garnered more support from both businesses and voters, and have been adopted more widely, as shown in Fig. 2. They are also increasingly featured in policy advice[15]. For example, the adoption and expansion of Germany's renewable energy policy relied on providing substantial and direct economic benefits to rural actors[16]. In an example beyond climate policy, the Montreal Protocol that tackled the ozone hole offered concentrated benefits and diffuse costs[17]. The chemical company DuPont benefited by providing the technological substitute for ozone-harming hydrofluorocarbons while supporting the US push for global action to phase them out.

Expanding the set of policy winners includes the strategy of linking climate policy with other salient issues, as distributive climate politics unfold in the context of multiple policy goals. To the extent that policies can advance multiple goals through issue linkage, they are more likely to mobilize political support. For example, both climate-related goals and energy security interests in reducing dependence on Russia for natural gas imports have mobilized support for the European Union's (EU's) renewable energy policy. Co-benefits from job and industry creation as well as from reduced local air pollution also drove climate progress[18]. When key constituencies believe that directly supporting clean energy serves these adjacent goals, clean energy policies, which are often technology-specific, may be favoured over more technology-neutral approaches such as carbon pricing.

A second set of policy designs focuses on combining policies that impose concentrated and visible costs, notably pricing policies, with policies that have concentrated benefits[19]. Such policy packages work politically either by compensating those that bear the costs (for example, through revenue recycling to consumers to offset pricing costs), thereby reducing opposition from policy losers, or by providing benefits to mobilize policy winners by advancing objectives they care about (for example, investing revenues in renewable energy deployment). Figure 2 shows that such carbon pricing with redistribution is more widely adopted than carbon pricing without revenue recycling.

BOX 1

Cap-and-trade versus renewable energy policy in the United States

The 2009 American Clean Energy and Security Act, also known as the Waxman–Markey Bill, is an example of how distributive politics can sink climate policy proposals. The bill, introduced into the US House of Representatives by Henry Waxman (California) and Edward Markey (Massachusetts), centred on the creation of a cap-and-trade system for GHGs that covered most emitting sectors. Ultimately, the bill failed because of powerful opposition, including from the US Chamber of Commerce, major industry associations and agriculture groups[103,104]. At the same time, it did not provide sufficient benefits to powerful groups or voters to mobilize support[105].

The failure of Waxman–Markey contrasts with the ongoing support for federal tax credits for low-carbon technologies in the United States, including the production tax credit and the investment tax credit. Both have been essential to the expansion of wind and solar power in the United States[9]. Bipartisan support has kept the tax credits alive despite periodic expiration and renewal. The production tax credit and the investment tax credit provide concentrated benefits to various groups invested in renewable energy expansion. This includes core constituents of the Republican party, such as farmers in Texas that built wind power plants. The Inflation Reduction Act of 2022 in the United States followed the same political logic by providing subsidies and tax rebates for clean energy deployment.

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More opposition → Less opposition

Policy	Carbon price with redistribution?		Technology-specific policies	
	No	Yes	Mandates	Incentives
		Revenue recycling to taxpayers Allocating free permits to polluters Allocating revenues to special interests	Deployment mandates Performance mandates	Subsidies Tax rebates
Adoption (number of jurisdictions with electricity-related policies)	6	54	70*	158**
Example(s)	Chile CO_2 tax	EU—ETS California—ETS, RGGI British Columbia	Renewable portfolio standards	Feed-in tariffs

Fig. 2 | Spectrum of opposition to climate policy instruments. The diagram shows how different policy instruments and designs are associated with more/less political opposition, resulting in lower or higher adoption rates globally. *Includes renewable portfolio standards, with US states counted individually; **includes both feed-in tarfiffs and other subsidies/tax rebates. EU-ETS, European Union Emissions Trading System; RGGI, US Regional Greenhouse Gas Initiative. Data from refs. 97–100.

In the case of British Columbia's carbon tax, the costs of the carbon tax were offset by cuts in corporate taxes, resulting in a revenue-neutral tax. Business, by and large, did not oppose the tax[20]. Similarly, the Regional Greenhouse Gas Initiative, a regional cap-and-trade system in the United States, channels revenues from auctioned emission permits to low-carbon investments, including energy efficiency investments by households, among other causes favoured by voters. The fact that policymakers stressed the public benefits of these investments also helped garner voter support for the policy, and shows that the framing of benefits and costs also matters[21]. What types of revenue recycling and compensation packages best mobilize voter support for costly climate policies is an important question to consider[22]. One finding is that compensation needs to address how vulnerable groups are exposed to both costly climate policy and the physical impacts of climate change[23]. Research, however, also points to the limits of building voter support through compensation, as ideology shapes how voters view the economic benefits provided through compensation[24].

Interest groups are important in determining which climate policies are politically viable and how stringent they are. But as climate politics has entered a period of mass mobilization, new questions have arisen on how shifts in public opinion and the rise of climate movements, such as the Sunrise and Fridays for Future movements, affect the adoption and ambition of climate policy[25,26]. Key questions on choice variables include how to frame policies for the public under ideological polarization, and which activist tactics, such as boycotting, lobbying and protesting, are most effective[27,28].

National differences matter

Institutions vary across jurisdictions in ways that affect climate policy ambition. Broad political institutions do not tend to be choice variables—policymakers cannot change them in the short to medium term. Yet, recognizing institutional opportunities and constraints leads to different assessments of what strategies are feasible in a given political setting, guiding context-specific political strategies.

First, democracies have been more likely than authoritarian systems to generate climate commitments, although the democracy effect on policy outcomes—that is, emission reductions—is ambiguous[29]. The reason given for democracies' willingness to commit to climate goals is that they tend to be more responsive to the interests of the median voter, whereas governments in non-democratic systems tend to rely on a small elite. Thus, the political strategies one might advance in democratic versus authoritarian settings would have very different target audiences.

Second, proportional electoral systems—in which coalitions of parties govern—are associated with more stringent climate policies, in particular those that impose costs on consumers such as carbon taxes, compared with majoritarian electoral systems—where the party with the majority rules[30]. Proportional voting rules insulate policymakers more from political backlash from voters. For example, Japan adopted ambitious energy efficiency and renewable energy policies after the 1970s oil crises, when it had proportional electoral rules. After electoral reform towards a majoritarian system in 1994, Japan's energy efficiency policy became less stringent[31]. While policies that impose visible costs on voters may be more likely to fail in countries with majoritarian rather than proportional rules, policies that create hidden and diffuse costs could more easily succeed. For instance, the Inflation and Reduction Act in the United States is a major public climate investment package, providing benefits to companies and households while imposing diffuse costs on taxpayers. It thus adopted an 'all carrots, no sticks' policy approach.

Third, parliamentary systems are associated with slower emissions growth than presidential systems[32]. One potential reason for this difference is that parliamentary systems tend to have fewer veto points, which climate policy losers can use to block policy, than presidential systems. This means that climate policy progress in presidential systems may require broad coalition-building, but that once policy has passed it is likely to withstand attempts to repeal it.

Fourth, how interest groups and governments interact through systems of interest intermediation shapes the ability of policy losers to oppose climate action. Long-term corporatist bargaining relations between business groups, labour and government actors, prevalent in continental Europe, can provide leverage for policy losers such as incumbent industries and labour unions to negotiate more favourable outcomes[12,33]. But long-standing bargaining relations also allow policymakers to negotiate deals with powerful parties that stand to lose by offering compensation through subsidies[34]. The German government negotiated a €40 billion compensatory package to develop an agreement for phasing out coal in electricity generation[35]. In more competitive pluralist political settings, such as the United States, policymakers face greater challenges in negotiating bargains across major interest groups, but they can more easily exclude interest groups opposing change. In such settings, advocates can organize ad hoc coalitions with like-minded interest groups and policymakers to push through policy reform.

Emerging research also examines the role of specific climate institutions such as science bodies or climate framework laws[36,37]. Policymakers can more easily build or transform such climate institutions compared with political institutions that apply to the entire political system. For instance, in 2008 the United Kingdom adopted the Climate Change Act and established an independent body of experts—the Climate Change Committee—to guide and evaluate the formulation and implementation of climate policy across the government[38]. The two climate institutions have facilitated high policy ambition. Beyond such success stories, it remains an important research need to understand the causal effects of climate institutions.

Implementation gap

Analysts often assume policy implementation is uniform and complete[39]. Yet, countries do fail to implement adopted policies and to meet their environmental and climate targets, or repeal them, leaving an implementation gap. For instance, local incentive conflicts have contributed to weak and uneven implementation of environmental controls in China, while Australia adopted a carbon pricing system and repealed it two years later. These weaknesses in policy durability and enforcement undermine progress. Policy durability refers to both maintaining policies in place beyond initial adoption so that they can start affecting behaviour and to increasing ambition over time[40,41]. Enforcement refers to the capabilities of the governing bureaucracy to ensure emissions reductions as specified in adopted policies.

Enhancing policy durability

Political backlash presents a central challenge to making climate policy durable. Costly policies can face opposition long after they are first implemented, as costs accumulate and/or become more visible to policy losers. For instance, opposition by electric utilities has at times led to the retrenchment of renewable energy policies, despite economic benefits for other groups[42]. Similarly, wind technology support policy has met resistance from homeowners concerned by the effect of nearby wind turbines on home values[43]. Such resistance to energy transitions has emerged across industrialized and emerging economies[44–47], and it may increase as the transition to clean technology advances[48].

Durable climate policy often depends on positive feedbacks and path dependence, which in turn depend on policy design[41,49,50]. While policy feedback plays a central role in making policies durable so that they can start affecting behaviour, it can also help increase policy ambition over time. Research has highlighted specific policy designs that have the potential to generate positive feedback.

First, the more capital firms expend in complying with a policy, the more they may be willing to support that policy because they have already born the adjustment costs[51]. For instance, California's electric utilities fought off a proposition to roll back the state's landmark climate legislation partly because they had started investing in renewable energy assets[52]. Second, policies providing benefits to key political groups have led to positive feedback in a number of prominent cases, such as Germany's renewable energy policy[16,53]. Carbon pricing, by contrast, has faced many obstacles to durability. A carbon pricing system in Australia has been repealed, while other systems failed to increase stringency over time[12,19].

Third, initial policies that focus primarily on providing benefits can enable the adoption of more costly policies, such as carbon pricing, at a later stage[54]. They do so by gradually building broader coalitions and by facilitating declines in technology cost, which can weaken opposition to climate policy[14,55].

The notion of policy sequencing captures the fact that durability is not only about maintaining policies. It is also about how one policy sets the political stage for the next policy as policy mixes evolve. Different stages of technology transitions—from niche market creation to technology diffusion and system reconfiguration—require different policy interventions and mixes[56].

Enforcing policy

Enforcing policies against opposition from lobby groups relies on state capacity, defined as the existence of government agencies that are both sufficiently capable and autonomous from societal groups to devise and implement policy[57].

Government agencies may lack bureaucratic capacity to administer environmental regulations, including monitoring, reporting, verification and enforcement, as illustrated in Box 2. For instance, water resource management in India revealed gaps in state capacity to assess and collect water pollution fees[58]. In settings where state capacity to enforce regulation is weak, policies that do not require extensive administrative capacity and technical expertise may stand a greater chance of successful implementation.

The more stringent a policy, the greater the need for enforcement. For example, coal plants in regions facing tougher new sulfur dioxide regulations in China were more likely to misreport emissions compared with those in regions facing a smaller increase in stringency[59]. Similarly, Volkswagen placed defeat devices on particulate filters in vehicles when faced with stringent emission reduction requirements[60]. Box 2 illustrates enforcement challenges in the case of China's climate policy.

In industrialized economies, bureaucracies tend to have sufficient bureaucratic capacity, including staff and technical expertise. They can, however, lack bureaucratic autonomy, resulting in regulatory capture by polluting interests. In successful cases, policymakers have leveraged relatively autonomous agencies to advance climate policy and to insulate themselves from backlash. For example, the California Air Resources Board is an agency that developed high levels of expertise and autonomy in addressing air pollution. When California adopted its central climate law, the state legislature delegated the design of the policy to the California Air Resources Board, which helped reach the state's 2020 climate target[61]. The key choice variable for policymakers is thus delegation to autonomous bureaucracies, as building new autonomous agencies may be a long-term political investment.

BOX 2

Enforcing climate policy in China

China provides one example of the challenges of policy implementation despite growing policy ambition. In China, environmental policy implementation lagged during multiple decades of rapid economic growth, despite ever-stronger policies on the books[106]. China began managing GHG emissions through its participation in the Clean Development Mechanism. Scholars questioned the 'additionality' of voluntary emissions reductions generated in China, pointing to weaknesses in institutional capacity and misaligned incentives[107]. However, models and policy designs overlook this possibility, as they often assume by the construction of the counterfactual that reductions are 'additional.'

China has pledged increasingly ambitious action on climate change at the Copenhagen and Paris Conference of the Parties, and most recently in its announced intention to achieve carbon neutrality by 2060. Key challenges to implementing these pledges include developing strong and comprehensive measurement, reporting and verification systems for GHGs, and aligning incentives for implementing new policies, such as the national emissions trading system, across the layers of China's complex federal system[108]. All countries face challenges in implementing environmental policies. However, problems of bureaucratic capacity may be particularly acute in developing countries where leaders perceive sharper tradeoffs between economic and global environmental objectives.

International action gap

Deepening and broadening cooperation among nations, industries and subnational actors is necessary for achieving global climate targets. The current pledge-and-review approach of the United Nations climate regime, in which countries volunteer commitments, is a shallow form of cooperation that shows the dominance of domestic over international politics in determining climate ambition[62]. Climate politics research, however, points to important additional international choice variables and dynamics that can help deepen and broaden global cooperation over time.

Deepening global cooperation

The move to pledge-and-review formalized in the 2015 Paris Agreement opened an era of broader participation in international climate policy. The challenge remains to hold countries to their pledges, and to leverage international dynamics to increase global ambition, which falls far short of international temperature goals. Research in climate politics has focused on climate clubs and sectoral approaches as pathways to deepen cooperation.

Climate clubs involve cooperation on climate action among small groups of countries[63,64]. Membership and rules of climate clubs are distinct choice variables. Their content can include emission reduction commitments, commitments to technology deployment, and coordinated research and development on low-carbon technologies[65]. It can also involve erecting barriers at the club's borders, for instance, in the form of carbon border adjustment mechanisms that extend domestic carbon pricing to imported goods, neutralizing their cost advantage. Rationales for climate clubs have focused on their ability to enhance the bargaining efficiency of climate negotiations through smaller numbers, to shift interests of negotiating parties by providing club benefits, to strengthen the legitimacy of climate talks by deepening cooperation and to enable policy experimentation in the face of uncertainty[66,67]. Among these rationales, club benefits are particularly key to deepening global cooperation[62].

Other work focuses on clubs involving sectoral agreements, forms of international cooperation focused on distinct sectors or technologies[68]. These can be clubs of a few frontrunners but can also have broader participation. They have the potential to facilitate different functions across the stages of the technology diffusion cycle[69]. One benefit of sectoral agreements is that they can help mitigate competitiveness concerns in sectors with global trade exposure if firms among trading partners are subject to the same climate commitments under the sectoral approach. Recent research has pointed to the potential of sectoral approaches to generate dynamic benefits, that is, approaches that create increasing returns for participants. For instance, products with the least embodied carbon content within a sector could be exempt from trade tariffs. The more firms among participating countries that invest in decarbonizing products, the lower their overall tariff burden[70]. A similar logic of dynamic benefits could be instilled into broader climate clubs. A climate innovation club focused on technology development and deployment, for example, could offer tariff reductions to countries taking climate action[71].

Broadening global cooperation

Next to deepening climate commitments among frontrunners, a central challenge is to create international dynamics that broaden cooperation to countries that have no or very limited climate mitigation commitments. Research points to positive spillovers of climate leaders, and the potential and limits of transnational cooperation.

Climate politics can help explain why climate policy in both industrialized and emerging economies alike is often industrial policy, which aims to strengthen the position of domestic industries in the marketplace for climate solutions[72]. Such unilateral action can create spillovers for other countries, resulting in interdependent chains of policy adoption through at least two main mechanisms. First, policy in large markets that facilitates investment in low-carbon technologies helps to drive down technology costs by scaling technology deployment in first-mover markets[73]. In turn, lower costs facilitate greater deployment of low-carbon technologies in follower countries and increase their willingness to adopt emission reduction goals. Second, the policies of climate leaders can mobilize political actors in follower countries to also adopt green industrial policies[74], as they seek to grow green industries. For instance, China responded to Germany's feed-in tariff by providing cheap capital to domestic solar photovoltaics (PV) manufacturers, thus expanding global manufacturing capacity[75].

The resulting global chains of policy adoption can accelerate or slow down the global diffusion of clean technology. They accelerate technology diffusion when countries adopt supporting policies that increase investment in low-carbon technologies such as subsidies, which in turn leads to the emergence of global innovation and production[76]. Such a process can raise the rewards of broadening and deepening global cooperation. The decline in technology costs lowers adjustment costs for follower countries, increasing the likeliness of follower countries to act, as has been observed in the EU or at international climate conferences, like the 2015 United Nations Climate Change Conference in Paris, which we discuss in Box 3. If, however, states have starkly asymmetric capabilities to capture new technology markets, they may be less willing to cooperate internationally on climate goals[77]. Interdependent policy adoption can also slow down technology diffusion when countries erect trade barriers in low-carbon technologies[78], resulting in trade conflicts such as the US–China solar dispute that increase the cost of clean technologies.

Global diffusion of technology has also enhanced countries' willingness to enter into agreements to address other sustainability challenges. Governments signing on to a global agreement to mitigate

BOX 3

Cooperation in Copenhagen versus Paris

The Paris Agreement is generally viewed as more successful than the Copenhagen Accord in terms of global country participation, the share of global GHG emissions covered and GHG emissions reduction ambition. This is despite the fact that countries already shifted to the pledge-and-review model at Copenhagen. Two factors may help explain the different outcomes. First, the US–China agreement of 2014, a mini climate club, overcame the stalemate at which the two great powers found themselves in at Copenhagen. This speaks to the potential of climate clubs to increase bargaining efficiency and to incentivize ambition among follower countries. Second, between the Copenhagen (2009) and Paris (2015) summits, the cost of solar PV and onshore wind power dropped substantially. Over the same time period, the median price of non-renewable energy plants such as gas, coal and nuclear increased. Renewable energy thus started to become cost-competitive with non-renewable energy. Scholars have suggested that these reductions in cost led more countries to make commitments at Paris than at Copenhagen[109]. This relationship is illustrated in Fig. 3. The *y*-axis on the left shows the installed cost of wind or solar PV since 1995. Wind cost fell almost tenfold while solar PV cost fell by almost half. The *y*-axis on the right illustrates the increase in the share of GHGs covered by the two agreements. While 114 countries agreed to the Copenhagen Accord, 194 countries ratified the Paris Agreement.

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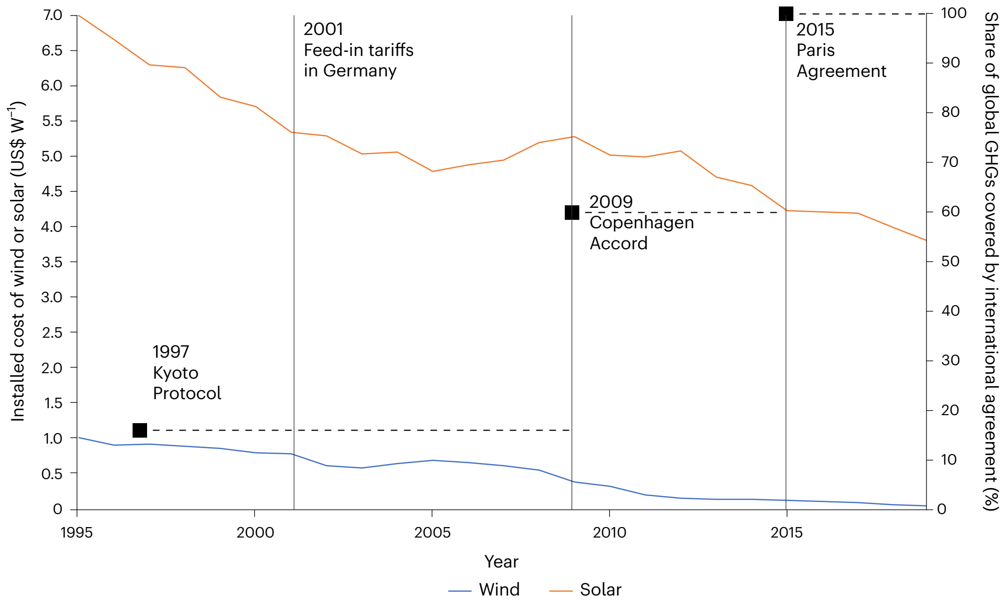

Fig. 3 | Cost of onshore wind power and solar PV over time, with key policy developments overlaid. Data from refs. 101,102.

mercury pollution, the Minamata Convention of 2013, no doubt benefited from the earlier diffusion of abatement technologies for co-emitted pollutants, such as sulfur dioxide, from the United States, Japan and Europe to developing and emerging countries[79]. Control technologies such as flue gas desulfurization target sulfur dioxide, but they also remove mercury from the waste gas stream as a co-benefit; these co-benefits were a major driver of countries' willingness to sign on to the Minamata Convention[80].

Subnational and private actors, including regions, cities and businesses, cooperate in various forms of transnational governance[81–84]. This includes information-sharing and rule-setting activities. Transnational cooperation is a complement to intergovernmental cooperation but cannot substitute for it: the ambition of subnational actors typically reflects the policy ambition of their national governments[85]. Transnational cooperation has thus broadened cooperation to non-state and subnational actors, but faces limits in broadening climate action to laggards. In particular, research suggests ways that international organizations can facilitate the creation of transnational initiatives and enhance its effectiveness through strategies of 'orchestration'[86].

Expanding the solution space

In this Review, we synthesized research that begins to identify political choice variables in order to broaden the set of solutions for climate change, which we argue holds lessons for other environmental challenges. We consider effective political levers to encompass policies with high chances of adoption and high potential to reduce barriers to future environmental action. Initial choices—including policy design, political strategies and institution building—can unleash political and institutional dynamics that reduce the political barriers to deeper emission cuts in the future. The question of political feasibility examines which factors shape the adoption of initial policies, whereas the question of removing barriers addresses how these initial policy choices shape political processes to raise the likelihood of greater climate policy action in the future (Fig. 3).

The challenge is to identify interventions that score highly on both feasibility today and potential to reduce barriers to future action. Box 4 and Table 1 illustrate how different historical climate policy cases vary along both dimensions. We suggest three avenues to further advance the research agenda on politically effective choices.

First, a key question is whether we can identify generic design principles for politically effective choices, that is, choices that have high feasibility and high potential to reduce political barriers to action on climate change and environmental problems. One principle frequently discussed is choosing policies that create increasing returns[14,41,66,87]. In other words, benefits grow over time relative to costs. Policies that generate increasing returns are likely to deepen and/or broaden support as benefits accrue. This applies to the durability of domestic climate policies and multilateral initiatives focused on green economic development such as Mission Innovation. Other insights emphasize institutional insulation[88]. Policies that originate from institutions with high degrees of autonomy—such as strong environmental agencies, central banks or supranational actors such as the European Commission—stand a greater chance at adoption, durability and implementation[34,61]. Increasing returns and institutional insulation are potential candidates for design principles for politically effective policy choices. While there may be some design principles with universal appeal across political contexts, they will probably need to be tailored to specific domestic political contexts in iterative strategy development.

Second, insights on politically effective strategies in this Review are largely derived from climate politics but matter broadly to environmental problems. Yet environmental challenges vary in their problem structure, which affects the kinds of political barriers environmental solutions will face. One central dimension of the problem structure is the magnitude and distribution of costs and benefits of environmental action. Climate change presents a hard case, given the overall cost of mitigation, the many actors impacted, and the distribution of costs and benefits[89]. Biodiversity loss resembles climate change in this regard. Other problems such as the ozone hole, acid rain and transboundary mercury pollution have more limited and more concentrated costs. Variation in the problem structure has implications for which policy and political choices are effective. For example, while clubs are a strategy for international climate action, a classic multilateral agreement proved effective in addressing the ozone hole, given the greater ease of developing dynamics of increasing returns for key industry actors[90]. Building on recent important work on problem structure[91], future research needs to examine more systematically how political effective strategies vary across different environmental problems.

Third, there is value in more cross-disciplinary conversations between environmental politics scholars and energy and environmental

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BOX 4

Variation in political effectiveness of climate policies

The Waxman–Markey Bill (Table 1)—discussed in Box 1—imposed costs on businesses and households, without offsetting those with direct benefits. Analysts suggest that the lack of benefits for households, for example, was one of the reasons that led to the failure of adoption[105]. The same feature would have made it very unlikely that the bill, had it been adopted and implemented, would have led to positive feedback dynamics that would have enabled more stringent emission reductions in the future.

British Columbia's carbon tax (Table 1) combined costs with benefits by reducing the tax bills of businesses and households. This mobilized sufficient support for the initial adoption of the policy[110]. In subsequent years, support for the tax waxed and waned, keeping it in place but not leading to any substantial ratcheting up. Reforms of the tax in 2017 to use revenue for green investments and social spending were measures to strengthen the positive feedback of the climate policy.

The EU's CO_2 standards for passenger vehicles (Table 1) of 2009 were hard to adopt in the first place but are showing substantial potential to reduce opposition to future regulation by automakers over time. The progressive tightening of these standards has led automakers not just to improve the fuel efficiency of vehicles with internal combustion engines, but also to invest in alternative transport technologies such as electric engines and hydrogen fuel cells. A shift in political stances has followed. Volvo and Ford, for example, publicly support a 2035 EU ban of sales of combustion engine vehicles.

Germany's feed-in tariff (Table 1) has proved to score relatively high on feasibility and potential to mobilize support for future action. It was adopted against limited political resistance in 1990. Then a broad coalition of environmental groups, conservative farmers, and industrial interests supported the expansion of the feed-in tariff in 2000 when a coalition government with participation of the Green party took power. In the following years, there was broad support to progressively expand the renewable energy deployment goals.

Table 1 | Examples of climate policies that varied along political feasibility at point of adoption and potential to remove barriers for future policy action

		Potential to remove barriers over time	
		Low	High
Feasibility of policy adoption	Low	Cap-and-trade in the United States	Fuel economy standards in the European Union
	High	Carbon tax in British Columbia, Canada	Feed-in tariff in Germany

systems modellers[92]. Demand for integrated analysis of the economic and environmental impacts of policies is growing, as policymakers increasingly seek scenario projections that can be used to benchmark policy development in addressing, for example, climate change and transboundary air pollution[80,93]. Cross-disciplinary engagement of the social sciences with modellers has begun to integrate and complement scenario projections of technology adoption and environmental outcomes with assessments of their political feasibility[94]. Extending this line of work to political effectiveness, including both feasibility of adoption and potential to reduce political barriers, is an important next step. This should be done with attention to broader model strengths and weaknesses[95]. While in some cases it may be appropriate to build political dynamics into models explicitly, in many cases climate politics scholarship will offer complementary insights that shape model inputs or identify the political implications of their outputs.

Making political barriers targets of intervention contrasts with the popular notion that politics presents nothing but constraints on environmental action. Instead, targeting political barriers makes political choices as much a lever of advancing environmental progress as technology choices. Given that substantial political obstacles to progress remain, we encourage scholars and policymakers alike to advance politically effective choices. Doing so would increase the climate and environmental solutions at our disposal.

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Author contributions

J.M. conceived the focus of this Review. J.M. and V.J.K. reviewed the literature. J.M. and V.J.K. synthesized the key messages and wrote the paper. J.M. and V.J.K. conceived the figures, V.J.K. created them.

Competing interests

The authors declare no competing interests.

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