6

Regulatory Intervention

Laws for Influencing Cumulative Harm

Links with Other Chapters

- Chapter 1 explains how examples used in this chapter were chosen.
- Chapter 2 synthesizes key challenges related to regulatory intervention and introduces the CIRCle Framework of regulatory functions for addressing cumulative environmental problems.
- Chapter 3 sketches the landscape of laws that may respond to cumulative environmental problems.
- Chapter 4 ("Conceptualization") discusses rules for articulating what and who we want to protect from cumulative impacts (the "matter of concern"), which rules for intervention seek to protect or restore.
- Chapter 5 ("Information") discusses rules for collecting and analyzing data and information needed to inform regulatory intervention.
- Chapter 7 ("Coordination") covers coordinating interventions between levels of government, including involving nongovernment and quasi-government stakeholders.
- Each case study (Chapters 8–10) discusses links between intervention and one other CIRCle Framework function.

6.1 INTERVENTION AS A REGULATORY FUNCTION

Rules for regulatory intervention are probably what we come to first when we think about rules. The basic purpose of regulatory intervention is to change

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

the impacts that accumulate to harm something that we care about – a "matter of concern."[1] The main argument of this chapter is that regulating cumulative environmental problems[2] requires a mix of formal rules[3] for intervention, combining different strategies and approaches from across the typologies developed here. The design of this mix should address key challenges (discussed in Chapter 2)[4] that make dealing with cumulative environmental problems difficult. To start with, these include challenges to perceiving the risks of many individually minor threats, a sense of futility and short-termism that can prevent intervention occurring. Then, even when intervention is on the cards, ethical ambiguity about how to allocate responsibility among many actors can hinder action. Finally, when interventions are in place, arguments about certainty and fairness, path dependence, risk aversion, and single action bias can impede adaptive management of interventions to suit changing circumstances and new information. To this catalog of difficulties, this chapter adds those posed by decision-making structures and interventions themselves, namely, legal silos that produce fragmented decision-making and administrative burdens. Although rules alone cannot solve a cumulative environmental problem, these challenges suggest rules will play an important role.[5]

This chapter explores[6] how rules for intervention can vary and the implications of this variation for addressing cumulative environmental problems. Section 6.2 develops a typology of regulatory "strategies" – harm-reducing, harm-offsetting, restoring, and coping – that focuses on how rules seek to change cumulative harm to the matter of concern. Section 6.3 expands a classic regulatory theory typology of "approaches" – regulatory sticks, carrots,

[1] As described in Chapter 4, matters of concern vary widely, from a species, to a pollutant, to a community's relationship with a place.

[2] For the full definition of cumulative environmental problems used in this book, see Section 1.1.

[3] Rules may be administrative, made by executive agencies, legislative, or even constitutional. The focus here is on substantive rules, rather than procedural rules that allow for challenges to administrative decision-making, which might also address multirisk impacts: Jonathan B. Wiener, "Learning to Manage the World" (2020) 40 *Risk Analysis* 2137–2143, 2139. This focus also excludes social controls outside formal rules and rules established by non-state actors. Note that Chapter 7 (Coordination) considers how quasi-governmental and nongovernmental actors can contribute to systems of rules for intervention in which the state is also an actor.

[4] See Section 2.2.3.

[5] See Sections 2.2.3 and 2.3.

[6] Note that this chapter has a slightly different structure to the foregoing chapters on the functions of conceptualization and information because of the prominent place of intervention as a purpose of rules.

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

and sermons – that focuses on how rules seek to change the activities of contributors to the cumulative harm or restoration (termed "contributors"). To these three approaches, I add "state rescue," where a state acts directly to address the harm rather than trying to influence others' behavior. Combining these typologies of strategies and approaches (Section 6.4) produces a matrix of formal rule-based interventions for dealing with cumulative environmental harms. Each individual "intervention" can be characterized by its "strategy" and regulatory "approach." This matrix helps identify diverse and some under-explored intervention opportunities. Section 6.5 then discusses crosscutting design features for interventions that respond to key challenges posed by cumulative environmental problems and presents examples of legal mechanisms that adopt them. These features involve ensuring that decision-making about individual activities is *connected* so that it reveals how harm accumulates, that intervention is *comprehensive* and appropriately enforced, that administrative *costs* are managed and that interventions can be adaptively *changed* where necessary, taking account of concerns about fairness. Throughout the chapter, the focus is on applying these ideas to cumulative environmental problems specifically, noting that extensive scholarship deals with design issues for different types of regulatory interventions in general and in relation to broader environmental issues.[7]

As emphasized in earlier chapters, each of the four functions of the CIRCle Framework advanced by this book (conceptualization, information, regulatory intervention and coordination) is needed to respond to cumulative environmental problems, and these functions are interlinked (Figure 2.1 depicts these basic links). Rules for *intervening* deal with potential or existing unacceptable cumulative harms to a *clearly conceptualized* matter of concern (Chapter 4), using *information* about something we care about (the "matter of concern") and the harms (Chapter 5), in a *coordinated* way (Chapter 8). Figure 6.1 summarizes these links in a more detailed way that is relevant to rules for intervention, and these links are explored further as the chapter proceeds.[8]

6.2 HOW CAN RULES AFFECT AGGREGATE HARM? A TYPOLOGY OF REGULATORY STRATEGIES

Our matrix of opportunities for regulatory intervention starts with regulatory strategies. This section develops a four-part typology of strategies by focusing on the matter of concern – what and who we want to protect from cumulative

[7] See notes 54 and 56 and accompanying text.
[8] See introductory paragraphs to Sections 6.2 and 6.3.

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

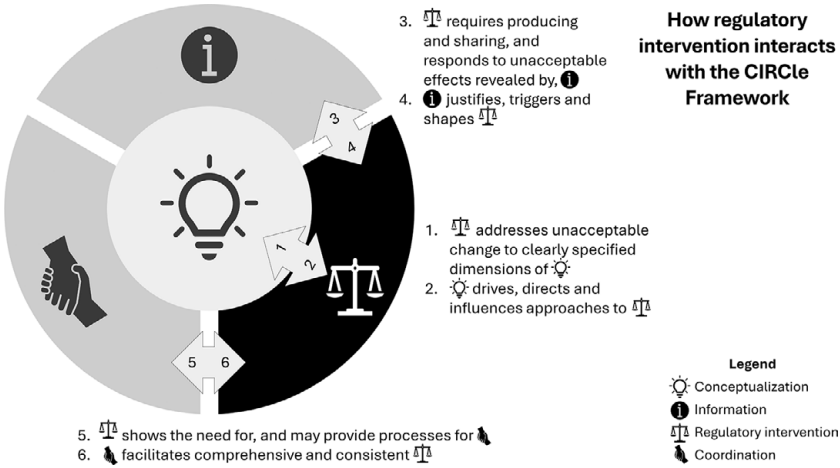


FIGURE 6.1 Integration of legal mechanisms for intervention with other CIRCle Framework functions, each necessary for regulating cumulative environmental problems

harm, or restore – and how rules try to influence cumulative change to its conditions. This closely links to thresholds of acceptable change that rules for conceptualization can formalize (cumulative threshold conditions lines, Figure 6.2),[9] supported by rules for information about the condition of the matter of concern relative to the threshold of unacceptable cumulative harm.[10] In addition to general regulatory literature, the typology of strategies developed here is loosely inspired by frameworks for responding to ecological transformation,[11] which implicitly address cumulative ecological harm; and prominent critiques of environmental offsets.[12]

Considering regulation by centering the matter of concern aligns with cumulative environmental impact analysis.[13] But focusing on the matter of concern differs from regulatory scholarship that tends to focus on how rules try to change the behavior of regulated parties, which has produced the typology of regulatory approaches discussed later.[14]

[9] See Section 4.3.3.
[10] See Section 5.1.1.
[11] E.g., Gregor W. Schuurman and others, "Navigating Ecological Transformation: Resist-Accept-Direct as a Path to a New Resource Management Paradigm" (2022) 72 *BioScience* 16–29.
[12] E.g., Laura J. Sonter and others, "Offsetting Impacts of Development on Biodiversity and Ecosystem Services" (2020) 49 *Ambio* 892–902.
[13] See Section 2.2.1.1.
[14] See Section 6.3.1.

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

FIGURE 6.2 Four regulatory intervention strategies to ensure acceptable cumulative effects – reducing harm, offsetting harm, restoring, and coping

In sum, rules can adopt four main strategies to influence cumulative change to a matter of concern: reducing cumulative harm in absolute terms, by reducing or avoiding adverse effects; "neutralizing" or offsetting proposed negative effects by encouraging beneficial actions; restoring (reversing legacy harm that occurred in the past); and employing measures that help a matter of concern cope with change to reduce the harm caused by cumulative impacts without changing the activities that lead to impacts (Figure 6.2). Section 6.2.1 introduces each, and Section 6.2.2 assesses their advantages and disadvantages in addressing cumulative environmental problems.

6.2.1 *Harm-Reducing, Offsetting, Restoring, and Coping Strategies*

Rules that adopt a harm-reducing strategy seek to directly reduce the absolute level of cumulative harm by preventing or changing actions with adverse effects ("adverse actions") to reduce or avoid harm (Figure 6.2, top right). This is probably what comes to mind first when we think of rules relating to environmental harm. For example, rules mandate and incentivize farmers to reduce polluted runoff that affects the Great Barrier Reef ("Reef"), prohibit commercial fishing in certain zones, and facilitate controlling harmful invasive starfish.[15] In each case, the absolute level of harm to the Reef decreases if the rule is effective.

A harm-reducing strategy most clearly links to cumulative impacts if it takes the form of a "performance standard"[16] that limits cumulative change to a matter of concern. A rule may require polluters to change their behavior to meet ambient air quality standards (cumulative conditions) rather than require them to adopt a specific pollution-reducing technology. The former option adjusts the required behavior to account for increasing numbers of polluters, and pollution; the latter does not. Quantitative limits, a type of performance standard, can apply to traditionally regulated resources (e.g., total water withdrawals, ambient air pollution), as well as emerging issues (e.g., consumption of "domestic primary raw materials").[17] Developing quantitative limits is more challenging where it is harder to express in quantitative

[15] See Figure 9.1.

[16] Jody Freeman and Daniel A. Farber, "Modular Environmental Regulation" (2005) 54 *Duke Law Journal* 795–912, 819–820.

[17] E.g., see Section 6.5.1; Ministry of Economic Affairs and Employment and Ministry of the Environment (Finland), "Finland's Circular Economy Programme Sets Targets to Curb Overconsumption of Natural Resources" (Press release, April 8, 2021) https://valtioneuvosto.fi/en/-//1410903/circular-economy-programme-sets-targets-to-curb-overconsumption-of-natural-resources, archived at https://perma.cc/W2KU-M8JD.

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

terms what is important about the matter of concern – a challenge that can arise in the context of biodiversity, for example.[18]

A second strategy is offsetting, or encouraging actions with positive effects to "make room" for adverse actions.[19] Rather than reducing absolute harm, the aim is usually to achieve or maintain an acceptable net level of harm (Figure 6.2, middle right). This strategy is important where small but cumulatively significant harms cannot be reduced.[20] Offsetting applies in diverse contexts, such as land use, biodiversity, greenhouse gas emissions, water quality, and water withdrawals,[21] and can form an important part of cap-and-trade systems.[22] Offsetting implies that impacts are fungible, which is not always the case, and it will be more difficult and controversial to develop where it is hard to develop quantitative limits.[23]

When the harm occurred in the past, we can distinguish a related third strategy of restoring. This looks similar to offsetting in terms of the end effect (Figure 6.2, middle right), but restoring rules likely target someone other than the original contributor to the impact, who may be long gone or not identifiable. Dedicated nature restoration or "repair" laws are now emerging in diverse jurisdictions,[24] though they are a long-standing part of nature laws in some places.[25]

As an alternative to focusing on adverse impacts and benefits, a strategy may seek to intervene by helping the matter of concern to cope better[26] with the cumulative impacts of adverse actions (Figure 6.2, bottom right). This strategy

[18] See Section 4.2.

[19] Riki Therivel and Bill Ross, "Cumulative Effects Assessment: Does Scale Matter?" (2007) 27 *Environmental Impact Assessment Review* 365–385, 368.

[20] See Section 6.5.2.2 on small harms.

[21] See Kenneth R. Richards, "Environmental Offset Programmes," in Kenneth R. Richards and Josephine Van Zeben (eds), *Elgar Encyclopedia of Environmental Law Vol. VIII* (Edward Elgar 2020) 325–351.

[22] E.g., see discussion of carbon offsetting in Chapter 9 on the Great Barrier Reef.

[23] Sonter and others, "Offsetting Impacts," 894; Andy Lockhart, "Developing an Offsetting Programme: Tensions, Dilemmas and Difficulties in Biodiversity Market-Making in England" (2015) 42 *Environmental Conservation* 335–344, 339.

[24] E.g., Regulation (EU) 2024/1991 of the European Parliament and of the Council of June 24, 2024 on nature restoration and amending Regulation (EU) 2022/869, OJ L 2024/1991, July 29, 2024 ("EU Nature Restoration Law"); Nature Repair Act 2023 (Australia).

[25] See, e.g. Section 10.4.1.3 regarding laws for restoring grasslands in South Tyrol, Italy.

[26] The climate change literature is replete with discussion of concepts such as coping capacity, adaptive capacity, resilience, and vulnerability. These concepts are interconnected and not always used consistently between authors: see generally, A. R. Siders, "Adaptive Capacity to Climate Change: A Synthesis of Concepts, Methods, and Findings in a Fragmented Field" (2019) 10:e573 *WIREs Climate Change* 1–18. Importantly for present purposes, a coping strategy does not reduce gross or net cumulative impacts, rather, it reduces harm.

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

breaks the link between impacts and harm. Unlike the other strategies, this one allows activities to cause comparatively more impacts without unacceptably harming the matter of concern. In the California groundwater case study,[27] rules support funding a householder whose well has gone dry to deepen their well to enable them to cope with declining groundwater levels. The result is that agricultural groundwater users can continue pumping even when this causes groundwater levels to decline, because householders can cope with these impacts, maintaining their access to groundwater using deeper wells – though with risks discussed later.

For completeness, it is worth noting a final possible response to a problem: reconceptualizing the matter of concern to accept greater cumulative change. Rather than being an intervention tool, this relates to conceptualization. It may require changing legal rules about "what matters"[28] to accept more degraded conditions or to pursue novel conditions. Making reconceptualization too easy, though, especially where this can occur on a project-by-project basis, poses the critical risk of "shifting baselines"[29] and inadvertently increasing cumulative impacts. Adapting conceptualizations – and the importance of not conflating this with intervention – are addressed in Chapter 4 (Conceptualization). The remainder of this chapter discusses regulatory intervention using reducing, offsetting, restoring, and coping strategies.

6.2.2 *Assessing Regulatory Strategies*

The legal, economic, political, social, and physical feasibility of each strategy will vary with the jurisdiction and matter of concern. However, we can make some general observations about likely drawbacks of different strategies by considering two factors – how reliably a strategy changes cumulative environmental outcomes ("outcome reliability") and the degree to which a strategy burdens contributors to the harm ("regulatory burden") – and how they can be addressed. These factors are likely to influence political and social feasibility – a key challenge to regulating cumulative environmental problems.[30]

A harm-reducing strategy most reliably controls cumulative harms because it prevents adverse impacts in the first place (Figure 6.2, top right). It avoids the well-recognized risks that a beneficial action will not adequately counter

[27] See Chapter 8.
[28] See Section 4.3.1.
[29] See Section 2.2.2.1.
[30] Section 2.2.3.

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

adverse effects (i.e., nonequivalence),[31] uncertainty about whether measures to increase coping capacity will work,[32] and risks that offsetting, restoring, or coping measures might fail or might work initially but fail with time (as where wildfire affects a forest planted for carbon credits).[33] Even high-fungibility contexts such as carbon offsets can involve "durability risks" or "risks of reversal."[34] Some regulatory regimes recognize that incomplete offsetting is sometimes inevitable – a planted forest gains ecological function only over time – and require "overcompensation" for "interim losses."[35] Another common way to reduce risk is to allow offsetting only after impacts have been avoided and reduced as much as possible.[36] An important question for implementation is whether this avoids the risk that the mere fact that offsets are available might shut out the more reliable, but burdensome, strategy of reducing harm (i.e., "mitigation deterrence").[37] The severity of these risks related to offsetting, restoring, and coping strategies can vary with context and deserve careful consideration. Helping a small community cope with declining groundwater in California's Central Valley by drilling deeper wells using existing technology produces more reliable outcomes than helping the spatially extensive Great Barrier Reef cope better with climate heating using novel shading infrastructure.[38]

To avoid unintended harms related to offsetting, restoring, and coping strategies, it is especially important to appropriately conceptualize the matter of concern. Firstly, conceptualization may "lock in" ongoing cumulative effects if a goal that forms part of the conceptualization, for example, "no

[31] E.g., if mitigation is not required to be in effect at the time damage occurs, or if there is unintentional nonequivalence between the effect and compensatory actions (Martine Maron and others, "Taming a Wicked Problem: Resolving Controversies in Biodiversity Offsetting" (2016) 66 *BioScience* 489–498, 494–495), noting that some offset rules encourage nonequivalence in pursuit of environmental benefit: Rebecca Nelson, "Paying Back the River: A First Analysis of Western Groundwater Offset Rules and Lessons for Other Natural Resources" (2015) 34 *Stanford Environmental Law Journal* 129–194, 185–187.

[32] See generally, Siders, "Adaptive Capacity."

[33] E.g., Lockhart, "Developing an Offsetting Programme," 340 (re initial failure); Kaya Axelsson and others, "Oxford Principles for Net Zero Aligned Carbon Offsetting (Revised 2024)" (*Smith School of Enterprise and the Environment*, University of Oxford, 2024) 18, www.smithschool.ox.ac.uk/sites/default/files/2024-02/Oxford-Principles-for-Net-Zero-Aligned-Carbon-Offsetting-revised-2024.pdf (re inadvertent re-release of biologically stored carbon).

[34] Axelsson and others, "Oxford Principles," 18–20.

[35] European Commission and Directorate-General for Environment, *Managing Natura 2000 Sites – The Provisions of Article 6 of the "Habitats" Directive 92/43/EEC* (2019) 61.

[36] Ibid 58.

[37] See generally, Duncan McLaren, "Quantifying the Potential Scale of Mitigation Deterrence from Greenhouse Gas Removal Techniques" (2020) 162 *Climatic Change* 2411–2428.

[38] See Chapters 8 (California groundwater) and 9 (Great Barrier Reef).

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

net loss," is expressed relative to a "presumed trajectory of 'background' decline," rather than relative to a stable set of conditions.[39] Secondly, offsetting might simply not be feasible in some situations, for example, where demand for offsets exceeds supply,[40] which could create pressure to allow offsets that do not benefit the matter of concern as originally conceptualized (i.e., nonequivalence). A finite supply of offsets raises the need for rules about enabling equitable access to offsets among proponents of activities that would require them for their activities to proceed.[41]

Offsetting, restoring, or facilitating coping related to one matter of concern may also harm another thing that is not formally recognized to "matter" in a particular context. If a rule adopts ecosystem services, which benefit people, as a matter of concern, an offset strategy may allow harm to biodiversity that offers no readily identifiable benefits to people.[42] Related to this, environmental offsets without adequate safeguards may also harm people through, for example, direct and indirect impacts on Indigenous rights.[43] A funding scheme for well deepening will not increase the coping capacity of ecosystems affected by declining groundwater, or of well owners who experience barriers accessing the scheme.[44] To avoid harming other matters of concern, regimes for offsetting, restoring, or coping that are directed at one cumulative environmental problem (e.g., carbon offsets) might require safeguards in the form of, for example, no negative impact on the matter of concern at the heart of another cumulative environmental problem or social values (e.g., carbon offsets that do not harm biodiversity or traditional access to land).[45] Designing these safeguards requires coordination across regulators responsible for dealing with these different problems.[46] If well-designed, offsetting and

[39] Maron and others, "Taming a Wicked Problem," 492. For a less risky approach to specifying cumulative threshold conditions, see Section 4.3.3.

[40] Ken Henry and others, *Final Report: Independent Review of the Biodiversity Conservation Act 2016* (State of New South Wales, 2023) 50–52, www.parliament.nsw.gov.au/lc/tabledpapers/Pages/tabled-paper-details.aspx?pk=186428&houseCode=lc, archived at https://perma.cc/7NUU-TRJQ.

[41] E.g., in the context of carbon offsets sourced from nature restoration, see generally, Kate Dooley, Zebedee Nicholls, and Malte Meinshausen, "Carbon Removals from Nature Restoration Are No Substitute for Steep Emission Reductions" (2022) 5(7) *One Earth* 812–824.

[42] See generally, Sonter and others, "Offsetting Impacts."

[43] E.g., see generally, Kathleen Birrell, Lee Godden and Maureen Tehan, "Climate Change and REDD+: Property as a Prism for Conceiving Indigenous Peoples' Engagement" (2012) 3 *Journal of Human Rights and the Environment* 196–216.

[44] See Section 8.4.2.6

[45] Axelsson and others, "Oxford Principles," 14.

[46] See Chapter 7 (Coordination).

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

restoring may have co-benefits for other matters of concern, say, community development benefits, and coordination can help structure regulatory systems to create synergies between offset regimes for different matters of concern.[47]

Considering how strategies burden contributors reveals trade-offs between these burdens and outcome reliability. Requiring a contributor to change their operations to reduce their impacts (a harm-reducing strategy) likely burdens them more than if they operated as normal, on condition that they fund riskier measures to neutralize their impacts (harm-offsetting) or on condition that they act to increase the coping capacity of a matter of concern. But different ways of requiring harm reduction can change burdens on contributors and may make it easier for them to reduce harm. Performance standards, for example, allow greater flexibility and reduce cost compared to reducing harm using a specified technology that applies universally to contributors.[48] If a cumulative environmental problem has more numerous and diverse contributors, it will logically be easier to reduce aggregate harm if one contributor can pay another to offset, compared to a problem involving fewer, more homogeneous contributors: offsets will reduce costs more in the first situation (which has the characteristics of a cumulative environmental problem) than in the second. Depending on how the matter of concern is conceptualized, spatially diverse contributors to the same environmental problem may allow for selecting an offset location to increase environmental benefits.[49]

Administrative burdens to government, on the other hand, are less easy to generalize within and across different strategies. Different types of harm-reducing strategies may entail different costs for contributors to harm and regulators. For example, performance standards that refer to cumulative harm arguably best reflect cumulative impacts, and may reduce costs for contributors, but enforcing them may cost regulators more than enforcing technology standards (e.g., continuous pollution monitoring vs confirming the installation of specified technology).[50] Scientific uncertainty will also influence administrative cost. If there is uncertainty about what activities cause harm, or whether

[47] Peter J. Whitehead, *Indigenous Livelihoods: Background Paper* (NAILSMA Knowledge Series, North Australian Indigenous Land and Sea Management Alliance 2012) 54–56, https://nailsma.org.au/uploads/resources/KS-011-Indigenous-Livelihoods-background-paper-Whitehead.pdf, archived at https://perma.cc/9YSR-5Y9R; Section 9.5.4.

[48] Cary Coglianese and Shana M. Starobin, "Social Science and the Analysis of Environmental Policy" (2020) 37 *Review of Policy Research* 578–604, 589–590.

[49] Deqiang Ma, Jonathan R. Rhodes and Martine Maron, "The Consequences of Coastal Offsets for Fisheries" (2022) 59 *Journal of Applied Ecology* 1157–1167, 1164.

[50] Cary Coglianese, "The Limits of Performance-Based Regulation" (2017) 50 *University of Michigan Journal of Law Reform* 525–564, 547–552.

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

an offsetting or coping strategy will work, justifying a strategy may require research and more intensive monitoring to verify the outcome,[51] increasing administrative burdens. Since legal regimes are not traditionally established to facilitate environment-related coping, relative to other strategies, more regulatory barriers may obstruct rules for coping.[52]

6.3 HOW CAN RULES INFLUENCE BEHAVIOR THAT HAS CUMULATIVE EFFECTS? A TYPOLOGY OF REGULATORY APPROACHES

While regulatory strategies focus on how rules affect cumulative harm relative to a level of acceptable conditions, regulatory approaches focus on contributors to the harm, and how rules try to change their behavior. Regulatory theorists have developed many ways of classifying regulatory approaches, none of which is universally accepted.[53] Section 6.3.1 uses the simple framework of mandatory "sticks," incentive-based "carrots," and information-based "sermons,"[54] adding an option that sidesteps influencing the behavior of contributors in favor of the state directly taking action ("state rescue") (Figure 6.3). A further important adjustment reflects this book's focus on formal rules: Each approach is based on enforceable rules.[55] Since regulatory theory[56] says little directly about cumulative effects, Section 6.3.2 applies a

[51] Robin Kundis Craig and J. B. Ruhl, "Designing Administrative Law for Adaptive Management" (2014) 67 *Vanderbilt Law Review* 1–87, 13 (citations omitted).

[52] E.g., in relation to the Great Barrier Reef, see generally, Pedro Fidelman and others, "Regulatory Implications of Coral Reef Restoration and Adaptation under a Changing Climate" (2019) 100 *Environmental Science and Policy* 221–229.

[53] Arie Freiberg, "Authority Tools: Pervasive, Persistent and Powerful" in Michael Howlett and Ishani Mukherjee (eds), *Routledge Handbook of Policy Design* (Taylor & Francis 2018) 243–260, 243.

[54] This simple typology, originally advanced by Bemelmans-Videc, Rist and Vedung (Marie-Louise Bemelmans-Videc, Ray C. Rist and Evert Vedung (eds), *Carrots, Sticks & Sermons: Policy Instruments and Their Evaluation* (Transaction Publishers 1998)) and much cited thereafter, suits present purposes for its parsimony, given the present purpose of constructing a matrix of both approaches and strategies. Other more complex regulatory typologies also exist, e.g., see Coglianese and Starobin, "Social Science and the Analysis of Environmental Policy," 588–592; James Salzman, "Teaching Policy Instrument Choice in Environmental Law: The Five P's" (2013) 23(2) *Duke Environmental Law and Policy Forum* 363; Karoline S. Rogge and Kristin Reichardt, "Policy Mixes for Sustainability Transitions: An Extended Concept and Framework for Analysis" (2016) 45 *Research Policy* 1620–1635. This chapter discusses some of the variation revealed by these more complex typologies within the categories of the simpler overall typology used here.

[55] Accordingly, this discussion does not include entirely self-regulatory approaches that include no role for the state. See also the description of this book's scope in Section 1.3.

[56] For useful references on regulatory theory, see, e.g., Michael Howlett and Ishani Mukherjee (eds), *Routledge Handbook of Policy Design* (Taylor & Francis 2018); Michael Howlett,

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

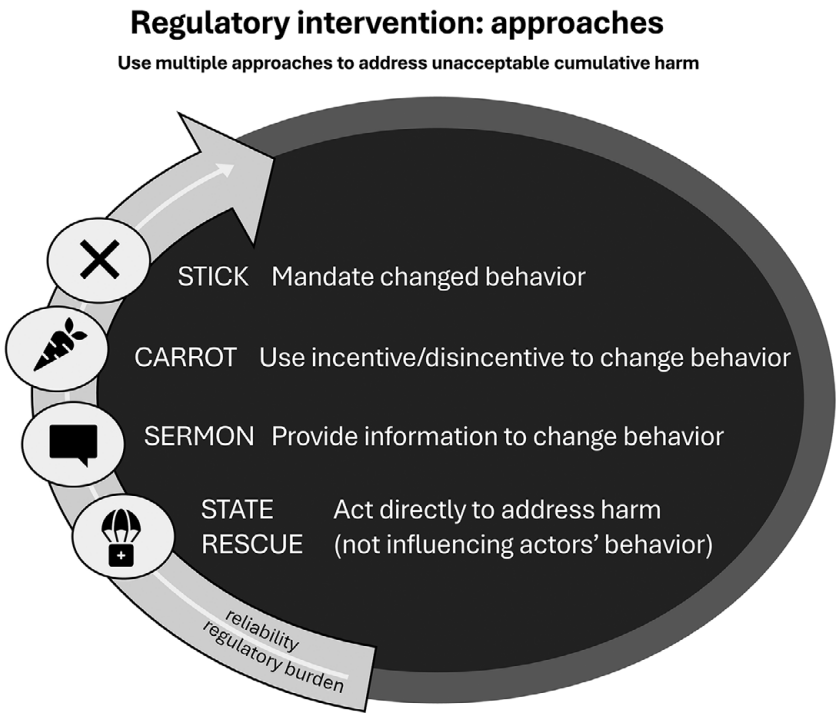


FIGURE 6.3 Four regulatory intervention approaches to change behavior or use direct state action – sticks, carrots, sermons, and state rescue

cumulative environmental harm lens to analyze, from first principles, the advantages and disadvantages of each approach. It argues that cumulative environmental problems magnify known theoretical weaknesses of each approach and that no single regulatory approach is universally best suited to dealing with cumulative environmental problems.

Designing an approach to intervention based on the categories discussed in this section depends on and links with rules for information about which actions affect the matter of concern, and are likely to do so in the future. Choosing between regulatory approaches requires information about the many heterogeneous contributors to the problem: their diverse activities; motivations; capacities to change their behavior; and the palatability to them of different regulatory approaches under different

Designing Public Policies: Principles and Instruments (2nd edn, Routledge 2019); Robert Baldwin, Martin Cave and Martin Lodge, *Understanding Regulation: Theory, Strategy, Practice* (OUP, 2nd edn, 2012); Cary Coglianese (ed), *Achieving Regulatory Excellence* (Brookings Institution Press 2017); Peter Drahos (ed), *Regulatory Theory: Foundations and Applications* (ANU 2017).

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

conditions.[57] In addition, coordinating actors that design and implement rules for intervention, as well as those subject to them, and affected communities, has numerous potential benefits. It can reveal the types of information just discussed, promote regulatory consistency, avoid inefficient duplication in rules, and may reveal potentially antagonistic or counterproductive rules.[58]

6.3.1 *Regulatory Sticks, Carrots, Sermons, and State Rescue*

The historically dominant (and enduringly popular[59]) approach to environmental governance is the regulatory stick used to "command and control." Traditionally, this approach involves imposing precisely specified and uniformly applied, court-enforceable obligations to control environmentally harmful behavior, supported by penalties for noncompliance.[60] Regimes might license polluting emissions, and perhaps allow licenses to be traded; prohibit or restrict specified activities or land uses in certain areas or in general; or allocate rights to access a natural resource such as water, fish, or timber.

Regulatory "carrots" use rules to incentivize behavior changes to alter environmental impacts, offering either material or symbolic incentives.[61] Rule-based subsidies, grants, and even government procurement rules reward those who undertake activities aligned with policy goals. Payments to farmers may encourage extensive pastoralism to preserve grasslands.[62] Legal rules can support conservation easements accompanied by tax benefits,[63] or confer formalized awards or other forms of praise.[64] Conversely, taxes, charges, or

[57] Eric L. Windholz, *Governing through Regulation: Public Policy, Regulation and the Law* (Routledge 2018) 112–113, 192–193.

[58] Ibid; see generally, P. M. Grabosky, "Counterproductive Regulation" (1995) 23 *International Journal of the Sociology of Law* 347–369. For a discussion of the regulatory function of coordination in the CIRCle Framework, see Chapter 7.

[59] Neil Gunningham and Cameron Holley, "Next-Generation Environmental Regulation: Law, Regulation, and Governance" (2016) 12 *Annual Review of Law and Social Science* 273–293, 275.

[60] Howlett, *Designing Public Policies*, 32, 192.

[61] Frans L. Leeuw, "The Carrot: Subsidies as a Tool of Government – Theory and Practice" in Marie-Louise Bemelmans-Videc, Ray C. Rist and Evert Vedung (eds), *Carrots, Sticks and Sermons* (Transaction Publishing 1998) 77–102, 77–79. See generally P. N. Grabosky, "Regulation by Reward: On the Use of Incentives as Regulatory Instruments" (1995) 17 *Law and Policy* 257–282.

[62] Section 10.4.1.2.

[63] E.g., "Claiming Conservation Covenant Concessions," Australian Taxation Office (April 4, 2023) www.ato.gov.au/businesses-and-organisations/not-for-profit-organisations/gifts-and-fundraising/in-detail/fundraising/claiming-conservation-covenant-concessions, archived at https://perma.cc/FJ2J-B9TP.

[64] Grabosky, "Regulation by Reward," 261–262. This might also be considered a carrot-sermon hybrid.

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

levies (for simplicity, "levies") direct behavior by making less harmful options cheaper, in a relative sense, consistently with the polluter pays principle[65] (I exclude charges that raise revenue without being designed to influence behavior). As discussed here, mandatory levies are not "sticks" because they do not directly mandate a change in the behavior that causes relevant harm – the contributor could pay the levy and continue their normal behavior.

Understood broadly, regulatory carrots can also encourage desired behavior in other ways. Management-based regulation obliges contributors to write plans rather than achieve substantive goals, which tends to encourage leading firms, though not laggards, to exceed minimum performance.[66] Other rules can support infrastructure that encourages behavioral change, for example, rules to promote electric vehicle charging infrastructure to encourage take-up of electric rather than gasoline vehicles.[67] Some rules pair a carrot with a stick, for example, reducing license fees for regulated activities that exceed a minimum regulatory standard.[68]

Regulatory sermons involve rules that require the state or contributors to provide information that aims to change the behavior of the information provider or receivers.[69] Such rules include requiring a state entity to run training or educational programs to persuade participants to change environmentally adverse behavior; or rules related to consumer-directed environmental information about products, including environmental certification schemes[70] or public-facing pollution

[65] Priscilla Schwartz, "The Polluter-Pays Principle" in Ludwig Krämer and Emanuela Orlando (eds), *Elgar Encyclopedia of Environmental Law, Vol VI* (Edward Elgar 2018) 260–271, 261–262 (contributors to environmental harm bear the cost of preventing or remedying the harm). The principle could also inform offset mechanisms and fees for licenses: ibid 265–267.

[66] Coglianese, "Limits of Performance-Based Regulation," 536; Gunningham and Holley, "Next-Generation Environmental Regulation," 279.

[67] E.g., see generally, Regulation (EU) 2023/1984 of the European Parliament and of the Council of September 13, 2023, on the deployment of alternative fuels infrastructure [2023] OJ L234/1.

[68] Environment Protection Authority (New South Wales), *Regulatory Policy* (2024) 31, www.epa.nsw.gov.au/Publications/About/2024p4550-Regulatory-Policy, archived at https://perma.cc/8TPD-DMUB.

[69] Chapter 5 discusses information issues not directly associated with changing behavior (e.g., a state's environmental condition reports). Note that some aspects of regulatory sermons may be enforceable, e.g., traceability recordkeeping required in relation to product labeling: e.g., Decreto Ministeriale 26 luglio 2017, n. 57167 Disposizioni nazionali per l'attuazione del regolamento (UE) n. 1151/2012 e del regolamento delegato (UE) n. 665/2014 sulle condizioni di utilizzo dell'indicazione facoltativa di qualita' «prodotto di montagna» [Ministerial Decree 57167 on national provisions for the implementation of Regulation (EU) No. 1151/2012 and Delegated Regulation (EU) No. 665/2014 on the conditions of use of the optional quality indication "mountain product"] (Italy), as amended art. 4.

[70] See generally, Thomas Vogelpohl, "Transnational Sustainability Certification for the Bioeconomy? Patterns and Discourse Coalitions of Resistance and Alternatives in Biomass Exporting Regions" (2021) 11:3 *Energy, Sustainability and Society* 1–13.

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

information.[71] There is growing global enthusiasm for mandatory and voluntary "environmental, social, governance" reporting and "environmental accounting" by firms and governmental units.[72] These systems recognize and publicize the economic importance of environmental assets, indirectly encouraging their protection.

Other regulatory sermons echo environmental impact assessment (EIA): The Taskforce on Nature-Related Financial Disclosures recommends that firms disclose their impacts on specific ecosystems and species, including cumulative impacts.[73] Under some circumstances, this approach may have binding force through company directors' duties.[74] Some "carrots" support "sermons," for example, incentives to provide public information about toxic releases.[75]

Finally, in some situations, rules may provide for the state to parachute in a solution to cumulative environmental harm without trying to influence the behavior of the contributors – here termed "state rescue." That is, the activities that cause impacts still happen, but the state adopts a strategy that affects the overall level of harm that results. In practice, this can be important to address harm from legacy activities that continue to cause impacts long after they have ceased being "active," or to address the impacts of activities that must continue, where the contributor lacks the capacity to change their behavior. Rules might, for example, provide for the state to remediate pollution from an abandoned mine site.[76] More controversially, rules might provide for the state

[71] E.g., Stuart Johnston Edwards and Tony R. Walker, "An Overview of Canada's National Pollutant Release Inventory Program as a Pollution Control Policy Tool" (2020) 63 *Journal of Environmental Planning and Management* 1097–1113, 1098.

[72] See generally, Rutger Hoekstra, How Natural Capital Accounting Can Help Accelerate Finance for Nature (Metrics for the Future 2022) https://seea.un.org/sites/seea.un.org/files/how-nca-can-help-accelerate-finance-for-nature.pdf; Taskforce on Nature-related Financial Disclosures, *Recommendations of the Taskforce on Nature-Related Financial Disclosures* (2023) 29–31, 122, https://tnfd.global/wp-content/uploads/2023/08/Recommendations_of_the_Taskforce_on_Nature-related_Financial_Disclosures_September_2023.pdf.

[73] Taskforce on Nature-related Financial Disclosures, *Recommendations of the TNFD*, 29–31, 122.

[74] Sebastian Hartford-Davis and Zoe Bush, Joint Memorandum of Opinion: Nature-Related Risks and Directors' Duties (October 24, 2023) 1–3, https://commonwealthclimatelaw.org/wp-content/uploads/2023/11/Joint-Memorandum-of-Opinion-Nature-related-risks-and-directors-duties.pdf.

[75] See generally, Robert Innes and Abdoul G. Sam, "Voluntary Pollution Reductions and the Enforcement of Environmental Law: An Empirical Study of the 33/50 Program" (2008) 51 *Journal of Law and Economics* 271–296 (where the primary, implicit, incentive was reduced inspections and enforcement proceedings, together with technical assistance).

[76] E.g., under the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. §§ 9601–9675: U.S. Environmental Protection Agency, "Abandoned Mine Land and Federal Facilities" (2024) www.epa.gov/enforcement/abandoned-mine-land-and-federal-facilities, archived at https://perma.cc/M243-YVVU.

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

to undertake geoengineering to remove carbon dioxide[77] if regulatory approaches to influencing the behavior of greenhouse polluters fail.

6.3.2 *Assessing Regulatory Approaches*

Regulatory literature finds clear differences in how reliably sticks, carrots, and sermons achieve policy goals, and their regulatory cost, which is influenced by how flexibly they apply to heterogeneous regulated entities.[78] This section applies a cumulative environmental harm lens to these issues, assessing the advantages and disadvantages of each approach from this perspective.

Regulatory sticks are traditionally perceived as rigid and inefficient, imposing uniform obligations (e.g., technology standards)[79] on entities with varying costs of compliance.[80] However, they offer certainty for regulated entities[81] and relatively high outcome reliability if well enforced. In practice, though, regulatory sticks can be more flexible than they appear due to "pervasive" negotiation between regulators and regulated entities.[82] This not only reduces burdens for diverse contributors with the resources to negotiate but may also make enforcement more variable and affect the reliability of environmental outcomes.

Contemporary "sticks" use design features that do a better job of accommodating the diverse contributors typical of cumulative environmental problems.[83] Performance-based or outcomes-based regulation increases flexibility and reduces costs for contributors[84] by letting them choose how they achieve preset goals, sometimes through collaborating with other contributors.[85] However, the fact that obligations vary may make monitoring and enforcing performance more burdensome.[86] Reliability also decreases if standards are loosely specified (which increases decision-makers' discretion), or if

[77] E.g., see generally, Jan McDonald and others, "Greenhouse Gas Removal in Australian Climate Law: A Positive Role for Negative Emissions" (2023) 46 *UNSW Law Journal* 79–110.
[78] E.g., Coglianese, "Limits of Performance-Based Regulation," 532, 545.
[79] Gunningham and Holley, "Next-Generation Environmental Regulation," 276.
[80] Robert N. Stavins, "The Problem of the Commons: Still Unsettled after 100 Years" (2011) 101 *The American Economic Review* 81–108, 94; Dave Owen, "The Negotiable Implementation of Environmental Law" (2023) 75 *Stanford Law Review* 137–203, 145–149.
[81] Gunningham and Holley, "Next-Generation Environmental Regulation," 277.
[82] Owen, "The Negotiable Implementation of Environmental Law," 153–184.
[83] Gunningham and Holley, "Next-Generation Environmental Regulation," 278–279.
[84] Coglianese, "Limits of Performance-Based Regulation," 532, 545.
[85] Therivel and Ross, "Cumulative Effects Assessment," 368.
[86] Coglianese, "Limits of Performance-Based Regulation," 549–550, 558–549. See Chapter 5 in relation to information about enforcement.

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

performance is specified as averages across multiple sites[87] (which may inadvertently cause significant localized cumulative harm).[88]

Regulatory carrots and sermons tend to be more palatable to governments and regulated entities than regulatory sticks because accepting an incentive and changing behavior in response to a levy or information is voluntary.[89] Nonetheless, participants must still expend effort to understand the rules. The state may also bear significant burdens in designing, monitoring, and enforcing the regime to ensure that participants deliver incentivized benefits, pay levies, and provide accurate information.[90] However, information-based instruments may cost less to administer than sticks or carrots.[91] The state generally pays for incentives, the costs of which are inefficient if recipients would have acted in the desired way anyway,[92] but gains revenue from levies.

However, carrots and sermons are also theoretically less reliable than well-enforced regulatory sticks because their voluntariness means they may cause fewer contributors to change their behavior than needed to ensure cumulative harm is acceptable.[93] Among diverse contributors, some will lack interest, willingness, or capacity to respond to monetary or, probably to a greater extent, information-based motivations.[94] Sometimes, individual nonparticipant "holdouts" in incentive schemes may significantly reduce outcome reliability if they compromise goals that depend on high participation in specific spatial areas for ecological reasons, such as habitat corridors.[95]

State rescue emerges with quite a different report card. Since it does not try to change contributors' behavior, it does not represent a burden for them, but it does for the state – and perhaps a significant one. Reliability-wise, the same considerations do not arise as for the other approaches because state rescue does not depend on the actions of non-state contributors. Rather, outcome

[87] E.g., Charles Halvorson, "Deflated Dreams: The EPA's Bubble Policy and the Politics of Uncertainty in Regulatory Reform" (2019) 93 *Business History Review* 25–49.
[88] Coglianese, "Limits of Performance-Based Regulation," 537–541 (describing many variables in specifying performance standards).
[89] E.g., Brian Murray and Jonas Monast, "Carrots, Sticks, and the Evolution of U.S. Climate Policy" (2024) 11 *Texas A&M Law Review* 431–450, 447.
[90] Gunningham and Holley, "Next-Generation Environmental Regulation," 280.
[91] Yayun Shen and Michael Faure, "Behavioural Instruments in Environmental Law and Policy: Potential and Challenges" (2024) 33 *Review of European, Comparative and International Environmental Law* 3–18, 7–8.
[92] Leeuw, "The Carrot," 79–80.
[93] Gunningham and Holley, "Next-Generation Environmental Regulation," 279.
[94] Ibid 280; Shen and Faure, "Behavioural Instruments," 10–11.
[95] E.g., Edwin Alblas and Josephine van Zeben, "'Farming out' Biodiversity: Implementing EU Nature Law through Agri-Environmental Schemes" (2023) 17:100180 *Earth System Governance* 1–10, 6.

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

reliability suffers if there are gaps or weaknesses in the capability of the state to deliver the "rescue" solution. This might happen because of overstretched budgets, changes in political appetite to act, and the like. Depending entirely on state rescue also means relying entirely on the state to deal with potential increases in cumulative harms from contributors, which are not subject to intervention in a direct way.

Overall, well-enforced regulatory sticks provide greater scope reliably to change the behavior of heterogeneous contributors to cumulative environmental harm, in exchange for imposing higher burdens on some of them and confronting potentially higher associated political and social barriers. The voluntariness of carrots and sermons involves lower burdens for contributors, who retain the option of not changing their behavior, but for the same reason, these approaches produce less reliable outcomes. State rescue removes burdens from contributors to the problem and places it on the state, exposing reliable outcomes to risks from politics and government budgets rather than contributors' failure to act. This high-level assessment of reliability is naturally premised on important assumptions about enforcement and acceptability. These factors need to be considered in a local context, perhaps including, as discussed earlier, harnessing coordination with stakeholders representing regulated entities and affected communities.[96]

6.4 MIXING REGULATORY INTERVENTIONS FOR CUMULATIVE ENVIRONMENTAL PROBLEMS

Real-world regulatory interventions are more complex than an individual strategy or approach, firstly, because a single mechanism for intervention combines both elements, and secondly, because addressing a cumulative environmental problem likely requires more than one type of intervention. This section discusses each of these issues in turn.

6.4.1 *A Matrix of Strategies and Approaches*

Combining regulatory strategies (Section 6.2) and approaches (Section 6.3) produces a matrix of theoretical modes of regulatory interventions. Table 6.1 gives corresponding examples, showing that sticks, carrots, and sermons are each flexible enough to accommodate the full range of harm-reducing, offsetting, restoring, and coping strategies. State rescue may apply to the last three approaches (since, as conceived here, state rescue involves the state

[96] See paragraph preceding Section 6.3.1. See also Section 6.5.2.3 regarding enforcement.

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

TABLE 6.1 *Options for increasing diversity of regulatory interventions: four strategies and four approaches to address cumulative environmental problems, with characteristics and examples.*



Approaches/ strategies	Mandating (Stick)	Incentivizing (Carrot)	Informing and persuading (Sermon)	State rescue
Harm-reducing	Reduce plastic pollution by limiting production of single-use plastic items (Vanuatu)[a]	Reduce total water withdrawals by buying and retiring farmers' water rights (Australia) [b]	Reduce air pollution via mandated emissions disclosure (Canada) [c]	N/A
Harm-offsetting (for contemporary impacts)	Reduce net biodiversity loss by requiring developers to offset loss[d] in one place by gain in another (Uganda)[e]	Reduce net wetland loss by facilitating aggregated wetland restoration through for-profit "banking" (US)[f]	Reduce net greenhouse gas emissions using a voluntary public "net zero" reporting framework (Australia)[g]	Reduce net groundwater depletion from ongoing groundwater pumping by the state undertaking aquifer recharge (Spain)[h]
Restoring (for past impacts)	Remediate legacy soil contamination by imposing obligation to remediate on landowner, even if they did not cause contamination (Japan).[i]	Restore biodiversity by providing incentives to landowners to rewet peatland (European Union).[j]	(Indirectly) counter urban heat islands by reporting on cool green spaces using ecosystem accounting to inform investment in further spaces (Australia)[k]	Reduce pollution by the state remediating abandoned mine sites (US).[l]
Coping	Require gas developers to "make good" effects on landowners affected by groundwater level declines drying up their wells (Australia)[m]	Assist species to disperse to cope with climate change by paying farmers to connect habitat (UK)[n]	Assist communities to adapt to climate change by requiring agency to publish climate vulnerability atlases (Mexico)[o]	Assist communities to cope with sea level rise using rules that facilitate the state building a sea wall (Maldives).[p]

TABLE 6.1 (*continued*)

Key: Arrows indicate the direction in which the intervention approach or strategy tends to involve (all else being equal) more reliable outcomes, less voluntariness, and a higher burden for contributors to harm

[a] Waste Management Regulations Order No. 15 of 2018 (Vanuatu) s 2.

[b] Rebecca Nelson, "Breaking Backs and Boiling Frogs: Warnings from a Dialogue between Federal Water Law and Environmental Law" (2019) 42 *University of New South Wales Law Journal* 1179–1214, 1209–1210.

[c] Canadian Environmental Protection Act 1999 (Canada) ss 46–50; Government of Canada, "National Pollutant Release Inventory" (n.d.) www.canada.ca/en/services/environment/pollution-waste-management/national-pollutant-release-inventory.html, archived at https://perma.cc/WC2A-8S9M. See also Johnston Edwards and Walker, "An Overview of Canada's National Pollutant Release Inventory Program."

[d] See generally, Sonter and others, "Offsetting Impacts."

[e] National Environment Act 2019 (Uganda) ss 115, 122 (2)(d), 179 (2)(c).

[f] J. B. Ruhl and James Salzman, "No Net Loss? The Past, Present, and Future of Wetlands Mitigation Banking" (2022) 73 *Case Western Reserve Law Review* 411–439, 420–422, 428–429.

[g] Clean Energy Regulatory (Australia), "Corporate Emissions Reduction Transparency Report 2023" (2024) https://cer.gov.au/markets/reports-and-data/corporate-emissions-reduction-transparency-report/corporate-emissions-0, archived at https://perma.cc/CU53-TU9Y.

[h] Jose David Henao Casas and others, "Managed Aquifer Recharge as a Low-Regret Measure for Climate Change Adaptation: Insights from Los Arenales, Spain" (2022) 14:3703 *Water* 1–22. This is formally facilitated under a royal decree: ibid 4. Another example is state provision of coral-friendly public vessel moorings on the Great Barrier Reef to reduce damage from anchoring: Minister for the Environment and the Great Barrier Reef, Minister for Science and Minister for Multicultural Affairs, "New Moorings Enhance Protection for the Great Barrier Reef" (Media statement, November 16, 2023) https://statements.qld.gov.au/statements/99162, archived at https://perma.cc/3NNE-G9PV.

[i] 土壌汚染対策法 [Soil Contamination Countermeasures Act] 2002 (Japan), as amended, art. 7(1); Miho Ishimaki, "Soil Protection Law in Japan" in Harald Ginzky and others (eds), *International Yearbook of Soil Law and Policy 2022* (Springer 2024) 227–242, 237–238. Obligations to remediate others' pollution may also be imposed under negotiated conditions of water pollution discharge permits in the US: e.g., Rhett Larson, "Orphaned Pollution" (2013) 45 *Arizona State Law Journal* 991–1032, 1001–1004.

[j] EU Nature Restoration Law 2024, art. 11.

[k] Phil Cryle and others, *Practical Guidance Notes for Urban Ecosystem Accounting: A Draft Report by Working Group on Urban Ecosystem Accounting in Australia*, Prepared for the Interjurisdictional Environmental-Economic Accounting Steering Committee (2021) 70, www.dcceew.gov.au/sites/default/files/documents/practical-guidance-notes-urban-ecosystem-accounting.pdf, archived at https://perma.cc/52D2-PR2Y.

[l] See n 76.

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

TABLE 6.1 (*continued*)

[m] Water Act 2000 (Queensland) s 409; see Rebecca Nelson, "Regulating Cumulative Impacts in Groundwater Systems: Global Lessons from the Australian Experience" in Cameron Holley and Darren Sinclair (eds), *Reforming Water Law and Governance: From Stagnation to Innovation in Australia* (Springer 2018) 237–256, 246–248.

[n] Department for Environment, Food and Rural Affairs (UK), "Environmental Land Management (ELM) Update: How Government Will Pay for Land-Based Environment and Climate Goods and Services" (2023) www.gov.uk/government/publications/environmental-land-management-update-how-government-will-pay-for-land-based-environment-and-climate-goods-and-services/environmental-land-management-elm-update-how-government-will-pay-for-land-based-environment-and-climate-goods-and-services, archived at https://perma.cc/QFD8-2C3R.

[o] Marco Heredia and Beatriz Corral, "Climate Governance and Federalism in Mexico" in Alan Fenna, Sébastien Jodoin and Joana Setzer (eds), *Climate Governance and Federalism: A Forum of Federations Comparative Policy Analysis* (CUP 2023) 218–240, 228.

[p] Geronimo Gussmann and Jochen Hinkel, "A Framework for Assessing the Potential Effectiveness of Adaptation Policies: Coastal Risks and Sea-Level Rise in the Maldives" (2021) 115 *Environmental Science and Policy* 35–42, 39–40; Environment Protection and Preservation Act of Maldives 1993 (Maldives) s 3 (providing for guidelines); *Guidelines for Climate Risk Resilient Coastal Protection in the Maldives* (2015) www.environment.gov.mv/v2/en/download/13722, archived at https://perma.cc/GR3W-KW5G.

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

acting in respect of others' harms; if the state directly causes harm, it is a contributor, and rules that adopt any of the four approaches could apply). However, the relative difficulty of finding examples that pursue some forms of coping strategy and sermon approach (Table 6.1) suggests anecdotally that these categories are less developed.

Overall, this matrix suggests that more modes of intervening are available to address cumulative environmental problems than are commonly recognized, and that some common concepts and categories contain more diverse ways of intervening than is first apparent. Take "market-based mechanisms." The term can refer to diverse things: a water rights market that allows governments to "buy back" rights to reduce aggregate consumptive withdrawals to sustainable levels (reducing harm);[97] permits that allow "trading" of protected habitat for habitat that will be harmed by a development (offsetting harm);[98] and a project condition that requires a project proponent to pay into a fund to develop heat-tolerant coral (coping).[99] Each provides economic incentives to contributors, and is likely to be more politically palatable than a regulatory stick alone. However, the merits of a market in regulating a cumulative environmental problem cannot be assessed without understanding *how* the market is used to change cumulative harm – the *strategy*. For the reasons discussed earlier, the harm-reducing strategy of the water rights market will more reliably achieve the desired aggregate outcome than the harm-offsetting strategy of habitat trading or the coping strategy of developing heat-tolerant coral. The matrix, then, allows for a more nuanced view of the risks of a particular intervention in addressing cumulative environmental problems.

The matrix also demonstrates how the choice of regulatory approach and strategy can exacerbate risks where both the approach and the strategy attract the same type of risk. This helps highlight when regulatory designers should pay special attention to making sure that a rule includes features to help combat the challenges that arise. Take burdens to contributors. The combination of regulatory approach and regulatory strategy can exacerbate these burdens (highest at upper left side, Table 6.1). In this case, regulatory designers have comparatively higher need to consider ways to reduce costs to ensure a rule is politically and socially palatable.

[97] Daniel H. Cole, "Explaining the Persistence of 'Command-and-Control' in US Environmental Law" in Kenneth R. Richards and Josephine van Zeben (eds), *Elgar Encyclopedia of Environmental Law* Vol. VIII (Edward Elgar 2020) 157–169, 157.

[98] J. B. Ruhl, "Regulation by Adaptive Management – Is It Possible?" (2005–2006) 7 *Minnesota Journal of Law Science and Technology* 21–57, 43–46.

[99] See Section 9.5.3.

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

Conversely, consider risks associated with reliably addressing cumulative impacts, that is, risks to outcome reliability (highest at lower right side, Table 6.1). Rules that take a carrot approach, for example, entail a relatively high risk to outcome reliability in influencing the behavior of contributors. A rule that sought to incentivize an unproven coping strategy would compound this risk with the further risk that even successful behavior change would not result in the desired ultimate effect – that the matter of concern could cope with higher cumulative impacts without experiencing unacceptable harm. Here, regulatory designers have comparatively higher need to use rules for intervening adaptively[100] to deal with these risks. Another way to address these realizations of heightened risk is to use a mix of regulatory interventions, so that mechanisms that are highly risky on one parameter are balanced by less-risky regulatory options – the topic to which we now move.

6.4.2 *The Need for a Mix of Regulatory Interventions*

Over two decades of scholarship argues that "policy mixes" offer flexibility and backup where one approach proves less effective, and help to accommodate conditions of uncertainty, complexity, and different types of target actors.[101] As suggested earlier, this rationale also supports using a mix of interventions that adopt different regulatory approaches and strategies to address cumulative environmental problems, for which these conditions are prominent.

Cumulative environmental problems have characteristics that inherently suggest a mix of regulatory interventions, either used concurrently or adaptively in sequence,[102] is likely to be more effective than a single strategy and approach. Firstly, contributors are heterogeneous, with different motivations, capacities to change behavior, and types of impact. This changes their receptivity to different regulatory designs. Individual petrol vehicle drivers, cattle farmers, and coal-burning electricity generators all produce greenhouse gas emissions, but their diversity requires different regulatory designs. A single rule or even type of rule could not conceivably address the many types of impact that affect the Great Barrier Reef: water pollution,

[100] See Section 6.5.4.

[101] Raul Pacheco-Vega, "Environmental Regulation, Governance, and Policy Instruments, 20 Years after the Stick, Carrot, and Sermon Typology" (2020) 22 *Journal of Environmental Policy and Planning* 620–635, 622–625; John Braithwaite, "Regulatory Mix, Collective Efficacy, and Crimes of the Powerful" (2020) 1 *Journal of White Collar and Corporate Crime* 62–71, 69.

[102] See Section 6.5.4 regarding adaptive interventions.

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

climate change, growth in invasive species, direct damage to habitat and fauna from vessels, and so on.[103]

Secondly, from a pragmatic view, cumulative environmental problems will inevitably involve a mix of interventions. These problems tend to engage multiple levels of government,[104] and even single levels of government often use multiple regulatory approaches, creating a regulatory mix across levels.[105] Reform costs and path dependence mean it will rarely be possible to engage in a regulatory "revolution" to wipe clean an existing regulatory slate and start again.[106] Regulatory mixes are also often inevitable as a result of "policy layering" over time,[107] so improving how they perform is critical. This highlights the value of being aware of potential weaknesses of each approach in a cumulative context and designing regulation in a way that combats these weaknesses. Combining interventions from the same corner of the matrix risks compounding disadvantages, whereas selecting interventions from across the matrix provides for counteracting risks.

Thirdly, theories of "smart regulation" and "new environmental governance" suggest that complex, dynamic environmental problems with low availability of centralized knowledge[108] benefit from engaging nongovernment regulatory actors and adaptively escalating to more interventionist approaches as needed.[109] This requires multiple regulatory approaches, both to allow for escalation and because different types of interventions will suit different nongovernment regulatory actors. Coordination with nongovernment actors is discussed in more detail in a later chapter.[110]

Finally, a mix of interventions can help address some key reasons why it is hard to deal with cumulative environmental problems.[111] Voluntary measures can surmount political and social to regulatory sticks, the ethical ambiguity of dealing with individually small actions, and causal uncertainty. Combining voluntary approaches with backup "sticks" helps reduce reliability risks of voluntary approaches. Combining strategies can help avoid similar problems.

[103] See Figure 9.1.
[104] See Section 2.2.4.1.
[105] Christopher Taylor and others, "Selecting Policy Instruments for Better Environmental Regulation: A Critique and Future Research Agenda" (2012) 22 *Environmental Policy and Governance* 268–292, 282.
[106] See generally, Cole, "Explaining the Persistence of 'Command-and-Control'."
[107] Michael Howlett, Ishani Mukherjee and Jeremy Rayner, "Understanding Policy Designs over Time: Layering, Stretching, Patching and Packaging" in Michael Howlett and Ishani Mukherjee (eds), *Routledge Handbook of Policy Design* (Taylor & Francis 2018) 136–144, 137 (citations omitted).
[108] Gunningham and Holley, "Next-Generation Environmental Regulation," 284.
[109] Ibid 280–281.
[110] See Chapter 7 ("Coordination").
[111] See Section 6.1 for a summary, and Section 2.2.3 for a fuller discussion.

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

In the Murray-Darling Basin, Australia, legal rules support a harm-reducing strategy, whereby governments "buy back" water rights from farmers to reduce aggregate water withdrawals to an "environmentally sustainable level of take."[112] Farmers lobbied to add a less burdensome but more costly coping strategy, now implemented through rules for artificially watering wetlands and using infrastructure to help ecosystems cope with less water.[113]

At the same time, as for other types of problems, mixes of interventions to deal with cumulative environmental problems must be designed with potential antagonistic effects in mind.[114] This issue is addressed further in Chapter 7 (Coordination).

Though compelling arguments support using a mix of regulatory interventions to regulate cumulative environmental problems, existing literature provides little guidance on designing them to deal with these problems, and calls for empirical testing.[115] Chapters 9 and 10 examine the way that combinations of regulatory interventions address case studies of cumulative environmental problems in Australia (the Great Barrier Reef) and Italy (Alpine grasslands).

6.5 CROSSCUTTING DESIGN FEATURES

Even a mix of carefully chosen interventions may strike significant challenges in addressing cumulative environmental problems. The effectiveness of tools for dealing with cumulative impacts can be compromised by various challenges – disconnected decision-making and legal silos, loopholes in coverage, excessive cost to administer, and difficulty adapting to changed circumstances.[116] This section takes up the issue of design features that cut across regulatory strategies and approaches to address these challenges.

Each section starts with a reflection on connections between the relevant challenge and the matrix of interventions advanced earlier, and then illustrates the diversity of potential regulatory design solutions with real-world examples.

6.5.1 *Connected Decision-Making*

To the already significant list of challenges related to intervention discussed in Chapter 2, law itself adds another: fragmented decision-making and laws that

[112] See Nelson, "Breaking Backs" and note b to Table 6.1.
[113] Water Act 2007 (Australia) ss 23A, 23B, 28–31; Basin Plan 2012 (Australia) ss 7.09–7.27; Nelson, "Breaking Backs," 1209–1210.
[114] See n 58.
[115] Gunningham and Holley, "Next-Generation Environmental Regulation," 281, 284.
[116] See Section 2.2.3.

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

consider sectors, impacts, and actions in isolation, unconnected to the effects of other actions that aggregate to affect the same matter of concern. Scholars and governments alike frequently observe that environment-related law comprises "hard, impermeable, organizational and institutional silos that prevent coordination or integration of laws and policies across systems and scales," or complaints to that effect, across diverse jurisdictions.[117] This is a key problem for addressing cumulative impacts: Taking a blinkered view of individual impacts in isolation does not reveal their cumulative context, and misrepresents their significance to decision-makers and the public.[118]

Legal mechanisms can "connect" decision-making about an individual action to other relevant actions in three key ways: requiring consideration of cumulative environmental principles ("principles"), applying aggregate limits and targets for impact ("limits") that will take effect immediately or in the future,[119] or using comprehensive management plans and strategic assessments ("plans") that assess how multiple existing and new impacts accumulate in a region.[120] Limits should relate to the cumulative threshold conditions for the matter of concern,[121] ensuring that this threshold is not crossed. Rules should also connect across impact types relevant to a matter of concern. Where the matter of concern is the ecological health of a water resource, carefully managing river flows but ignoring problematic invasive species will not produce the desired result.[122] Making these connections across impact

[117] Craig Anthony Arnold, "Environmental Law, Episode IV: A New Hope: Can Environmental Law Adapt for Resilient Communities and Ecosystems" (2015) 21 *Journal of Environmental and Sustainability Law* 1–46, 15. See also, e.g., European Environment Agency, *The European Environment – State and Outlook 2020: Knowledge for Transition to a Sustainable Europe* (2019) 374–375, www.eea.europa.eu/en/analysis/publications/soer-2020/soer-2020/@@download/file, archived at https://perma.cc/D33K-7G3Q; Nelson, "Breaking Backs," 1188; generally Margaret A. Young, "Fragmentation" in Lavanya Rajamani and Jacqueline Peel (eds), *The Oxford Handbook of International Environmental Law* (OUP 2021) 86–101.

[118] Rebecca Nelson and L. M. Shirley, "The Latent Potential of Cumulative Effects Concepts in National and International Environmental Impact Assessment Regimes" (2023) 12 *Transnational Environmental Law* 150–174, 152.

[119] E.g., Great Britain's zero emission vehicle mandate, which will phase out sales of non-zero emission cars and vans: Holly Edwards, Iona Stewart, Becky Mawhood and Paul Bolton, Electric Vehicles and Infrastructure, Commons Library Research Briefing CBP-7480 (UK House of Commons, July 12, 2024) 27–28, https://researchbriefings.files.parliament.uk/documents/CBP-7480/CBP-7480.pdf.

[120] For a discussion of different kinds of strategic environmental assessment (SEA), see Bram Noble and Kelechi Nwanekezie, "Conceptualizing Strategic Environmental Assessment: Principles, Approaches and Research Directions" (2017) 62 *Environmental Impact Assessment Review* 165–173, 167–170.

[121] For a discussion on cumulative threshold conditions, see Section 4.3.3.

[122] Rebecca Nelson, "Challenges to Improved Integrated Management of the Murray-Darling Basin" in Barry Hart and others (eds), *Murray-Darling Basin, Australia: Its Future*

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

types is feasible using principles and plans, but more difficult for limits unless the limit uses an index that aggregates different kinds of impacts, such as cultural health indices, cumulative exposure maps for ecosystems, or environmental justice index maps.[123] Table 6.2 gives illustrative examples of these "connecting" tools across different regulatory approaches.

Specificity and clarity are key to these approaches. Principles need policy guidance to encourage effective implementation and to constrain administrative discretion to avoid inconsistent approaches between individual decisions,[124] supported by adequate public sector capacity. Clearer and more specific limits provide greater certainty, for example, quantitatively rather than qualitatively expressed limits (though the former have the disadvantage of requiring intentional amendment to adapt to new circumstances). Notably, unlike targets for impacts, targets for positive actions (which adopt an offsetting or restoring strategy), without more, do not directly address cumulative harm because negative impacts may continue growing. Targets for renewable energy sources,[125] in contrast to regulatory carbon budgets,[126] demonstrate this difference.

To ensure that limits and plans influence and link individual actions, rather than "stay on the shelf,"[127] rules should apply limits and plans to project approvals,[128] or risk them being used inconsistently or overlooked entirely in the context of new projects.[129] Conversely, approval processes for individual

Management (Elsevier 2021) 339–361, 351. See Chapter 9 (Great Barrier Reef) for analysis that contrasts treatment of different activities and impact types (coal mining and cattle grazing; water pollution and climate change).

[123] See Section 4.3.3 (cultural health indicators); Table 6.2, row 1; Section 9.4.2 (cumulative exposure of the Great Barrier Reef).

[124] Melissa M. Foley and others, "The Challenges and Opportunities in Cumulative Effects Assessment" (2017) 62 *Environmental Impact Assessment Review* 122–134, 128.

[125] E.g., Directive 2018/2001 of the European Parliament and of the Council of December 11, 2018 on the promotion of the use of energy from renewable sources [2018] OJ L328/82, as amended, art. 3 (targets for share of energy to be derived from renewable sources).

[126] E.g., Ron Levy, "Fixed Constitutional Commitments: Evaluating Environmental Constitutionalism's 'New Frontier'" (2022) 46 *Melbourne University Law Review* 82–122, n 11 and accompanying text (five-yearly UK carbon budgets).

[127] Nataly Escobedo Garcia and Nicola Ulibarri, "Plan Writing as a Policy Tool: Instrumental, Conceptual, and Tactical Uses of Water Management Plans in California" (2022) 12 *Journal of Environmental Studies and Sciences* 475–489, 484.

[128] See generally, Riki Therivel and Ainhoa González, "'Ripe for Decision': Tiering in Environmental Assessment" (2021) 87:106520 *Environmental Impact Assessment Review* 1–10. See Chapter 9 (Great Barrier Reef, Section 9.5.1) for an example of a relative lack of clarity under the Cumulative Impacts Management Policy.

[129] Julia Dehm, "Coal Mines, Carbon Budgets and Human Rights in Australian Climate Litigation: Reflections on *Gloucester Resources Limited v Minister for Planning and Environment*" (2020) 26 *Australian Journal of Human Rights* 244–273, 253–254.

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

TABLE 6.2 *Mechanisms for connected decision-making about cumulative environmental impacts*

Legal mechanism	Illustrative examples
Cumulative environmental principle	Grants under California's statutory Transformative Climate Communities program (a "carrot" that incentivizes projects to reduce greenhouse gas emissions and achieve other community benefits) are prioritized for communities that face significant cumulative environmental burdens based on the CalEnviroScreen cumulative environmental justice tool.[a] This tool "connects" across several types of impacts, including multiple dimensions of air and water pollution, traffic, and solid waste, but omits water sustainability issues that could compromise access to water.[b]
Limit that requires reduced impacts	Danish building regulations employ a progressively decreasing limit on the embodied carbon of new buildings.[c]
Target for restoration	Kenyan environmental law seeks to "achieve and maintain a tree cover of at least ten per cent of the land area of Kenya," which is pursued by measures including a system of payments for ecosystem services.[d]
Qualitative limits on aggregate effects	A legal right to a healthy environment implicitly caps adverse impacts to a level that remains "healthy" but leaves for case-by-case determination key elements like the boundaries of the "environment," for whom it must be healthy, and whether proportionality justifies limiting a right, e.g., if beneficial effects of a limitation to the right outweighs its negative effects.[e]
Plan that manages aggregate effects on natural resources	Withdrawals of water in Australia's Murray-Darling Basin must reflect an "environmentally sustainable level of take" that is quantified in a federal regulatory "Basin Plan," which constrains state-administered water allocation regimes. The limit may be reached by reducing withdrawals and may be changed by measures that increase coping capacity.[f] The Basin Plan connects across water quality and water quantity impact types, but is constrained in considering impacts associated with land use.[g]
Link between strategic and project-level assessment	Strategic assessment of land use plans (as is required by European law, for example) inherently involves tiering between the assessment, the land use plan, and the authorizations given for development under

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

Legal mechanism	Illustrative examples
	the plan, which may themselves require project-level environmental impact assessment (EIA); this context has produced a cumulative effects-focused strategic assessment of zoning options for the peri-urban areas of Milan, Italy.[h]

[a] California Statutes 2012 ch 830 (SB 535) §§ 2–4; California Strategic Growth Council, Transformative Climate Communities Program Round 5 Final Program Guidelines FY 2022–2023 (2023), 9, 13, 31, https://sgc.ca.gov/grant-programs/tcc/docs/20240906-TCC_Round_5_Guidelines.pdf, archived at https://perma.cc/77MT-A5WQ. See also Chapter 10 note 92 and accompanying text.
[b] See generally, Lauren Zeise and Jared Blumenfeld, *CalEnviroScreen 4.0* (California Environmental Protection Agency 2021) https://oehha.ca.gov/media/downloads/calenviroscreen/report/calenviroscreen40reportf2021.pdf, archived at https://perma.cc/8YG9-FXCQ. See also Section 8.3.2.2.
[c] Freja Nygaard Rasmussen and others, "Embodied Carbon in Building Regulation – Development and Implementation in Finland, Sweden and Denmark" in Rahman Azari and Alice Moncaster (eds), *The Routledge Handbook of Embodied Carbon in the Built Environment* (Routledge 2023) 85–102, 87; Minister of Social Affairs and Housing (Denmark), "New Agreement Sets Ambitious Climate Requirements for New Construction" (Press release, May 30, 2024) www.sm.dk/nyheder/nyhedsarkiv/2024/maj/ny-aftale-stiller-ambitioese-klimakrav-til-nyt-byggeri, archived at https://perma.cc/84BZ-8GE8.
[d] Environmental Management and Co-ordination Act 1999 Cap. 387, as amended (Kenya), ss 9(2)(q), (r); Gordana Petrovska Dojchinovska and Alex Lyons, "Natural Resources Management in Kenya (Water and Forest): Centralised Policies, Between Exclusion and Participation of the Local Population" in Marie-Aude Fouéré, Marie-Emmanuelle Pommerolle and Christian Thibon (eds), *Kenya in Motion 2000–2020* (AfricaE, 2021) 223–248, 231–234.
[e] For issues relevant to proportionality assessment, see Grant Huscroft, Bradley W. Miller and Grégoire Webber (eds), *Proportionality and the Rule of Law: Rights, Justification, Reasoning* (CUP 2014).
[f] See note *b* to Table 6.1 and accompanying text in table.
[g] See generally, Nelson, "Challenges to Improved Integrated Management."
[h] Ainhoa González, "Strategic Environmental Assessment of Spatial Land-Use Plans" in Thomas B. Fischer and Ainhoa González (eds), *Handbook on Strategic Environmental Assessment* (Edward Elgar 2021) 142–163, 158–159; see generally, Chiara Bragagnolo and Davide Geneletti, "Dealing with Land Use Decisions in Uncertain Contexts: A Method to Support Strategic Environmental Assessment of Spatial Plans" (2014) 57 *Journal of Environmental Planning and Management* 50–77.

projects should trigger the formulation of a limit or plan where the process reveals potentially unacceptable accumulating harm (two-way influence termed "tiering").[130]

[130] Therivel and González, "'Ripe for Decision': Tiering." For a more comprehensive summary of the relationships between tiers, see Thomas B. Fischer, "Strategic Environmental Assessment and Transport Planning: Towards a Generic Framework for Evaluating Practice and Developing Guidance" (2006) 24 *Impact Assessment and Project Appraisal* 183–197, 189.

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

6.5.2 *Comprehensiveness: Regulatory Coverage and Enforcement*

To avoid the risk of unregulated, cumulative harm, a set of regulatory interventions must comprehensively – that is, without "gaps" in regulatory coverage – consider all activities capable of causing cumulatively significant impacts to a matter of concern. Gaps can stem from how the coverage of a regulatory intervention is specified, and how it is enforced. Imagine that activities in categories A, B, C, and D accumulate to harm a matter of concern. A rule may be specified, or interpreted, to apply only to categories A and B, allowing category C and D activities to cause unregulated cumulative impacts (a "gap by omission"). Or, the rule may be specified to apply to all activities other than category D activities, which are intentionally exempt (a "gap by exemption"). Finally, inadequate enforcement and inadequate response to voluntary tools may mean that some activities in one or more categories may cause cumulatively significant impacts in practice, even if many rules are in place. The discussion that follows considers regulatory design solutions to each of these types of gaps. Coordination mechanisms are necessary to deal with gaps that would emerge because a regulator lacks jurisdiction to cover all relevant impacts; I address this separately later in the book.[131]

6.5.2.1 Gaps by Omission

Gaps by omission arise in many ways. Rules may cover only specific sectors or types of actions, only some types of relevant impacts, or only direct human activities and not other impacts or "background effects" that are difficult to attribute to individual actors, such as invasive species and wildfire.[132] Limits that are expressed per person do not prevent overshoot of a cumulative target caused by population growth. Interventions may apply to actions above specified size thresholds, missing the cumulative impacts of smaller actions, for example, laws that require EIA for "intensive rearing of poultry … with more than … 60 000 places for hens"[133] Most significantly, individual rules or an entire area of law (like land use planning) may apply only to new activities, overlooking the ongoing impacts of existing activities. Table 6.3 sets out examples of diverse ways to avoid and reduce gaps by omission. In each case, the mechanism is specified

[131] See Chapter 7 on Coordination.

[132] Nelson, "Challenges to Improved Integrated Management," 351–352.

[133] Directive 2011/92/EU of the European Parliament and of the Council of December 13, 2011, on the assessment of the effects of certain public and private projects on the environment [2012] OJ L26/1, as amended, art. 4(1), annex I point 17(a).

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

TABLE 6.3 *Mechanisms for comprehensive regulatory intervention: avoiding gaps by omission*

Legal mechanism	Illustrative examples
Environmental impact assessment (EIA) requirements determined by considering cumulative impacts	Under the EU EIA Directive's "screening process," EIA requirements apply to listed project types, and additional projects, taking into consideration certain criteria, including "the cumulation of the impact with the impact of other existing and/or approved projects."[a] This approach covers projects that would not otherwise require assessment due to their cumulative impacts.[b]
Duty that specifies impacts or risks, not individual types of actions	A general environmental duty in Victoria, Australia, requires any person "engaging in an activity that may give rise to risks of harm to human health or the environment from pollution or waste [to] minimise those risks, so far as reasonably practicable."[c] Gaps are minimized, based on practicability.[d] This duty was formulated to capture the cumulative effects of smaller pollution sources.[e]
Area-based management boundaries that encompass broader adverse impacts	Wildlife Management Areas established under Tanzania's wildlife law provide for communities to undertake conservation outside "core" protected areas, guided by model bylaws, management plans developed in a participatory manner, and benefit sharing arrangements.[f] A key objective is to "mainstream" and facilitate conservation planning across wider connected landscapes than traditional protected conservation areas allow, including communal and private lands, which brings challenges related to governance, capacity, equity, and enforcement.[g]

[a] Directive 2014/52/EU of the European Parliament and Council of April 16, 2014, amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment [2014] OJ L124/1, art. 4(3), annex III point 3(g). For a similar approach, see Decree on Environmental Impact Assessment No. 112/PM 2010 (Lao People's Democratic Republic) art. 6(2), noting that this approach is no longer adopted in the decree currently in force, Decree on Environmental Impact Assessment No. 329 of 2022 (Lao People's Democratic Republic), which nonetheless requires cumulative impact assessment: arts. 3(9), 22(4), 23(7).

[b] Nelson and Shirley, "Latent Potential," 16.

[c] Environment Protection Act 2017 (Victoria) s 25(1).

[d] See generally, Bruce Lindsay, Dru Marsh and Rebecca Nelson, "Conceptualising and Activating Knowledge in Environmental Protection Law" (2023) 46 *Melbourne University Law Review* 422–466.

[e] Ibid 426.

[f] Wildlife Conservation Act 2009, as revised 2022, Cap. 283 R.E. 2022 (Tanzania) ss 31–34.

[g] Ministry of Natural Resources and Tourism (Tanzania), *National Wildlife Management Areas Strategy 2023–2033* (n.d.) 10–11, 22–24, https://maliasili.go.tz/assets/pdfs/DOC-20230601-WA0038_230705_135553_compressed.pdf, last accessed March 19, 2025, archived at https://perma.cc/725H-KFQ4.

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

in a way that is intended to apply more broadly than is common for laws of that type, but this can, in turn, raise challenges with implementation and enforcement.[134]

6.5.2.2 Gaps by Exemption and Derogation

Regulatory mechanisms also create gaps through express exemptions, which are also termed waivers or carve-outs, or derogations from rules that would otherwise apply. These may be thought necessary because an impact is small or low risk;[135] or socially desirable or necessary (e.g., small-scale agriculture,[136] military activities in the national interest,[137] activities intended to produce environmental benefits or adapt to climate change,[138] or activities undertaken during emergencies[139]). Rule makers may want to avoid burdening long-established activities, producing "grandfathering" exemptions that may apply to diverse impacts (e.g., exempting existing power plants from new air pollution standards[140] or existing building construction from environment-related requirements[141]). Relevant to all regulatory approaches, another motivation for exempting activities is to reduce administrative and enforcement costs for regulators.[142]

[134] See Section 6.5.3.

[135] Martin Z. P. Olszynski, "Ancient Maxim, Modern Problems: De Minimis, Cumulative Environmental Effects and Risk-Based Regulation" (2015) 40 *Queen's Law Journal* 705–740, 718–721, *contra* Albert C. Lin, "Unifying Role of Harm in Environmental Law" (2006) *Wisconsin Law Review* 897–986, 902.

[136] Chris Wood, *Environmental Impact Assessment: A Comparative Review* (Routledge 2003) 109 (exemption from EIA requirements).

[137] Mark P. Nevitt, "Environmental Law in Military Operations," in Geoffrey S. Corn, Rachel E. VanLandingham, and Shane R. Reeves (eds), *U.S. Military Operations: Law, Policy, and Practice* (2015) 401–436, 405–413.

[138] E.g., "overriding beneficial consequences for the environment" under art. 6(4) of the EU Habitats Directive: Commission and Directorate-General for Environment, *Managing Natura 2000 Sites*, 67.

[139] See generally, Victor B. Flatt, "Holding Polluters Accountable in Times of Climate and Covid Risk: The Problems with 'Emergency' Enforcement Waivers" (2020–2021) 12 *San Diego Journal of Climate and Energy Law* 1–18.

[140] See generally, Richard L. Revesz and others, "Grandfathering Coal: Power Plant Regulation under the Clean Air Act Dialogue" (2016) 46 *Environmental Law Reporter News and Analysis* 10541–10551.

[141] E.g., exemptions from some UK minimum energy efficiency requirements apply to some historical buildings, but selling or renting a property usually triggers a regulatory "sermon" in the form of an energy performance certificate: Chamara Panakaduwa, Paul Coates and Mustapha Munir, "Identifying Sustainable Retrofit Challenges of Historical Buildings: A Systematic Review" (2024) 313:114226 *Energy and Buildings* 1–10, 7.

[142] E.g., Barbara Schreiner and Barbara van Koppen, "Hybrid Water Rights Systems for Pro-Poor Water Governance in Africa" (2020) 12 *Water* 155, 4–5 (concern re billing small-scale irrigators in Kenya for water use). Other factors may also be locally important, e.g., associating

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

Rules can reduce the risk of excluded activities having cumulatively significant impacts in diverse ways. The first is simply removing the exemption so that the "regular" intervention applies to at least some formerly excluded activities, perhaps adding an element (extra time to comply, one-off compensation) to reduce the burden. A variation is to simplify a regulatory process to "reduce red tape". However, global experience simplifying EIA alerts us to the dangers of "ultra-simplification" removing public participation requirements in a way that affects the basic requirements of EIA,[143] and relying on inadequate impact assessments that fail to prevent cumulative environmental impacts.[144] An alternative is to maintain the exemption and deal with the resulting cumulative impacts in other ways, either through state rescue or incentivizing action from others, using a coping strategy, or focusing on data collection as an interim measure, to inform future intervention (Table 6.4).

6.5.2.3 Implementation and Enforcement Gaps

Even if a regulatory mechanism is comprehensive in its coverage on paper, gaps in implementation – lower than desirable take-up of voluntary tools and noncompliance – can create a comprehensiveness challenge. This creates risks of uncontrolled cumulative harm. Under incentive- and information-based interventions (regulatory carrots and sermons), gaps arise where small contributors face barriers to accessing a scheme, including lack of awareness and insufficient resources to engage with complex regimes.[145] In this case, the impacts of their activities are not covered in practice even though they are eligible to participate. This may also be the case for state rescue mechanisms aimed at communities that must apply for them, but face barriers to doing so.[146] Regulatory interventions may include express mechanisms to address this by reducing administrative barriers to entry. The current EU Common Agricultural Policy, which provides subsidies to small farmers that are linked

a regulatory tool with colonialism: ibid, 5. For responses to challenges of enforcement capacity see Section 6.5.2.3.

[143] Álvaro Enríquez-de-Salamanca, "Simplified Environmental Impact Assessment Processes: Review and Implementation Proposals" (2021) 90:106640 *Environmental Impact Assessment Review* 1–8, 6.

[144] Sara Elizabeth Da Silveira and Marlene De Paula Pereira, "Os Princípios Ambientais Na Licença Ambiental Simplificada" (2023) 16:e1200 *Revista Foco* 1–19, 12–13, 15.

[145] Neil Gunningham "Regulating Small and Medium Sized Enterprises" (2002) 14 *Journal of Environmental Law* 3–32, 3–4, 21–22.

[146] See Section 8.4.2.6.

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

TABLE 6.4 *Burden-reducing alternatives to exemptions to increase regulatory comprehensiveness, in order of most to least similar to the "regular" intervention applied to nonexempt activities*

Legal mechanism	Illustrative examples
Use a version of the regulatory intervention, modified to…	
… make the regulatory approach less stringent	South African law provides for a limited monthly supply of a volume of water free of charge, without significant impact on overall consumption; where volumetric charges usually apply to water use, a tiered tariff system makes available a quantity of water at a lower rate for basic household needs, with a higher rate for higher use.[a]
… use a more collaborative/ voluntary regulatory approach	Despite famously strong attachment to property rights, some western US water laws (e.g., Utah) explicitly accept that cumulatively significant groundwater depletion can justify restricting both existing and proposed withdrawals if users agree.[b]
… use a different regulatory strategy: offsetting	Rather than being exempt from regulation, individually minor activities (like vessel moorings, which damage seagrass) in the Great Barrier Reef Marine Park, Australia, require permission; a permit may be granted on condition of paying a monetary offset, which enables pooling of funds to repair or mitigate damage to the Marine Park.[c]
Maintain exemption, but …	
… ensure the derogation benefits the cumulatively impacted matter of concern	New Jersey's Environmental Justice Law prohibits approving a facility that would add to disproportionate cumulative environmental stressors for an overburdened community, unless necessary to "serve an essential environmental, health, or safety need of the host overburdened community" (noting that economic benefit cannot be considered).[d]
… apply a cumulative limit that includes activities with special status	Fish harvest agreements negotiated between the federal government and tribes in British Columbia, Canada reserve a percentage of the total allowable catch (a cumulative limit) for the relevant tribe.[e]
… use a coping strategy	The city of Adelaide in Australia deals with high cumulative vehicle noise by subsidizing improved window glazing for occupants of affected houses,[f] as distinct from regulating vehicles or traffic.

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

Legal mechanism	Illustrative examples
. . . collect data on cumulative impact for possible or planned future intervention	A Seychelles multistage plan to recover populations of shark pursuant to its international obligations begins with identifying and recording artisanal shark fishers, paving the way for phased interventions.[g]

[a] Constitution of the Republic of South Africa 1996, s 27(1)(b); Water Services Act 108 of 1997 (South Africa) ss 2(a), 3, 5; Andrea Szabó, "The Value of Free Water: Analyzing South Africa's Free Basic Water Policy" (2015) 83 *Econometrica* 1913–1961, 1913, 1914.

[b] E.g., Utah Code § 73-5-15(4)(a)(iii), (c) (regarding state regulation of withdrawals pursuant to voluntary arrangements between water users).

[c] Great Barrier Reef Marine Park Regulations 2019 (Australia) s 117(2)(j); Great Barrier Reef Marine Park Zoning Plan 2003 (Australia) s 2.2.4(l)(iii); regarding offsets for seagrass damage, see generally, Ma, Rhodes and Maron, "The Consequences of Coastal Offsets."

[d] New Jersey Admin. Code § 7:1C-9.2; New Jersey Department of Environmental Protection, "Environmental Justice Rules Frequently Asked Questions" (2023) 18–19, https://dep.nj.gov/wp-content/uploads/ej/docs/ej-rule-frequently-asked-questions.pdf, archived at https://perma.cc/ZYW7-D97M.

[e] E.g., Nisga'a Nation Harvest Agreement between Canada, British Columbia and the Nisga'a Nation, May 11, 2000, art. 2, available at Government of Canada, "Nisga'a Harvest Agreement" (May 11, 2000) www.rcaanc-cirnac.gc.ca/eng/1100100031747/1543410863980, archived at https://perma.cc/97AU-NT8C.

[f] E.g., City of Adelaide, "Noise Management Incentives" (n.d.) www.cityofadelaide.com.au/about-council/grants-sponsorship-incentives/noise-management-incentives, last accessed March 19, 2025, archived at https://perma.cc/CLF6-RMFH. This is sometimes framed as integrating consideration of the victims of the problem: Ruth Wiedemann and Karin Ingold, "Solving Cross-Sectoral Policy Problems: Adding a Cross-Sectoral Dimension to Assess Policy Performance" (2022) 24 *Journal of Environmental Policy and Planning* 526–539, 530.

[g] Seychelles Fishing Authority, *National Plan of Action for the Conservation and Management of Sharks 2016–2020* (2016) 68, https://mofbe.gov.sc/wp-content/uploads/2021/09/National-Plan-of-Action-for-the-Conservation-and-Management-of-Sharks-2016-2020-3.pdf, archived at https://perma.cc/7XW9-VPLA; identified international obligations include those under the United Nations Convention on the Law of the Sea, December 10, 1982, Montego Bay, in force November 16, 1994, 1833 U.N.T.S. 396), among other laws: ibid 93.

to environmental conditions, expressly requires member states to plan to reduce burdens for farmers.[147]

Risks of noncompliance affect not just regulatory sticks (e.g., enforcing conditions of a pollution authorization) but also regulatory carrots (e.g., enforcing conditions of a stewardship payment) and regulatory sermons

[147] Regulation 2021/2115 of the European Parliament and of the Council of December 2, 2021, on Common Agricultural Policy Strategic Plans [2021] OJ L435/1 (CAP Regulation), art. 139 (3)(f); see generally, Mirta Alessandrini and others, "Smallholder Farms in the Sustainable Food Transition: A Critical Examination of the New Common Agricultural Policy" (2024) 33 *Review of European, Comparative and International Environmental Law* 124–135. See Chapter 10 for a case study in which the CAP is a key intervention.

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

(e.g., ensuring the accuracy of information about impacts provided to regulators or the public). While the focus of this book is regulatory design, this section touches on enforcement briefly and narrowly, drawing out selected issues that are pronounced for cumulative environmental problems and that pose regulatory design issues.

Since cumulative environmental problems involve numerous, diverse contributors, they can stretch enforcement resources.[148] Some common strategies for responding to this will not necessarily suit cumulative environmental problems. For example, relying on third-party enforcement will be difficult if causation is hard to prove, there are numerous activities, and the third party is resource-poor. Guiding discretion to best use scarce resources using "risk-based" enforcement principles[149] can be problematic if principles focus solely on an individual contributor's risk of noncompliance and overlook the cumulative risk of noncompliance to a matter of concern. Enforcement discretion can also be a challenge because cumulative environmental problems are relatively hard to perceive, more diffuse, and require engagement with scientific complexity,[150] and so are more likely to "fly under the radar" of regulators. Providing regulators with information and training geared to these challenges is one possible solution. Rules can address these enforcement problems by using cumulative impact principles directly or indirectly to guide regulatory discretion, facilitating enforcement by relatively resource-rich third parties, or providing for automatic enforcement for categories of contributors that are numerous and homogeneous (Table 6.5).

6.5.3 *Administrative Cost and Using Cumulative Impact Concepts to Reduce It*

In addition to burdens on regulated parties,[151] administrative costs to government can be a significant challenge to regulating problems that involve many different actors. Considering alternatives among regulatory sticks, carrots, sermons, and state rescue may reveal ways to reduce administrative costs, though the choice may trade off more reliable outcomes.[152] One solution is

[148] See also Section 6.5.3 on administrative cost.

[149] E.g., *Independent Inquiry into the Environment Protection Authority* (State of Victoria, 2016) [4.3.2], https://apo.org.au/sites/default/files/resource-files/2016-03/apo-nid72340.pdf, archived at https://perma.cc/R934-UX6W. See Peter Mascini, "Why Was the Enforcement Pyramid So Influential? And What Price Was Paid?" (2013) 7 *Regulation and Governance* 48–60, 54.

[150] See discussion in Section 2.2.2.3.

[151] See Section 6.2.2 (re strategies) and 6.3.2 (re approaches).

[152] See Table 6.1.

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

TABLE 6.5 *Mechanisms for considering cumulative environmental impacts in enforcement*

Legal mechanisms	Illustrative examples
Enforcement policy that prioritizes responding to risks of cumulative impacts	Under formal policy, California's environmental agencies must prioritize enforcement in communities that suffer disproportionate burdens of cumulative environmental harm.[a]
Power of affected communities to guide or displace regulators' enforcement discretion (cf. direct third-party enforcement)	Contemporary Texas groundwater law allows an "affected person" to petition a state body to review a local groundwater conservation district's failure to enforce its rules.[b] Past Nebraska groundwater law allowed well owners to petition to shift enforcement powers to the state if local districts failed to enforce rules in a "control area" to protect against cumulative depletion.[c]
Power to enforce of non-state actors or other states with significant resources	Under the Equator Principles, signatory financiers require project developers to comply with national environmental impact assessment (EIA) requirements (which often include cumulative impact assessment).[d] Financiers can then enforce these requirements as a contractual obligation, independent of state enforcement. For cumulative environmental problems with a transnational element, extraterritorial action may avoid domestic barriers to enforcement, e.g., Japan's timber legislation and Papua New Guinea's fisheries legislation disallow importing specimens from other nations that prohibit their export.[e]
Technology that supports enforcement capacity for numerous contributors	To address pollution from poorly maintained vehicles and enforce air pollution requirements, Hong Kong's vehicle emissions control measures involve remote sensors to detect noncompliant vehicle emissions more cost-effectively than testing each vehicle during a roadworthiness examination.[f]
Displacement of obligation to change behavior to a smaller set of different parties to reduce enforcement burden	Vanuatu bans the production of disposable plastic items rather than relying solely on banning littering of plastic items.[g]

[a] Section 8.3.2.2, notes 95–98 and accompanying text.
[b] Texas Water Code § 36.3011 and 30 Texas Administrative Code § 293.23.
[c] Nebraska Laws 1975 (LB 577), s 12.
[d] Nelson and Shirley, "Latent Potential," 163.

(*continued*)

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

TABLE 6.5 (*continued*)

[e] Lydia Slobodian, "Shifting the Burden of Wildlife Protection: The Role of Extraterritorial Jurisdiction in Implementing CITES" in Marie-Claire Cordonier Segger, David Andrew Wardell and Alexandra Harrington (eds), *CITES as a Tool for Sustainable Development* (CUP 2023) 49–78, 66.
[f] Air Pollution Control (Vehicle Design Standards) (Emission) Regulations 1992, Cap. 311 sub. leg. J, as amended (Hong Kong SAR); Legislative Council Panel on Environmental Affairs (Hong Kong SAR), *Improvement of Roadside Air Quality*, LC Paper No. CB(1)(949/16-17(03) (2017) [9]–[12] www.legco.gov.hk/yr16-17/english/panels/ea/papers/ea20170522cb1-949-3-e.pdf, archived at https://perma.cc/4E6H-ZUQ2; Environmental Protection Department (Hong Kong SAR), "Strengthened Emissions Control for Petrol and LPG Vehicles" (n.d.) www.epd.gov.hk/epd/english/environmentinhk/air/guide_ref/remote_sensing_Petrol_n_LPG.html#Vehicle%20Emissions%20Standard, last accessed March 19, 2025, archived at https://perma.cc/P5ER-PSY5. See also the discussion of information and technology in Section 5.3.2.
[g] See Waste Management Regulations Order No. 15 of 2018 (Vanuatu) s 2.

to design rules so that a single regulatory decision influences multiple activities – a sort of regulatory "economy of scale" (Table 6.6). These mechanisms carry benefits for regulating cumulative impacts beyond reducing administrative cost. They promote connected decision-making[153] by considering many contributors at once. They may also make it easier to manage adaptively,[154] since a single decision can modify requirements that apply to multiple contributors, for example, reducing the "cap" in a cap-and-trade system.[155]

Conversely, issues of scale and participation present risks. Cumulative performance standards that apply to large areas may inadvertently allow "hotspots" of cumulative impact that are locally significant.[156] The alternative, considering the impacts of sources of harm individually, though, would increase uncertainty for participants and costs for regulators.[157] A lower cost but lower precision option to prevent hotspots is to use trading zones (Table 6.6). The types of "bulk" regulatory mechanisms included in Table 6.6 also tend to restrict public participation requirements[158] to the single "aggregated" decision rather than inviting comment about individual impacts (e.g., decision to issue multisource permit, decision to set trading

[153] See Section 6.5.1.
[154] See Section 2.2.3.3.
[155] For a broader guidance on the establishment of cap and trade systems, see, e.g., Richard Schmalensee and Robert N. Stavins, "Lessons Learned from Three Decades of Experience with Cap and Trade" (2017) 11 *Review of Environmental Economics and Policy* 59–79.
[156] 33 C.F.R. § 330.5(c) (regarding regional conditions); US Army Corps of Engineers, "Reissuance and Modification of Nationwide Permits [FR Doc #2021-00102]" (January 13, 2021) 86 *Federal Register (USA)* 2744–2878, 2758. Note that the conditions may only be made stricter through regional conditions: 33 C.F.R. § 330.1(d).
[157] Schmalensee and Stavins, "Lessons Learned," 63, 72.
[158] Terence J. Centner, "Challenging NPDES Permits Granted without Public Participation" (2011) 38 *Boston College Environmental Affairs Law Review* 1–40, 20–23.

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

TABLE 6.6 *Mechanisms for reducing administrative costs by applying a single decision to multiple sources of impact*

Legal mechanisms	Illustrative examples
Single permit for multiple impact sources under the same control	A "bubble" policy under the US Clean Air Act applied an average performance standard and an aggregate emissions limit to multiple air pollution points controlled by the same person in the same industrial grouping, considering them a single "source."[a]
Single opt-in permit for a sector or pollution type	"General" permits under the US Clean Water Act place conditions on a sector or discharge type in a geographic area (e.g., cranberry production, industrial stormwater sources).[b] This reduces processing times for authorizing cumulatively minor activities[c] (though concerns have arisen about the supporting cumulative impact analyses[d]). An individual discharger opts in to be covered,[e] and in some circumstances requires an individual permit.[f]
Cumulative performance standard applied to similar activities across sectors	German "dynamic environmentally sensitive traffic management systems" (*dynamisches umweltsensitives Verkehrsmanagement*) alter legally binding road speed limits in response to local (cumulative) air quality conditions.[g]
Cap-and-trade system that limits aggregate impacts (a cumulative performance standard), with local trading rules to prevent cumulative impact hotspots	Cap-and-trade systems limit aggregate adverse effects or resource use in diverse environmental contexts (e.g., air pollution, water use, land use development rights[h]), while enabling contributors to trade individual rights to cause impacts or use resources. Zone-based trading rules that prevent trades from downstream/downwind to upstream/upwind seek to prevent local hotspots, e.g., under Australian water trading rules designed to protect local water-dependent environments and California's Regional Clean Air Incentives Market to prevent hotspots of NO_x and SO_2 caused by trade.[i]

[a] Coglianese, "Limits of Performance-Based Regulation," 540. Note that other elements of the bubble policy, and some of its fine details, made it controversial and uncertain for firms, and ultimately take-up was not high: see generally, Halvorson, "Deflated Dreams."
[b] 33 C.F.R. Ch. II Pt. 330, 40 C.F.R. § 122.28(a).
[c] U.S. Army Corps of Engineers, "Reissuance and Modification of Nationwide Permits," 2762.
[d] Ibid 2751.
[e] 40 C.F.R. § 122.28(b)(2).
[f] 40 C.F.R. § 122.28(b)(3)(i)(A), (G).
[g] See generally, Volker Diegmann and others, Dynamisches umweltsensitives Verkehrsmanagement (Bundesanstalt für Straßenwesen, 2020) https://bast.opus.hbz-nrw.de/frontdoor/index/index/docId/2335 (report in German, summary in English), archived at https://perma.cc/WX96-ZHD9.
[h] See generally, Schmalensee and Stavins, "Lessons Learned."
[i] Ibid 64.

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

rules within a cap). This suggests the need for more frequent review to guard against unintended consequences.[159]

6.5.4 *Adaptive Intervention to Respond to Accumulating Impacts*

Regulating cumulative environmental problems inherently requires adapting rules[160] for intervening and adapting how they apply to individual contributors when actual or predicted cumulative impacts approach maximum acceptable levels ("intervening adaptively," for short).[161] Contributors to the problem or their activities may change, introducing new impacts or types of impacts; and scientific complexity and unpredictability mean new information about the matter of concern or the harm will likely emerge with time. This need to adapt environment-related rules is well-established, pointing to regulatory design for flexibility and iterative evaluation, including "provisional decision making, monitoring, and adjustment."[162] Here, then, the focus is exploring implications and options in the cumulative impact context.

Intervening adaptively in anticipation of serious cumulative impacts finds support in diverse formulations[163] of the precautionary principle. Notably, this principle appears in legislation,[164] policy guidance,[165] and judicial decisions

[159] See intervening adaptively in Section 6.5.4.

[160] B. Guy Peters, "Information and Governing: Cybernetic Models of Governance" in David Levi-Faur (ed), *The Oxford Handbook of Governance* (OUP 2012) 113–128, 116; Howlett, *Designing Public Policies*, 64–66 ("evidence-based policy"). See also Section 2.2.3.3.

[161] Understanding when this level is reached requires information as a trigger: Martin A. Nie and Courtney A. Schultz, "Decision-Making Triggers in Adaptive Management" (2012) 26 *Conservation Biology* 1137–1144, 1138, 1141–1142. See Chapter 5 (Information). Note that other elements of the CIRCle Framework also require an adaptive approach, e.g., adapting how the matter of concern is conceptualized: see Section 6.5.4.

[162] Alejandro E. Camacho, "De- and Re-Constructing Public Governance for Biodiversity Conservation" (2020) 73 *Vanderbilt Law Review* 1585–1642, 1613; Jonathan H. Adler, "Dynamic Environmentalism and Adaptive Management: Legal Obstacles and Opportunities" (2015) 11 *Journal of Law Economics and Policy* 133–162, 147.

[163] Eloise Scotford, "Environmental Principles across Jurisdictions: Legal Connectors and Catalysts" in Emma Lees and Jorge E. Viñuales (eds), *The Oxford Handbook of Comparative Environmental Law* (OUP 2019) 651–677, 660; Jonathan B. Wiener, "*Precautionary Principle*" in Ludwig Krämer and Emanuela Orlando (eds), *Elgar Encyclopedia of Environmental Law* Vol. VI (Edward Elgar 2023) 174–185, 175–179.

[164] See, e.g., Impact Assessment Act 2019 (Canada) s 6(2); Directive 2008/56/EC of the European Parliament and of the Council of June 17, 2008, establishing a framework for community action in the field of marine environmental policy [2008] OJ L164/19, preamble (27), (44), art. 8(1)(b)(ii).

[165] E.g., G. Hegmann and others, *Cumulative Effects Assessment Practitioners Guide Prepared for Canadian Environmental Assessment Agency* (1999) 48, https://publications.gc.ca/site/eng/9.647223/publication.html, archived at https://perma.cc/XN7W-R544; "Navigating the

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

dealing with cumulative impacts.[166] In its original form, the principle facilitates preventive regulatory intervention without conclusive proof about the cause-and-effect relationship between pollution and harm.[167] More broadly, the principle holds that scientific uncertainty should not justify postponing preventive action in the case of potential serious environmental harm. Uncertainty about precise effects does not preclude regulatory measures, and early actions are "provisional and should be updated over time in light of learning."[168]

Intervening adaptively can mean either changing how an administrative decision applies to an entity (Section 6.5.4.1); or changing an element of an existing rule, or introducing a new rule to the mix (Section 6.5.4.2). Adapting may be triggered by actual or predicted cumulative impacts approaching maximum acceptable levels (i.e., cumulative threshold conditions[169]).

6.5.4.1 Adapting an Administrative Decision

Some areas of law and some regulatory approaches[170] provide more scope for adapting administrative decisions in response to cumulative effects than others. EIA laws focus resources and scrutiny at the proposal stage,[171] including predicting cumulative effects, rather than follow up once an activity commences,[172] which would allow for adaptation. By contrast, "decentralized behavior-coordinating mechanisms" such as markets involve iterative decision-making by individual actors,[173] and inherent scope for contributors to change their impacts. Regulatory sermons are also inherently adaptive in that regularly provided information about impacts changes with time. The focus of this section is therefore adapting mandatory regulatory approaches ("regulatory sticks"), which tend to strike prominent barriers to adaptation.[174]

Implementation Impasse: Enabling Interagency Collaboration on Cumulative Effects" (July 2019) Aotearoa Cumulative Effects (ACE) Framework, 5, www.sustainableseaschallenge.co.nz/tools-and-resources/ace-framework/, archived at https://perma.cc/9323-P2EM.

[166] Tom Kaveney, Ailsa Kerswell and Andrew Buick, *Cumulative Environmental Impact Assessment Industry Guide* (Minerals Council of Australia 2015) 48–49 (describing several Australian state-level judicial decisions).

[167] Noga Morag-Levine, "Is Precautionary Regulation a Civil Law Instrument? Lessons from the History of the Alkali Act" (2011) 23 *Journal of Environmental Law* 1–43, 3.

[168] Wiener, "Precautionary Principle," 179.

[169] See Section 4.3.3.

[170] See Section 6.3.

[171] Ruhl, "Regulation by Adaptive Management," 35.

[172] See generally, ibid.

[173] Ibid 27.

[174] See Section 2.2.3.3.

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

Rules can help address concerns that changes unfairly frustrate regulated parties' "legitimate expectations"[175] by forewarning them of the potential need to adapt,[176] and using transparent, predetermined triggers for adaptation. Table 6.7 sets out examples of rules that facilitate adapting individual decisions in response to concerns about cumulative impacts, with key variables being how frequently change is anticipated to occur, and the parties that may trigger the review that leads to adaptation.

As well as positively facilitating adaptation (Table 6.7), regulatory mechanisms should avoid elements that impede adaptation, keeping in mind the characteristics of the relevant cumulative environmental problem. For example, where there is uncertainty about precisely how impacts aggregate to cause harm,[177] rules for adapting a decision should avoid requiring conclusive proof of a causal link between a specific activity and a harm. Instead, they could simply require adaptation in response to an indicator of cumulative environmental effect (e.g., ambient air quality);[178] frame a regulatory requirement around avoiding risk, rather than an actual effect (e.g., a general environmental duty);[179] or apply a presumption about a causal link.[180]

6.5.4.2 Adapting a Regulatory Intervention or Regulatory Mix

Larger-scale adaptation occurs by changing the rules, or the set of rules, themselves. Increasing impacts may require adjusting a performance standard to keep cumulative impacts acceptable. New rules might be needed to improve regulatory "comprehensiveness" to cover previously unregulated activities,[181] or respond to a realization that a riskier regulatory intervention has not effectively addressed cumulative impacts.[182] Adopting rules for this kind of adaptation usefully forewarns the public of possible future change, potentially reducing concerns about legitimate expectations and fairness.

[175] Fergus Green, "Legal Transitions without Legitimate Expectations" (2020) 28 *Journal of Political Philosophy* 397–420.
[176] Ruhl, "Regulation by Adaptive Management," 49.
[177] See Section 2.2.2.3.
[178] E.g., Table 6.6, row 3.
[179] E.g., Table 6.3, row 2. See also Environment Protection Act 2017 (Victoria) s 25(1); Lindsay, Marsh and Nelson, "Conceptualising and Activating Knowledge."
[180] E.g., a presumption of hydraulic connectivity between groundwater proposed to be withdrawn and a river, which applies to proposed withdrawals within a specified distance from a river and leads to measures to protect surface water rights from interference: Oregon Administrative Rules Ch. 690, Div. 9.
[181] See Section 6.5.2.
[182] See Section 6.4.1.

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

TABLE 6.7 *Mechanisms that facilitate adapting a decision in response to cumulative impacts*

Legal mechanisms	Illustrative examples
Frequent (e.g., annual) reviews to adapt rights to take resources	Making an annual "seasonal determination" of water availability in Victoria, Australia, affects the water available to be taken under different categories of water entitlements (which are expressed as a proportion of the total) and responds to the cumulative conditions of water resources.[a] Malawi's water law requires a water license holder to update an impact assessment before the expiration of a license (which must last for at least five years), to be reviewed by the National Water Resources Authority.[b]
Time-limited approvals to implement lower-frequency (e.g., five-yearly) review and adaptation	Nationwide general permits under the US Clean Water Act expire after five years unless they are modified or reissued.[c] They may be modified at any time if the cumulative effect of the activities would be more than minimal;[d] reissuance expressly may consider climate change.[e]
Ad hoc review using a stakeholder-initiated process in response to changed conditions	In Chile, if environmental conditions change significantly compared to predictions, a project proponent or a directly affected person may request revisions to an environmental permit ("resolución de calificación ambiental") for projects that required full impact assessment documentation.[f]
Review by the state using an approval condition to respond to specified unacceptable cumulative effects	Water law in Oregon, US, requires conditions on water rights to allow the state to reduce allowable water use if future data shows that flows in scenic waterways have cumulatively reduced more than a specified threshold.[g]

[a] Water Act 1989 (Victoria) ss 33AC, 64GB. For an explanation of the place of seasonal determinations in Victoria's water allocation system, see Department of Energy, Environment and Climate Action (Victoria), "How Is Water Managed?" (n.d.) https://accounts.water.vic.gov.au/water-explained/how-is-water-managed/, last accessed March 20, 2025, archived at https://perma.cc/27YC-42RR.

[b] *Water Resources Act 2013*, ch 72:03 (Malawi) ss 61, 62. It is unclear whether this provision is implemented. Water law in Western Australia also provides for renewable, time-limited water licenses, guided by water allocation plans: Rights in Water and Irrigation Act 1914 (Western Australia) s 5C, Sch. 1, cll. 7(2), 22; Quantum Management Consulting and Assurance, *Report for the Economic Regulation Authority Inquiry into Water Resource Management and Planning Charges*, Department of Water's Processes (2010) 32, www.erawa.com.au/inquiries/completed-inquiries/2009-inquiry-into-water-resource-management-and-planning-charges, archived at https://perma.cc/8RPS-LYVC.

(*continued*)

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

TABLE 6.7 (*continued*)

[c] 33 C.F.R. § 330.6(b).
[d] 33 C.F.R. §§ 330.1(d), 330.5. See also US Army Corps of Engineers, "Reissuance and Modification of Nationwide Permits," 2751.
[e] Ibid 2755.
[f] Ley sobre Bases Generales del Medio Ambiente, Ley No. 19300 [Law on the General Bases of the Environment, Law No. 19300], 1994, as amended, art. 25 quinquies; Kay Bergamini and Cristian Pérez, "Environmental Impact Assessment Follow-up Institutional and Regulatory Frameworks: Lights and Shadows of the Chilean Experience" (2022) 40 *Impact Assessment and Project Appraisal* 423–436, 429.
[g] Oregon Revised Statutes §§ 390.835(9)(g), 390.835(12).

Openly flagging different trajectories of intervention might also, perhaps, reduce the effects of path dependence.

Scholars have advanced general ways in which law can facilitate adaptation, while ensuring appropriate stability, such as formally allowing for ad hoc or recurring amendment, relying on inherently evolutionary forms of law like the common law, and using more easily changed standards and delegated powers.[183] Table 6.8 directs this question to the situation of cumulative environmental problems, giving examples of mechanisms for adapting rules in response to cumulative impacts.

6.6 CONCLUSION

Diverse rules can influence cumulative impacts. In analyzing rules for intervention, it helps to consider the *strategy* employed by a rule (harm-reducing, harm-offsetting, restoring, and coping), which focuses on how the rule seeks to change harm to the matter of concern; and the rule's *approach* (stick, carrot, sermon, or state rescue), which focuses on how the rule seeks to change the behavior of contributors to the harm – or avoid the need to do this by relying on the state. Combining these two dimensions produces a matrix of rule types, some of which seem less used than others, presenting options for further developments. Some combinations give rules characteristics that compound weaknesses such as burdens on contributors to harm or riskiness of the outcome. This points to issues that need attention in regulatory design. No single type of rule will be universally effective to address all aspects of a cumulative environmental problem.

A major way of dealing with the weaknesses of certain types of rules for intervention is to use a mix of rules so that some can compensate for the

[183] E.g., Robin Kundis Craig and others, "Balancing Stability and Flexibility in Adaptive Governance: An Analysis of Tools Available in U.S. Environmental Law" (2017) 22(2):3 *Ecology and Society* 1–15, 8–9.

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

TABLE 6.8 *Mechanisms that facilitate adapting a set of rules in response to cumulative impacts*

Legal mechanism	Illustrative examples
Sequenced, predetermined regulatory designations and rule changes in response to escalating cumulative impacts	To increase regulatory controls, groundwater law in Arizona, US, provides for converting the designation of an area within which controls apply to groundwater withdrawals from an "irrigation non-expansion area" (less restrictive, relatively) to an "active management area" (more restrictive).[a]
Regular assessment of regional cumulative impacts, linked to considering new rules, without specifying the nature of the rules	In Australia's multistate Murray-Darling Basin, states are required to identify broad risks to the condition or continued availability of water resources in ten-yearly plans, before identifying strategies to address them (which expressly may include regulation).[b]
Regular review of whether a rule is effectively controlling cumulative impacts to trigger adaptation	To assess the impact of the Common Agricultural Policy,[c] an agricultural subsidy program that is intended to reduce impacts on the environment and climate,[d] the European Commission uses a rule-based "performance framework" based on set indicators.[e] These include "context" indicators of aggregate (cumulative) environmental conditions and trends.[f]
Self-updating standard (e.g., responsive to monitoring, or adaptive interpretation)	German "dynamic environmentally sensitive traffic management systems" adjust traffic speed limits to respond to cumulative impacts in real time; the content of a "general environmental duty," as used in Victoria and Queensland, Australia, adjusts relevant standards through interpretation.[g]

[a] Arizona Revised Statutes § 45-439. See generally, "Active Management Area'" Arizona Department of Water Resources (US), "AMAs 101" (n.d.) www.azwater.gov/sites/default/files/2025-02/AMA101_2025.pdf, last accessed March 19, 2025, archived at https://perma.cc/BJS9-BA5G.

[b] Water Act 2007 (Australia) s 22(1) items 3, 5; Basin Plan 2012 (Australia) chapter 4.

[c] CAP Regulation arts. 141–143.

[d] Ibid preamble (30).

[e] Ibid annexes I, XIV; EU CAP Network, "EU level CAP Evaluation Framework" (n.d.) https://eu-cap-network.ec.europa.eu/support/evaluation/evaluation-framework_en#paragraph-8970, last accessed March 19, 2025, archived at https://perma.cc/ML8Z-CM9Z.

[f] E.g., "water quality," "greenhouse gas emissions from agriculture," "percentage of species and habitats of Community interest related to agriculture with stable or increasing trends": ibid annex I, indicators C.37, C.39, C.44.

[g] See Environment Protection Act 2017 (Victoria) s 25(1); Lindsay, Marsh and Nelson, "Conceptualising and Activating Knowledge," 443; and Diegmann and others, Dynamisches umweltsensitives Verkehrsmanagement. Note that the Queensland duty is supported by codes of practice that require active change: Environmental Protection Act 1994 (Queensland) ss 319, 551; see also Queensland Government, "Environmental Codes of Practice for Industry" (n.d.) www.business.qld.gov.au/running-business/environment/industry-codes, last accessed March 19, 2025, archived at https://perma.cc/A9NS-SYJW.

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008

weaknesses of others. A mix is also necessary to accommodate heterogeneous contributors to the cumulative environmental harm and the multiple levels of government, with different powers and capacities, that are inevitably involved.

In designing rules for intervention, key issues are ensuring connected decision-making so that individual actions are not considered in isolation; comprehensiveness, so that few or no actions that could cause cumulatively significant impact are unaddressed; manageable costs associated with intervention; and adaptive interventions, so that the rules and their implementation can change as impacts accumulate or new circumstances arise. Numerous examples from around the world illustrate how rules can be designed with these challenges in mind. Inevitably, tensions arise in balancing different objectives for intervention rules and in bridging what is desirable and what is possible in designing a rule. Chapters 9 and 10 examine some key issues discussed here in case studies of interventions to address cumulative environmental problems in Australia and Italy.

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 09:05:57, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009091930.008