

# THE ROLE OF REGULATION IN RESTORING NATURE AND DELIVERING NET ZERO

A report for the Aldersgate Group

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# FOREWORD

## Foreword

Reducing emissions and restoring nature have never been more important. The challenges are great, and it is crucial that every tool available to policymakers is used as effectively as possible to overcome them while simultaneously achieving economic growth. Regulation has the potential to make significant strides towards meeting climate and nature goals, but to do so it needs to be well-designed, implemented and enforced. This report provides a framework that can be used across all sectors as a starting point, to make sure that environmental regulation in the UK is working well. The next step will be for decision-makers and regulators in individual sectors to apply this framework in practice, to design better regulation and improve the regulation that already exists. This will involve innovative techniques, increased collaboration and a strengthening of regulators to make sure they have the resources to meet the great challenges faced.



**Lord Gus O'Donnell**



**Rachel Solomon Williams**

## Special thanks to...

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## ABOUT US

### About Frontier Economics

Frontier Economics is one of the largest economic consultancies in Europe with offices in Berlin, Brussels, Cologne, Dublin, London, Madrid and Paris. Frontier uses cutting edge economics to solve complex business and policy problems, and works with leading private and public sector organisations. Further information about Frontier is available at [www.frontier-economics.com](http://www.frontier-economics.com).

### About The Aldersgate Group

The Aldersgate Group is an alliance of major businesses, academic institutions, professional institutes, and civil society organisations driving action for a sustainable and competitive economy. Our corporate members believe that ambitious and stable low carbon and environmental policies make clear economic sense for the UK. Our independent policy proposals are formed collaboratively and benefit from the expertise of our members who span a wide range of industry sectors and public interests. Our breadth and collegiate approach allows us to articulate progressive policy positions to benefit all organisations and individuals.

## EXECUTIVE SUMMARY

Environmental regulation needs to accelerate progress towards climate and nature policy goals and drive economic growth

The UK has set high ambitions for tackling climate change and restoring the natural environment. The coming years provide an opportunity to achieve these ambitions while also growing the economy, creating jobs and increasing investment. Well-designed, implemented and enforced regulation can be a powerful policy tool to accelerate emissions reductions, and protect and restore nature, while also driving economic growth. It can do this by protecting the ecosystems that our economy relies upon, providing businesses with a level playing field, and sending signals that incentivise innovation. This report establishes four key principles for effective and smart regulation that delivers on these goals. It provides a practical framework for policy makers and politicians to design better regulation and reform existing regulation more effectively.

The four principles constitute a practical way to capture the complexities of the natural environment

In this report, we build on existing literature to provide a practical framework that can be used to design new regulation and reform existing regulation. The basis of this framework is four principles for good environmental regulation (“the four principles”). They reflect how the environment is different from other areas that are regulated, and they aim to move regulatory authorities away from breaking the environment down into its constituent parts and uses, to encourage a more accurate understanding of the environment’s complexity. The four principles for good environmental regulation are:

1. **Whole of the environment:** This principle highlights the importance of not targeting one aspect of climate or nature without considering others.
2. **Multidisciplinary perspective:** This principle acknowledges the limitations of a narrow cost-benefit analysis approach to support decision making, and the importance of including evidence from a range of disciplines.
3. **Cross-sector approach:** This principle emphasises the importance of considering multiple sectors to develop more consistent incentives, reduce costs and deliver greater environmental benefits than when sectors are viewed in isolation.
4. **Fairness:** This principle outlines that it is important to make sure that location, ability-to-pay and intergenerational fairness are considered when determining where the burden of improving the environment should fall.

In addition to the four principles, the report provides a practical checklist that details how the principles can be applied in practice. We have also tested the framework on two case studies (diesel vehicles and water catchments) to illustrate the benefits of this approach. These case studies are detailed in full in annexes to this report, but relevant sections are used to illustrate the principles throughout the main report.

It is worth noting that there is similarity between these four principles and the UK Government's five Environmental Principles. The four principles build on the Environmental Principles, but they focus on both nature and climate change, and centre more specifically on designing environmental regulation; whereas the Environmental Principles focus on nature and are used for regulation in all areas.

### Key recommendations

In addition to the practical checklist, we have translated the framework into a set of policy recommendations that summarises how environmental regulation needs to change. To maximise the value of regulation, it is essential that policy makers and politicians focus on:

- **Target outcomes not outputs:** This should be the default for regulation, with deviations permitted when targeting the outcomes is too difficult or too costly - as long as regulators have evaluated the unintended consequences and transaction costs that come with targeting outputs.
- **Full assessment of societal costs and benefits:** Building on guidance in the HM Treasury's *Green Book* to move beyond narrow financial cost-benefit analysis (CBA), regulatory design and reform should draw on quantitative and qualitative evidence from other disciplines (biology, chemistry, ecology, economics, engineering and health).<sup>1</sup>
- **Recognise the cost of inaction or insufficient action:** There is an economic and social cost to doing nothing when it comes to the environment. However, some interpretations of the precautionary principle can entrench a status quo bias within regulators, so it is important that the damage from inaction is properly counted alongside the costs and benefits from action.
- **Innovation at scale for the environment:** As this report makes clear, regulation can help incentivise innovation at scale as it provides a level playing field and certainty for investment. New environmental regulation might come with risks but regulators cannot be overly risk-averse given the pace of change that is needed.
- **Factor in climate and nature tipping points and irreversibility:** Tipping points in both climate and nature require special treatment as repairing damage past a tipping point may not be possible, contrary to much economic analysis which assumes damages can be reversed with sufficient money and effort.
- **Primary focus on polluter pays:** The default for regulation should be that the polluter pays for the damage they are causing and they have flexibility in how they meet the requirements. When this is not possible, regulators should consider how the cost should

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<sup>1</sup> HM Treasury (2022), The Green Book. Available at: <https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government/the-green-book-2020>

be allocated and prioritise acting early to undo environmental damage over full cost recovery from past polluters.

- **Increased cross-sector collaboration:** Current regulation is fragmented, and greater collaboration is required. The fact that environmental responsibilities are split across many bodies make it even more important to ensure that regulation takes a broad perspective. It also needs to be matched by greater comprehensive oversight.
- **Ensure the resources of regulators increase with their responsibilities:** Meeting existing environmental objectives require extra analysis and responsibilities for regulators and new requirements place added demands on regulators. The financial and human resources available to regulators need to be increased accordingly.

This report outlines the framework as a practical starting point for improving environmental regulation, but more work will be needed to implement it. The next step is for regulators and policymakers in individual sectors to apply this framework to existing climate and nature regulations to demonstrate its benefits. Collaboration amongst decision-makers in different sectors will also be critical for the success in creating smarter, well-designed regulation.

**Figure 1** Demonstration of the four principles



Source: Frontier Economics



# 1 Introduction

## 1.1 Purpose and scope

Successive UK governments have made significant commitments to improve the climate and nature. The 2050 net zero objective is legally binding and, as outlined in the Climate Change Act 2008, the UK must progressively reduce greenhouse gas emissions between now and 2050. Equally, in 2018 the UK government published an ambitious 25 Year Environment Plan (25YEP) to accelerate nature restoration in England. The 25YEP made a commitment to be the first generation to pass the natural world on to the next generation in a better state than it received it. The 25YEP was underpinned by the 2021 Environment Act, which provides legally binding statutory targets and a long-term Environmental Improvement Plan. Separately, Scotland and Wales have their own legislation governing net zero ambitions and wider environmental priorities. For example, Scotland has 26 priority actions to restore its natural environment and halt biodiversity loss by 2030,<sup>2</sup> and the Welsh government has committed to using statutory domestic biodiversity targets to drive forward the ambition of the COP15 Global Biodiversity Framework – of which the UK is a signatory.

However, progress towards achieving climate and nature goals has been challenging. The most recent assessment by the Office for Environmental Protection (OEP) of the government's progress against legally binding targets found that *“the Government is largely off track to meet its ambitions and its legal obligations”*.<sup>3</sup> The latest Progress Report from the Climate Change Committee (CCC) said that *“...policy development continues to be too slow [to meet carbon budgets and net zero targets]...our confidence in the UK meeting its medium term targets has decreased in the past year”*.<sup>4</sup>

One of the key challenges that policy makers currently face is to accelerate progress towards climate and nature goals in a way that is affordable for households and businesses and supports a growing economy.

Achieving the UK's climate and nature objectives will require a mix of policy tools, including investment, taxation and regulation. This report focuses on environmental regulation, which encompasses a wide range of instruments such as permits, consents, licensing, product standards, statutory requirements and direct regulation. We use the term “environment” here

<sup>2</sup> Scottish Government (2022), Scottish Biodiversity Strategy to 2045 – Tackling the Nature Emergency in Scotland. Available at: <https://www.gov.scot/binaries/content/documents/govscot/publications/strategy-plan/2022/12/scottish-biodiversity-strategy-2045-tackling-nature-emergency-scotland/documents/scottish-biodiversity-strategy-2045-tackling-nature-emergency-scotland/scottish-biodiversity-strategy-2045-tackling-nature-emergency-scotland/govscot%3Adocument/scottish-biodiversity-strategy-2045-tackling-nature-emergency-scotland.pdf>

<sup>3</sup> Office for Environmental Protection (2024), Progress in Improving the Natural Environment in England 2022/2023. Available at: [https://www.theoep.org.uk/sites/default/files/reports-files/E02987560\\_Progress%20in%20Improving%20Natural%20Environment\\_Accessible.pdf](https://www.theoep.org.uk/sites/default/files/reports-files/E02987560_Progress%20in%20Improving%20Natural%20Environment_Accessible.pdf)

<sup>4</sup> Climate Change Committee (2023), Progress Report to Parliament. Available at: <https://www.theccc.org.uk/publication/2023-progress-report-to-parliament/>

as short-hand to cover a range of objectives linked to the climate (e.g. net zero), adaptation (e.g. preventing risks from changing climate) and stewardship (e.g. improving the natural environment). We use the term “environmental regulation” in a broad sense to include policy tools that are different from taxes, subsidies, and direct government spending and investment. Well-designed environmental regulation, whether new or reformed, can support economic growth and plays a key role in achieving the UK’s climate and nature objectives.<sup>5</sup>

The Aldersgate Group commissioned Frontier Economics to identify how environmental regulation can support the delivery of climate and nature goals as well as economic growth. In this report, we present a new framework for regulators and other stakeholders which builds on existing literature. Case studies discuss and illustrate how this framework can be applied in practice, alongside policy recommendations for regulators and policymakers going forwards. The scope of the report and the topic of discussion is regulation and regulators, whilst acknowledging that regulation is not designed and implemented in isolation but part of a broader set of policies and levers that include investment and taxation.

### 1.2 Approach

Regulation is developed with the aim to protect and benefit people, businesses and the environment and to support economic growth by increasing investment, creating jobs and supporting innovation. However, when regulation is poorly designed, overly complicated or highly uncertain, it can introduce excessive costs, inhibiting growth and productivity. It can even have perverse effects and result in poor outcomes for the people, businesses and environments that it seeks to protect.

In this report, we first review the general principles of good regulation based on existing literature. We then consider the specific characteristics of the environment and develop four new principles which are specific to environmental regulation and address the most common issues faced by regulators when regulating the environment. We include illustrative case studies on how regulation in two sectors could evolve when the principles are applied. We then outline how applying the principles would lead to environmental regulation that supports economic growth and discuss how the principles can be applied in practice.

We conclude by setting out priorities and high-level policy recommendations that are applicable to regulators in a broad range of sectors. These recommendations cover the implications for the role of regulators and propose a vision for the role of regulation in protecting nature and reaching net zero carbon emissions.

### 1.3 Structure

This report is structured as follows:

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<sup>5</sup> Catapult Energy Systems, UK Productivity Figures Fail to Reflect Value of a Cleaner Economy. Available at : <https://es.catapult.org.uk/news/uk-productivity-figures-fail-to-reflect-value-of-a-cleaner-economy/>

- Section 2 summarises principles of good regulation based on existing literature.
- Section 3 discusses the specific characteristics of the environment, identifies four principles for good environmental regulation specifically, and provides illustrative examples (case studies) from two sectors.
- Section 4 outlines how applying the principles for good environmental regulation leads to regulation that supports economic growth.
- Section 5 discusses how the principles can be applied in practice.
- Section 6 concludes by providing policy recommendations that apply to regulators in a broad range of sectors.

## 2 General principles for good regulation

### 2.1 Summary of five core principles

Better regulation has been a focus for governments of all types over many decades. A common formulation of good regulation includes five core principles to test whether any regulation is “fit for purpose”.<sup>6</sup> These principles were first developed by the Better Regulation Task Force and still form the basis for considering and developing new areas of regulation. For example, a similar version is found in the current Better Regulation Framework published in 2023 by the Department for Business and Trade (see next section).<sup>7</sup> These are:

- **Proportionality:** Regulators should only intervene when necessary. Regulatory solutions must be proportionate to the perceived problem or risk and justify the compliance costs imposed. Regulators need to balance the costs and benefits of different scales of intervention to ensure that proportionality does not lead them to focus solely on areas where big impacts can be realised in the short term to the detriment of other areas in need of reform. Ignoring or delaying regulation relating to smaller environmental offences, such as fly-tipping, pollution of rivers and loss of protected species, may lead to a loss in confidence about the effectiveness of regulation. All the options for achieving policy objectives must be considered, not just the subset of options linked to regulation.
- **Accountability:** Regulators should be accountable for ensuring that their regulation is enforceable and enforced, which may require having the appropriate penalties in place and the appropriate resources to monitor, investigate and prosecute those who do not comply with the regulation. They should clearly explain how and why final decisions have been reached. There should be well-publicised, accessible, fair and effective complaints and appeals procedures, and regulators should have clear lines of accountability to ministers, parliaments and assemblies, and the public.
- **Consistency:** Regulators should be consistent with each other and work together in a joined-up way. Enforcement agencies should apply regulations consistently across the country. Regulation should be predictable in order to give stability and certainty to those being regulated.
- **Transparency:** Policy objectives, including the need for regulation, should be clearly defined and effectively communicated. Regulations should be simple and user-friendly. Those being regulated should be made aware of their obligations and given the time and support to comply.

<sup>6</sup> Better Regulation Taskforce (2003), Principles of Good Regulation. Available at: <https://www.rqia.org.uk/RQIA/media/RQIA/Resources/Better-Regulation-Task-Force-Principles-of-Good-Regulation.pdf>

<sup>7</sup> Department for Business & Trade (September 2023), Better Regulation Framework. Available at: [https://assets.publishing.service.gov.uk/media/65420ee8d36c91000d935b58/Better\\_Regulation\\_Framework\\_guidance.pdf](https://assets.publishing.service.gov.uk/media/65420ee8d36c91000d935b58/Better_Regulation_Framework_guidance.pdf)

- **Targeting:** Regulation should be focused on the problem and be systematically reviewed to test whether it is still necessary and effective. Where appropriate, regulators should adopt a “goals-based” approach, with enforcers and those being regulated given flexibility in deciding how to meet clear, unambiguous targets and minimise side effects. However, regulators may want to be cautious in implementing this principle to ensure that those reforming regulation do not incorrectly remove an “ineffective” piece of regulation when its lack of efficacy is a result of inadequate resources or penalties.

## 2.2 Overview of other guidance documents relating to good regulation

Other regulatory guidance documents present principles or policy messages related to good regulation. Most include some form of the five principles discussed above – although they may be more granular or emphasise aspects of how the principles can be implemented in practice. These include:

- The **Better Regulation Framework**, which was reformed by the Department for Business and Trade and launched in September 2023 as part of the regulatory reform announcements following the UK’s departure from the EU.<sup>8</sup> The framework does not contain new principles but builds on the five core principles above by providing a new focus on finding non-regulatory solutions (aligned with proportionality) and puts a greater emphasis on consistent monitoring and ensuring delivery of its aims. It also highlights the importance of more holistic assessments of the impacts of regulation “beyond the direct costs to business”.
- The **Principles of Effective Regulation**, a guide created by the National Audit Office (NAO) based on its experience of past audits of regulatory frameworks and interactions with departments, regulators and other stakeholders.<sup>9</sup> This guide creates a greater number of principles that are more granular than the five core principles above. However, the focus of the principles is the same: ensuring that regulatory policies are designed proportionally, and having clear accountability frameworks and performance measures for assessing the regulations that have been put in place.
  - Twenty-four principles were identified across the four steps of the cycle of regulation – design, analyse, intervene and learn.
  - Some of the NAO’s principles – “ensuring accountability”, “embedding consistency and predictability” and “ensuring transparency” – directly reflect the five core principles above.

<sup>8</sup> Department for Business & Trade (September 2023), Better Regulation Framework. Available at: [https://assets.publishing.service.gov.uk/media/65420ee8d36c91000d935b58/Better\\_Regulation\\_Framework\\_guidance.pdf](https://assets.publishing.service.gov.uk/media/65420ee8d36c91000d935b58/Better_Regulation_Framework_guidance.pdf)

<sup>9</sup> National Audit Office (May 2021), Good Practice Guidance: Principles of Effective Regulation. Available at: <https://www.nao.org.uk/wp-content/uploads/2021/05/Principles-of-effective-regulation-SOff-interactive-accessible.pdf>

- Other NAO principles, such as “using information and data”, “developing a theory of change” and “engaging with stakeholders”, reflect the ideas of the five core principles but focus more granularly on how these can be embedded in practice.
- The **Better Regulation for the Green Transition**, a policy paper published by the Organisation for Economic Co-operation and Development (OECD) which outlines how better regulation tools and practices can enable governments to promote the green transition.<sup>10</sup> The paper does not set out specific principles, but the key policy messages highlighted by the OECD include (amongst others) that regulatory impacts on the environment are currently not sufficiently assessed from the environmental and societal view, and that the domestic and international regulatory bodies must collaborate further to tackle transboundary environmental issues.
- Similarly, previous reports commissioned by the **Aldersgate Group** and produced by **Frontier Economics** and others which highlight a number of key factors that are necessary for regulation to be effective. Such factors include the requirements that regulation should be cross-sectoral and provide a clear direction over time (see Box 1 below).

### Box 1: Summary of previous publications by Frontier and the Aldersgate Group

- *Help or Hindrance? Environmental Regulations and Competitiveness*. A report by Buro Happold – an international engineering consultancy – for the Aldersgate Group concluded that regulation is most effective when it is pitched at the right scale, provides a clear direction, is coherent and is implemented within adequate timescales to allow business to develop and implement appropriate strategies.<sup>11</sup>
- *Fostering Prosperity: Driving Innovation and Creating Market Opportunities Through Environmental Regulations*. Another report by Buro Happold for the Aldersgate Group highlighted that good environmental regulation should be forward-looking, with clear, ambitious outcomes and targets that tighten over time. It should also be cross-sectoral, align with other policy areas and infrastructure changes, and provide consistency along supply chains.<sup>12</sup>

<sup>10</sup> OECD (November 2023), Better Regulation for the Green Transition. Available at: <https://www.oecd-ilibrary.org/docserver/c91a04bc-en.pdf?expires=1705008580&id=id&accname=quest&checksum=0CF3576DC0740A8B1E489B7E48B80E9A>

<sup>11</sup> Buro Happold (December 2017), Help or Hindrance? Environmental Regulations and Competitiveness. Available at: <https://www.aldersgategroup.org.uk/content/uploads/2022/03/Help-or-hindrance-Environmental-regulations-and-competitiveness.pdf>

<sup>12</sup> Buro Happold (2021), Fostering Prosperity: Driving Innovation and Creating Market Opportunities Through Environmental Regulations. Available at: <https://www.aldersgategroup.org.uk/content/uploads/2022/03/2103-Fostering-Prosperity-report.pdf>

- *Outcome Based Environmental Regulation: Enabling the Water Sector to make its Contribution to the 25 Year Environment Plan.* A report by Frontier Economics for Wessex Water explained that, for regulation of the water sector to be effective, it needs to employ a cross-sector, outcome-focused approach that is based on systems thinking.<sup>13</sup>
- *How Product Standards Can Grow the Market for Low Carbon Industrial Products.* A report by Frontier Economics for the Aldersgate Group noted that effective product standards are based, amongst others, on a clear direction of travel for the development of product standards from the government. The standards should also apply throughout the supply chain to both intermediate and finished products.<sup>14</sup>

## 2.3 The Environmental Principles

Alongside the best practice regulation described above, there is guidance that is specific to tackling nature issues in policy making. The Environmental Principles were transposed into UK law as part of the 2021 Environment Act, and it places a legal duty of ministers to have due regard to these principles when making policy.<sup>15</sup> These principles focus on nature and do not explicitly consider carbon emissions. They aim to apply a nature focus to the application of all good regulation. They are:

- The integration principle – which ensures integration of environmental protection into all policies;
- The prevention principle – which seeks to prevent environmental harm before it occurs;
- The rectification at source principle – which aims to tackle environmental damage at its source, rather than later effects;
- The polluter pays principle – the cost of environmental damage should be paid by those causing it; and
- The precautionary principle – which focuses on “where there are threats of serious or irreversible damage, lack of scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation”.<sup>16</sup> When there

<sup>13</sup> Frontier Economics (November 2021), *Outcome Based Environmental Regulation: Enabling the Water Sector to Make Its Contribution to the 25 Year Environment Plan*. Available at: <https://corporate.wessexwater.co.uk/media/e05cim0k/outcome-based-environmental-regulation-report-2021.pdf>

<sup>14</sup> Frontier Economics (December 2022), *How Product Standards Can Grow the Market for Low Carbon Industrial Products*. Available at: <https://www.aldersgategroup.org.uk/content/uploads/2022/12/stc-How-product-standards-can-grow-the-market-for-low-carbon-industrial-products.pdf>

<sup>15</sup> DEFRA (2022), *Environmental Principles Policy Statement*. Available at: <https://www.gov.uk/government/publications/environmental-principles-policy-statement/environmental-principles-policy-statement>

<sup>16</sup> United Nations Global Compact – The Ten Principles of the UN Global Compact. Available at: <https://unglobalcompact.org/what-is-gc/mission/principles/principle-7>



is reasonable suspicion of harm, decision-makers need to apply precaution and consider the degree of uncertainty that appears from scientific evaluation.<sup>17</sup>

As with the guidance documents cited in the previous section, the Environmental Principles incorporate the five core principles of good regulation. For example, discussion of these principles in an accompanying policy statement emphasises that proportionality and a consistent approach are key.<sup>18</sup> Our report builds on the Environmental Principles to identify how current and future environmental regulation can be improved to help achieve the UK's net zero and nature goals.

## 2.4 Conclusion

The literature on the principles of good regulation provides a well-established set of core principles around proportionality, targeting, monitoring and accountability. This is important as consistency of regulatory policies over time and with international bodies is important to provide businesses with the regulatory framework they require to invest and innovate. It is crucial to make sure that these core principles are followed in practice and that regulators are given the resources to be able to enforce their regulations, otherwise well-designed regulation may be seen as ineffective. This is discussed in more detail later in the report (Section 5).

More recent guidance has built on these core principles and applied them to more-specific contexts. An example of this is the Environmental Principles which build on the core principles to provide a framework that regulators and policymakers should use to bring an environmental lens to regulation and policymaking across all areas.

Our report builds on the Environmental Principles to identify how current and future environmental regulation can be improved to help achieve the UK's net zero and nature goals. This is elaborated further in the next section, where we consider the unique characteristics of the environment and the implications for regulatory design and reform. This report therefore takes the core principles of good regulation as a foundation and builds upon them to establish a framework for our particular context – the design and reform of environmental regulation.

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<sup>17</sup> United Nations Global Compact – The Ten Principles of the UN Global Compact. Available at: <https://unglobalcompact.org/what-is-gc/mission/principles/principle-7>

<sup>18</sup> DEFRA (2022), Environmental Principles Policy Statement. Available at: <https://www.gov.uk/government/publications/environmental-principles-policy-statement/environmental-principles-policy-statement>



### 3 Specific principles for good environmental regulation

#### 3.1 How the environment is different from other areas

Environmental regulation includes a wide range of instruments that are imposed on individuals or firms to prevent environmental damage. In order to identify how best to design or reform environmental regulation, we first need to consider “what we are regulating”.

*The Economics of Biodiversity: The Dasgupta Review* (The Dasgupta Review) highlighted that many of the elements and processes that sustain the environment and ecosystem are silent and invisible.<sup>19</sup> For example, photosynthesis by plants and chemical reactions of microbes are some of the most important processes for sustaining our ecosystems, but they are silent and invisible to most humans. The environment is also mobile.<sup>20</sup> This means that a deterioration of the environment is often not contained to a specific location because the wind blows and water flows.

Drawing on the Dasgupta Review and our experience with regulation, the key characteristics of the environment that are relevant to regulation are:

- **Multifaceted and interconnected:** The environment is a deeply complex, multifaceted system and a healthy environment encompasses a large number of different aspects. For example, measuring “good ecological status” in our rivers alone involves more than 80 different nutrients that all contribute to the health of the river, and there are seven different greenhouse gases that directly contribute to climate change. As the environment is a complex, interconnected system, existing environmental regulation has often focused on specific aspects to simplify the regulatory design. In some cases, this approach is adequate as there are positive externalities from some policies – e.g. encouraging the use of electric vehicles (EVs) to reduce emissions has a knock-on positive impact on air pollution. However, there are examples where protecting one aspect of the environment has a negative impact on others.
- **Impacts are not easily quantifiable in monetary terms:** In contrast to impacts on consumers and businesses, environmental impacts are hard to value, as it is challenging to capture the intrinsic value of a forest using the available methods. Stated and revealed preference studies can provide indicative values but these are always context dependent. As there is no clear substitute for the environment as a whole, it is difficult to value the absence of the environment. Over the past decades, efforts have been made to develop more robust valuations of different aspects of the environment but quantifying the intrinsic value of environmental impacts in monetary terms remains a challenge.

<sup>19</sup> Dasgupta, P (2021), *The Economics of Biodiversity: The Dasgupta Review*. Available at: [https://assets.publishing.service.gov.uk/media/6014329ce90e076265e4d9ba/Dasgupta\\_Review\\_-\\_Abridged\\_Version.pdf](https://assets.publishing.service.gov.uk/media/6014329ce90e076265e4d9ba/Dasgupta_Review_-_Abridged_Version.pdf)

<sup>20</sup> Dasgupta, P (2021), *The Economics of Biodiversity: The Dasgupta Review*. Available at: [https://assets.publishing.service.gov.uk/media/6014329ce90e076265e4d9ba/Dasgupta\\_Review\\_-\\_Abridged\\_Version.pdf](https://assets.publishing.service.gov.uk/media/6014329ce90e076265e4d9ba/Dasgupta_Review_-_Abridged_Version.pdf)

- **All sectors interact with the environment:** All sectors of the economy interact with the environment. Some (e.g. agriculture, tourism, certain types of manufacturing and water) are dependent on the environment to provide key inputs, while others (e.g. energy producers, consumers and transport) have a big impact on the environment. The impact of different sectors accumulates in different parts of the environment. For example, domestic greenhouse gases are the result of contributions of different sectors (most notably heating and transport). Similarly, river water quality is a result of run-off and discharges from agriculture, road, wastewater treatment plants and manufacturing. Existing environmental regulation is often sector based as it is simpler to consider solutions to environmental issues in individual sectors rather than in multiple sectors at once. However, this means that we do not end up with the most efficient way of achieving environmental outcomes as the cost of improving the environment across different sectors is not the same.
  
- **Impacts are not linear and some are irreversible:** The cost of maintaining the status quo (i.e. not improving the environment) and the benefits of improving the environment can be difficult to quantify as ecosystems are complex. For example, the Dasgupta Review noted that once a rainforest turns into a savannah, it passes a “tipping point” and *“the move is to all intents and purposes irreversible”*.<sup>21</sup> Equally, the target to maintain the 2-degree Celsius warming limit is informed by an understanding of the likelihood of the planet reaching irreversible damage.<sup>22</sup> These tipping points make it difficult to clearly estimate the long-term impacts. The risks of these tipping points are exacerbated further both by environmental damage and by environmental restoration not happening overnight, as the long-time horizons can lead to procrastination by making action at any particular point in time difficult to justify. Historically, this has meant that environmental regulations have only been enacted after significant environmental damage has already taken place, which may make it harder and more expensive to reverse, if that is even possible.

This means that it can be difficult to appropriately measure and directly attribute the extent of the harm caused to the environment from any individual action, because there are multiple factors that determine how an action affects the environment. Existing environmental regulation therefore often focuses on regulating inputs or outputs in specific sectors which are easier to measure, instead of on broader environmental outcomes. This approach would work well if the relationship between inputs and environmental outcomes were simple. However, the focus on inputs can mean that, while one aspect of the environment improves, others deteriorate, and using current techniques to quantify the harm done can be challenging. Moreover, focusing on one sector in isolation does not address the overall issue, and even if

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<sup>21</sup> Dasgupta, P (2021), The Economics of Biodiversity: The Dasgupta Review. Available at: [https://assets.publishing.service.gov.uk/media/6014329ce90e076265e4d9ba/Dasgupta\\_Review\\_-\\_Abridged\\_Version.pdf](https://assets.publishing.service.gov.uk/media/6014329ce90e076265e4d9ba/Dasgupta_Review_-_Abridged_Version.pdf)

<sup>22</sup> The 2-degree warming limit is the target to keep the increase in average global temperatures as a result of climate change to below 2 degrees Celsius.

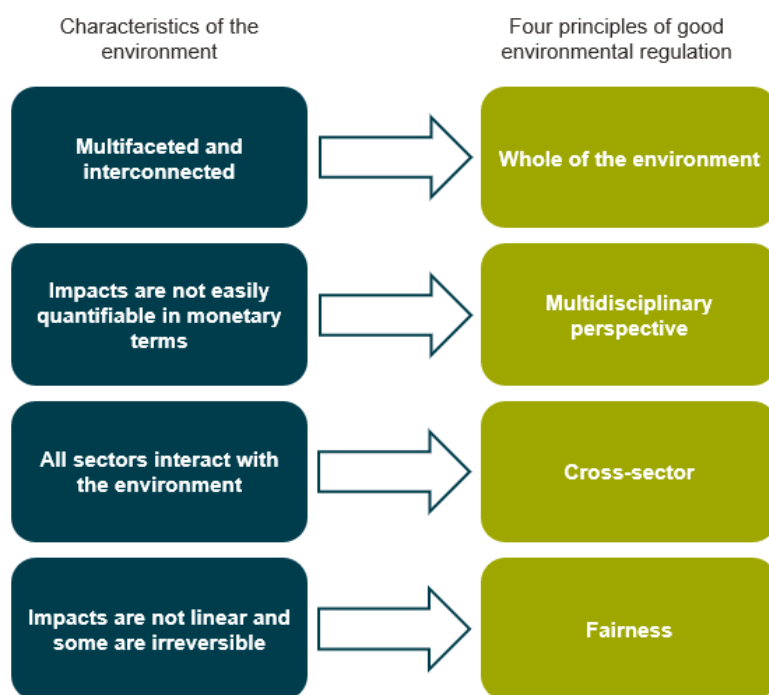
the harm to the environment can be measured, it is often not straightforward to trace this back to those that are responsible.

### 3.2 The four principles for good environmental regulation

While the general principles of good regulation provide a broad framework that can be applied to the environment, the specific characteristics of the environment discussed above demonstrate that good environmental regulation requires additional considerations. This report establishes four principles of good environmental regulation (the four principles) which build upon the existing five core principles of good regulation (Section 2.1) and on the Environmental Principles (Section 2.3). We build on the Environmental Principles for the specific context of new regulation or reform to existing regulation about the environment.

The four principles are depicted in Figure 2, which provides an overview and shows how they relate directly to the specific characteristics of the environment.

**Figure 2** Four principles that relate to the unique characteristics of the environment



Source: Frontier Economics

The principles challenge the common approach which oversimplifies regulation of the environment. They encourage regulators to focus on designing and reforming environmental regulation in a way that captures the complexity of the environment. The most valuable

outcome of applying the four principles is the possibility of opening up different regulatory solutions that deliver more environmental benefits for lower societal costs.

The remainder of this section explains the four principles in detail and provides case studies as illustrative examples. While the full end-to-end case studies are included in Annexes B and C, the following four subsections contain highlight boxes that pull out relevant sections from the case studies.

Section 4 then demonstrates how these principles also lead to environmental regulation that supports economic growth, and Section 5 explains how these principles can be applied in practice.

### 3.2.1 Whole of the environment

*This principle highlights the importance of not targeting one aspect of climate or nature without considering others.*

It is important to take a holistic view of the environment when designing or reforming regulation. Regulation that seeks to improve one aspect of the environment should not lose sight of the potential harm that may be incurred by other areas of the environment at the same time. This will allow regulators to centre on the true environmental benefits that are desired and unlock the potential of achieving multiple benefits across multiple environmental objectives.

Outcome-focused regulation centres on targeting the desired result of an action or behaviour, while output-focused regulation prioritises the action or behaviour itself. For example, outcome-focused regulation would prioritise reductions in carbon emissions, whereas output-focused regulations might dictate boiler standards. Starting with an outcome-focused approach rather than an output-focused approach ensures that regulators focus on the overall environmental benefits, rather than focusing on regulating inputs, which can lead to damaging unintended consequences. While outcomes can be difficult to measure, technological improvements (such as drones and sensors) and a clear mapping from inputs to outcomes can help.

It is also important to consider positive synergies when designing or reforming environmental regulation. Regulation that achieves multiple benefits for the environment or benefits for a longer time horizon should be considered more valuable than ones that only achieve a single short-term aim.

#### Whole of environment – example from Case Study #1

- In the late 1990s and early 2000s, there was an increase in the use of diesel cars in the UK and Europe. This was partly driven by a voluntary fleet emissions standard

which focused on reducing CO<sub>2</sub> emissions because diesel cars have lower CO<sub>2</sub> emissions than petrol cars.

- However, while diesel has lower levels of CO<sub>2</sub>, it has much higher levels of nitrous-oxides and particulate matter. These together meant that the increase in diesel reduced air quality and led to adverse nature and health outcomes.
- Hence, while the emissions standard was well intentioned, it did not consider all aspects of the environment and the potential unintended consequences it might have. An approach which took account of the whole of the environment might have designed a different piece of regulation (perhaps centring around CO<sub>2</sub>e, which includes gases besides carbon) that would have reduced carbon emissions without damaging nature and health. This regulation therefore acts as an illustrative example of the importance of taking a whole-of-environment approach.

*For more details and the full end-to-end case study, see Annex B.*

### 3.2.2 Multidisciplinary perspective

*This principle acknowledges the limitations of a narrow cost-benefit analysis (CBA) approach to support decision making and the importance of including qualitative arguments from a range of disciplines.*

Despite best efforts, it can be difficult to appropriately value all aspects of the environment in a monetary way as part of a quantitative assessment. In addition, impacts on the environment may be non-linear and irreversible. This can mean that a traditional CBA with a heavy quantitative focus is unlikely to capture the true costs and benefits of different types of environmental regulation. This is not a new concept, and HM Treasury's *Green Book* is already a helpful tool in this regard by providing guidance on natural capital and unmonetizable assets, but this needs to be implemented more widely in practice.

Moreover, to ensure that benefits and costs that cannot easily be quantified are included, it is important for environmental regulation to consider qualitative assessments from other disciplines. Relevant disciplines are likely to include chemistry, biology, ecology, health, social sciences and engineering. By including proper consideration of these benefits and costs, regulators may be able to see that an alternative course of action is needed or is more effective.

#### Multidisciplinary perspective – example from Case Study #2

- Regulation of water companies is currently based on a point-source approach, i.e. targeting a single identifiable localised source of pollution, such as wastewater treatment works. However, including the multidisciplinary perspective when

assessing regulation could provide regulators with alternative solutions that deliver additional benefits to the environment.

- For example, in the Cam and Wellow sub-catchment, Wessex Water is working closely with wider stakeholders to develop a data- and modelling-led approach that achieves greater environmental outcomes. The work has demonstrated that alternative solutions, such as land-based measures and river restoration, will allow the catchment to achieve up to 50% reduction in phosphorus loadings per waterbody, and £48m of additional environmental benefits, such as improved fish habitat and diversity, compared to a traditional point-source approach.
- Talks are currently underway between Wessex Water, the Environment Agency (EA) and Natural England to finalise the extent to which the alternative solutions would be used in the forthcoming regulatory period as the EA has traditionally considered these solutions to be too risky given the uncertainty around the extent and timeframe of benefits that could be delivered in the short term.
- However, a multidisciplinary approach, for example by including the views of biologists and ecologists, might highlight the importance of other environmental outcomes, including fish biodiversity, such that the alternative solutions are more attractive than traditional point-source approaches.

*For more details and the full end-to-end case study, see Annex C.*

### 3.2.3 Cross-sector approach

*This principle emphasises the importance of considering multiple sectors to develop more consistent incentives, reduce costs and deliver greater environmental benefits than when sectors are viewed in isolation.*

Environmental regulation needs to take a cross-sector approach. This is because:

- Environmental regulations will have different impacts on different sectors. A cross-sector approach makes any trade-offs explicit and helps to achieve the biggest environmental improvement for the lowest societal cost. By bringing together different sectors and parts of the value chain, regulators may be able to identify different solutions that maximise whole system benefits.
- While there may be an optimal solution, sometimes difficult choices need to be made to prioritise environmental objectives in certain areas and sectors over others. It is only by considering the whole system that this can be done in an informed way. Considering sectors in isolation reduces the information available when understanding trade-offs and could lead to regulators making decisions that do not balance their objectives appropriately.

This final point raises the important topic of the precautionary principle. As outlined in Section 2.3, there have been different interpretations of the precautionary principle, with some viewing it as demanding action and others viewing it as justifying inaction. A “do no harm” perspective would apply the latter interpretation leading, in the extreme, to a “do nothing” approach where the environment continues to degrade without intervention. Understanding any trade-offs between environmental impacts in different sectors is the focus of this principle. A trade-off involves accepting that an action may cause some environmental damage, but that it is worthwhile for the reduction in environmental damage that it will achieve in another area. It is a refinement of the precautionary principle.

### Cross-sector approach – example from Case Study #1

- Using both hydrogen and electric heavy goods vehicles (HGVs) is a possible way to decarbonise the sector in the long term. The appropriate split between hydrogen and electric HGVs in the future is not yet known, but regulation could have a role in shaping that decision. To understand the potential respective roles of each and to regulate in accordance with a net zero future, the regulation of HGVs needs to be developed not just by the road haulage sector but along with the full supply chain affected by the transition.
- Fuel producers would need to be involved to ensure that enough fuel was generated, given demand in other sectors, to supply HGVs. It would be important to avoid a situation where regulation was designed to encourage hydrogen HGVs only to find that the hydrogen production was not available to support this transition.
- Distribution and transmission networks would also need to be involved to ensure that fuel would be available at the right place and time to be used by HGVs. Regulation that encouraged electric HGVs to be the zero-emission solution could fail if it did not understand whether the required grid reinforcements were feasible.
- Synergies with other transport modes could also be helpfully utilised, and therefore representatives in these sectors should be involved in decisions about HGV regulation. If new infrastructure and grid connections on motorways are being brought in to support the transition of passenger cars to EVs, then the regulation of HGVs might lower costs to society if it encouraged electric HGVs rather than hydrogen HGVs. Equally, if planes, ships and other types of heavy transport are being fuelled by hydrogen, the regulation of HGVs might lower costs to society by encouraging HGVs to be hydrogen rather than electric.
- The potential decarbonisation of HGVs therefore provides an illustrative example of how a cross-sector approach can be crucial to ensure that regulation is designed in such a way that it can succeed and reduces societal costs.



*For more details and the full end-to-end case study, see Annex B.*

## Whole of environment and cross-sector – example from Case Study #2

- The Water Framework Directive, which is enshrined in UK law, requires 75% of water bodies in England to achieve “good ecological status” by 2027.<sup>23</sup> “Good ecological status” refers not only to the chemical quality of the UK’s bodies of water but also to all the associated biological elements, such as the plants, fish and creatures living in the water. Failure to meet any one individual test means that the whole water body fails to achieve good ecological status.
- To date, much of the focus on achieving good ecological status has been on water companies reducing the nutrients in wastewater treatment plant discharges, targeting chemicals such as nitrogen, phosphorus and ammonia. Phosphorus, in particular, has been heavily targeted by the EA in recent years as, historically, it has been the most common reason for rivers not achieving good ecological status.<sup>24</sup> In the past, obliging water companies to deliver a prescriptive list of outputs was an effective approach to improve river water quality as there were many “low-hanging fruit”. However, investments made by water companies over the years means that these low-hanging fruit have already been delivered, and now marginal costs are rising.
- As an example, Wessex Water’s experience in the Midford Brook sub-catchment demonstrated that the water company contributes less than a quarter of the excess phosphorus within the catchment. This illustrates that additional improvements to Wessex Water’s discharges as envisaged by the EA would have limited impact on the overall phosphorus levels in the catchment, and interventions would be better targeted at other nutrients and other sectors.
- Going forward, the effort to improve river water quality needs to include all nutrients that affect good ecological status and all sectors. In addition, alternative solutions, such as nature-based solutions, would offer an improvement in ecological status and deliver wider benefits, such as reduced air pollutants, reduced greenhouse gas emissions and an increase in biodiversity.

*For more details and the full end-to-end case study, see Annex C.*

<sup>23</sup> Defra (2022), Environment Act 2021: Environmental Targets , Available at: <https://deframedia.blog.gov.uk/2022/03/17/environment-act-2021-environmental-targets/>

<sup>24</sup> Environment Agency (February 2018), The State of the Environment: Water Quality. Available at: [https://assets.publishing.service.gov.uk/media/5b03e097ed915d3968dc5a78/State\\_of\\_the\\_environment\\_water\\_quality\\_report.pdf](https://assets.publishing.service.gov.uk/media/5b03e097ed915d3968dc5a78/State_of_the_environment_water_quality_report.pdf)



### 3.2.4 Fairness

*This principle outlines that it is important to make sure that location, ability to pay and inter-generational fairness are considered when determining where the burden of improving the environment should fall.*

Environmental regulation has long-term impacts for generations in the future. Particularly in the context of non-linear and potentially irreversible damage, it is important to consider fairness appropriately. Fairness is also important as a great deal of research in psychology and policy studies has demonstrated that when citizens feel fairly treated in their encounters with government agencies, they are more likely to accept and comply with regulatory rules and decisions.<sup>25</sup> Many environmental regulations need citizens' participation (e.g. recycling) to achieve the optimum outcome. Assessing fairness properly therefore means that we need to consider:

- **Location:** What is a fair allocation of the costs and benefits of improving the environment between different locations? For example, should citizens in one part of the country pay for improvements elsewhere? Does that differ if the improvements are to local environmental issues (such as water quality) vs. global environmental issues (such as carbon emissions)?
- **Ability-to-pay:** What is a fair allocation of the costs of improving the environment between different income groups, especially considering those who are vulnerable? Should the level of environmental improvement in a local area be based on the local strength of the economy and the ability to pay, or should this be shared equally?
- **Inter-generation:** What is a fair allocation of the costs of improving the environment and the costs of not improving the environment (i.e. the risk that the environment passes tipping points) between different generations?

#### Fairness and cross-sector – example from Case Study #2

- Nutrient neutrality is the concept that requires new housing developments in certain areas to not add more “nutrient pollution” to the water catchment. An excess of nutrients such as nitrogen and phosphorus can be damaging to the environment because it can lead to eutrophication and algal blooms in rivers and lakes. The idea is that nutrient neutrality rules only apply to new housing developments in areas with protected habitat sites that are already in an “unfavourable condition” (due to existing nutrient pollution). In areas affected by “nutrient neutrality” rules, developers

<sup>25</sup> OECD (2016), Perceived Fairness and Regulatory Policy. Available at: [https://www.oecd-ilibrary.org/governance/perceived-fairness-and-regulatory-policy\\_1629d397-en](https://www.oecd-ilibrary.org/governance/perceived-fairness-and-regulatory-policy_1629d397-en)

must demonstrate that run-off from their proposed development will not add to the nutrient load in a particular catchment area.

- If a developer finds that its development will produce additional nutrient load, it needs to invest in mitigation measures. It needs to provide mitigation measures onsite to prevent nutrient pollution or make sure it is “offset” elsewhere within the same catchment. Offsite measures can include creating or restoring semi-natural habitats or creating a treatment wetland that is specifically designed to capture run-off from agricultural land or wastewater treatment works.
- Over the past years, the government has proposed various ways of implementing nutrient neutrality and the debate on the way forward is likely to continue. This debate illustrates the key considerations around fairness, as there is a question about who should pay for avoiding additional nutrient pollution. Putting the responsibility on developers of new houses means that new home buyers ultimately pay for avoiding a worsening of river quality. However, in 2023 the government proposed dropping the requirements for developers, instead requiring all water companies in sensitive catchment areas to upgrade all relevant water treatment works to the “technically achievable limit” with regard to nutrients in their discharges. This would mean that water customers would pay for improving river water quality to allow new home owners to add more nutrient pollution without river water quality deteriorating as a whole.
- The government’s proposals were blocked by the House of Lords. This was because members from different parties were concerned that the water company measures would not be able to offset increased pollution from housing developers, and that the overall effect would be increased nutrient pollution. There were fears the government proposals were “abandoning legal protections for the nation’s most precious and sensitive habitats” and that there was “no guarantee that any of the mitigation measures [...] will be able to be put in place before the pollution happens”.<sup>26</sup>
- Despite rejecting the government’s proposals, the requirement for water companies has been maintained.<sup>27</sup>
- This case study highlights the importance of taking account of the contributions of all sectors and carefully considering fairness, i.e. who should pay for environmental improvements or for avoiding deterioration.

*For more details and the full end-to-end case study, see Annex C.*

<sup>26</sup> House of Commons Library (2023) Nutrient neutrality and housing development. Available at: <https://researchbriefings.files.parliament.uk/documents/CBP-9850/CBP-9850.pdf>

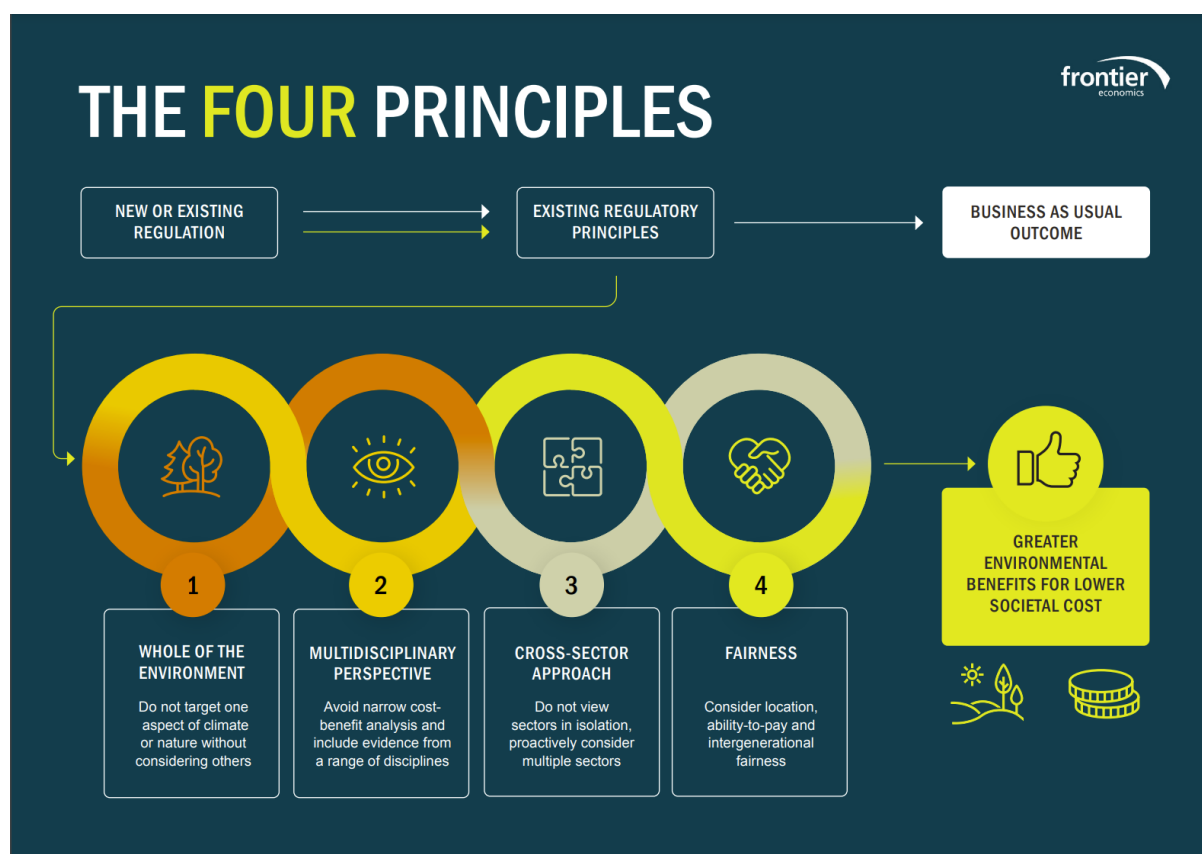
<sup>27</sup> Department for Levelling Up, Housing and Communities (2023), Nutrient Neutrality: Update, <https://www.gov.uk/guidance/nutrient-neutrality-update>

### 3.3 Conclusion

Building on the general principles of good regulation, we have developed four principles for good environmental regulation and have provided illustrative examples about how applying these principles could improve environmental outcomes in two sectors. The four principles are built on the unique attributes of the environment and its complex nature to explain why regulating the environment is different from regulating other sectors.

The four principles challenge the common approach to environmental regulation by refusing to break the environment down into its constituent parts and users. Instead, they encourage policymakers and regulators to capture the complexity of the environment as this maximises benefits and lowers societal costs.

Figure 3 Demonstration of the four principles



Source: Frontier Economics

## 4 How the principles for good environmental regulation support economic growth

### 4.1 The link between good environmental regulation and economic growth

Good environmental regulation is better for economic growth than bad environmental regulation

A number of papers and studies outline the benefits of good regulation for increasing productivity and improving economic growth. Equally, the harms that can come from poorly designed regulation which is time-consuming, costly and bureaucratic have been documented as constraining productivity and dampening economic growth.

As an example of recent discussions, in 2023, the Department for Business and Trade focused on removing the potential negative impact of regulation on businesses and productivity in its “Smarter Regulation to Grow the Economy” policy paper.<sup>28</sup> Similarly, an OECD report noted that *“economies and societies need effective regulations, for growth, investment, innovation, market openness, to support the rule of law and to promote better lives. A poor regulatory environment undermines business competitiveness and citizens’ trust in government, and it encourages corruption in public governance”*.<sup>29</sup>

When thinking about environmental regulation in particular, badly designed environmental regulation can act as red tape, whereas well-designed environmental regulation can be an important tool for delivering the benefits of environmental improvements with the lowest societal costs. Good environmental regulation helps firms to identify the most efficient solution, therefore keeping the cost of implementing and complying with the regulation to a minimum. By keeping the cost of regulation low, businesses can focus their time, money and efforts on other areas. For example, businesses could improve their products further and deliver more value to consumers.

Good regulation of the environment is especially necessary because it supplies the necessary foundation for economic growth

Good environmental regulation is essential for economic growth as the environment is an important asset underpinning our economy. A good environment – including but not limited to

<sup>28</sup> Department for Business & Trade (May 2023), Smarter Regulation to Grow the Economy. Available at: <https://www.gov.uk/government/publications/smarter-regulation-to-grow-the-economy/smarter-regulation-to-grow-the-economy>

<sup>29</sup> OECD (2011), Regulatory Policy and Governance: Supporting Economic Growth and Serving the Public Interest. <https://www.oecd.org/gov/regulatory-policy/regulatorypolicyandgovernancesupportingeconomicgrowthandservingthepublicinterest.htm#:~:text=and%20intergenerational%20justice-.Regulatory%20Policy%20and%20Governance%3A%20Supporting%20Economic%20Growth%20and%20Serving%20the,of%20public%20goods%20and%20services.>

biodiversity in the form of plants and wildlife as well as manageable global temperatures and weather conditions – provides us with the foundations for economic growth in the form of higher productivity and greater ecosystem resilience.<sup>30</sup> As the Dasgupta Review noted, “[w]e are part of Nature, not separate from it”.<sup>31</sup>

Individuals, businesses and communities all rely on nature and the environment on a daily basis, for example for basic resources such as food and water as well as mental health benefits (e.g. from a walk in the park) and oxygen production. The CCC has noted that *“Humanity has prospered in a largely stable global climate. That stability is now at risk.”*<sup>32</sup> Our dependency on the environment is universal and far reaching. A healthier environment is the foundation of a healthier economy, and good environmental regulation has the potential to create the local, national and global conditions that allow economies and people to flourish.

### Moreover, good environmental regulation can spark innovation

There are fears that environmental regulation can reduce productivity in the short term as it represents a cost to firms. That is a risk that should be considered and mitigating actions may be needed. However, environmental regulation and carbon policy can also stimulate innovation and productivity growth. This can improve productivity if the innovation outweighs the cost of compliance. This was demonstrated by Porter (1991) and has been tested empirically in numerous studies.<sup>33</sup> While the literature that directly links environmental policy to productivity is relatively limited and context specific, there is evidence that environmental policies can lead to innovation (if well implemented) and the well-established link between innovation and productivity.<sup>34</sup>

Good environmental regulation can provide clear incentives for businesses and individuals to find new ways of doing things. Knowing the overall direction of travel (e.g. towards a lower carbon economy) provides regulated businesses with the conditions and incentives to invest in technology and other products. Recent work has found that the EU Emissions Trading System has increased low-carbon patenting by 10% without crowding out other innovation.<sup>35</sup> Environmental regulation can ensure a level playing field for all businesses to compete

<sup>30</sup> Dasgupta, P (2021), The Economics of Biodiversity: The Dasgupta Review. Available at: [https://assets.publishing.service.gov.uk/media/6014329ce90e076265e4d9ba/Dasgupta\\_Review\\_-\\_Abridged\\_Version.pdf](https://assets.publishing.service.gov.uk/media/6014329ce90e076265e4d9ba/Dasgupta_Review_-_Abridged_Version.pdf)

<sup>31</sup> Dasgupta, P (2021). The Economics of Biodiversity: The Dasgupta Review. Available at: [https://assets.publishing.service.gov.uk/media/6014329ce90e076265e4d9ba/Dasgupta\\_Review\\_-\\_Abridged\\_Version.pdf](https://assets.publishing.service.gov.uk/media/6014329ce90e076265e4d9ba/Dasgupta_Review_-_Abridged_Version.pdf)

<sup>32</sup> CCC (2017), 2017 Report to Parliament – Summary and Recommendations. Available at: <https://www.theccc.org.uk/publication/2017-report-to-parliament-summary-and-recommendations/>

<sup>33</sup> Porter, M. E., (1991), Towards a Dynamic Theory of Strategy. Available at: <https://onlinelibrary.wiley.com/doi/10.1002/smj.4250121008>

<sup>34</sup> Frontier Economics (2019), Carbon Policy and Economy-wide Productivity. Available at: <https://es.catapult.org.uk/news/uk-productivity-figures-fail-to-reflect-value-of-a-cleaner-economy/>

<sup>35</sup> Calel, R., & Dechezlepretre, A., (2016), Environmental Policy and Directed Technological Change: Evidence from the European Carbon Market. Available at: [https://eprints.lse.ac.uk/62723/1/\\_lse.ac.uk\\_storage\\_LIBRARY\\_Secondary\\_libfile\\_shared\\_repository\\_Content\\_Dechezlepretre%2C%20A\\_ENVIRONMENTAL%20POLICY%20AND%20DIRECTED%20TECHNOLOGICAL%20CHANGE\\_Dechezlepretre\\_ENVIRONMENTAL\\_POLICY\\_AND\\_DIRECTED\\_TECHNOLOGICAL\\_CHANGE.pdf](https://eprints.lse.ac.uk/62723/1/_lse.ac.uk_storage_LIBRARY_Secondary_libfile_shared_repository_Content_Dechezlepretre%2C%20A_ENVIRONMENTAL%20POLICY%20AND%20DIRECTED%20TECHNOLOGICAL%20CHANGE_Dechezlepretre_ENVIRONMENTAL_POLICY_AND_DIRECTED_TECHNOLOGICAL_CHANGE.pdf)

effectively rather than favouring a "race to the bottom". Previous reports from the Aldersgate Group demonstrate that, when implemented correctly, there are clear benefits from environmental regulation in terms of innovation, upskilling and job creation.<sup>36</sup>

Frontier Economics also wrote a report for the Energy Systems Catapult outlining how carbon pricing and environmental standards can drive innovation in the production of less damaging outputs.<sup>37</sup> This innovation will be needed to meet future challenges in climate resilience. A recent CCC report highlighted that, in the UK, there are *"gaps in planning and delivering climate resilience across the board. [...] Proactively building this resilience to climate change will require significant investment"*.<sup>38</sup> Meeting these investments requires appropriate resources including access to funding, skills and time for innovation as well as increased certainty on returns to investment. All of these are more easily accessible in a good regulatory environment.

## 4.2 How the four principles maximise environmental improvements while minimising societal costs

In this section, we provide an illustrative example of how applying the above four principles for environmental regulation could result in positive outcomes. These outcomes include both increased benefits and reduced costs. This example is merely illustrative and does not come from real-world analysis, but we hope it is helpful in demonstrating the benefits of the principles described above.

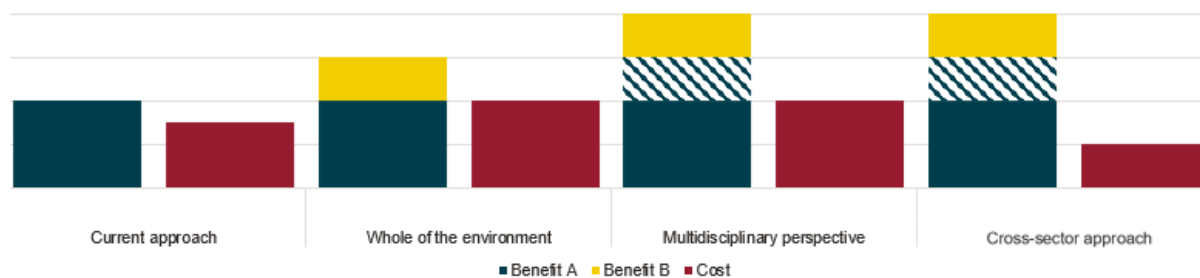
Figure 4 outlines the potential positive outcomes from applying the four principles discussed above. The bars farthest to the left represent the costs (red) and benefits (blue) of enacting a particular piece of regulation using a narrow quantitative CBA approach.

For simplicity, we assume that the benefits of the regulation would outweigh the costs in each case. However, it is simple to envisage a scenario where a regulatory policy that was previously considered to be net negative under the traditional CBA approach turns out to be net positive when considering the four principles. Notwithstanding the above, the most valuable outcome from applying the four principles is the possibility of opening up different regulatory solutions that lead to greater improvements in net societal outcome.

<sup>36</sup> Buro Happold (December 2017), Help or Hindrance? Environmental Regulations and Competitiveness. Available at: <https://www.aldersgategroup.org.uk/content/uploads/2022/03/Help-or-hindrance-Environmental-regulations-and-competitiveness.pdf> and Buro Happold (2021) Fostering Prosperity: Driving Innovation and Creating Market Opportunities Through Environmental Regulations. Available at: <https://www.aldersgategroup.org.uk/content/uploads/2022/03/2103-Fostering-Prosperity-report.pdf>

<sup>37</sup> Frontier Economics (2019), Carbon Policy and Economy-wide Productivity. Available at: <https://es.catapult.org.uk/news/uk-productivity-figures-fail-to-reflect-value-of-a-cleaner-economy/>

<sup>38</sup> Climate Change Committee (January 2023), Investment for a Well-adapted UK. Available at: <https://www.theccc.org.uk/wp-content/uploads/2023/01/Investment-for-a-well-adapted-UK-CCC.pdf>

**Figure 4** Illustrative example of positive outcomes of applying key principles

Source: Frontier Economics

Note: This example is not based on a real-world sector or piece of regulation and is purely illustrative. The left-hand blue and yellow bars represent the benefits of a given piece of regulation, and the right-hand red bars represent the costs of the regulation. All costs and benefits are societal rather than private.

Using a whole of the environment approach highlights that tweaking the regulation could achieve benefits across multiple environmental objectives. To repeat an example used earlier, the switch towards EVs to reduce carbon emissions would also lead to improvements in air pollution and nature outcomes. In this illustration, the costs of this alternative piece of regulation are higher than under the original piece of regulation, in this case by 25%. However, the benefits increase by a greater amount than the costs – in this case by 50% – because benefit B (yellow) has been added to benefit A (blue). This means that the net societal benefit is twice as large under the alternative regulation than under the original.

Including a multidisciplinary perspective in our example demonstrates to regulators that valuing benefit A under a traditional quantitative CBA approach has in fact undervalued it. By including a wider multidisciplinary perspective, the regulator can see that the benefits to society from the piece of regulation are greater than previously expected, in this case doubling the net benefit to society from the regulation.

Finally, using a cross-sector approach uncovers an alternative piece of regulation that achieves the same benefits to society. However, these benefits can be realised at half the cost under a new piece of regulation compared to under the previous regulation, which increases net benefit to society by another 50%.

As these positive outcomes stack on top of each other, the cumulative improvements from following the key principles result in regulators identifying alternative regulations that deliver more environmental value for lower societal cost. However it is important to note that while these net impacts on the environment will likely be positive, there could be trade-offs.

## 4.3 Conclusion

Good environmental regulation can support economic growth and innovation. As with all regulation, there is a need for environmental regulation to be well designed and well implemented to achieve these benefits, but the necessity for environmental regulation is clear



given that the environment is the underpinning of our economy. Moreover, the fears of productivity loss in the short term by increasing the regulatory burden on businesses do not take account of the dynamic effect of environmental regulation and its ability to spark innovation. This was first raised by Porter in 1991 and the literature has multiple examples since to support this theory.

Our illustrative example demonstrates how the applications of the four principles could have the potential to change the cost-benefit ratio and deliver more environmental improvements at lower costs. This would be through the combination of exploring new options for environmental regulation and understanding the full costs and benefits of any given approach.



## 5 How to apply the principles for good environmental regulation in practice

This section unpacks the four principles and outlines how they can be applied in practice when designing or reforming regulation to improve environmental outcomes at a reduced cost to society.

### 5.1 How the principles fit into existing policy frameworks

#### 5.1.1 The ROAMEF framework

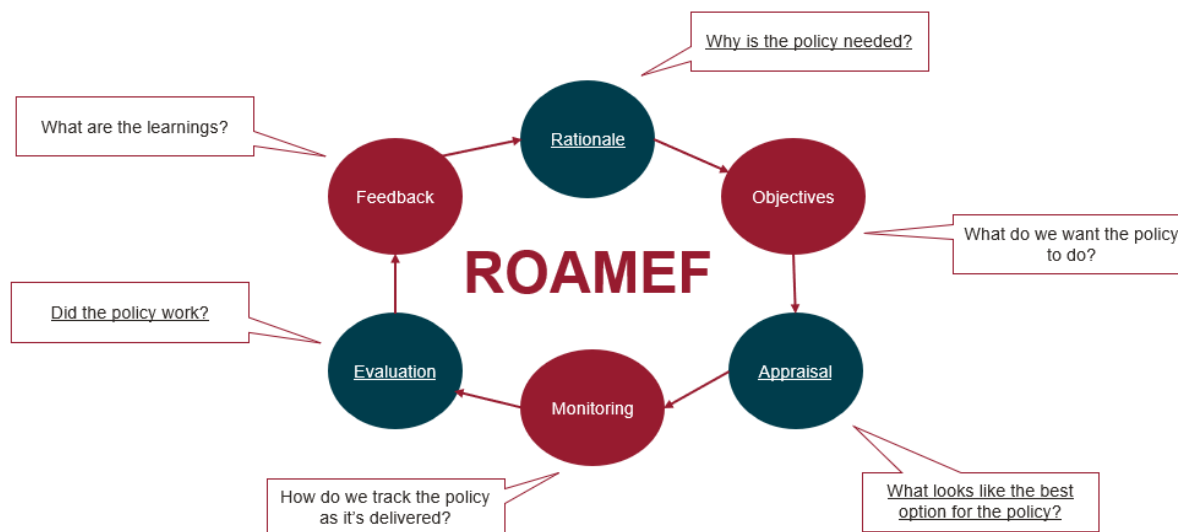
HM Treasury's *Green Book*<sup>39</sup> is the central guidance document for policy design and appraisal used by the UK government. While other department-specific guidance documents exist, the foundations of each of these tailored documents is the *Green Book*. We therefore focus on the *Green Book* and how the four principles can fit within this framework, to increase the applicability of our principles across multiple government departments.

The *Green Book* presents a framework called “ROAMEF” (Rationale, Objectives, Appraisal, Monitoring, Evaluation, and Feedback – see Figure 5.) that should be used for the appraisal and evaluation of all programmes. As regulation is a subset of policy, the ROAMEF framework is a useful tool for critically assessing the stages of regulation making, spanning:

- The design phase (including articulating the rationale, defining objectives and conducting appraisal);
- The delivery or implementation phase (encompassing monitoring); and
- The evaluation or reform phase (including feeding evaluation evidence back into the policy cycle).

The four principles are designed to be used alongside this framework and to fit into the existing stages. Our view is that it would be most relevant to consider the four principles during the rationale, appraisal and evaluation stages of the cycle. The rationale stage is where the justification for an intervention is developed, the appraisal stage is where various options for the intervention are compared, and the evaluation stage is where the chosen intervention is assessed. The four principles could form the foundation of the criteria used in each of these stages, which are highlighted in blue in Figure 5.

<sup>39</sup> HM Treasury (2022), The Green Book. Available at: <https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government/the-green-book-2020>

**Figure 5** ROAMEF policy cycle

Source: Frontier Economics based on the UK Green Book

Note: Rationale, Appraisal and Evaluation are in blue and underlined (along with their accompanying question) as these are the areas where the four principles are likely to be most appropriate to consider.

Consider the illustrative scenario where a regulator is designing a new piece of regulation.<sup>40</sup> Following the ROAMEF cycle, the regulator would articulate the rationale for the regulation by explaining how it could improve the intended outcomes and impacts. Regulators should therefore carefully consider what the outcomes of interest are by taking a whole of the environment approach which includes a multidisciplinary perspective. The rationale for the regulation should also consider whether there are cross-sector synergies that could be exploited and whether the costs and benefits of the regulation should be equally distributed. The four principles could equally be applied in a similar manner in the appraisal and evaluation phases of existing and new regulations.

Section 5.2.1 provides further details on the specific questions that regulators could consider at each of these stages.

### 5.1.2 The Environmental Principles

As outlined in Section 2.3, the UK government has five Environmental Principles. These are the integration principle, the prevention principle, the rectification at source principle, the polluter pays principle and the precautionary principle. The aim of these principles is to ensure that the environment is considered in new policies and regulation in all areas.

The four principles outlined in this report are designed specifically for circumstances where new environmental regulation is being considered or when reviewing the effectiveness of

<sup>40</sup> In practice, the responsibility for designing regulation may not fall solely to the regulator, but as the piece of regulation would likely be included in a broader policy envelope, the responsibility for designing the regulation may be undertaken by the relevant governmental department or split between the UK government and the regulator.

existing policies. This report builds on the existing principles and expands them in the context of environmental regulation:

- The whole of the environment principle builds on the prevention principle to emphasise consideration of a broader perspective. Regulations that seek to improve one aspect of the environment should not lose sight of the potential harm incurred in other areas of the environment at the same time.
- The multidisciplinary perspective principle acknowledges the limitations of narrow CBA approaches and encourages the use of wider evidence and other techniques that are more appropriate for handling the non-linear and irreversible effects of environmental damage, while bringing in evidence from other disciplines. This fully supports the integration principle. In many cases, this broader approach is also likely to prioritise addressing environmental damage at its source, rather than tackling some of the later effects on the environment and implicitly allowing the damage to build up in others. This is in line with the rectification at source principle.
- The fairness principle makes sure that multiple elements – location, ability to pay and intergenerational fairness – are considered when determining where the burden of improving the environment should fall. This builds on the polluter pays principle but takes a broader view. In many cases, polluters paying for the damage they cause may be the fair outcome, but the fairness principle permits regulators to allow for other arrangements in appropriate circumstances, whereas of the polluter pays principles is more restrictive.

## 5.2 The role of regulators

### 5.2.1 Questions for consideration when developing options for new regulation or reforming existing regulation

To help apply the four principles, we outline a list of practical questions for regulators. This is not exhaustive but is intended as a starting point to encourage regulators to assess new or existing regulation in order to ensure that regulation maximises environmental benefits and minimises social costs. These questions can be used when reforming existing regulation, or when appraising options for new regulation.

Our list is split by the four principles, and for each principle we list a small number of binary (yes/no) questions and one open question (in italics). Regulation that responds “yes” to the binary questions tends to follow the four principles better. While we do not necessarily expect all good environmental regulation to respond “yes” to all of the binary questions, a large number of negative responses might suggest that regulators should consider modifying the design of new regulation or reforming current regulation to reflect the principles.

- Whole of the environment

- ☐ Does the regulation consider all aspects of the environment rather than centring on one?
- ☐ Does the regulation focus on broader environmental outcomes instead of narrow inputs and outputs?
- ☐ Does the regulation consider the costs and benefits over a long-term horizon?
- ☐ Does the current approach maximise synergies and deliver additional benefits to other areas of the environment?
- ☐ Does the current approach minimise the effects of unintended consequences on the environment?
- ☐ *How could the regulation be redesigned such that it maintains the current environmental improvements and improves other environmental outcomes? How could any barriers to this be overcome?*
- Multidisciplinary perspective
  - ☐ Does the approach to evaluating regulatory options include non-monetizable benefits and costs instead of relying solely on a standard CBA?
  - ☐ Does the evaluation approach take sufficient account of threshold effects, tipping points and other non-marginal effects?
  - ☐ Does the evaluation methodology consider the risk of inaction or limited action?
  - ☐ Is the evaluation methodology capable of estimating cost and benefits when there are uncertainties?
  - ☐ *How would involving the views of other disciplines – including chemistry, biology, ecology, engineering, health and land use – change the choice of regulatory approach?*
- Cross-sector approach
  - ☐ Does the regulation target multiple relevant sectors rather than focusing on a single sector in isolation?
  - ☐ Is there a good understanding of how this regulation would influence other sectors that are not directly covered by the regulation but are connected to the regulated sector(s)?
  - ☐ Does this regulation take account of potential synergies with existing or new regulation in other sectors to maximise environmental benefits and reduce costs?

- Is the regulator coordinating with other regulators that are either necessary for the regulation to be effective or that are tackling similar environmental issues?
- Has the regulation carefully considered the trade-offs between different policy objectives to ensure that net benefits are achieved across all the regulated sectors?
- *How could incorporating the impacts of a regulation on other sectors into the decision on regulatory approach improve the regulation from society's perspective (either by increasing societal benefits or by reducing societal costs)?*

### ■ Fairness

- Is the allocation of the costs and benefits of a regulation fair between groups located in different locations?
- Is the policy addressing a previous place-based inequality?
- Does the regulation fairly allocate the costs and benefits between different income groups, ensuring that vulnerable groups are sufficiently supported and protected?
- Does the regulation follow the default of the polluter pays or have a good reason for deviating?
- Does this regulation improve or help maintain intergenerational fairness?
- *Are all current and future individuals treated equally by this regulation? If not, then how is that difference justified?*

## 5.2.2 Resources required

This report provides a tool for regulators and regulatory authorities to use, with the four principles providing a means to improve the regulations they design and reform. The report therefore outlines both the basic and more environmentally focused principles that regulators (alongside policymakers) currently use, how the four principles might improve regulatory design, and how these principles can be practically used alongside current regulatory and policy frameworks.

These new tools will be of limited use if regulators are not given the resources and powers to use them. Regulators must design enforceable regulation and be given the financial and human resources to enforce it.

For example, in 2023 Ofgem was given a new statutory regulatory duty around net zero. This requires Ofgem to continue protecting the interest of current and future gas and electricity consumers, but to do so by supporting the government in meeting its legal obligations to get to net zero by 2050, as required by the Climate Change Act 2008. This duty formed part of Ofgem's consultation on its 2024/25 work programme which was published last year and closed in early February. However there has been no announcement of increased funding or

human resources provided to Ofgem to support this increased responsibility. Making decisions consistent with environmental regulation is not a generalist skill, and Ofgem will need experts who can understand how to apply this duty in practice.

It is beyond the scope of this work to detail what additional resources regulators need to accompany their increasing environmental responsibilities. It is clear to say that some additional resources are needed.

### 5.3 Conclusion

It is important for the four principles to be practical, otherwise they present helpful tools in theory only. This section showed how the principles can be used at multiple stages of the existing ROAMEF framework to either design new regulation or reform existing regulation, and how these principles can work alongside the existing Environmental Principles to apply some of their direction to environmental regulation specifically.

Regulators have a crucial role in ensuring that good environmental regulation is not just designed but is implemented and enforced. We provide a starting point for regulators to use during the relevant ROAMEF stages in the form of a list of questions. While not exhaustive, regulators can use the binary questions to start assessing whether a piece of regulation is fit for purpose or needs adapting and modifying. The open questions challenge regulators to think more broadly about the regulation they are designing or reforming, and whether any significant improvements could be made.

However, providing additional responsibilities to regulators may not improve environmental and economic outcomes if additional financial and human resources are not provided alongside. Regulators have increasing responsibility to support the government in reaching net zero and nature goals, but this responsibility may not convert into results if the regulatory tools used are not enforceable and hence do not elicit behavioural change. Therefore improvements to regulation should be considered alongside strengthening regulators.

## 6 Policy recommendations and conclusion

### 6.1 Policy recommendations

The four principles described in this report can also be interpreted as providing a series of recommendations for regulators. These recommendations follow the principles below:

- **Target outcomes not outputs:** The purpose of environmental regulation is to improve environmental outcomes. Regulators should therefore target the outcome of interest as directly as possible. There may be times when targeting the outcome is not possible, is more difficult or is more costly. In these instances, regulators should evaluate and consider whether targeting outputs can still enable the desired outcomes, and keep in mind the unintended consequences and transaction costs that may come with targeting outputs instead of outcomes.
- **Full assessment of societal costs and benefits:** CBAs often do not consider the non-quantifiable benefits and non-marginal effects on the environment. Evaluation of regulatory policies to improve the environment should follow best practice by supplementing a narrow focus on costs and benefits with evidence from other disciplines, such as chemistry, biology, ecology, health, engineering and economics (which may be in a qualitative form). This can be done within a rigorous, economic framework and builds upon guidance that already exists in HM Treasury's *Green Book*. Employing multi-criteria analysis, for example, would allow consideration of qualitative and quantitative factors to identify the most appropriate regulatory option.
- **Recognise the cost of inaction or insufficient action:** There is an economic and social cost to a "do nothing" or "do minimal" approach in the case of environmental regulation. There may be societal costs in the form of a worse natural environment, and it could also cost more in the future to reverse the damage done to the environment (in some cases it may not be possible at any cost to reverse the damage). While technically the costs of a "do nothing" approach do need to be considered in a CBA, some interpretations of the precautionary principle can bias regulators and policymakers towards the "do nothing" approach, if taking any particular action has the potential to damage some part of the environment. It is therefore important to actively remove any status quo bias and consider the damage from inaction on a level playing field with the damage from action. One way to account for the cost of inaction in regulatory assessments may be for regulators to consider longer time horizons when evaluating and comparing potential solutions, i.e. more than just the next five to ten years that often form the basis for price control (or similar) reviews.
- **Innovation at scale for the environment:** As this report makes clear, regulation can help incentivise innovation at scale as it provides a level playing field and certainty for investment. Regulatory policies can be seen to have encouraged and promoted innovation by creating the environment where businesses can safely innovate.



Environmental regulation should not be risk averse. The pace of environmental change means it is important and urgent that this type of regulation is encouraged further, to promote innovation within environmental boundaries, and that the perfect is not the enemy of the good. A new approach to learning-by-doing may be needed, and this could involve the following steps:

- Employ regulatory sandboxes so that businesses are able to test innovative propositions in the market with real consumers without creating wider risks to environmental systems;
  - Evaluate and assess the tested solution by gathering the necessary data and performing regulatory assessments, taking broader environmental objectives into account;
  - Collaborate with businesses, consumers and other stakeholders (e.g. those with specialist environmental knowledge) to refine and improve solutions where needed; and
  - Incrementally roll out the refined solutions while continuously monitoring, evaluating and refining the solutions to ensure widespread rollout of the most efficient and innovative solutions.
- 
- **Factor in climate and nature tipping points and irreversibility:** Regulators should be conscious of tipping points in both climate and nature when formulating regulatory policies. There are certain thresholds in time or certain areas of environmental regulation that, if passed, cannot be undone (e.g. extinction of a species). While this report encourages the promotion of innovation in regulatory activities, tipping points may be times where the risk of something going awry is too large for regulators, and hence regulators should not take risks with alternative solutions. These red lines should then be shared transparently with regulated businesses. Note that some of these red lines may not be evident from the outset, but we expect that these may become known when regulators assess and evaluate regulations in accordance with the four principles.
  - **Primary focus on the polluter pays:** The default for regulation should be that the polluter pays for the damage it causes – this reflects an existing Environmental Principle (Section 2.3). This default would be consistent with an outcomes approach whereby polluters have flexibility in how they meet the requirements. Deviations should be clearly justified and consistent with efficiently tackling the issues identified. There may be times when it is not possible to attribute pollution to a single source – given the silent, mobile interconnectedness of the environment – or when applying the polluter pays principle would involve applying retrospective responsibility. In these cases, regulators should carefully consider how the cost of improving the environment is allocated between sectors and business, and should avoid a situation where all the burden falls on one group of individuals, unless there are good reasons for doing so. This may involve government accepting that there can be a trade-off between acting early to undo environmental



damage and ensuring full cost recovery from past polluters, and that achieving the former should more than compensate for compromising on the latter.

- **Increased cross-sector collaboration:** Current regulation across sectors is fragmented, with different sectors having different incentives. Greater collaboration between regulators can be achieved in numerous ways. While an assessment of the potential approaches to achieve this is out of scope for this report, we outline three ways in which increased collaboration can be achieved, with varying degrees of intervention:
  - A low intervention approach could keep the current regulatory bodies and reporting pathways unchanged but promote greater collaboration between regulators of different sectors on a day-to-day basis.
  - A medium intervention approach could keep the current regulatory bodies as they are but have an overarching regulatory body that operates across the different sectors, ensuring that regulations are designed with consideration of cross-sector factors and impacts. The OEP could make a good candidate for this overarching regulatory body, although it would need to be strengthened and have its roles and resources expanded to be able to successfully achieve these aims.
  - A high intervention approach could replace current regulatory bodies with a single regulator that would have the power to regulate across all the different sectors on issues relating to the environment.
- **Ensure the resources of regulators increase with their responsibilities:** The recommendations above suggest that regulators should undertake new and more detailed analysis, prioritise action over inaction, create an environment that fosters innovation and collaborate more systematically to build a more consistent and holistic approach to regulation across the economy. These suggestions are also combined with the increasing responsibility of regulators to help the UK government reach its legal net zero goals as well as increasing calls for regulators to improve adherence to existing regulation. For regulators to meet these objectives and ensure that, as well as regulation being well designed, it is well enforced, they will likely need the financial, administrative and human resources that they have available to increase, especially to ensure they have the relevant experts.

## 6.2 Conclusion

The Aldersgate Group commissioned Frontier Economics to identify how to design and reform environmental regulation to support the delivery of climate and nature goals as well as economic growth.

The literature on the principles of good regulation provides a well-established set of five core principles that can be usefully applied to regulation across all sectors. This report develops an additional set of four principles that are specific to the design and reform of environmental

regulation. The four principles challenge the common approach to environmental regulation of splitting the environment up into its constituent parts and sectors, and instead encourages policymakers and regulators to capture the complexity of the environment.

The four principles for a whole-of-environment and cross-sector approach are particularly important in the context of the current fragmented structure of government when viewed from an environmental perspective. For example, net zero is part of the Department for Energy Security and Net Zero, the Environmental Improvement Plan falls under the Department for the Environment, Food and Rural Affairs and policies around nutrient neutrality come from the Department for Levelling Up, Housing and Communities. This means that it is even more important to ensure that environmental regulation is not designed in a silo with a focus on a single aspect of the environment or a single sector.

Our case studies and illustrative examples demonstrate how the application of the four principles has the potential to change the cost-benefit ratio and therefore deliver greater environmental improvements at lower costs. Successfully applying these principles would not only reduce environmental damage and help restore the environment but could spark innovation and lead to increases in productivity and economic growth within the UK. This dynamic effect should be taken into account to counter short-term concerns that regulation acts as red tape that costs businesses and slows down progress.

However, for these principles to have a positive impact, they need to be implemented in practice. This means ensuring that they have a place in the regulatory cycle and that regulators have the means for implementing and enforcing the regulation that they design. We demonstrated how the principles fit into the existing ROAMEF policy framework and how they can sit alongside the Environmental Principles already in place. Recognising that the status quo is a choice, we recommend that regulators re-evaluate existing regulatory policies, and we provide a starting set of questions to be used for this purpose (and to be used when designing new regulation). However, high-quality regulation can only be reformed or designed in the first place if regulators have the resources required for the task. This includes financial resources and having the necessary experts who can understand the environmental costs and benefits, so that increased regulatory responsibility is converted into results.

## Annex A – Glossary and Abbreviations

- 25YEP - 25 Year Environment Plan: a report published by the UK government in 2018 to accelerate nature restoration in England.
- CBA - Cost-benefit analysis
- CCC - Climate Change Committee: an independent non-departmental public body, formed under the Climate Change Act 2008 to advise the UK and devolved governments on tackling and preparing for climate change.
- EA - Environment Agency: a non-departmental public body in the UK responsible for the protection and enhancement of the environment in England.
- HM Treasury's Green Book: guidance issued by HM Treasury on how to appraise policies, programmes and projects.
- NAO - National Audit Office: the UK's independent public spending watchdog, which supports parliament holding the government to account.
- OEP - Office of Environmental Protection: a public body which protects and improves the environment by holding government and other public authorities in the UK to account.
- The Dasgupta Review - Dasgupta, P., (2021). The Economics of Biodiversity: The Dasgupta Review
- The Environmental Principles: five principles introduced as part of the Environment Act in 2021 which it is now the legal duty of ministers to have due regard to when making policy.<sup>41</sup> These are: the integration principle, the prevention principle, the rectification at source principle, the polluter pays principle and the precautionary principle.
- The five core principles: five core principles of good regulation which were succinctly set out by the Better Regulation Taskforce.<sup>42</sup> They are: proportionality, accountability, consistency, transparency and targeting.
- The four principles: the four principles outlined in this report which should be applied when designing or reforming environmental regulation specifically. These build on the five core principles of good regulation and the Environmental Principles. The four principles are: whole of the environment, multidisciplinary perspective, cross-sector approach and fairness.
- WINEP - Water Industry National Environment Programme: the programme of work that water companies in England are required to do to fulfil their obligations arising from environmental legislation and UK government policy.

<sup>41</sup> DEFRA (2022), Environmental Principles Policy Statement. Available at: <https://www.gov.uk/government/publications/environmental-principles-policy-statement/environmental-principles-policy-statement#environmental-principles-an-overview>

<sup>42</sup> Better Regulation Taskforce (2003), Principles of Good Regulation. Available at: <https://www.rqia.org.uk/RQIA/media/RQIA/Resources/Better-Regulation-Task-Force-Principles-of-Good-Regulation.pdf>

## Annex B - Case study #1

This case study examines the issues raised in the report through the lens of previous (“backward-looking”) and future (“forward-looking”) measures to reduce carbon emissions from vehicles.

### B.1 Backward-looking: increase use of diesel in passenger vehicles

#### Background

In the late 1990s and early 2000s, there was a move towards diesel cars in Europe. Rates of diesel car ownership in Great Britain increased from fewer than 2.5 million registered cars in 1997 to over 7 million in 2008, meaning that the proportion of cars that were diesel more than doubled from 11% to 25%.<sup>43</sup> The intention behind this shift towards diesel was to reduce the level of carbon dioxide and hence slow climate change but, as diesel has higher levels of air pollutants than petrol, this led to worse nature and health outcomes. These included acid rain, depletion of soil nutrients, reduced ecosystems and damaging health effects on people’s hearts and lungs.<sup>44</sup> This was driven by a number of policies including fuel prices, scrappage schemes and vehicle excise duty, as well as two specific pieces of regulation:

1. **Fleet CO<sub>2</sub> emissions standard:** In 1997, the EU signed the Kyoto protocol, agreeing to cut carbon emissions. This led to an agreement with European car manufacturers that they would reduce emissions by 25% in ten years. This converted to an average emissions intensity standard of 140gCO<sub>2</sub>/km across the fleet of European cars sold in 2008.
2. **Vehicle air pollutant regulation:** The EU designed standards on air pollution from vehicles, known as EU1-6. These standards became more stringent over time and were based on the latest technologies. As diesel had historically emitted more nitrous-oxide and particulate matter than petrol, there were separate standards for petrol and diesel cars where the standards on diesel cars were less stringent.

As diesel had 15% lower CO<sub>2</sub> emissions than petrol, increasing the sale of diesel cars helped manufacturers’ attempts to meet the emissions standards, and the more lenient EU1-6 emissions standards for diesel allowed this to occur.

#### Assessment of both regulations against the four principles

- **Whole of the environment:** Both regulations were outcome focused rather than output focused, which is generally a positive approach that allows firms to innovate. However,

<sup>43</sup> DfT and DVLA (2022), VEH1103: Licensed Vehicles by Body Type and Fuel Type.

<sup>44</sup> US Environmental Protection Agency (2023), Learn About Impacts of Diesel Exhaust and the Diesel Emissions Reduction Act (DERA). <https://www.epa.gov/dera/learn-about-impacts-diesel-exhaust-and-diesel-emissions-reduction-act-dera>

the voluntary standard only considered CO<sub>2</sub> emissions rather than something broader (such as CO<sub>2</sub>e emissions), and this allowed greater use of diesel cars to contribute to meeting the fleet standard, despite their negative consequences on nature and health.

- **Multidisciplinary perspective:** While it is not clear how the views of disciplines such as those of biology and health experts were taken into account, we expect that more emphasis on a multidisciplinary perspective could have broadened the scope beyond CO<sub>2</sub> emissions or encouraged more stringent standards for diesel.
- **Cross-sector approach:** The voluntary agreement and EU1-6 standards were inherently focused on passenger vehicles. Even more than that, the EU1-6 standards treated petrol and diesel vehicles distinctly – meaning that they had different emissions standards – rather than together as “passenger cars”. A joined-up approach that treated petrol and diesel equally under the EU 1-6 standards might have prevented high-polluting diesel cars being permitted.
- **Fairness:** While the reduction in CO<sub>2</sub> emissions would have benefitted everyone equally, the increase in air pollution would have been more significant in areas where there was heavy traffic. Applying a place-based lens, this would have led to unfair outcomes as the benefits were felt by all but the costs were borne more heavily by some. A careful consideration of fairness might have revealed these distributional impacts.

In conclusion, the principles can be used to demonstrate that, while the two regulations were well intentioned, they did not consider other regulations in the sector or areas of the environment and hence led to negative health and nature outcomes. Bringing in other disciplines might have led to a different regulatory approach.

## B.2 Forward-looking: decarbonising diesel-heavy HGVs

### Background

HGVs are commercial vehicles over 3.5 tonnes and the typical lifespan is 7-14 years.<sup>45</sup> Light HGVs are 3.5-26 tonnes and heavy HGVs are over 26 tonnes. HGVs operate urban and regional journeys where drivers generally return to depots overnight (depending on distance) as well as long-haul journeys where drivers rest overnight as part of the journey.<sup>46</sup>

<sup>45</sup> DfT (2021), Consultation on When to Phase Out the Sale of New, Non-zero Emission Heavy Good Vehicles. Available at: <https://assets.publishing.service.gov.uk/media/611150c68fa8f506cca9226f/consultation-on-when-to-phase-out-the-sale-of-new-non-zero-emission-heavy-good-vehicles.pdf>

<sup>46</sup> SMMT(2023), Charging and Refuelling Requirements of the Heavy Good Vehicles Sector. Available at: <https://www.smmmt.co.uk/wp-content/uploads/SMMT-Position-Paper-Charging-and-Refuelling-Requirements-for-the-Heavy-Goods-Vehicle-Sector.pdf>

Ninety-nine percent of HGVs use diesel,<sup>47</sup> and HGVs were responsible for 18% of UK domestic transport emissions in 2019<sup>48</sup> and 21% in 2021.<sup>49</sup> The government has implemented a ban on the sale of non-zero emission light HGVs by 2035 and heavy HGVs by 2040, and has set fleet emissions standards which require fleet emission reductions of 15% by 2025 and 30% by 2030.<sup>50</sup>

There are four methods for reducing the CO<sub>2</sub> emissions of HGVs. Technology and operations can be improved to increase fuel efficiency, and low-carbon fuels can reduce lifecycle emissions. However, these are generally accepted to be short-term transition options, while longer-term decarbonisation technologies – electric and hydrogen – are being developed.<sup>51</sup> Nevertheless, there are a number of barriers to decarbonising HGVs:

- **Technology:** Operators are concerned they will choose the “wrong” technology out of electric and hydrogen while the market is developing, and they therefore hesitate to decarbonise at all.
- **Infrastructure:** Neither depot nor on-the-go infrastructure is currently available to support either the charging or refuelling of zero-emission HGVs.
- **Cost:** The upfront costs of zero-emission HGVs are greater than for diesel and there is uncertainty about lifecycle costs including the price of repairs and end-of-life value.
- **Operational challenges:** Bringing in new technology may disrupt current operations, especially if the skills are not available to support vehicle repair. Moreover, leasing of HGVs can make it difficult for operators to switch even if they want to.
- **Vehicle availability:** Limited models and supply chains mean it can be hard for operators to purchase a zero-emission vehicle even if they want to.
- **Other regulation:** Other regulations can be slow to catch up to zero-emission technologies. For example, there is a maximum limit on vehicle weight, and heavy batteries and hydrogen storage tanks would mean that HGVs would struggle to carry the same loads.

<sup>47</sup> SMMT(2023). Charging and Refuelling Requirements of the Heavy Good Vehicles Sector. Available at: <https://www.smm.co.uk/wp-content/uploads/SMMT-Position-Paper-Charging-and-Refuelling-Requirements-for-the-Heavy-Goods-Vehicle-Sector.pdf>

<sup>48</sup> DfT (2022), Future of Freight: A Long-term Plan. Available at: <https://assets.publishing.service.gov.uk/media/62b9a2ec8fa8f53572e3db68/future-of-freight-plan.pdf>

<sup>49</sup> DfT (2023), Call for Evidence: Infrastructure for Zero Emission Heavy Good Vehicles and Coaches. Available at: <https://www.gov.uk/government/calls-for-evidence/infrastructure-for-zero-emission-heavy-goods-vehicles-and-coaches/infrastructure-for-zero-emission-heavy-goods-vehicles-and-coaches>

<sup>50</sup> DfT (2022), Future of Freight: A Long-term Plan. Available at: <https://assets.publishing.service.gov.uk/media/62b9a2ec8fa8f53572e3db68/future-of-freight-plan.pdf>

<sup>51</sup> The CCC has stated that low-carbon fuels should be phased out of HGVs by 2050, as they arguably have better uses in other sectors. CCC (2020), Sixth Carbon Budget. Available at: <https://www.theccc.org.uk/wp-content/uploads/2020/12/The-Sixth-Carbon-Budget-The-UKs-path-to-Net-Zero.pdf>

## Applying the principles for good environmental regulation

As an illustration of the four principles, we undertake a preliminary assessment of two regulations that could be used to decarbonise HGVs (alongside the proposed ban and emissions standards already in place). To keep the assessment broad, we assess categories of regulation rather than individual pieces.

5. **Mandates on vehicle numbers** – while there is currently a proposed ban on new HGVs from 2035/2040, some are calling for increasing annual mandates that create a staircase to the ban. This would increase demand for zero-emission HGVs, which could encourage investment in infrastructure and greater vehicle availability and could lead to economies of scale and learning-by-doing, which could reduce upfront vehicle costs.
6. **Regulation related to depot charging/refuelling** – including improved planning processes, an improved process for grid connections and mandating landlords to approve plans for charging/refuelling. While on-the-go infrastructure will be important, we focus on depot infrastructure because 70-90% of refuelling currently happens at depots or destinations (rather than on the go). This regulation would not directly impact demand but would enable investment in infrastructure.

**Table 1** Preliminary assessment for regulatory options to decarbonise HGVs

Principles	Mandate on vehicle numbers	Regulation on depot charging/refuelling
Whole of environment	<ul style="list-style-type: none"> <li>■ Output-focused regulation which targets a technology rather than emissions more broadly, meaning that zero-emission HGVs could be purchased but rarely used (having little impact on emissions).</li> <li>■ Would need to consider lifecycle emissions of battery and risk of hydrogen leakage.</li> </ul>	<ul style="list-style-type: none"> <li>■ Output-focused regulation rather than outcome-focused, but this could be helpful to remove specific and identified barriers that are in the way.</li> <li>■ Charging/refuelling would require additional land use, so it is important to make sure this does not impact biodiversity. This consideration would need to be part of the improved and more streamlined planning process.</li> </ul>
Cross-sector approach	<ul style="list-style-type: none"> <li>■ The design of the mandate could influence the respective roles of electric and hydrogen HGVs. This decision should consider the whole system benefits of either option, as any decisions made related to the technology of HGVs should consider the technology used in passenger vehicles as well as the networks available.</li> </ul>	<ul style="list-style-type: none"> <li>■ Improving the planning and grid connection processes will involve significant collaboration between sectors with the relevant regulators.</li> <li>■ The regulation could influence the respective roles of electric and hydrogen HGVs and this decision should be made jointly with the relevant networks and fuel producers to ensure fuel will be available for HGVs to use. Given that networks and fuel producers have a number of demand sectors, this decision will need to align with those sectors.</li> </ul>
Multi-disciplinary perspective	<ul style="list-style-type: none"> <li>■ Zero-emission HGVs should not have the same unintended health or nature outcomes as occurred with diesel, but health and biology experts may still need to be consulted.</li> <li>■ Given the cross-sector approach outlined above, specialists such as engineers may need to be consulted when considering how to maximise whole system benefits.</li> </ul>	<ul style="list-style-type: none"> <li>■ As network capacity and requirements are of crucial importance, an engineering perspective should be included.</li> <li>■ Given the potential trade-off with alternative land use, land use teams within government should be consulted.</li> </ul>
Fairness	<ul style="list-style-type: none"> <li>■ Mandate and regulatory reform would both reduce air pollution in geographic areas where zero-emission HGVs are used (due to the reduction in diesel). This would undo a current place-based inequality where air quality is lower in areas with higher HGV traffic.</li> </ul>	

Source: Frontier Economics



## Conclusion

Given that both types of regulation could influence the respective roles of electric and hydrogen HGVs or remain agnostic, a cross-sector approach is of crucial importance to maximise whole system benefits. This would require collaboration with fuel producers, networks and other demand sectors to understand whether there were synergies that should be exploited or competition and bottlenecks that should be avoided.

Both types of regulation are more output focused than outcome focused. There is an important trade-off between making vehicle mandates overly prescriptive and usefully dismantling specific barriers to infrastructure investment if these barriers are definitively known. It is important to consider this trade-off when determining whether a more outcome-focused or a more output-focused set of regulation has greater societal benefits.

Using the principles to assess and compare different options for regulation has helped to pull out important considerations that need to be made and the relative advantages and disadvantages of either approach.

## Annex C - Case study #2

This case study examines the issues raised in the report based on experience in the water sector of balancing multiple objectives for nature and the use of water.

### C.1 Overview of water catchments

In England, the government's 25YEP provides an ambitious policy framework for improving the environment. Its targets aim to deliver a more diverse, resilient and healthy natural environment, which includes progress on clean and plentiful water.

A water catchment is an area of land through which water from any form of precipitation (such as rain, melting snow or ice) drains into a body of water (such as a river, lake or reservoir). Water catchments are an example of a "common pool resource". It is very difficult to limit access to them, but their supply is fixed, meaning they can be depleted over time through overuse.

Water quality in the catchments is affected by the actions of a range of agents (see Figure 6), including discharges by water companies as a result of the wastewater treatment process and run-off from fertiliser and pesticides in agriculture.

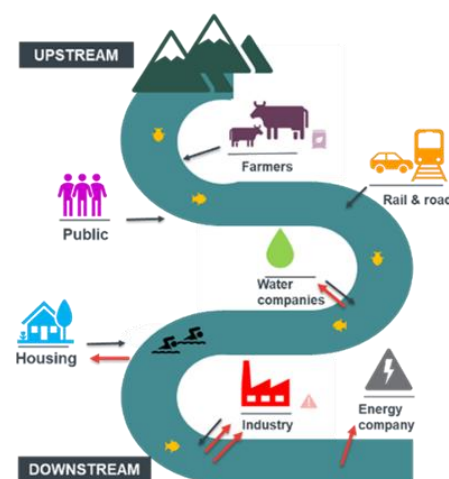
In addition to the numerous agents, there are a multitude of regulators that regulate water quality in England. For example, the EA and Ofwat regulate water companies. The EA also works alongside the Department for Environment Food and Rural Affairs (DEFRA) to regulate farmers and landowners, and Natural England provides guidance to local planning authorities on the regulation of new housing developments in protected sites.

This section does not seek to perform a comprehensive assessment of all the regulators and their regulation in the catchments. Instead, we provide illustrative examples that demonstrate how the principles of good environmental regulation can be applied in practice to improve regulation.

### C.2 Whole of the environment

Regulation of water catchments currently deals with specific issues and/or nutrients in isolation, rather than focusing on the overall outcome within the catchment. For example, the

**Figure 6** Illustration of agents in water catchments



regulatory regime under the EA has been focusing water company assets to target chemicals such as nitrogen, phosphorus and ammonia. Phosphorus in particular has been heavily targeted by the EA in recent years as it has historically been the most common reason for rivers not achieving good ecological status.<sup>52</sup>

In the past, obliging water companies to deliver a prescriptive list of outputs was an effective approach to improve river water quality as there were many “low-hanging fruit”. However, investments made by water companies over the years mean that these low-hanging fruit have already been delivered, and now marginal costs are rising. In fact, analysis by Wessex Water in the Midford Brook sub-catchment demonstrated that the water company contributes less than a quarter of the excess phosphorus within the catchment. This illustrates that additional improvements to Wessex Water’s discharges as envisaged by the EA would have limited impact on the overall phosphorus levels in the catchment.

Alternative solutions, such as nature-based solutions, would offer an improvement in ecological status and deliver wider benefits, such as reduced air pollutants, reduced greenhouse gas emissions and an increase in biodiversity. However, the EA often considers these to be too risky given the uncertainty around the extent and timeframe of benefits that could be delivered in the short term.

To achieve greater environmental benefits in water catchments, regulatory objectives should be set in line with wider environmental outcomes within the catchment. For example, regulation of water companies could be based on outcomes instead of outputs. Regulation should also value the wider environmental improvements such as biodiversity improvement and carbon reduction instead of focusing solely on the statutory requirements of water companies.

### C.3 Multidisciplinary perspective

Regulation of water catchments currently lacks the multidisciplinary perspective as evaluation of the potential solutions are mostly based on economically driven CBA. For example, under the Water Industry National Environment Programme (WINEP), water companies must carry out a CBA for statutory plus obligations.<sup>53</sup> Cost-benefit analyses are also recommended by the EA *“to ensure that the most cost effective options are selected and evidenced for the price*

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<sup>52</sup> Environment Agency (February 2018), The State of the Environment: Water Quality. Available at: [https://assets.publishing.service.gov.uk/media/5b03e097ed915d3968dc5a78/State\\_of\\_the\\_environment\\_water\\_quality\\_report.pdf](https://assets.publishing.service.gov.uk/media/5b03e097ed915d3968dc5a78/State_of_the_environment_water_quality_report.pdf)

<sup>53</sup> The 2022 WINEP Methodology states that: “Statutory plus obligations are obligations on the water companies set out in primary or secondary legislation but that include an added element of cost benefit assessment, and in some cases an additional step of affordability testing. In cases where action is considered disproportionately expensive to meet statutory plus obligations, alternative objectives or timescales to meet them may be set.” Defra (2022), WINEP Methodology, Available: <https://www.gov.uk/government/publications/developing-the-environmental-resilience-and-flood-risk-actions-for-the-price-review-2024/water-industry-national-environment-programme-winep-methodology>

review” for projects that may not explicitly require them.<sup>54</sup> However, as highlighted in Section 3.2, CBAs do not appropriately consider the non-quantifiable benefits and non-marginal effects on the environment, nor do they necessarily take account of the full economic benefits of nature.

Regulation of water companies is currently based on a point-source approach, i.e. targeting a single identifiable localised source of pollution, such as wastewater treatment works. However, in the Cam and Wellow sub-catchment, Wessex Water has identified that alternative solutions, such as land-based measures and river restoration, will allow the catchment to achieve up to 50% reduction in phosphorus loadings per waterbody and £48m of additional environmental benefits, such as improved fish habitat and diversity, compared to a traditional point-source approach.

The EA has traditionally considered alternative solutions to be too risky given the uncertainty around the extent and timeframe of benefits that could be delivered in the short term. However, taking a multidisciplinary approach, for example by including the views of biologists and ecologists, could highlight the importance of other environmental outcomes, including fish biodiversity, such that the alternative solutions are more attractive than traditional point-source approaches.

Regulators should therefore ensure that CBAs reflect the impacts that can be described and assessed in qualitative analysis (e.g. multi-criteria analysis) to explicitly consider a comprehensive range of non-quantifiable impacts on the environment. Consulting other disciplines, such as biology, ecology and chemistry, would provide regulators with the qualitative arguments that could be used as inputs in the assessment of regulatory options.

### C.4 Cross-sector approach

As shown in Figure 6, there are many agents across many sectors (e.g. farmers, rail and road users, water companies and industry) that have an impact on the water quality within a catchment. Different sectors that impact the water environment are currently subject to different types of environmental regulation, and face very different incentives.

While there are clear reasons for this fragmented approach (e.g. the primary focus on agricultural policy is food security rather than the environment), different incentives between sectors lead to perverse outcomes. For example, agricultural run-off may increase right next to a site where sewage treatment work discharges are required to be improved.

A previous report by DEFRA on the reasons that prevent water bodies from achieving good ecological status indicates that, after the physical modification of rivers (a factor unavoidable

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<sup>54</sup> Environment Agency (July 2021), Draft Water Industry National Environment Programme (WINEP) Methodology. Available at: [https://consult.environment-agency.gov.uk/environment-and-business/review-of-the-winep/user\\_uploads/draft-water-industry-national-environment-programme-methodology.pdf](https://consult.environment-agency.gov.uk/environment-and-business/review-of-the-winep/user_uploads/draft-water-industry-national-environment-programme-methodology.pdf)

in many urban environments), the main three drivers that prevent water bodies from achieving good status are:<sup>55</sup>

- Agricultural pollution from rural areas (which affects 40% of water bodies);
- Sewage and wastewater (36%); and
- Run-off from towns, cities and transport, referred to as urban diffuse pollution (18%).

Regulators should therefore seek to create a regime that incentivises collaboration between different sectors, for example water companies and their catchment partners. It should also encourage schemes to be co-developed, co-delivered and co-funded as the norm. Further, increased collaboration between relevant regulators and government bodies, such as the EA, Natural England and DEFRA, would allow regulators to identify and implement solutions that achieve greater societal benefits at least cost and ensure that schemes deliver the intended outcomes.

### C.5 Fairness

Current environmental regulation of water does not meet the requirement for fairness on the basis of location, as the cost of improving the environment does not always fall on those that are most responsible for the problem.

For example, housing developers are subject to nutrient neutrality requirements which stipulate that new housing developments in certain areas should not add more “nutrient pollution” to the water catchment. To obtain planning permission, developers must demonstrate that run-off from their proposed development will not add to the nutrient load in a particular catchment area. If a developer finds that its development will produce additional nutrient load, it needs to invest in mitigation measures.

Over the past years, the government has proposed various ways of implementing nutrient neutrality and the debate on the way forward is likely to continue. This debate illustrates the key considerations around fairness as there is a question about who should pay for avoiding additional nutrient pollution. Putting the responsibility on developers of new houses means that new home buyers ultimately pay for avoiding a worsening of river quality. However, in 2023 the government proposed dropping the requirements for developers, instead requiring all water companies in sensitive catchment areas to upgrade all relevant water treatment works to the “technically achievable limit” with regard to nutrients in their discharges. This meant that water customers would pay for improving river water quality to allow new homeowners to add more nutrient pollution without river water quality deteriorating as a whole. While the government’s proposals were blocked by the House of Lords, the requirement for water companies has been maintained. This case study highlights the importance of taking

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<sup>55</sup> HM Government (October 2021), 25 Year Environment Plan Annual Progress Report. Available at: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/1032472/25yep-progress-report-2021.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1032472/25yep-progress-report-2021.pdf)

account of the contributions of all sectors and carefully considering fairness, i.e. who should pay for environmental improvements or for avoiding deterioration.

### C.6 Conclusion

In conclusion, this section highlighted a few examples where water catchment regulation could be made better to deliver greater environmental improvements. While the recent reforms via the WINEP reform taskforce have been a useful step in the right direction, they have not gone far enough in taking a whole of the environment view which involves a broader multidisciplinary perspective and cross-sector approach with an eye on fairness. The consequence of the current approach is that the maximum benefits are not realised within water catchments.

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