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Impacts of Environmental Regulation on Sustainable Economic Growth

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Abstract: There is considerable concern and debate about the economic impacts of environmental regulations. Jonathan Fisher, former Economics Manager at the Environment Agency in England and Wales, reviews the available evidence on this subject. Section 2 presents estimates of the costs and benefits of environmental regulations. Section 3 examines the impacts of environmental regulations on economic growth, innovation and technical change as well as impacts on competitiveness and any movement of businesses to less pollution havens. He questions call for greater certainty regarding future environmental regulations, whereas in fact there should be calls for less uncertainty. This section then suggests how this could be achieved. This section then finishes with an overview of the available evidence. This includes an examination of the Porter Hypothesis that environmental regulations can trigger greater innovation that may partially or more than fully offset the compliance costs. Section 4 then sets out principles for how better environmental regulation can improve its impacts on sustainable economic growth and illustrates how the European Union (EU) Water Framework Directive is a good example of the application of these principles in practice. Section 5 reviews current and recent political perspectives regarding developments in environmental regulations across the EU and shows how the United Kingdom (UK) has successfully positively managed to influence such developments so that EU environmental regulations now incorporate many of these principles to improve their impacts on economic growth. Section 5.1 then examines the implications of Brexit for UK environmental regulations. Finally, Section 6 sets out some best practice principles to improve the impacts of environmental regulation on sustainable economic growth, innovation and technical change.

Key words: environmental regulations; sustainable economic growth; economic impacts; Brexit; European Union (EU); EU Water Framework Directive

JEL codes: O3, O44, O13, Q56

1. Introduction

There is considerable concern and debate about the economic impacts of environmental regulations; but the available evidence on this matter is much contested and not clear cut. Statements and positions on this subject are often based on partial, anecdotal and selective "evidence", which in some cases is misreported or misinterpreted. Therefore this paper aims to examine objectively the available evidence on the economic impact of environmental regulations. The objective is not only to put the record straight; but also to set out best practice principles and

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guidance for how environmental regulations can be designed, developed and implemented so as to improve their economic impacts.

The paper's method for achieving this involves research to review the available evidence set out as follows.

Section 2 of this paper first sets out a methodology and framework for assessing the impacts of environmental regulations on economic growth. Section 3 then reviews the available evidence on the impacts of environmental regulations on economic growth, innovation and technical change as well as impacts on competitiveness and any movement of businesses to less well regulated pollution havens. This starts with presenting presents estimates of the costs and benefits of environmental regulations and their impact on the growing environmental goods and services sector.

It then examines the available evidence on the impacts of environmental regulations on competitiveness and any movement of businesses to less well regulated pollution havens. It then questions calls for greater certainty regarding future environmental regulations, whereas in fact there should be calls for less uncertainty. This section then suggests how this could be achieved. This section then provides an overview of the available evidence. This includes an examination of the Porter Hypothesis that environmental regulations can trigger greater innovation that may partially or more than fully offset the compliance costs.

Section 4 then sets out principles for how better environmental regulation can improve its impacts on sustainable economic growth and illustrates how the European Union (EU) Water Framework Directive is a good example of the application of these principles in practice.

Section 5 reviews current and recent political perspectives regarding developments in environmental regulations across the EU and shows how the UK has successfully positively managed to influence such developments so that EU environmental regulations now incorporate many of these principles to improve their impacts on economic growth. Section 5.1 then examines the implications of Brexit for UK environmental regulations.

Finally, section 6 concludes by setting out some best practice principles to improve the impacts of environmental regulation on sustainable economic growth, innovation and technical change.

This paper is based on the economics chapter of a recently published book on "Developments in Environmental Regulation" (Foreman et al., 2018)[1] that various former Environment Agency managers in England and Wales have written and for which the royalties are going to Water Aid — a UK based international charity. This book comprises the following chapters:

(1) Introduction to Environmental Regulation and Practice in the UK and Europe — Martin Bigg
(2) Environmental Regulation and Growth: Impact on Sustainable Economic Growth — Jonathan Fisher
(3) Better Regulation Initiatives — Chris Booth
(4) Steps Towards Radically Smarter Regulation in the UK (2012-2017) — Edward Lockhart-Mummery
(5) The Sector-Based Approach and Partnerships: Regulatory Interventions to Reduce Risk and Promote Compliance — Jon Foreman
(6) Implementing the Industrial Emissions Directive: The UK Environmental Permitting Regime for High-Risk Activities — Adrian Kesterson
(7) Environmental Regulation for High-Risk Materials and Hazardous Wastes — Ken Westlake
(8) Environmental Risk Management and Assurance — Duncan Giddens

[1] https://www.palgrave.com/gb/book/9783319619361#aboutBook.

(9) The Impact of Leaving the European Union and the Future of Environmental Regulation Martin Bigg

2. Economic Impacts of Environmental Regulations

2.1 Methodology and Framework for Assessing Impact of Environmental Regulation on Sustainable Economic Growth

UK environmental regulators have high level objectives to support growth. Thus the Environment Agency has an objective to "support sustainable growth". The Scottish Environment Protection Agency (SEPA) has an objective to "protect and improve the environment in ways that, as far as possible, also help create health and wellbeing benefits and sustainable economic growth". The Northern Ireland Environment Agency has an objective to "support a sustainable economy". One of the UK Department for Environment and Rural Affairs (Defra)'s objectives is "A cleaner, healthier environment benefitting people and the economy".

Therefore this section sets out a framework and methodology specifying how environmental regulations could affect economic growth and then reviews the evidence on this subject.

Environmental regulations could affect economic growth through their impacts on the following factors in H. M. Treasury's (2015, p. 11) framework for raising productivity:

(1) Business investment for the long term. On the one hand, environmental regulations increase investments in environmental protection measures and economic activity in the environmental goods and services sector (see S. 3.3) and they might bring underused resources into use thereby increasing economic activity. However, they entail net costs to business (see S. 3.1) which Sato (2014) states take resources that businesses could otherwise use to implement more productive investments. Moreover, any delays in securing permits can discourage business investments.

(2) Enhancing skills and human capital. The Aldersgate group (2018) report evidence that environmental regulation has led to the creation of new jobs. HM Government (2012) and Aldersgate Group (2012b) stress the importance of enhancing skills to achieve more efficiently environmental improvements, sustainable growth and a transition to a green economy. NERC (2012) identified 15 critical skill gaps in the environmental sector. These include computer modelling, multi-disciplinary working, data management and translating research into practice.

The UK Prime Minister in her speech to the CBI conference (May (2016)) said "we are not strong enough in STEM subjects, and our technical education isn't good enough." Policy on skills is a devolved matter. In England, the policy is demand led by the needs of business. But Defra (2102, p. 38) report that businesses are uncertain about future green skills needs and the skills requirements and opportunities for progress in achieving a successful green economy. The Aldersgate Group (2012b, p. 4) sees a vital role for Government to intervene to ensure that education and training is designed for future needs and not merely to remedy current shortages. The coalition Government (in HM Government (2012, p. 9)) concluded that a new 'skills for a green economy' grouping of Sector Skills Councils could help business understand changing skills requirements. Other proposed actions included improving the quality of information advice and guidance available on careers in a Green Economy together with information on the skills linked to the Green Economy that will be needed in the future. They also recommended improving the quality of skills provision in the further education system and raising awareness and understanding of the green economy to support lifelong learning among the workforce. Since then, there appears to have been little action on these matters. HM Government (2017) emphasised the importance of enhancing skills, especially technical skills. This is the second pillar in their Green Paper setting out their proposed industrial

strategy, which includes boosting STEM (Science, Technology, Engineering and Maths) skills and raising skill levels in lagging areas. However, (at January 2017), the current Government does not appear to address environmental skills needs.

(3) Improving water and flood defence infrastructure are important elements of the third pillar of the UK Government's Green Paper on Industrial Strategy. Ensuring sustainable provision of water resources, waste water management and flood risk management supports and sustains economic activities dependent on such resources. Thus the Environment Agency's regulation of abstractions and work on Water Resource Management Plans and abstraction incentive mechanisms and abstraction trading can enable economic development to proceed in water stressed catchments while still ensuring sustainable water resources and environmental safeguards. For example, Pepsico are significantly reducing the water consumption of their agricultural and agro-industrial operations (e.g., crisp manufacture) (Pepsico, 2010). They collaborated with the Environment Agency to increase the water efficiency of Pepsico's farm businesses, cutting water consumption by 30% and enabling them to grow sustainably in a water stressed catchment. Similarly, the UK Natural Capital Committee (2014, p. 56) report that Walkers Crisps increased the water efficiency of their manufacturing processes which saved £630k pa and enabled them to continue operating in a seriously water stressed area.

(4) Enhancing ideas, knowledge and development and adoption of innovations and technical change. Defra (2013, p. 8) and Sato (2014) report that environmental regulation has been a positive driver of innovation, especially in achieving more effective and efficient environmental protection and may increase overall innovation by large firms especially in the long run when it leads to changes in corporate strategies to enhance innovation. But Defra (2013, p. 9) also report that R&D driven by environmental regulations has displaced other R&D especially for small firms.

(5) Flexible, fair markets, openness and competition. Environmental regulations can provide an even playing field for all businesses and hence not only prompt them to adopt efficient control measures but also provide a clear basis for the growth of the Environmental Goods and Services Sector (see S. 3.3). The Environment Agency's work on controlling waste crime can prevent illegal operators undercutting otherwise worthwhile efficient and viable firms. This can provide a good basis for environmentally preferable firms acting legally as well as reducing the illegal operators' significant environmental damages.

However, there are risks that big companies could dominate and this could lead to regulatory capture and inhibit the entry of entrepreneurial (small) companies offering environmentally and economically attractive alternative products. For example, in the UK, the big 6 waste management companies have tended to dominate waste management policies and strategies. They have pressed County Councils to commit to large incinerators and waste management facilities on 25 year contracts under Private Finance Initiative (PFI) funding schemes[2], which restrict the entry into the waste market of entrepreneurial companies offering smaller scale and more environmentally and economically attractive alternative waste management options. Other European countries seem to promote more positively the adoption of such options and moves to achieve a more circular economy.

Moreover, tradeable permit systems that grant (grandfather) rights to existing firms can adversely affect growth by preventing new firms (especially dynamic small firms) from entering the market.

[2] House of Commons Treasury Select Committee (2011) found that the costs of capital of PFI schemes were also high — about 8% in real terms. There is little or no evidence of the PFI waste incinerator schemes yielding efficiency savings that could offset these high capital costs so that these PFI schemes were excessively expensive.

3. Evidence on Economic Impacts of environmental regulations Costs and Benefits of Environmental Regulation

3.1 Net Costs to Business

Direct costs of regulations to business include (annualized) investment and operating costs (e.g., in pollution control equipment) and administrative costs (e.g., form filling); the latter amount to about £808m p.a. (14% of the direct costs to business) (Defra, 2015).

Defra (2015, p. 1) reviewed the available estimates for these costs — drawing largely on findings of Impact Assessments of specific regulations plus other studies and cross checking the various data. They found that the gross direct costs to business of environmental regulations[3] in 2012 were about £6bn p.a. (in 2012 prices). Figure 1 shows these costs for Defra's main environmental policy areas. Figure 2 shows which industry sectors (eg water, manufacturing, agriculture, fisheries and food) incurred these costs. Defra (2015, p. 10) show that environmental regulation's gross costs to all businesses account for just 0.16% of turnover of all businesses and only 0.2% of turnover of manufacturing businesses. These costs of environmental regulations are lower than other regulations. For water industry and waste sector, the gross costs of environmental regulations account for 12% and 2.5%, of their turnover, respectively. For agriculture, fish and forestry, the costs are 3% of turnover.

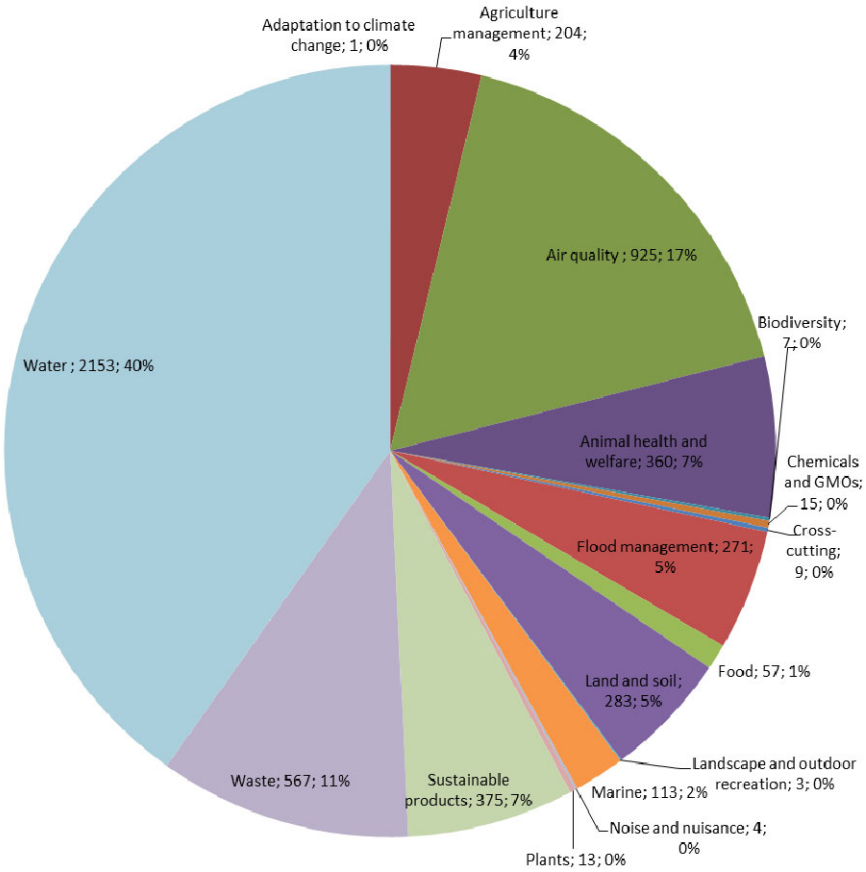

Figure 1 Direct Costs to Business of Defra's Regulations by Policy Area, 2012 (£m, %)

Source: Defra (2015). Emerging Findings from Defra's Regulation Assessment, First update covering 2012

[3] This is all Defra regulations, which are a good proxy for environmental regulations. But they include farming regulations and

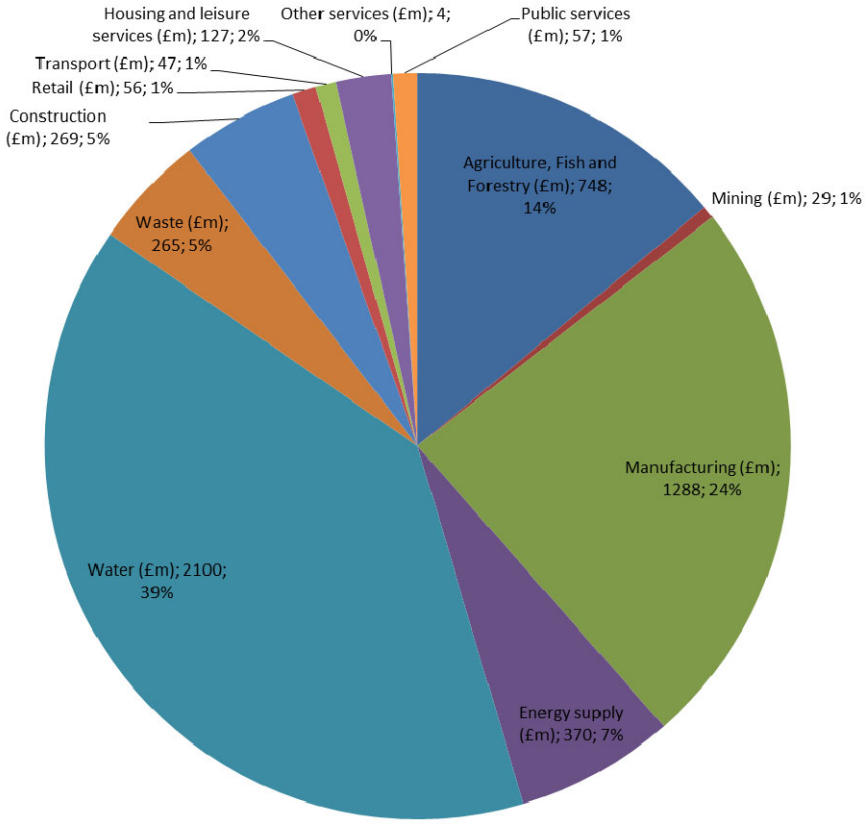

Figure 2 Direct Costs to Business of Defra's Regulations by Industry Sector, 2012 (£m, %)

Source: Defra (2015). Emerging Findings from Defra's Regulation Assessment, First update covering 2012

Defra estimate that these regulations had direct financial benefits to businesses (e.g., more efficient use of resources and energy) amounting to about £2bn which lower the net costs to business by about a third to £4bn p.a.

The European Commission (2015) report environmental expenditures for the period 1995-2012 which show that these expenditures declined in absolute real terms between 1996 and 2012 and have fallen to become about 2-3 % of value added in 2012.

Defra (2015, p. 5) report that the number of domestic UK environmental regulations in 2012 increased by 1 while the number of EU regulations declined by six. Likewise, the Economist (2016, p. 24) states that "the EU is proposing far fewer rules now. The European Commission's better regulation agenda limits new regulations and even withdraws existing ones. It is ironic that Britain should consider Brexit just when the EU has come round to a more competitive, less intrusive approach" (see Section 6).

3.2 Benefits of UK Environmental Regulations

Environmental regulations yield significant benefits in terms, for example, of improving people's health and welfare and reducing environmental damage caused by pollution as well as enhancing ecosystems and the natural capital on which people's welfare and future prosperity depends (Defra et al., 2011, 2014), Natural Capital Committee (2014)).

As part of their analysis of costs reported in Section 2.1 above, Defra (2015, p. 1) also estimate that the monetized benefits of environmental regulations amount to about £10bn p.a. Accordingly they estimate that the

exclude carbon schemes and other climate mitigation regulations which are covered by other UK Departments.

ratio of their estimates of the monetised benefits to net costs (BCR) of environmental regulations is about 3:1. In addition, there are non-monetized benefits associated, for example, from improvements in natural habitats and ecosystems.

Consequently, the Aldersgate Group (2011) argue that the focus should be on increasing the effectiveness and efficiency with which environmental regulations address environmental pressures and achieve these benefits better through better regulation measures — rather than headline grabbing initiatives to cut the regulations in any "bonfire of the regulations".

3.3 Environmental Goods and Services Sector (EGSS) in EU and UK

Eurostat (2016) report that the EU market for environmental goods and services (EGSS) has grown by about 50% between 2003 and 2013. The UK has a significant share of this international market. The EGSS is not conventionally a sector as such in the national economic accounts. Nevertheless, the Office for National Statistics (ONS) has derived estimates for the EGSS through satellite accounts and using the commonly accepted definition for the environmental goods and services sector (EGSS) developed by Eurostat and adopted by the System of Environmental Economic Accounting (SEEA).

The EGSS contributes significantly to the UK economy. ONS (2015) report that the UK EGSS in 2012 had an output of £55bn and a Gross Value Added (GVA) of £26bn (or 1.6% of GDP). This exceeds the GVA of the agricultural sector (at £10bn in 2012). EGSS employed 357,200 people in Full Time Employment in 2012. Between 2010-2012, its output, GVA and employment grew by 9.1%, 1.5% and 5.3%, respectively.

The Dutch and German Governments assist businesses to pursue export opportunities for this sector. The environmental regulator in Scotland (SEPA) participates in the European Commission's Environmental Technology Verification (ETV) pilot programme which provides independent verification of the performance and environmental benefits of a new technology to accelerate its market entry.

3.4 Impacts on International Competitiveness and Pollution Havens

The impact on international competitiveness is the combination of the above effects on production costs, productivity, innovation and technical change. Angus et al. (2013) report some studies which show that environmental regulations have impaired industries' competiveness and led to pollution intensive industries moving to less regulated jurisdictions. Ederington, Levinson and Minier (2005) found that the impact of regulation on competiveness is negative but small. They also show that those industries with the largest pollution abatement costs also happen to be the least geographically mobile or footloose. Therefore the concerns may not be so much that the industries move investments overseas but rather that plants close in the face of strong international competition especially where there is global overproduction — as for steel.

However, Angus et al. (2013) also report that several studies found no evidence that environmental regulations have negatively affected trade and competitiveness and investment moving to countries with lax environmental regulations (see also Sato, 2014). Aldersgate group's (2018) study of the views of senior polluting industries found that environmental regulations do not hinder productivity, and at best the impact of environmental regulation on the competitiveness of their business was positive overall, especially in the long run. They found that the costs of compliance are more than offset by gains in improved quality, performance and competitiveness or are absorbed. Similarly OECD (2014) states that "more stringent environmental policies, when properly designed, can be introduced to benefit the environment without any loss in productivity".

Environmental regulation's costs are a small % of businesses' turnover (see S. 3.1). Other costs (e.g., labour, energy) and other factors such as access to a big market, well defined property rights, good governance and a good

regulatory environment are much more important in determining foreign direct investment.

Moreover, investments in new plant concern the long term. Therefore the key comparison for business decision-making is not between current environmental regulations and those currently in other countries but with the future regulations in these other countries over the life of the plant in question. The UK is in a strong position to help these other countries develop their policies and programmes to address these problems and UK firms in the Environmental Goods and Services Sector are well placed to export technologies, products and systems to help them solve these problems.

3.5 Uncertainties about Future Environmental Regulations

There are often calls to make environmental regulations more certain, stable and predictable. Thus the Aldersgate Group (2012a) calls for "Credible, Consistent and Bankable Policy". But achieving "certainty" regarding future environmental regulations is in fact not feasible. Future environmental regulations depend on a balanced assessment of likely developments in the following factors about which there is inevitably considerable uncertainty:

1) The scale and nature of the environmental problem and pressures. Defra's National Ecosystems Assessment and the Natural Capital Committee have effectively highlighted the growing pressures on natural ecosystems which will require increasing environmental protection measures.
2) The public's concern and valuation of these problems.
3) The costs and technical feasibility of control options, which depend on likely technological advances and innovations.

Recent attempts to provide foresight and visionary "certainty" regarding future environmental regulations have been illusory and failed miserably because they did not adequately address all of these factors in determining the current regulations let alone future regulations. Morgenstern (2016, p. 10) states "Uncertainty is prevalent in every day life, and it's no less prevalent in the regulatory world." Martin Bigg, states "In an uncertain world, one certainty is change". Business has always to deal with uncertainty — including on much more important and volatile factors such as the price of oil and exchange rates. Therefore what is needed is "less uncertainty" and more stable and predictable environmental regulations — rather than trying to provide "certainty" about future regulations.

This can best be achieved by the environmental regulators openly providing clear and credible information on the current situation and likely future developments regarding the scale and significance of environmental problems and pressures and public concerns about them — and hence the need for (stricter) environmental regulations now and in the future (see factors 1 and 2 above). Enhancing State of the Environment reporting could be a useful vehicle for this. This could give a good clear information and signal to business who are best placed to assess likely developments in technologies and the costs of control options, which will input into determining future regulations (see Factor 3 above) — in line with principles set out in Section 4.

3.6 Overview of Evidence

The available evidence on all these matters is contested and not clear cut. Specific, partial or anecdotal claims that environmental regulations have significant positive or negative economic impacts need to be treated with considerable caution. For example:

(1) There are often claims that environmental regulations increase growth by enabling the growth of the UK Environmental Goods and Services sector (see S. 3.3). Such growth is important and the environmental regulations need to be designed and implemented to maximise the beneficial impacts on this important UK

business sector. But these outputs are paid for by other business' costs (as shown in S. 3.1). So they offset impacts on growth of such costs rather than necessarily being overall net positive impacts on growth.

(2) Conversely, one needs to be wary of claims of environmental regulations imposing very high costs and significant adverse economic impacts. Morgenstern's (2016, p. 8) retrospective analyses of 34 case studies of US environmental regulations found that there is a tendency to overstate the costs and benefits of regulations in the analyses done before the regulations were issued. Similarly, Fisher (2008) found that water companies' estimates of the costs of environmental measures in their draft business plans were about 40% higher than their costs in the final business plans once OFWAT and the Environment Agency had scrutinized their estimates to remove over-estimation and gold plating. OFWAT and the Environment Agency then sought more efficient alternatives and refined the requirements accordingly. Morgenstern (2016, p. 10) suggest that "One thing that the agencies could do is to build a plan of retrospective analysis into the regulation at the time it's promulgated… Obviously you can't do it for all rules — especially in times of tight budgets. You should be selective". The UK Government now requires Post Implementation Reviews of regulations (Department for Business, Innovation and Skills, 2016). This is largely a qualitative review that examines the following questions:

a) Whether the policy or regulation achieved its objectives?
b) Whether it had any unintended consequences?
c) Whether there could be opportunities to reduce burdens on business?
d) How does the UK's implementation compare with that in other EU member states in terms of costs to business?

It would also be worthwhile carrying out some empirical analysis comparing the actual costs to business with the ex ante estimates in the Impact Assessment. But requiring this for all regulations would impose an excessive burden for regulators who need to focus efforts on improving the design and implementation of regulations to improve their impacts (see S. 4). So perhaps such plans for retrospective empirical analysis should just be required for any regulation for which the Impact Assessment showed the estimated costs would exceed a certain threshold — perhaps 2% or 5% of the regulated sectors' turnover. Moreover, the lessons from such retrospective analyses need to taken into account in designing and implementing future regulations and estimating their costs and benefits. Their findings should be incorporated into data bases of unit costs of control measures used in future Impact Assessments.

There has been much debate about the Porter Hypothesis (PH), tho Ambec et al. (2016) state that there is "oftentimes a misunderstanding of what the PH does and does not say". The "Porter Hypothesis" expounded in the seminal work by Porter and Linde (1995b, p. 98) states that "properly designed environmental standards *can* trigger innovation that may partially or more than fully offset the costs of complying with them" — *I have added in parenthesis their use of the word "can".* Ambec et al (2016, p. 2) add that environmental standards can do so "in some instances". Porter and Linde do not actually say or conclude that environmental regulations will (always) reduce costs and enhance competitiveness. Porter and Linde (1995a, p. 130) state: "Certainly, misguided regulatory approaches have imposed a heavy burden on companies" and (in Porter and Linde (1995b: 98)) that "these costs are far higher than they need to be". Porter and Linde (1995b: 100) actually say: "We readily admit that innovation cannot always completely offset the cost of compliance, especially in the short term before learning can reduce the cost of innovation-based solutions". They also say that successful visionary companies tend to have a better environmental record.

Similarly, the Aldersgate Group (2018, p. 6) conclude that "well designed environmental regulations can

have positive knock-on impacts on the economy in the form of job creation, increased investment in research, development and skills. Good regulations can reveal the value in social and environmental factors that the existing market had overlooked, allowing economic players to identify opportunities for investment and innovation. Good regulation creates valuable economic opportunity. Unsurprisingly, there is such a thing as good and bad regulation. To be environmentally and economically effective, regulations must be pitched at the right geographic scale, be coherent with other existing policies, set a clear direction that increases in stringency over time and be implemented in such a way that works with business timescales. Critically, environmental regulations cannot be effective in a vacuum. They need to be accompanied by other policies such as measures on skills and innovation to deliver broader industrial benefits." They also stress the need to further reduce bureaucratic and regulatory barriers to growth, innovation and productivity.

Similarly Sato (2014, p. 4) concludes that "green innovations developed to reduce the cost of environmental regulations do not seem to increase firms' profits enough to fully offset the private costs of regulation". The extent of such offsetting depends on the potential for environmental regulations to lead to increased innovation by businesses, which is probable since there are many untapped worthwhile innovations and technical changes that businesses need an external spur from regulations to consider and implement.

Conclusions to take from Porter's work are in fact the following:

1) The need for properly designed and implemented regulations and for regulators with strong technical capabilities to work collaboratively with businesses.
2) Businesses need to devote their efforts to respond positively and innovatively to environmental concerns and pressures rather than being adversarial and litigious.
3) Successful visionary businesses with dynamic corporate strategies have better environmental and economic records.
4) There is a need to link environmental regulations with industrial policies to promote innovation and technical changes in businesses and their corporate strategies. This should include dissemination of information and training about latest best practice techniques. Technically capable environmental regulators and trade associations can play an important role in informing businesses about efficient best practice ways of tackling specific environmental problems.
5) Growth is driven by improving total factor productivity, which includes all factors of production such as capital, labour and raw materials. Need to incorporate into this positively natural resources and improved resource productivity that Porter and Linde (1995b) highlight and advocate.
6) Greater environmental benefits and improvements in natural capital are needed to sustain economic activity and growth (see Section 3.2).

3.7 Summary on Impacts of Environmental Regulations on Economic Growth

Nevertheless, the following conclusions can clearly be drawn from the available evidence:

(1) Defra (2013, p. 15) conclude that "The weight of evidence suggests that there is no significant economic impact of environmental regulation". Defra (2015, p. 10) show that environmental regulation's gross costs to all businesses account for just 0.16% of their total turnover and only 0.2% of turnover of manufacturing businesses. For the most polluting sectors of water and waste, the gross of environmental regulations account for 12% and 2.7% of their turnover, respectively. For agriculture, fisheries and forestry they account for 3% of turnover. The net costs to business of environmental regulations are about one third lower when account is taken of the financial benefits of environmental regulations to business (see Section 3.1).

(2) What is clear is that better environmental regulation can significantly enhance their benefits and improve their impacts on economic growth and their positive impacts on the UK Environmental Goods and Services Sector. The next section therefore then explores this aspect.

4. How to Improve Environmental Regulation's Economic Impacts

This section set out the following principles for regulatory design that will improve their economic impacts. It draws on recommendations in the literature (e.g., Porter & Linde, 1995a, p. 124; Aldersgate Group, 2018) and also best practice guidance for regulations (e.g., Defra, 2013, Cabinet Office Better Regulation Task Force, European Commission, 2012):

a) The regulations need to be pitched at the most effective geographic scale (regional, national or local).
b) **Develop regulations in collaboration with other countries** to minimise any possible competitive disadvantages in comparison with foreign companies not subject to the same regulations. Moreover, there is a need to share knowledge and experience (e.g., on best practice) internationally through, for example, Impel and the Belfast group of UK regulators.
c) **Focus on outcomes not prescribed technologies.** Regulations that prescribe specific technologies or are based on them can discourage innovation. Regulations should set out desired environmental outcomes and be flexible as to how best to achieve them.
d) **Proactively have ambitious rather than lax objectives.** Regulations need to be strict enough and well enforced with clear compliance requirements to induce business to implement real innovation and technical changes to achieve them.
e) **But allow flexibility** for how to achieve these objectives and desired outcomes
f) The regulations need to be based on based on a **sound economic and financial appraisa**l to ensure they are efficient and affordable and do not impose excessive costs on business so as to minimize any adverse economic impacts. This is in line with the requirements that regulators such as the Environment Agency and Natural Resources Wales report annually on the economic impact of their regulatory policies and practices.
g) **Integrate regulations coherently in associated fields.** Porter and Linde (1995:111) stress the need to move away from single media and piecemeal approaches to integrated approaches fundamentally geared to tackling all problems at a site which can lead to more innovative and efficient solutions. In addition, they stress the need to r**egulate as close as possible to the end user and desired outcomes as possible, while flexibly encouraging all solutions — including upstream options.** Avoiding pollution and addressing pressures at source is almost always less costly than end of pipe controls, remediation or clean up.
h) **Set clearly and consistently long term goals with well defined phase-in periods and deadlines.** Linking these to an industry's capital investment cycles can enable firms to integrate the environmental controls in investments for new plant and equipment which can facilitate development and adoption of innovative technologies that are better in economic, environmental and resource terms, and less costly than adding end of pipe controls to existing plant (Aldersgate Group, 2018).
i) **Make the regulatory process more proactive, stable and predictable** so that business can build in environmental considerations into their development, design and implementation of investments in new

plant, equipment and technologies.

j) **Involve businesses in setting standards from an early stage.** There should be a more collaborative and less adversarial relationship between business and regulators. Business should focus their efforts, resources and attention on seeking innovative solutions to tackle environmental problems rather than contesting the regulations with expensive litigation. There should be greater positive use and attention to environmental managers and less resorting to (expensive) lawyers.

k) **Use market incentives**, such as pollution charges (e.g., the landfill tax (Aldersgate Group, 2018), deposit-refund schemes or tradable permits) to provide continuing incentives for business to develop and apply innovative solutions and go beyond just complying with any current standards (Wagner, 2003). The impacts of tradable permit schemes can significantly depend on the initial allocation of permits since Section 2.1 highlights that granting (grandfather) rights to existing firms can adversely affect growth by preventing new firms (especially dynamic small firms) from entering the market.

l) **Minimize the time and resources involved in the regulatory process** so that it does not hinder or discourage innovation and investments.

m) **Enhance the technical capabilities of regulators** so that they are better able to understand the economics of the businesses they regulate and are better able to communicate with businesses regarding the best way to tackle the environmental problems in a well reasoned and ordered way.

n) **Transparency.** The regulator needs to provide clear, credible and comprehensible information on the scale, nature and significance of the current and likely future environmental problems and pressures and their causes. This should be the essential rationale and basis for the environmental regulations. It can also provide business with the information needed to respond innovatively with long term solutions rather than short term compliance. Moreover, there needs to be clear transparent information on the measures implemented and their costs and benefits. Transparent exchange of such information internationally can provide good evidence of the extent to which foreign competitors are subject to similar requirements and costs so that complying UK firms will not be at a competitive disadvantage vis a vis foreign firms.

o) The environmental regulators need to have **strong links with the Industrial strategy being developed by the UK Department for Business, Energy and Industrial Strategy and particularly Government programmes to promote innovation** (e.g., through Innovate UK) and the application of best practice technical changes. Examples include:

- research in environmental technologies (e.g., ADEME's 1.3bn € programme);
- guidance and information (e.g., the Austrian Ministry of Agriculture's Ökoprofit Programme);
- demonstration plants (e.g., Germany's Environmental Innovation Programme);
- and verification and certification of new environmental technologies (e.g., the Environment Agency's Environmental Technology Verification Programme and Germany's Blue Angel eco label).

A key question here is whether advice to businesses about environmental technologies is best provided by environmental regulators, or by bodies promoting innovation and technical change by businesses or through industry association or by business advisers. Alternatively this could be achieved through the close collaboration of these parties — such as the waste minimization clubs and Resource Efficiency Clubs for specific sectors or regions (see Chapter on the sector approach). Businesses need to determine which of these is best — since they have to pay for the service through either charges to recover regulator's costs or trade association contributions or

direct payments to advisers. Public expenditure constraints could limit the extent to which any advice service by the environmental regulators could be funded by Central government through Grant in Aid tho it could fit well with the Government's Industrial Strategy.

The better regulation initiatives described by Chris Booth, Edward Lockhart-Mummery, Martin Bigg and Adrian Kesterson in other chapters of the book have substantially lowered environmental regulations' compliance costs for business and significantly improved their impacts on economic growth.

The EU Water Framework Directive (WFD) is now the main basis for water regulations in the UK and EU. It is well in line in the following ways with most of these principles:

a) The WFD is pitched at the catchment scale at which most of the measures are implemented and are effective in terms of improving the state of water bodies. At the same time, the measures are developed and monitored within clear national policies and an international reporting framework.

b) **The WFD was developed in close collaboration with other EU countries** at UK instigation (see Section 5) and with considerable UK regulators' expert technical and economic help. The WFD is a valuable model for efficient integrated water management by other countries outside Europe who can benefit by going directly to integrated water management. This provides good potential exports for UK environmental services to aid these countries improve their water management.

c) **The WFD focuses on environmental outcomes** specified in terms of Good Ecological Status (GES) or Good Ecological Potential that is appropriate to particular types of water bodies in specific locations.

d) **The WFD sets out the ambitious long term objective of aiming to achieve GES.** This prompts businesses to implement real innovation and technical changes to achieve them.

e) **WFD gives Member States flexibility** in determining their measures in their River Basin Management Plans to achieve efficiently these objectives and desired outcomes.

f) The WFD also explicitly **allows pragmatically for exemptions if achieving these objectives is not technically feasible or disproportionately expensive.** Moreover, the UK managed to secure inclusion of such consideration of costs and provision of exemptions in the implementation of the precautionary controls on Priority Hazardous Substances which could otherwise have been excessively expensive. The UK achieved this in close collaboration with other EU countries (e.g., the Netherlands) who were similarly concerned about these potentially high costs. This ensures that the WFD measures in the RBMPs are proportionate, affordable and do not impose undue costs on business. Accordingly the Environment Agency (2015a, p. 17) have developed systematic economic appraisal processes for assessing the costs and benefits of options so as to select the most efficient and effective measures to improve the water body in question. These processes are essentially designed so that the EA's technical managers can apply them as an integral part of their determining the programmes of measures. These EA's technical experts are duly trained to apply these economic appraisal techniques.

g) **Integrate regulations in associated fields.** The WFD involves the integrated management of water bodies and catchments that addresses issues of water quality and water resources. It explicitly pulls together previously separate Directives such as those concerning Bathing Waters, Shell fish waters, Natura 200, etc. Moreover, the European Commission and Member States are currently working to link implementation of WFD with the EU Marine Strategy Framework Directive and the EU Floods Directive. This is less costly than dealing with each of these issues separately and sequentially. It is also more efficient and can prompt more innovative responses in the programmes of measures.

h) **Have well defined phase in periods.** The WFD is currently being implemented in cycles of River Basin Management Plans (RBMPs) that have to be reviewed and updated every 6 years.

i) This helps m**ake the WFD regulatory process more stable and predictable.**

j) Article 14 of the WFD states that "Member States shall encourage the **active involvement of all interested parties** in the implementation of this Directive, in particular in the production, review and updating of the river basin management plans". The preparation of the 2015 update of the RBMPs and periodic review of the water industry (PR14) embodied a more collaborative and less adversarial relationship between the water industry and the economic regulator (OFWAT) and environmental regulator (Environment Agency). Hopefully, water companies can then focus their efforts, resources and attention on seeking innovative solutions to tackle environmental problems; rather than contesting the regulations with expensive litigation, which happened in earlier appeals on the previous technology based Urban Waste Water Treatment (UWWT) Directive. For example, United Utilities' unsuccessful appeals against measures to control Combined Sewerage Overflows that were required under the EU Urban Waste Water Treatment (UWWT) Directive.

k) **Market incentives.** The WFD encourages the use of economic instruments. The environmental regulator and management body in Wales — Natural Resources Wales — have included trialing of a reverse auction scheme to address more efficiently the impact of high nutrient loading in a waterbody. Such reverse auction schemes involve asking polluters (e.g., farmers) to bid in terms of their costs for measures to control nutrients. The Environment Agency then selects from the bids the most cost-effective suite of options to control nutrients. This is more efficient than just paying grants for the polluters to implement measures. Article 9 of the WFD specifically requires member states to report on the extent to which water prices cover the full financial, environmental and resource costs of water services. This encourages them to implement charges to cover the environmental and resource costs of water supply, abstraction and discharges. Moreover and potentially more important in practice, it requires that Member States set out transparently their current subsidies in terms of the extent that water charges or prices do not cover the full financial costs of water services such as irrigation or abstraction of water. Such subsidies can distort competition. It puts at a competitive disadvantage UK businesses and farmers who rely more on rain and whose irrigated water supplies are not subsidised. WWF in Spain carried out analyses which showed that strawberry farmers in Spain received significant water subsidies which exceeded their profits.

l) The WFD is often criticised for being a complex and time consuming process because in reality achieving water management concerns many complex matters. But the **integrated regulation in the WFD takes less time and resources** than separate regulation of each water matter.

m) The Environment Agency has enhanced its teams' **technical capabilities** so that they are better able to derive plans for the best way of tackling water problems in their catchments.

n) **Transparency.** Potentially important, Member States also will have to set out transparently the measures in their RBMPs and their costs and benefits and the extent to which they cover the full costs of water services (see above). UK environmental regulators have to justify the costs and benefits of measures to the regulated businesses paying for them. At the same time, they have to set out clearly where the costs of some measures are disproportionately expensive to justify to the European Commission and Environmental NGOs why they have not implemented them and require exemptions

from achieving good status. This alters the burden of proof to explain why the costs are too high, which should reduce tendencies to over-estimate costs.

5. Recent Political Perspectives on EU Environmental Regulation

The UK has had a major and increasing influencing in shaping European environmental regulations over the last 20 years. Thus the UK developed, in 1991, integrated pollution control (IPC) for the integrated regulation of discharges to air, water and solid wastes from major installations. Subsequently the EU introduced the integrated pollution prevention and control (IPPC) Directive in 2008 (Office of Journal of the European Union, 2008). Kestersen and Bigg discuss these Directives in their chapters of the book.

As a result, EU environmental policies have increasingly incorporated many of the features highlighted in Section 4 that help improve the impacts on economic growth. European environmental regulations are now to a much greater extent in the form of "framework" directives that aim to achieve specific environmental objectives and outcomes but give member states flexibility to determine how to achieve them efficiently.

Developments in European water policy are a particular notable example, which I focus on here. In the 1970s, there was a strong debate whether water regulations should be based on the "Uniform Emissions Standards" approach, advocated mainly by Germany on the continent, or Environmental Quality Objectives (EQO) advocated by the UK. The former technology based regulations involve uniform standards for each firm or plant in an industry regardless of their location. This held sway in the 1970s, in the form, for example, of the EU Urban Waste Water Treatment Directive, which set standards for discharges from waste water treatment plants and sewerage systems so as to make them fit for the end of the twentieth century and to reduce their significant pollution of water bodies. But these standards' costs were very high. Moreover, they led water companies to move to large sewage treatment plants at the bottom of catchments, which took water away from the top of catchments and significantly increased water resource problems there.

In the late 1990s, the European Commission developed the EU Water Framework Directive, which has the major positive features described in Section 4. It was implemented in 2000 (Official Journal of the European Communities, 2000). It superseded the earlier specific technology based standards such as the UWWT, the member states still had first to achieve compliance with these existing directives and then go on to implement the WFD to improve further their water management more effectively and efficiently. It fundamentally embodies and enshrines the principles of the UK's EQO approach. The UK played a major role in the development of the WFD, which at that time was called the "English Directive" by many on the continent. For example, Pamela Taylor (Water UK) in her evidence to the House of Commons Select Committee on Food and Rural Affairs Select Committee (2003, para 324) stated that "in Europe this Directive is often referred to as the British Directive, or the English Directive.." Similarly, Helen Rimmer (2003) stated that "The government has never had a better chance to address such problems as it finalises details for implementation of the European water framework directive (WFD). Known in Europe as the 'English' directive, because it was developed largely by British scientists, it has been hailed as the most ambitious piece of European environmental legislation ever." Similarly Jacob Tomkins (2016) of Water Wise stated that "the Water Framework Directive, the largest piece of environmental legislation ever, which aimed to ensure good quality water across Europe and was adopted by countries worldwide (so even if we have left Europe and are drifting in the Atlantic when you read this, it is still relevant). This policy was led by the UK, and it's nickname was 'the English Directive'."

It was ironic that, at first, in preparing the first RBMP cycle in 2009, Defra and the Environment Agency (EA) actually had great difficulty in implementing its "English" Directive in England and Wales because they implemented it nationally rather than at River Basin District or catchment level as the WFD requires. This was because of limited capability and capacity at catchment level and the high costs of the outstanding requirements for the existing Directives (e.g., UWWT and Habitat) meant that there was little room left for affordable WFD measures.

The Angling Trust (2010) and WWF took Defra to judicial review because they claimed that the first RBMPs did not fully comply with the requirements of the WFD. However, this seriously diverted scarce resources at Defra and the Environment Agency from important work to prepare measures to implement the WFD. A less adversarial approach would have been more productive and environmentally beneficial. Moreover, it would have been better to focus on working internationally to highlight the much greater inadequacies in the implementation of the WFD in other EU countries — as WWF did well in highlighting the significant distortions caused by subsidized water in Spanish strawberries (see Section 4).

In 2013, Defra launched the Catchment Based Approach which formed the basis of their preparing the second cycle of RBMPs in line with the WFD.

The WFD is criticised for being too complicated. However, effective and efficient water management inevitably covers many complex matters. In addressing them, the WFD does all the right things in the right way and that is inevitably complex. This means that it takes time to develop appropriate processes for preparing RBMPs to implement the WFD. It will not be until the third cycle of RBMPs that Defra and the Environment Agency can get it right.

When the WFD was being negotiated in 2000, 2027 seemed a long time away and rivers were improving; so achieving GES by 2027 seemed pretty realistic. Now, however, people in all member states realise that GES is not at all easy to achieve everywhere in these timescales. Therefore it will be essential that WFD's initial 2027 deadline is extended so that less stringent objectives can be permitted well beyond 2027 since this deadline would either not be technically feasible or would be excessively costly. This extension would enable the Environment Agency to continue to build on its current good work to achieve efficiently and effectively significant improvements to the water environment.

6. Issues Regarding Brexit

Following the referendum decision on 23 June 2016, the key question now is what sort of Brexit is best for the UK and the EU and accordingly what degrees of "hard" or "soft" Brexit that the UK Government goes for and can negotiate during the two year period after Article 50 was invoked at the end of March 2017. Key issues surrounding this question and debates include:

a) Whether the UK can retain "friction free" access to the EU single market — i.e., access that current EU member states have without tariffs or customers barriers. The EU single market is the largest market in the World. It currently accounts for 44% of UK trade. Exports to the EU currently account for 12% of UK GDP. Loss of such free access to the Single Market could result in significant losses to sectors currently exporting to the EU. The Economist (2016b, p. 28) reports estimates by Oliver Wyman that losing such free access to the Single market could cost 35,000 jobs in Finance. Moreover, business investment could decline due to uncertainties and lost confidence arising from Brexit and reductions in

foreign direct investments by firms that have traditionally located in the UK to be able to trade easily in EU's single market.

b) Control on immigration from the EU was a key issue behind the referendum result and is likely to cause an impasse in the negotiations on Brexit. EU member states are demanding agreement to freedom of movement of people as a key core freedom and a sine qua non requirement for free access to the single market; while the UK demand controls on EU immigration. There are concerns that neither side is prepared to derive a practical pragmatic compromise. It is ironic that, having campaigned during the referendum for reducing the burden of EU red tape, hard Brexit proposals would impose bureaucratic immigration and border controls which would have much more adverse economic impacts on the ability of businesses to grow dynamically than any economic impacts of environmental regulations which Section 3 showed to be not significant.

c) What regulations the UK will impose?

This chapter therefore examines this last subject in more depth focusing on economic aspects first in the context of overall environmental regulation and then in the specific context of the latest EU Water regulation — the EU Water Framework Directive.

6.1 Environmental Regulations and Brexit

During the referendum, there was little reference specifically to environmental regulations, which means that that there is not really a mandate for any knee jerk dismantling of environmental regulations post Brexit. Only reference I can recall was a bogus claim that the WFD gives preference to the environment over people and this led to flooding. The WFD and EU Floods Directive gives full consideration to both people and the environment. Reduced flood risks to people and businesses account for the majority of the benefits that the Environment Agency takes into account in determining flood risk management measures.

On Brexit, in order to reduce uncertainties for both regulators and business, an essential immediate legal task is to convert the current body of EU law into UK legislation with changes to the law so that it continues to work as it currently does (e.g., where regulation currently relies on EU systems/institutions/quotas etc). There will not be any significant immediate changes to environmental regulation, including the provisions of the Water Framework Directive. The exceptions are replacing the Common Agricultural and Fisheries Policies.

There are criticisms that this (misleadingly named) "Great Repeal Bill" fundamentally goes against the objectives of and reasons for Brexit to break free from EU regulations (Shapps, 2016). Consequently, Shapps calls for a five-year sunset clause in this Bill to allow MPs to scrutinise former EU laws, removing job-destroying clauses. However, this would create considerable uncertainties for business concerning what will be the regulations after this sunset period. It would also create considerable legislative burden and logjam. Even extending the sunset clause to ten years would still divert parliament from developing and improving other more important legislative changes. We need a more focused approach.

Depending on the UK's new relationship with the EU arising from the Article 50 negotiations and as part of transitioning the exit from the EU, Defra will need to review environmental regulation in a measured and focused way in the context of Defra's 25 Year Environment Plan (Defra (HM Government, 2018)).

We must retain as much stability and predictability regarding environmental regulations so as not to create unnecessary uncertainty which would have adverse economic impacts on business. Moreover, it needs to be focused and based on sound overall evidence - not dogma and anecdotal misinformation. We must not throw the baby out with the bath water.

Consequently, Defra's review should cover the following matters:

a) Identify those EU Directives and regulations from which we have exemptions and hence would not need to be transposed into UK law. So take these out of the debate. These matters should be covered by any current UK Laws and regulations that we currently apply instead.
b) Focus on specific concerns about the remaining EU laws currently applicable here.
c) Determine whether these concerns could best be handled by amending the targets and by judicious efficient implementation in line with our current better regulation principles (rather than legal changes as such). This could address many of the concerns in the area of EU environmental regulations which are largely "framework" Directives and give considerable flexibility in how the Member States implement them (see S. 5 earlier) especially regarding the Water Framework Directive.
d) Collate actual hard evidence of those cases where EU regulations impose excessive costs and destroy UK jobs. This would also usefully show whether the concerns during the Referendum about bureaucratic EU laws is based on misinformation or actual facts in the light of this proper scrutiny of the evidence.
e) Accordingly focus on any of these outstanding EU laws that impose excessive costs and require legal amendment. Then have a measured 5-10 year plan for making these amendments in a sensible staged way focusing first on the most important ones,
f) Set out the scale, nature and significance of the costs, especially costs to business of these regulations requiring amendment. Brexit means that there will be increasing attention concerning the economic impacts of regulations for political reasons — given demands to reduce the burden of EU red tape — and economic reasons. The UK is likely to face difficult economic challenges following Brexit. Moreover, there will be increasing attention concerning impacts on international competitiveness especially concerning countries outside the EU and any potential for UK firms to relocate investments to non-EU countries with lower environmental standards.
g) Set out the scale, nature and significance of the environmental problems that the amended regulations tackle and the benefits of the regulations. Brexit means that the environmental authorities (and also the environmental pressure groups) will have to move from focusing on compliance with EU Directives to seeking justifiable environmental improvements that are worthwhile for the UK (i.e., that their benefits exceed their costs). This is all to the good and consistent with the best practice principles outlined in Sections 4 and 7 and with which most current environmental regulations are well in line.

The assessment in (g) above should help show that environmental regulations are addressing major environmental problems and also that these problems are likely to be even more significant in other non-European countries with currently lower environmental standards who will therefore need to implement tighter environmental regulations in future. This will reduce any tendency for business to relocate to such current pollution havens (see S.3.4)

Where an environmental regulation does not allow (adequately) for the costs of complying and where their targets are not currently feasible or too costly to achieve and not sufficiently beneficial and worthwhile, then they should be treated as "aim to achieve" objectives requiring proportionate measures to be implemented over reasonable time periods.

Any such review should assess the UK's implementation of EU Directives in terms of the better regulation principles outlined in Sections 4 and 7. Items (f) and (g) would need to be covered in the Impact Assessments that

Defra would need to provide as part of the regulatory reviews and to underpin any regulatory and legislative changes. Defra need to pay particular attention to any reviews that the European Commission is itself carrying out regarding how their own regulations need to be amended to better fit their own guidelines.

There will be strong pressure from the EU to make any continued current frictional free access to the EU's single market conditional upon UK complying with EU regulations — as in the European Economic Area (EEA) model (IIEP, 2016a, b)) — to retain an even playing field across Europe. Therefore it will be essential that, as far as possible, the UK continues to play its traditional role of positively influencing and shaping environmental regulations that it has so successfully carried out over the last two decades. In particular, the UK authorities need to ensure that the EU targets and environmental regulations are based on a sound economic and financial appraisal and that the targets and deadlines are feasible and worthwhile in achieving important benefits and not entailing disproportionate costs

We must retain those environmental regulations and processes that are well in line with these principles and are essentially 'British' in basis.

6.2 The Water Framework Directive (WFD) and Brexit

Brexiteers gave rhetorical arguments for Brexit during the referendum debates and now for a "hard" Brexit, which superficially appear convincing. In the context of the water sector, Stephen Topping (2016) set these out eloquently as including:

A) Brexit could lower the water sector energy costs if it did not have to implement costly EU targets for increased renewable energy.

B) Brexit could increase the sector's ability to hire skilled labour from non-EU countries.

C) Brexit gives the UK the opportunity and flexibility to decide what EU regulations are best for the UK and thus what it wants to adopt in what form and what it does not.

D) Brexit provides opportunities for UK companies to export water infrastructure and engineering services to non-EU countries, which is a major world market.

I examine each of these arguments in turn.

A) Lower Costs

Horton (2016) acknowledges Topping's point A above. But counters that a hard Brexit could in fact lead to higher energy costs for the water sector since it might mean that the energy sector would no longer be subject to EU competition laws, which, in the absence of equivalent UK measures, would reduce competitive pressures to contain or lower energy prices in the UK. Also the UK is a net energy importer. Grubb (2018) reports that data on European energy prices are complex; but that generally European energy, especially European imported energy, is cheaper than UK energy. A hard Brexit could weaken the cross-border energy market and hinder cross border arrangements (e.g., the cross channel interconnector). Moreover, falls in the pound following Brexit could further raise the cost of imported energy.

In addition, Horton (2016) argues that Brexit will lead to lower investment in the UK water sector due to the loss of the major investments (of about £ 0.5bn pa on average) that the European Investment Bank (EIB) has provided for the UK water sector. In the last periodic review of the water industry in 2014 prior to Brexit, the water industry's cost of capital was at an all time low of about 3.7% in real terms (Ofwat, 2014, p. 10). Ofwat's (2017) methodology for the current 2019 price review proposes a low cost of capital of 2.4% real (in terms of RPI) and 3.4% real (in terms of RPIH) due to the current lower cost of debt. But this report does not consider impacts of Brexit. The water industry's cost of capital is likely to rise following Brexit due to this loss of EIB finance and

increased uncertainties and financing difficulties arising from Brexit. Also if the fall in sterling following Brexit leads to a rise in inflation, then the Bank of England might have to raise interest rates to contain inflation to within its 2% target. This could further increase the pressure on the sector's cost of capital. The water industry's capital costs account for about half of its total costs; so this could increase water prices for the consumers.

B) Hiring Skilled Labour

Horton (2016) stresses that the UK water sector (along with other business sectors in the UK) currently is severely short of skilled labour. Excell (2017) states that the engineering sector will require 265,000 pa engineers in the UK over the next 10 years. At present this gap is largely filled by EU nationals. Therefore strong immigration controls from the EU would damage this sector in terms of loss of access to this skilled workforce and/or bureaucratic regulatory costs and delays as they have to seek work permits for these staff to fill the posts for which there are currently not sufficient UK employees. Moreover, it is not evident that the UK immigration policy post Brexit would lead to increased ability to hire skilled labour from outside the EU to fill the shortfall. It would appear that the water sector (as with other sectors) would still incur the regulatory costs and uncertainties of having to overcome bureaucratic hurdles to obtain work permits for these staff. Brexit will necessitate greater concerted action to improve training of the UK labour force to fill this skills shortage — this is needed anyway regardless of Brexit. But it will take time for such action to lead to significant increases in skilled workers. So a key question for the Government and Brexiteers is how to handle the significant skills shortages that UK businesses will face in the interim.

C) Allow UK to Choose Flexibly the Regulations that Are Best for the UK

Fisher (2016) agrees with Topping here. But this should not mean dismantling the WFD, about which we need to retain with its sensible "English" processes and requirements. Recent RBMPs will achieve important environmental benefits (with a present value of about 22.5bn) that exceed their costs (with present value of 17.5bn) (Environment Agency, 2015b).

However, it will not be feasible and would be too costly to achieve GES by 2027. Thus the Environment Agency CEO (Sir James Bevan) stated (at the House of Commons EFRA Select committee hearing on 21 November 2017) that "My honest answer is that, no, we are not going to meet that target" and that "The UK is not alone in that. Most EU member states will not meet those targets."

Consequently this current EU deadline should be extended and we need to treat GES as an objective which various subsequent rounds of River Basin Management Plans will "aim to achieve". This is also the view of others in EU Member States. So it should happen anyway — regardless of Brexit. Defra need to link with, inform and influence any such reviews of the WFD, its GES target and deadlines that the European Commission is itself carrying out. We should also promote efficient ways such as abstraction trading to enable compliance with the WFD's "no deterioration" objective without restricting development.

D) Export Opportunities for the Water Sector in Non-EU Countries

Fisher (2016) acknowledges that the market for water supply and waste water treatment infrastructure in non-EU countries is big, although it can be limited due to existing low water prices there and affordability constraints that limit the ability to raise water prices. The UK water companies have historically not exploited this market, which is now dominated by incumbent French and German water companies who will strive hard to keep out any new competitors from the UK.

There is greater potential for UK companies in providing integrated services to help non-EU countries develop and apply new more efficient water management policies, regulations and systems. These countries

should go directly to integrated water management based around the "English" WFD and the Floods Directive (see Section 5). The UK water companies and consulting services ought to have a strong comparative advantage in exploiting this market. However, if Hard Brexit means abandonment of the WFD and exclusion of UK companies from engaging with European partners on its development and implementation, then these UK companies would rapidly lose this essential advantage and potential exports.

To sum up: This review of the evidence suggests that a Hard Brexit would lead to a loss of essential skilled labour and increased labour, energy and capital costs for the UK water sector and a loss in future exports to both EU and non-EU countries rather than the potential gains advocated by Brexiteers. Brexit should lead to desired changes in how the WFD will be implemented. But these changes should happen anyway. The UK needs to retain the WFD and continue to influence how the EU should sensibly refine and implement this 'English' Directive. Hence the UK and EC should treat environmental regulations and the WFD in particular as core matters for which there is regulatory alignment and continuation of close involvement of UK policy and technical experts in their development.

7. Summary and Conclusions

There is considerable concern and debate about the economic impacts of environmental regulations. Therefore this paper in Section 2.1 set out a framework of the factors by which environmental regulations could affect economic growth. It then critically examined the available evidence on these factors, which highlights that the economic impacts of environmental regulations is somewhat contested and not perfectly clear cut. Moreover it shows that reported statements and positions on this subject are often based on partial, anecdotal and selective "evidence" and need to be treated with caution. The paper also reveals that in some cases the "supporting" evidence is often misreported or misinterpreted.

Nevertheless, the following clear conclusions can be drawn from the available evidence:

1) The weight of evidence suggests that there are not any *significant* adverse economic impacts of environmental regulations. Environmental regulations' gross costs to all businesses account for just 0.16% of the turnover of all businesses and only 0.2% of the turnover of manufacturing businesses. The net costs to business of environmental regulations are generally about one third lower when account is taken of the direct financial benefits of environmental regulations to business.
2) Better regulation initiatives can significantly improve the impacts on economic growth and positive impacts on the UK Environmental Goods and Services Sector, which is an important growing UK industry catering for a market that is increasing significantly especially in Europe and worldwide (see Section 3.3).

Increasing environmental pressures and scarcity of important ecosystems services and rising public concerns about environmental matters (Defra et al., 2011, 2014), Natural Capital Committee (2014)) are likely to lead to the need for stricter environmental regulations in future. At the same time, the UK will face increasingly difficult economic challenges. There will be increasing concern about the economic impacts of environmental regulation.

Nevertheless, greater environmental protection can still be achieved without significant adverse economic impacts. Such focus on enhancing the economic impacts of environmental regulations can considerably improve the efficiency and effectiveness with which desired environmental improvements can be achieved — probably more so than the customary focus in academic circles on the valuation of environmental benefits.

Therefore to that end, Section 4 shows that the design and implementation of the environmental regulations need to be based on the following 16 best practice principles to improve their economic impacts. These are similar to those in other reviews and guidance (Defra, 2013; Cabinet Office Better Regulation Task Force, European Commission, 2012):

A) Collaborate with other countries, especially in Europe, and share best practice.

B) Focus on achieving environmental outcomes not any prescribed technologies.

C) Have ambitious rather than lax objectives to provide ongoing incentives to promote innovations to achieve the strict regulations and their desired outcomes.

D) But allow flexibility for how to achieve these objectives and desired outcomes

E) At the same time take due considerations of the costs and feasibility of the regulations and allow explicitly for exemptions where the costs can be shown to be disproportionately expensive. In this way, ensure that the regulations do not impose an undue cost burden on businesses.

F) To that end, base the regulations and their implementation on a sound economic and financial appraisal of their full costs and benefits with particular attention on impacts on small firms. In UK Government and European terminology, these appraisals are called "Impact Assessments". Defra and the Environment Agency need to evaluate performance of regulations and carry out empirical analyses of actual ex post costs vs ex ante estimates for regulations which the Impact Assessment showed could have major costs for businesses. They need to learn from these evaluations and incorporate their findings in appraisals of future regulations.

G) Be proportionate. Ensure that the measures and their costs are proportionate to the significance of the problem and worthwhile in terms of the benefits they achieve.

H) Integrate regulations coherently to promote more innovative and efficient solutions that address various related environmental problems in one go and provide a one stop shop to interact with business on the implementation of the regulations. Integrated solutions and avoiding pollution and addressing pressures at source is almost always less costly than end of pipe controls, remediation or clean up.

I) Have well defined phase-in periods. Linking these to an industry's capital investment cycles can enable businesses to integrate the environmental controls in investments for new plant and equipment which can prompt development and adoption of new technologies that are better in economic, environmental and resource terms, and substantially less costly than adding end of pipe controls to existing plant.

J) Make the regulatory process more stable and predictable so that business can build in consideration of environmental controls to their development, design and implementation of investments in new plant, equipment and technologies. This is best achieved by the regulators providing clear, credible and comprehensible information on the current situation and likely future position regarding the scale and nature of environmental problems and pressures and public concerns about them — and hence the need for (stricter) environmental regulations. This could give a good clear signal to business who will be best placed to assess likely developments in technologies and the costs of control options which the regulators will need to take into account to determine future regulations in a sound balanced way.

K) Involve businesses, environmental NGOs and stakeholders at an early stage in drawing up the regulations and setting the targets. There needs to be a more collaborative and less adversarial relationship between these various bodies.

L) Use market incentives to provide continuing incentives for business to develop and apply innovative

solutions, especially in the long run.

M) Minimise the time and resources consumed in the regulatory process so that it does not delay and hinder or discourage innovation and investments.

N) Enhance the technical and economic capabilities of regulators so that they are better able to understand the economics of the businesses they regulate and are better able to communicate with businesses regarding the best way of tackling the environmental problems in a well ordered way.

O) Provide clear guidance for business regarding the regulations and how firms can best achieve the targets.

P) Transparency regarding the measures to be implemented and their costs and benefits not only in this country but also in competing countries, especially in Europe.

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Acronyms and Abbreviations

EA: Environment Agency
EEA: European Economic Area
EGSS: Environmental goods and services sector
EIB: European Investment Bank
DEFRA: Department for Environment, Food and Rural Affairs
GES: Good Ecological Status
OFWAT: Office for Water Services
ONS: Office for National Statistics
RBMP River Basin Management Plans
SEEA: System of Environmental Economic Accounting
SEPA: Scottish Environment Protection Agency
UWWT: EU Urban Waste Water Treatment Directive.
WFD: EU Water Framework Directive (WFD)

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