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Environmental Outcomes from Licence Enforcement Activity

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Rialtas na hÉireann
Government of Ireland

ENVIRONMENTAL PROTECTION AGENCY

The Environmental Protection Agency (EPA) is responsible for protecting and improving the environment as a valuable asset for the people of Ireland. We are committed to protecting people and the environment from the harmful effects of radiation and pollution.

The work of the EPA can be divided into three main areas:

Regulation: *We implement effective regulation and environmental compliance systems to deliver good environmental outcomes and target those who don't comply.*

Knowledge: *We provide high quality, targeted and timely environmental data, information and assessment to inform decision making at all levels.*

Advocacy: *We work with others to advocate for a clean, productive and well protected environment and for sustainable environmental behaviour.*

Our Responsibilities

Licensing

We regulate the following activities so that they do not endanger human health or harm the environment:

- waste facilities *(e.g. landfills, incinerators, waste transfer stations)*;
- large scale industrial activities (*e.g. pharmaceutical, cement manufacturing, power plants)*;
- intensive agriculture *(e.g. pigs, poultry)*;
- the contained use and controlled release of Genetically Modified Organisms *(GMOs)*;
- sources of ionising radiation *(e.g. x-ray and radiotherapy equipment, industrial sources)*;
- large petrol storage facilities;
- waste water discharges;
- dumping at sea activities.

National Environmental Enforcement

- Conducting an annual programme of audits and inspections of EPA licensed facilities.
- Overseeing local authorities' environmental protection responsibilities.
- Supervising the supply of drinking water by public water suppliers.
- Working with local authorities and other agencies to tackle environmental crime by co-ordinating a national enforcement network, targeting offenders and overseeing remediation.
- Enforcing Regulations such as Waste Electrical and Electronic Equipment (WEEE), Restriction of Hazardous Substances (RoHS) and substances that deplete the ozone layer.
- Prosecuting those who flout environmental law and damage the environment.

Water Management

- Monitoring and reporting on the quality of rivers, lakes, transitional and coastal waters of Ireland and groundwaters; measuring water levels and river flows.
- National coordination and oversight of the Water Framework Directive.
- Monitoring and reporting on Bathing Water Quality.

Monitoring, Analysing and Reporting on the Environment

- Monitoring air quality and implementing the EU Clean Air for Europe (CAFÉ) Directive.
- Independent reporting to inform decision making by national and local government *(e.g. periodic reporting on the State of Ireland's Environment and Indicator Reports)*.

Regulating Ireland's Greenhouse Gas Emissions

- Preparing Ireland's greenhouse gas inventories and projections.
- Implementing the Emissions Trading Directive, for over 100 of the largest producers of carbon dioxide in Ireland.

Environmental Research and Development

- Funding environmental research to identify pressures, inform policy and provide solutions in the areas of climate, water and sustainability.

Strategic Environmental Assessment

- Assessing the impact of proposed plans and programmes on the Irish environment *(e.g. major development plans)*.

Radiological Protection

- Monitoring radiation levels, assessing exposure of people in Ireland to ionising radiation.
- Assisting in developing national plans for emergencies arising from nuclear accidents.
- Monitoring developments abroad relating to nuclear installations and radiological safety.
- Providing, or overseeing the provision of, specialist radiation protection services.

Guidance, Accessible Information and Education

- Providing advice and guidance to industry and the public on environmental and radiological protection topics.
- Providing timely and easily accessible environmental information to encourage public participation in environmental decision-making *(e.g. My Local Environment, Radon Maps)*.
- Advising Government on matters relating to radiological safety and emergency response.
- Developing a National Hazardous Waste Management Plan to prevent and manage hazardous waste.

Awareness Raising and Behavioural Change

- Generating greater environmental awareness and influencing positive behavioural change by supporting businesses, communities and householders to become more resource efficient.
- Promoting radon testing in homes and workplaces and encouraging remediation where necessary.

Management and structure of the EPA

The EPA is managed by a full time Board, consisting of a Director General and five Directors. The work is carried out across five Offices:

- Office of Environmental Sustainability
- Office of Environmental Enforcement
- Office of Evidence and Assessment
- Office of Radiation Protection and Environmental Monitoring
- Office of Communications and Corporate Services

The EPA is assisted by an Advisory Committee of twelve members who meet regularly to discuss issues of concern and provide advice to the Board.

EPA RESEARCH PROGRAMME 2014–2020

Environmental Outcomes from Licence Enforcement Activity

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EPA Research Report

Prepared for the Environmental Protection Agency

by

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This report is based on research carried out/data from July 2018 to January 2019. More recent data may have become available since the research was completed.

The EPA Research Programme addresses the need for research in Ireland to inform policymakers and other stakeholders on a range of questions in relation to environmental protection. These reports are intended as contributions to the necessary debate on the protection of the environment.

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Executive Summary

While there is increasing public awareness of the impact of climate change, more actions need to be undertaken so that Ireland makes strides in achieving its targets for greenhouse gas emissions by 2030 and in bringing water quality up to a satisfactory level. To build a culture of compliance and to deliver a healthy and well-protected environment, regulatory and enforcement agencies will need to work with industrial, water and waste sectors in a more targeted way to deliver greater change in the behaviour of licensees.

Environmental protection now encompasses waste reduction, resource efficiency and habitat protection as well as emission limits and this is reflected in the conditions and reporting required in integrated licences. The EPA has stated that a key environmental action and priority for Ireland going into the future is the need to "integrate resource efficiency and environmental sustainability ideas and performance accounting across all economic sectors". An assessment of performance indicators for Ireland pointed to an overreliance on emission outputs and gaps in the following areas: natural capital including biodiversity; resource efficiency; decoupling environmental harm from economic activity, e.g. low-carbon economy; supply chain impacts; and people's health and quality of life.

Compliance promotion activity has been extended to include more co-operative approaches rooted in behavioural economics and behavioural insights theory and this is referred to as "compliance assurance". Examples include information programmes, electronic monitoring and reporting, incentives for participation in environmental management schemes and formal reporting methods such as International Organization for Standardization (ISO) 14001. Environmental agencies support sustainable development and the circular economy by working with businesses to find solutions to reduce the environmental impact of business activity while fostering an economic growth strategy. In this model, the position of the regulated enterprises changes to that of clients supported by the agency. While popular in some countries, the evidence to the efficacy of this approach is scarce.

Empirical results consistently show that strong traditional sanction-based enforcement is critical to environmental protection work. There is some evidence to support the use of co-operative activity in conjunction with strong regulatory pressure. The effectiveness of compliance assurance activities is difficult to measure; evidence is scarce and results are mixed. More evidence is required on the effectiveness of co-operative activity to determine a good balance between traditional enforcement and compliance assurance. Notwithstanding this, encouraging a co-operative attitude from business is valuable, as it moves licensees further into the realm of holistically monitoring their environmental performance. Disclosure has been found to lead to greater compliance.

Sector-level approaches represent a global trend in environmental compliance assurance. Some compliance assurance techniques, such as peer-to-peer learning and effective knowledge transfer, are very suited to sector plans. Engagement at a sectoral level offers an opportunity to build a culture of compliance (encouraging beyond compliance) and deliver the vision of a healthy and well-protected environment.

Sector-level approaches also facilitate the development of sector-specific environmental performance rating systems consisting of key performance indicators. Indicators can simplify a complex situation. Robust procedures for designing and validating sector-specific composite performance indicators have been developed. Environmental performance can be used to direct the effort of the regulation agency and to assess its effectiveness. The indicators are a useful tool in discussions with sectoral representative bodies and in workshops with key sectoral stakeholders in seeking improvements in the environmental performance of their members.

The development of sector plans and measuring the effectiveness of sector plans needs to balance the principle of integrated pollution control and the need to avoid overcomplexity. The experience of a number of countries suggests that it is best to focus on a few priority pollutants rather than aggregating a wide range

of weighted indicators in generating composite sectoral environmental performance measures.

As a compliance promotion tool, deviations from performance bands or grades on environmental performance measures (or on single priority indicators of pollutants) for sectors can be monitored and licensees within these sectors can strive to find the best solutions to reduce their environmental impact and thus the environmental impact at a sectoral level.

There are two approaches available to assess the effectiveness of sector-based licence enforcement activity. One is the development of a dynamic environmental performance rating system. This system would provide information to the regulator and the regulated and to citizens and other stakeholders. Notwithstanding the recent availability of electronic data via mandatory reporting, the commitment to ongoing resources, expertise and development that such a system requires should not be underestimated. The other approach is periodic investigations using historic data to get snap shots of what is working. The latter could be regular, included in State of the Environment reports, or sporadic.

Key Recommendations

- Sector plans based on problem-solving key issues should be developed in Ireland.
- Sectoral environmental indicators should be constructed and tested based on key priority problems for key sectors to develop a sector benchmarking process.
- A system of digital badges should be initiated. Electronic certificates can be used to indicate compliance (similar to having a tax compliance certificate). The system can be developed to communicate the status of the facilities' environmental performance if a sector benchmarking process is developed.
- Given the greater availability of data, consideration should now be given to more formally test the link between licensing and enforcement activities and compliance, at least using sectoral-, but preferably facility-, level data. An analysis of this nature would identify what elements of enforcement and monitoring are more effective in delivering on regulatory compliance and in improving final outcomes for the environment. This would assist environmental regulators and enforcement offices in prioritising resources towards enforcement and monitoring actions that deliver greater improvements in intermediate and final outcomes for the environment.
- A data access policy should be developed for researchers to access current and historic Office of Environmental Enforcement records, Annual Environmental Reports and other types of data to enable researchers to formally test these links.
- European Union (EU) networks, such as the EU Environmental Implementation Review (EIR) initiative and the EU Network for the Implementation and Enforcement of Environmental Law (IMPEL), should continue to be leveraged to build up case evidence on international practice through their peer-to-peer networks on the usefulness of co-operative approaches to garner greater compliance from industry.

1 Introduction

This report reviews (1) the development of environmental performance measures for the dual purpose of promoting compliance and measuring the impact and outcomes from enforcement activity; and (2) new trends in environmental enforcement approaches. Case evidence shows international best practice. We also consider the types of metrics of environmental outcomes available in Ireland and gaps in these metrics.

Standard measures of the impact of enforcement activity include measures of compliance and the duration of non-compliance. There are few examples in the literature of impacts measured as relative changes in pollution discharges (Gray and Shimshack, 2011). An expanded holistic measurement of environmental outcomes in response to enforcement activity involves determining a composite measure of environmental performance at the facility level and aggregating up to the sector level if required. The latter approach is not well developed but is discussed in this report. Environmental performance at the national level is more developed but it is difficult to link these indicators directly to environmental outcomes from enforcement activity.

In this chapter we examine the evolution of environmental enforcement in Ireland, provide a broad overview of enforcement evaluation and introduce new trends in environmental enforcement. In Chapter 2 we look at approaches used to measure the impact of environmental regulation enforcement. Environmental performance measurement is a broad subject with no settled definitions or nomenclature and many niche systems. In Chapter 3 we look at the theoretical foundations and methodologies for developing environmental performance instruments. With appropriate indicators, environmental performance measures can provide a measurement of environmental outcomes in response to enforcement activity. In Chapter 4 we discuss environmental performance indicators in more detail. In Chapter 5 we examine the evaluation of environmental performance at different levels (e.g. at enterprise, sectoral and national levels). Chapter 6 gives an overview of new trends in enforcement activity. In Chapter 7 we present the experience of other regulation agencies with some case studies from different jurisdictions. In Chapter 8 we conclude and make recommendations for further development of performance measures.

1.1 The Evolution of Environmental Enforcement in Ireland

The Irish Environmental Protection Agency (EPA) has, to date, undertaken several innovations to maximise its effectiveness in the enforcement of environmental regulations. Integrated Pollution Control (IPC) licensing, integrating the control of emissions to air, water and soil, has been in effect since 1992 (Styles *et al*., 2010). The EPA has been regulating large industries since 1994 and large waste facilities since 1996. The EPA licenses and regulates approximately 800 enterprises in Ireland. To maximise the effectiveness of enforcement in environmental regulation the Office of Environmental Enforcement (OEE) was established in 2003. The OEE is an office within the EPA dedicated to the implementation and enforcement of environmental legislation in Ireland. It also supervises the local authority statutory functions and regulates Irish Water (e.g. through waste water authorisations and the regulation of drinking water). The Network for Ireland's Environmental Compliance and Enforcement (NIECE) was founded in 2004 and the EPA, local authorities and other bodies with environmental enforcement responsibilities are involved with the network. The network facilitates better enforcement through the communication and co-ordination of enforcement efforts, increased national capacity, improved performance of local authorities and the development of a national environmental complaints procedure. A risk-based enforcement methodology to concentrate resources where most environmental risk occurs was introduced in 2006. The Licensing, Enforcement, Monitoring and Assessment (LEMA) web portal system was introduced in 2013; this system allows the relevant EPA inspectors and licensees to communicate electronically. The licensees can submit documents via the portal and follow progress on licensing and enforcement matters. It allows automated compliance

assessment for waste water discharge licences. The National Priority List, which lists the poorest-performing installations, based on enforcement factors, was first published in July 2017.

The EPA Strategic Goals for 2016–2020 are as follows:

- trusted environmental regulator;
- leader in environmental evidence and knowledge;
- effective advocate and partner;
- responding to key environmental challenges;
- organisationally excellent.

1.2 The OECD Model of Environmental Enforcement and Outcomes

The Organisation for Economic Co-operation and Development (OECD, 2009) has developed a model of environmental enforcement programme delivery (i.e. inputs, outputs, intermediate outcomes and final outcomes). Most enforcement offices use output-based (e.g. the number of inspections carried out) and intermediate compliance-based (e.g. compliance rate) indicators for the assessment of their activities. The ultimate objective of regulation enforcement relates to achieving environmental quality at the national level that is improved and decoupled from economic growth. Many regulators are working to develop indicators based on a broader range of intermediate (e.g. environmental performance-based indicators such as reduced environmental risk) and final outcomes (e.g. kilometres of rivers of high environmental status). These indicators can provide an evaluation of enforcement effectiveness in changing culture within organisations, assist with strategic planning and policy design nationally and develop comparable indicators to benchmark across sub-national jurisdictions (OECD, 2015). The OECD approach that is applied to environmental regulation enforcement is examined in more detail in section 2.3.

Environmental performance at the national level has developed in recent years, based on national inventories and monitoring activities, but it is difficult to link national environmental outcomes directly to enforcement activity. We review the frameworks and methods used to develop environmental performance measures (intermediate outcomes) and link them to national measures (final outcomes). We also review the empirical literature on the effectiveness of environmental enforcement activity.

1.3 New Relationships between the Regulator and the Regulated

Problem-solving and efficiency represent new approaches seen internationally in environmental compliance assurance (OECD, 2009). We have noted four new interconnected trends in enforcement activity that impact on the relationship between the regulator and the community it regulate:

1. **The type of enforcement activity employed.** Traditional enforcement activity is of the coercive "command and control" type, with measures of enterprise compliance being the outcome. Internationally there has been a move to extend enforcement activity with a more flexible co-operative approach, which emphasises the inducement of going beyond basic compliance to good environmental performance (Earnhart and Glicksman, 2015).
2. **The use of integrated environmental performance measures.** These measures incorporate compliance status and other indicators of environmental performance (Trumpp *et al*., 2015).
3. **The use of sector plans.** These plans are used to assess environmental impacts at a sectoral level.
4. **The role of environmental regulation authorities.** In many jurisdictions, environmental authorities are expected to play a part in the development of the circular economy by partnering with businesses to find the best solutions to reduce the environmental impact of business activity while fostering an economic green growth strategy (Mazur, 2012). Once basic compliance is assured, the position of the regulated enterprises is shifted to that of a client supported by the agency (EA, 2011).

2 Measuring the Impact of Environmental Regulation Enforcement

2.1 Introduction

In this chapter we examine current performance measures of environmental enforcement and the OECD framework for measuring the impact of enforcement activity. We review some empirical studies on the effectiveness of traditional enforcement activity, such as monitoring, inspections and penalties. We then examine the literature regarding some non-enforcement initiatives, such as education, to identify activities likely to increase the motivation for compliance and overcompliance. We briefly introduce the European Union (EU) Environmental Implementation Review (EIR) and the European Union Network for the Implementation and Enforcement of Environmental Law (IMPEL) set up to facilitate the exchange of best practice between Member States.

2.2 The OECD Framework for Measuring the Impact of Enforcement Activity

The logic-based model developed by the OECD traces environmental regulation to its impact on environmental quality and suggests opportunities for performance measurement along this pathway (see Figure 2.1). Figure 2.1 shows that the model begins with the introduction of regulation into national law (step 1). This is not within the remit of the regulator. Government departments transpose EU law into national legislation. The measurement of this aspect is not in the scope of the current document but could be measured by the time taken to transcribe EU directives into national law, derogations sought or the stringency of environmental policies similar to the OECD Environmental Policy Stringency Index.[1] Step 2 involves the enforcement of regulation: input measures (i.e. the resources dedicated to enforcement) and output measures (i.e. enforcement activity). Enforcement activity can be assessed by the type of actions undertaken by the agency and their frequency. Enforcement agencies often report on their performance using output measures based on the level of their activity (e.g. number of inspections). Step 3 (in Figure 2.1) involves the measurement of intermediate outcomes, including the response of the regulated community to enforcement activity assessed at the enterprise, sector or national level. This is captured by compliance-based data or by a more complex environmental performance measure. Compliance-based measures alone fail to capture the complete benefit that can be achieved by effective enforcement activity. For example, reduced compliance issues may make the regulator appear to be less effective but it may be a result of successful deterrence. Lastly, the impact of the enforcement

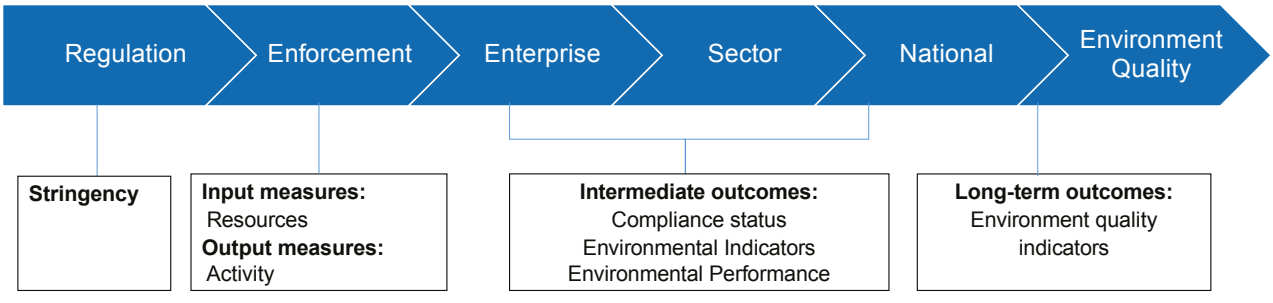

Figure 2.1. The path from regulation to environmental quality.

1 The OECD produces an Environmental Policy Stringency Index (from 6, stringent, to 1, lax). Ireland's index moved from 0.52 in 1990 to 2.05 in 2012 (the last year that a score for Ireland was determined). In 2012, Ireland had the second-lowest score among the OECD countries; Turkey had the lowest score.

activity on local, regional and global environmental conditions is considered (i.e. the final outcomes) as a more complex environmental performance measure.

Figure 2.1 demonstrates that a results perspective assessment of enforcement activity can be applied at the third step (intermediate outcomes) and/or the last step (long-term outcomes). Linking enforcement activity to intermediate and final outcomes requires an expanded measurement framework. Mazur (2010) investigated quantitative indicators to assess results-based outcomes of environmental enforcement authorities' efforts to ensure compliance with pollution prevention and control regulations. Six measures of environmental performance that aim to assess improvements in either the behaviour of the regulated community (intermediate outcomes) or environmental conditions (final outcomes) are given in Table 2.1.

A composite environmental performance measure can be determined by integrating categories 1–4 (from Table 2.1) at the site and sector levels. Intermediate compliance-based indicators (categories 1 and 2) are well established in current enforcement reporting (section 2.3). Compliance-based data can be improved by using a range of non-compliance categories rather than a "yes"/"no" score. The UK uses an indicator that combines compliance rating and environmental risk (potential harm) scores. The Scottish Environment Protection Agency (SEPA) uses the degree to which the licence conditions were breached to categorise the seriousness of compliance issues and potential harm in serious cases. Pollution release data for category 3 and efficiency and resource use for category 4 are routinely captured by the EPA in Ireland in monitoring reports and these data are summarised in Annual Environmental Reports (AERs).

Intermediate environmental performance indicators (categories 3 and 4) contribute to the production of environmental quality indicators (i.e. category 6 measures). These environmental quality indicators include the EPA environment indicators[2] and the national environmental indicators[3] published by the Central Statistics Office (CSO) on a biennial basis. The CSO reports its indicator results to Eurostat, where they are used for international comparisons.[4] While categories 1 and 2 can often involve reporting of non-compliance events, category 4 is harder to capture quantitatively. Thoresen (1999) proposes that the management and operational actions taken by regulated entities to prevent pollution and improve resource efficiencies in all dimensions with the potential to have environmental impacts could be added to the compliance/non-compliance data to arrive at a composite environmental performance measure. This would then capture evidence of good management as well as reduced levels of pollution emissions. Indicators of environmental management systems (EMSs) are included in the mandatory annual reporting of licensed sites. The latter and the compulsory environmental liabilities and financial provision determinations can assist in the assessment of improved environmental management

Table 2.1. Intermediate and final outcome performance measures

Category	Measure	Type
1	Compliance rates	Intermediate
2	Measures of recidivism and duration of non-compliance	Compliance-based outcomes
3	Pollution release indicators	Intermediate
4	Indicators of improved environmental management practices and reduced risk	Environmental performance outcomes
5	Measures of effectiveness of compliance assistance	
6	Environmental quality indicators	Final outcomes

2 https://www.epa.ie/irelandsenvironment/environmentalindicators/ (accessed 27 January 2020).

3 https://www.cso.ie/en/releasesandpublications/ep/p-eii/eii18/backgroundnotes/ (accessed 27 January 2020).

4 https://ec.europa.eu/eurostat/data/database?p_p_id=NavTreeportletprod_WAR_NavTreeportletprod_INSTANCE_nPqeVbPXRmWQ&p_p_lifecycle=0&p_p_state=normal&p_p_mode=view&p_p_col_id=column-2&p_p_col_pos=1&p_p_col_count=2 (accessed 27 January 2020).

practices and reduced risk associated with a licensed site. Compliance assistance, category 5, includes all the information and education activity undertaken by the enforcement agency. The impact of compliance assistance, such as the production of guidelines, is difficult to assess. The average measure of categories 1–4 for sectors in years of normal enforcement activity could be used as a reference point for environmental performance in that period. Similar categories could be compared with the expected baseline in years when compliance assistance has been added to the enforcement activity to roughly estimate the effectiveness of these activities.

2.3 Current Performance Indicators of Environmental Enforcement

The range of compliance indicators used for annual reporting by the EPA is listed in Box 2.1. The indicators include output measures (i.e. enforcement activity) and compliance-based intermediate outcomes

Box 2.1. EPA enforcement reporting

Non-compliance detected and recorded:

- number of non-compliance;
- type (%): exceed limits, neglect to notify, sector;
- number of sites with no non-compliance(#).

CIs:

- number of new CIs;
- number of CIs compared with previous year;
- type (%): Issue, mode of detection, closed within 12 months.

Prosecutions:

- number (and names), amount (€), outcome, sector (%).

Site visits (IED annual inspection plan):

- number, coverage (%), planned visits, reasons for visit;
- frequency: number of sites visited > 1, > 3;
- names of sites visited > 10.

NPS (based on a score: >30 = NPS, 20–30 = candidate):

- number of NPS, number carried over;
- % relating to NPS: of total sites, issue, CIs, complaints.

Complaints from public:

- number received, compared with previous year;
- %, per site, issue and sector;
- top 10 facilities.

Financial provision for environmental liabilities:

- total amount of financial provision secured;
- proportion of financial provision secured compared with current estimated requirements.

Measures of recidivism and duration of non-compliance:

- repeat offenders;
- time in non-compliance status.

CI, compliance investigation; IED, Industrial Emissions Directive; NPS, National Priority Site.

when using Mazur's (2010) categories (Table 2.1). Most environmental enforcement agencies target inspections based on environmental risks (OECD, 2009). Risk-based targeting has many advantages, particularly the targeting of resources to where they are most needed. However, targeted non-random inspection programmes mean that the compliance indicators listed in Box 2.1 must be interpreted with care, as low non-compliance rates are an objective of enforcement, but high non-compliance rates can result from effective targeted activity. In addition to annual enforcement reporting, the EPA produces pollution release indicators for key priority pollutants covered by the National Emission Reduction Plan and the State of the Environment reports every 4 years.

The EPA has been through two OECD Environmental Performance Reviews (OECD 2000, 2010). The OECD is currently conducting a review of the EPA's institutional and organisational set-up (Pat Byrne, Office of Environmental Enforcement, EPA, 25 May 2019, personal communication). The OECD review will analyse the EPA's governance arrangements, including how the EPA assesses its own performance and the EPA's transparency about its obligations and results. The review will benchmark the EPA's internal and external governance arrangements against the OECD Best Practice Principles on the Governance of Regulators[5] and the practices of other regulators participating in the OECD Network of Economic Regulators. Following the collation of information about the EPA, the OECD will then carry out a fact-finding mission to go into more specific detail. A report outlining the main findings and recommendations was discussed at the meeting of the OECD Network of Economic Regulators in late 2019, following which a final report was published in 2020 (OECD, 2020). Many of the 399 data sets listed in the EPA Ireland Catalogue have the potential to be used as intermediate or final outcome measures if a sound scientific link is established between the enforcement activity and change in the final outcome measures. In addition, a system for scaling compliance violations (low, medium and high non-compliances) is in place on the LEMA system for the National Priority Sites scheme.

2.4 The Impacts of Environmental Enforcement Activity: Empirical Evidence

Empirical information on environmental enforcement in the EU is mainly from case studies. There is a lack of quantitative studies in Europe, which Tosun (2012) attributed to difficulties regarding measurement and data availability. However, since Tosun's publication there have been improvements in data collection and availability. However, most studies still pertain to the USA and to the period 1976–1990. Empirically, these studies model compliance as a function of regulatory pressure and control variables (X) and the error term (ε) as follows:

$$\text{Compliance} = \beta_0 + \beta_1 \text{ (regulatory pressure)} + \beta_k (X) + \varepsilon \quad (2.1)$$

The control variables are included because regulated communities tend to be heterogeneous and their behaviour may be affected by factors other than the actions of the regulators (Gouldson *et al.*, 2008). The control variables are characteristics considered to influence compliance (e.g. firm age, size, sector, carbon intensity). The coefficient β_1 tells us how much influence enforcement activity has on compliance. Variables used as a measure for enforcement activity include the number of inspections and/or regulatory actions. Often the regulatory pressure variable is lagged so as to capture the subsequent compliance effect. Equation 2.1 can be extended to cover an array of enforcement actions and firm responses. The economic theory of public enforcement of law argues that there is an economic advantage to the firm to incur minimum pollution abatement costs and that there is an economic cost for compliance and overcompliance (Gray and Shimshack, 2011). In this context, Gray and Shimshack (2011) conclude that the decisions made by a firm regarding abatement activity is a function of the firm's perceived probability of (1) a violation given its chosen abatement effort; (2) detection by the regulator if it violates; (3) a penalty if a violation is detected; and (4) a severe penalty being levied. Several empirical studies are summarised in Table 2.2. These studies inform us that enforcement activity results in increased compliance of the inspected firms (Gray and Shimshack, 2011). Enforcement activities also generate substantial

5 http://www.oecd.org/gov/regulatory-policy/governance-regulators.htm (accessed 27 January 2020).

Table 2.2. A summary of empirical studies investigating the impact of enforcement activity

Enforcement measurement	Sector	N	Compliance measurement	Outcome	Reference
Enforcement (2-year lag)	Steel mills	41	Compliance rate	Increased the probability of compliance by ~32%	Gray and Deily (1996) Deily and Gray (2007)
Inspections and enforcement actions	Paper and pulp	116	Compliance rate	Compliance rate of sector increased by 10%. Paper mills responded more than pulp. Firms with large parent company also had reduced response	Gray and Shadbegian (2005)
Monitoring and enforcement actions (10% increase in probability)	Paper and pulp	175	Duration of non-compliance	Enforcement action resulted in a 10% reduction. Monitoring resulted in a 0–4% reduction	Nadeau (1997)
Inspections	Paper and pulp	77	Compliance rate	The probability of non-compliance increased by 50% if there had not been a visit in the last 3 months	Magat and Viscusi (1990)
Regulatory actions	Paper and pulp	217	Compliance rate	Monitory actions reduced non-compliance rate by 65%. Non-monitory actions not significant	Shimshack and Ward (2005)
Increase in size of potential fine	Facilities that deal with hazardous waste	8400	Compliance rate	15% decrease in probability of non-compliance	Stafford (2002)
Enforcement measurement	**Sector**	**N**	**Pollution measurement**	**Outcome**	**Reference**
Increase of one standard deviation in the probability of litigation by enforcement agency	Coal-fired power plants	249	SO_2	10% reduction in SO_2 release	Keohane *et al*. (2009)
Inspections	Paper and pulp	77	Discharge to water	Emissions reduced by 20%	Magat and Viscusi (1990)
Enforcement	Waste water treatment plants	40	Discharge to water	Emissions reduced by 20%	Earnhart (2004)
	Chemical plants	400	Discharge to water	Emissions reduced by 20%	Glicksman and Earnhart (2007)
Regulatory actions	Paper and pulp	251	Discharge to water	Monitory actions reduced state-wide discharge rate by 7%	Shimshack and Ward (2005)

general deterrence, particularly if enforcement action results in a monetary fine (Shimshack and Ward, 2005). Studies show that they result in significant reductions in emissions as well as significant improvements in compliance rates (Gray and Shimshack, 2011). They also consistently show that strong enforcement is critical to environmental protection work. The US EPA has pioneered many new initiatives in enforcement, but it maintains strong criminal and civil enforcement (Giles, 2013).

Some difficulties with applying models to link enforcement activity with final outcomes include the following:

1. the translation between the activity-based sector definitions used in the issuing of licences and economic/statistical sectors defined by the Statistical Classification of Economic Activities in the European Community (NACE) system;
2. the range of sectors included in the Industrial Emissions Directive (IED) licencing regime;
3. finding good cause and effect within the same timeframe, e.g. water quality measures;
4. scaling measures and indicators, e.g. biodiversity is an important final environmental quality measure but difficult to scale down to a facility level.

In recent years there have been major developments in electronic data capture, including the electronic recording of IED licence data. There is an opportunity for the EPA to use this type of analysis to measure the impact (on compliance and on pollution emissions) of their activity and any particular campaign undertaken by linking licence data, AER reporting and enforcement activity data.

2.5 The EU Environmental Implementation Review Initiative and IMPEL

There are two EU-based organisations that provide assistance and advice to enforcement agencies. The EU EIR is a Directorate-General (DG) Environment initiative to support the national authorities responsible for promoting, monitoring and enforcing compliance with EU environmental law. A review to provide information regarding possible root causes of implementation issues, good practices and common challenges was carried out in 2016 across all Member States. Some of the problems and challenges in environmental compliance assurance identified by EIR[6] include:

- inefficient national compliance assurance systems on account of a lack of effective evidence-based interventions related to the risks of non-compliance;
- insufficient know-how on strategic and operational planning, targeting compliance assurance work and choosing the right interventions depending on the causes of non-compliance;
- insufficient knowledge on use of modern technologies and techniques to reduce administrative burden on duty-holders;
- lack of structured mechanisms for co-operation and co-ordination between competent authorities;
- insufficient involvement of the citizens and lack of adequate complaint-handling mechanisms;
- insufficient transparency on organisation, functioning and outcomes of compliance assurance activities and lack of public confidence;
- lack of proper evaluation of effectiveness of national compliance assurance systems.

The EIR for Ireland noted three successful practices for Ireland driven by the EPA, namely:

1. major reform of the waste sector;
2. the LEMA system, to enable officials to electronically manage, analyse, share and use the data they collect from the holders of industrial permits and through inspections, including for the planning of future work;
3. the co-ordination of a national compliance and enforcement network (NIECE), aimed at ensuring a high level of consistency in compliance assurance work across more than 30 local authorities.

In 2017 the EU DG Environment published a roadmap[7] to signal its intended action plan to support Member

6 http://ec.europa.eu/environment/eir/index_en.htm (accessed 27 January 2020).

7 http://ec.europa.eu/environment/eir/pdf/report_ie_en.pdf (accessed 27 January 2020).

States in how they promote, monitor and enforce compliance.

IMPEL is the European Union Network for the Implementation and Enforcement of Environmental Law. The EPA is one of three Irish organisations/ regulators that are members of IMPEL. IMPEL facilitates environmental regulators and enforcers to learn and discuss challenges and experiences related to the practical implementation of EU environmental law. IMPEL has a training and capacity-building programme. IMPEL undertakes specific projects and looks at transnational environmental issues. The International Network for Environmental Compliance and Enforcement (INECE) is a partnership of government and non-governmental organisations (NGOs) from 150 countries to improve compliance and strengthen enforcement capacity.

3 Environmental Performance Theory

3.1 Introduction

The term “environmental performance” is used for international and regional comparisons, scientific research and business corporate responsibility without a consensus on its meaning and what components should be included (Zopf and Guenther, 2015; Braam et al., 2016). Generally, environmental performance assesses adherence to an environmental plan or policy that is often externally validated by organisations such as the International Organization for Standardization (ISO). Often environmental performance is reported without using an aggregated measure. However, we examine environmental performance as an assessment instrument that measures the environmental impact of activity on the natural world following the approach in Figure 3.1. Environmental performance is a multi-dimensional measure and needs a range of observable and measurable indicators to cover each dimension. Environmental indicators of each dimension are selected, normalised to account for enterprise characteristics and weighted according to importance to provide a series of metrics obtained from indicators over a range of categories (dimensions) that affect the environment. The behaviour of organisations can be explicitly included in the assessment. The metrics are presented or are aggregated to create an environmental performance measure displayed as a rating or score (see Figure 3.1). It should be noted that environmental performance can be applied at the product, process, enterprise, sector and national levels. It can be used to direct the effort of the regulation agency and to assess its effectiveness. A well understood environmental performance measurement and its component indicators can be used to influence policy in the same manner as economic and social indicators.

The array of different types of environmental performance instruments and components makes environmental performance difficult to compare and analyse. The empirical research involving environmental performance has produced contradictory results. Significant associations found in some studies are found to not be significant in other studies (Trumpp *et al*., 2015). Poorly constructed environmental performance measures lead to incorrect conclusions and poor decision-making (Konar and Cohen, 2001; Trumpp *et al*., 2015; Dragomir, 2018). For example, empirical studies of the impact of environmental performance

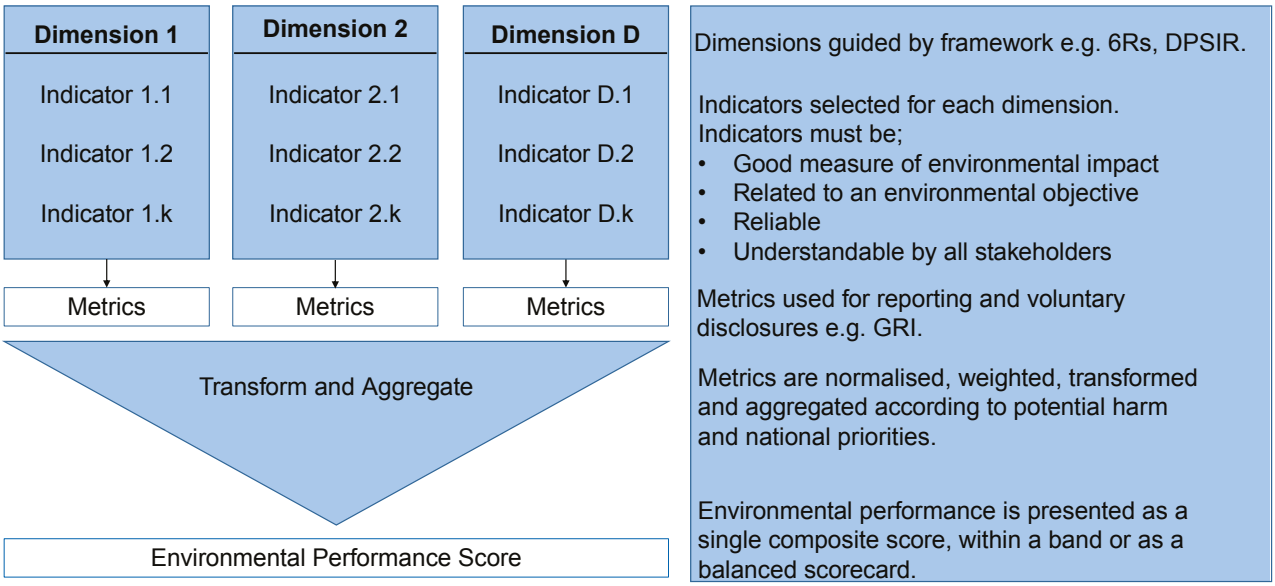

Figure 3.1. Outline of environmental performance structure. DPSIR, Driver–State–Pressure–Impact–Response; GRI, Global Reporting Initiative.

on firm financial performance have produced positive, neutral and negative results (Ramanathan, 2018). A common definition and good measure(s) of environmental performance allows the study of the drivers and facilitates comparison across companies and countries. Sector-level environmental performance is not as well defined. This reflects the fact that environmental performance determinants tend to be highly context-specific (Goldstein *et al*., 2011). Factors such as local environment and size of operation have to be incorporated in composite environmental performance measures across a range of entities operating in a sector to ensure fairness and transparency. Using a theoretical foundation for developing an environmental performance measurement ensures that a range of dimensions are covered (Trumpp *et al*., 2015; Huang and Badurdeen, 2018). Then appropriate indicators to represent the dimensions of environmental performance can be selected and validated (Chapter 4).

3.2 Theoretical Foundations for Managing and Assessing Environmental Performance

The progression from framework to indicators is presented in Figure 3.1. Here we introduce briefly four common performance evaluation frameworks that are used to underpin environmental performance: the 6Rs, the triple bottom line (TBL), life cycle analysis (LCA) and the Pressure–State–Response (PSR) model. We also present a new approach by Dragomir (2018) where the functional dimensions of the business process model are used without reference to a higher-level framework.

3.2.1 The 6R methodology: reduce, reuse, recycle, remanufacture, redesign, recover

The 6Rs relates to the six dimensions of reduce, reuse, recycle, remanufacture, redesign and recover. It is particularly suited to industrial processes and manufacturing. It has evolved from the 3R concept of reduce, reuse and recycle to include remanufacture, redesign and recover. There is a tendency to equate environmental performance with emissions output and consider other indicators, such as recycling and inputs, to a lesser degree. Using the 6Rs as the framework ensures that indicators that cover all of the six dimensions are incorporated.[8]

3.2.2 Life cycle analysis

The ISO defines LCA as the “compilation and evaluation of the inputs, outputs and the environmental impacts of a product system throughout its life cycle” (ISO, 2006). LCA began in the late 1960s and was initially used as an energy analysis tool to compare different packaging and different products. The Society of Environmental Toxicology and Chemistry and ISO developed and standardised methods in the 1990s. LCA became established as a policy evaluation tool in the 2000s and many variants exist (Guinée *et al*., 2011). LCA is often required as part of European funding programmes for new materials and technologies (T. Sullivan, School of Biological, Earth and Environmental Sciences, University College Cork, 15 January 2019, personal communication). The range of potential dimensions that could be included in LCA are shown in Figure 3.2. The extended life cycle sustainable analysis is a comprehensive framework that incorporates economic and society aspects in addition to the environmental impact aspect of LCA. Another variant is the Product Sustainability Index (ProdSI), which is an assessment of the overall product sustainability throughout its total life cycle, covering four stages (pre-manufacturing, manufacturing, use and post-use) and is comparable to the 6Rs methodology.

3.2.3 Triple bottom line: economic, environmental and social pillars

The idea that firms should account for all three economic, environmental and social pillars has been around for a long time. Elkington (1998) first introduced the phrase the “triple bottom line” in the 1990s. The TBL is an accounting framework that incorporates the economic, environmental and social pillars of environmental performance. Savitz (2006) described the TBL as capturing “the essence of sustainability by measuring the impact of an organisation’s activities on the world [...] including both

8 More information about the 6Rs approach is available online: https://www.stem.org.uk/elibrary/resource/30113 (accessed 27 January 2020).

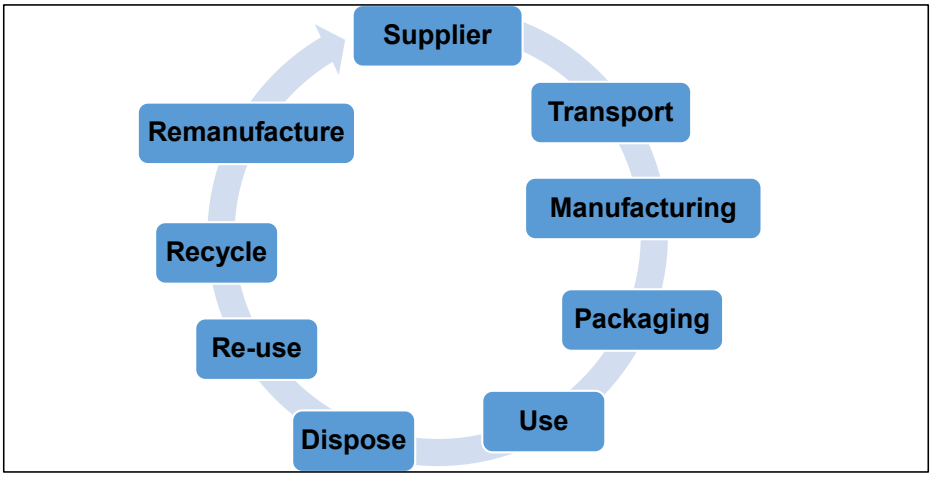

Figure 3.2. Potential span of dimensions incorporated into environmental performance measurement for industry.

its profitability and shareholder values and its social, human and environmental capital" (p. xiii).

An issue with the TBL is that the three dimensions cannot easily be amalgamated into an overall score. The TBL is often presented as a balanced scorecard with the three pillars scored separately or reports without a score, such as in the Global Reporting Initiative format or in company annual reports (e.g. Nike). Some advocate applying the common language of monetary cost to all three pillars, using, for instance, the "ecosystem services" concept to monetarise the value of nature and facilitate comparability with the value applied to conventional goods and services (Boyd and Banzhaf, 2007). Another solution is using an index. However, issues arise with these solutions in determining the appropriate weighting to give to the profit, people and planet aspects.

3.2.4 Dragomir's functional model of corporate environmental performance

A recent publication by Dragomir (2018) called for a functional approach to environmental performance measurement. He found that the quantitative indicators could be categorised into functional domains that reflect the underlying industrial processes model: suppliers, inputs, outputs, recycling, products and transport. In Dragomir's corporate environmental performance model, management operations are seen as support structures to the industrial process. This approach reduces the reliance on qualitative or subjective management of policy indicators, which he deems weak or distorting. Dragomir (2018) also arranges the indicators from his literature review into the process domains. Mapping indicators to dimensions is a useful technique to highlight where indicators tend to bunch and where they are sparse.

3.2.5 The Pressure–State–Response model and variants

The PSR model is based on the causal network concept (Niemeijer and de Groot, 2008). Here the dimensions of environmental performance are not linked to individual business processes' but to higher level interconnected systems impacting on environmental quality. The Drivers–Pressure–State–Impact–Response (DPSIR) framework is one variant of this model that is used by the EPA and the European Environment Agency (EEA) (see Figure 3.3). The drivers (causes) are the societal processes that drive activities with environmental impacts (effects), e.g. population growth and economic activity. Government

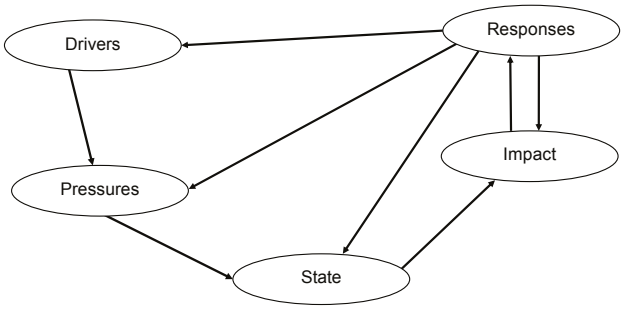

Figure 3.3. The DPSIR framework. Reproduced from Smeets and Weterings (1999).

agencies and policymakers must consider these drivers in decision-making. Pressures include resource depletion (deforestation, mining) as well emissions to air, land and water. The OECD has predicted that the world's consumption of raw materials is set to double by 2060,[9] driven by increased economic activity and increased living standards. State refers to the current environment. Impacts are the direct or indirect impacts on the environment arising from the drivers and pressures. The impacts contribute to human wellbeing and the environmental status and influence the developmental options (social and economic policy). Response includes actions that address the impacts, including legislation, policy and science. The UK Millennium Ecosystem Assessment was developed from the DSPIR framework.

3.3 The Usefulness of the Frameworks

There is some consensus between countries and international environmental enforcement agencies to use versions of the PSR model as a common reference framework. The OECD uses the PSR model. The Dragomir and DPSIR models involve a holistic approach with indicators covering "greening the supply chain" and resource use employed. Dragomir's approach is useful for metric evaluation and indicator gap analysis. Other approaches, such as the 6Rs and LCA models, are more suited to the individual company level, particularly to industrial manufacturing and processing.

Mapping indicators to dimensions is a useful technique to highlight where indicators tend to bunch and where they are sparse. Dragomir (2018) maps the indicators from his literature review into the process domains. Figure 3.4 relates different types of indicators applicable to the DPSIR framework. Niemeijer and de Groot (2008), using the DPSIR framework, first develop a causal network for the specific issue of interest with abstract (less detailed) indicators applied to the different nodes in the network to reflect the interconnected complexities of real-life situations. Niemeijer and de Groot (2008) identified key nodes and sought potential indicators to represent them. At this stage, the quality aspects, such as measurability and international compatibility, are applied to potential indicators. The authors provide a worked example to demonstrate the process (see Niemeijer and de Groot, 2008, p. 20).

Environmental performance measures at site, sector and national levels can be used to assess policy impacts and regulation design. Environmental performance measure at the facility level can be aggregated to evaluate sector performance. The site and sector levels indicators bridge the link between enforcement activity and final environmental

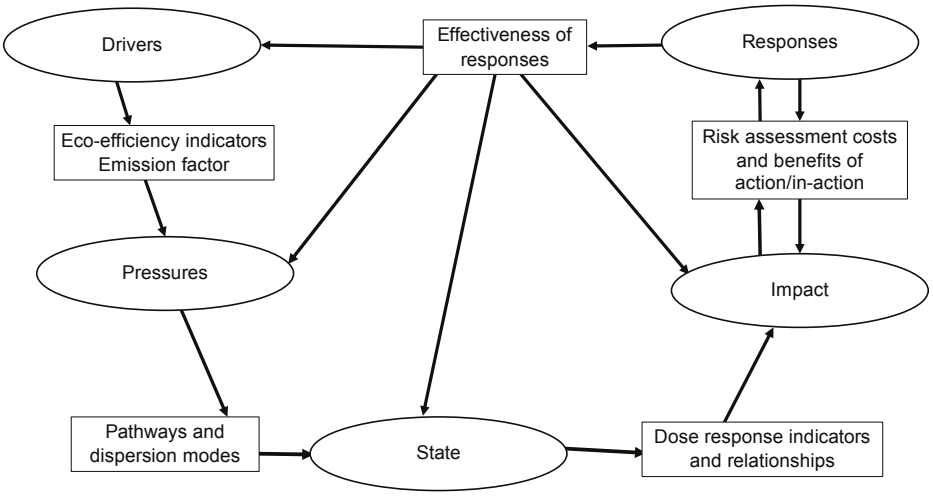

Figure 3.4. Indicators and information linking DPSIR elements. Reproduced from Smeets and Weterings (1999).

9 http://www.oecd.org/environment/raw-materials-use-to-double-by-2060-with-severe-environmental-consequences.htm (accessed 27 January 2020).

outcomes. Average performance measures can be used to generate performance bands relating to a single environmental priority factor (e.g. ammonia emissions – kg NH_3-N per kg live weight – in intensive agriculture).[10] The bands can be used in strategic planning and operational practice. This can be done by setting and monitoring the achievement of targets for a sector, e.g. to reduce the proportion of regulated entities in the worst performance band.

Producing environmental performance assessments of regulated companies could also assist in building a compliance culture in Ireland and in communicating the impact of environmental licensing and enforcement to the public. Irish citizens have repeatedly conveyed that the environment is important to them. A recent EPA survey[11] found that Irish citizens consider climate change, waste, water quality and pollution the most pressing environmental issues that Ireland faces. The survey found that 86% think that the environment is a valuable asset to the people of Ireland. This is similar to a previous survey where protection of the environment was found to be very important (56%) and important (38%) in a Eurobarometer Survey (European Commission, 2014). In particular, the Eurobarometer Survey found that the issues of most concern to Irish citizens were water pollution, growing waste, air pollution, the impact on health of chemicals used in everyday products and shortage of drinking water. The public also considered that protection of the environment and the efficient use of natural resources could help boost economic growth in the future. Environmental indicators and performance measures are a communication tool for citizens, the regulation authority, the regulated population and all stakeholders to illustrate progress to achieving intermediate and final outcomes. An ideal performance measure would account for all emissions and include resource efficiency and risk-reduction efforts but would also avoid overcomplexity to the point that the information that they are to communicate is lost.

Undertaking performance assessments depends on access to good-quality data and the use of a scientifically sound methodology. Three key publications highlight the progress in data capture and previous attempts at sector environmental performance efforts in circumstances of incomplete data availability. Duffy *et al*. (2002) identified the requirement/opportunity for electronic reporting that takes into account the needs of companies and the EPA to provide mandatory reporting and which also captures EMS activity among licensees. Electronic reporting also facilitates benchmarking by performance indicators. Styles and Jones (2010) showed the potential of environmental performance measures with their Environmental Emissions Index (EEI) model, based on the 20 major air and water emission parameters routinely reported in AERs submitted by integrated pollution prevention and control (IPPC) licensees. They noted that, at that time, there were data constraints. They examined the impact of IPPC licensing on pollution prevention. Styles and Jones (2010) also noted the need for some production measures to calculate the eco-intensity of production (normalising the data according to facility output to capture resource efficiency). Goldstein *et al*. (2011) used the number of employees (obtained from financial reports at the Companies Registration Office) as a proxy for product output levels to normalise data with respect to facility size or production level. Both data constraints noted above have been addressed with the LEMA electronic reporting system and the information supplied in the AERs submitted by licensed facilities. The LEMA electronic reporting system is in place (for data collection and input) and AERs include production levels (for normalising the data) and EMS information. Data access (especially enforcement data), key indicators for different sectors, validated methodologies and appropriate presentation of environmental performance measures (league tables, bands, ratings) are the next steps in environmental performance comparisons between sectors and in measuring the impact of enforcement activity.

10 In Ireland, 99% of ammonia emissions have been attributed to agriculture, in particular intensive pigs and poultry production. Ammonia emissions will be one of the key challenges to expansion of pig and poultry production. Ireland is committed to the EU National Emission Ceilings Directive (2016/2284/EU), which sets emissions reduction targets for five important air pollutants, including ammonia (NH_3). Ireland is obliged to reduce ammonia emissions by 1% per year compared with 2005 levels in the years until 2029 and 5% annually thereafter.

11 http://www.epa.ie/pubs/reports/other/corporate/Red%20C%20infographic%20with%20changes2.pdf (accessed 27 January 2020).

4 Indicators

4.1 Environmental Indicators: Nature and Quality

Environmental indicators enable communication of information regarding the issue they address and, thus, are tools for monitoring environmental changes, measuring environmental performance and informing decisions (Zhang *et al*., 2018). Veleva (2001) describes indicators as measures, usually quantitative, that provide key metrics about a physical, social or economic system. They transform data collection for compliance to a communication that identifies areas for performance improvement and monitors progress in reaching objectives. In order to be useful, an indicator needs to be communicated to a range of stakeholders and incorporated into operational and strategic decision-making. In summary, indicators have three key objectives:

1. to raise awareness and understanding;
2. to inform decision-making;
3. to measure progress towards established goals.

Robust procedures for selecting indicators are required to validate the information provided by those indicators (Niemeijer and de Groot, 2008). There are several aspects to the quality of indicators. To ensure quality there should be (1) an adequate range of indicators to employ; (2) indicators clearly related to environmental objectives or targets; and (3) reliable, timely and comprehensible indicators. The range of indicators employed must cover different dimensions to build a comprehensive environmental performance measure. To ensure quality, indicators must provide good measures of the environmental impact of the process that they are representing and have a clear relationship with the associated environmental objective or targets (e.g. reduce greenhouse gas – GHG – emissions by X% over X years). Like all accounting systems, reliability is an essential characteristic for information to be useful for decision-making. Maines and Wahlen (2006) describe the elements that determine reliability as completeness, verifiability, neutrality, unbiased and adequate reporting. For environmental indicators, reliability is achieved with monitoring, reporting and validation requirements and schedules. Timeliness is another important quality aspect of indicators, as a regulation authority would want a close to real-time analysis. Finally, the indicator needs to be understood by all stakeholders (i.e. it should be comprehensible).

Indicators may be simple indicators, resulting from the measurement of an indicative variable or composite indicators that are obtained by aggregation of several variables (Girardin *et al*., 1999). If necessary, indicators may be estimations developed by modelling a baseline (Styles and Jones, 2010). Indicators have been based on the toxicity of emissions. However, Goldstein *et al*. (2011) state that the information relating to toxicity of emissions “is limited, complex, and ambiguous”. Risk assessment of chemical use and emissions must consider both the chemical’s toxicity and the probable human and/or wildlife exposure, which depends on how the chemical is used (Coria, 2018). The receiving environment is key to estimating potential harm. In developing sector indicators, Goldstein *et al*. (2011) based the indicators on environmental impacts in the form of emissions, waste and resource usage.

While indicators are used to simplify a complex situation, the method of indicator selection should not be oversimplified to what is available, what has been used before or intuition. The most important criterion is whether or not they adequately represent a key dimension of environmental performance. Ideally, management aspects, such as environmental strategy, risk evaluation and other qualitative variables, should be incorporated into an environmental performance measure. Eco-efficiency and resource use efficiency indicators bridge the gap between environmental and economic aspects of sustainability.

4.2 Developing Indicator Sets to Underpin Environmental Performance Measures

Many systems to appraise indicator sets have been developed. Schomaker (1997) called for SMART indicators: specific, measurable, achievable, relevant and time-bound. More elaborate selection criteria

are suggested by Riley (2000), who advocates for indicators that are universal, repeatable, reproducible, sensitive to change, operationally easy, inexpensive and already existing with historical comparative data and which have wide use for comparability. The OECD simply have three criteria for the evaluation of environmental indicators, i.e. measurability, analytical soundness and policy relevance (OECD, 2015). Bockstaller and Girardin (2003) state that indicators need to be validated under three headings: (1) design validation (scientifically sound), (2) output validation (relevant) and (3) end-use validation (useful and used), summarised in Figure 4.1. Under the different headings, Bockstaller and Girardin (2003) outline procedures used for model validation by frequently using "panel of experts" techniques but also visual and statistical methods. Jackson *et al*. (2000) developed a set of guidelines for the development and review of indicators through a series of four phases (see Table 4.1). These guidelines ensure that the potential indicators were evaluated in a structured manner and that the following four phases are considered: (1) conceptual relevance, (2) feasibility of implementation, (3) response variability and (4) interpretation and utility.

In addition, the suite of indicators used should be periodically reviewed, as their reliability, relevance and priority will change over time as environmental

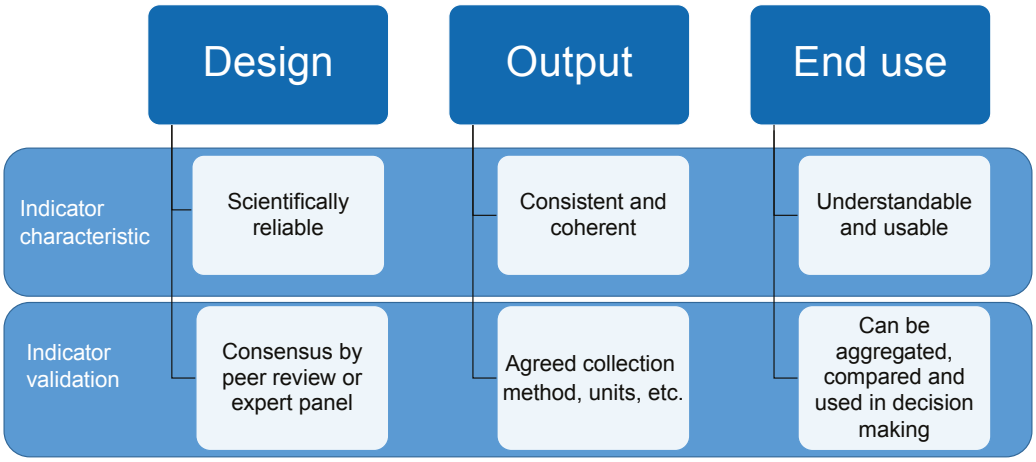

Figure 4.1. Indicator validation.

Table 4.1. Overview of the US EPA evaluation process guidelines for ecological indicators

Phases	Guidelines
Conceptual relevance	Guideline 1: relevance to the assessment
	Guideline 2: relevance to ecological function
Feasibility of implementation	Guideline 3: data collection methods
	Guideline 4: logistics
	Guideline 5: information management
	Guideline 6: quality assurance
	Guideline 7: monetary costs
Response variability	Guideline 8: estimation of measurement error
	Guideline 9: temporal variability (within season)
	Guideline 10: temporal variability (across year)
	Guideline 11: spatial variability
	Guideline 12: discriminatory ability
Interpretation and utility	Guideline 13: data quality objectives
	Guideline 14: assessment thresholds
	Guideline 15: linkage to management action

Adapted from Jackson *et al.* (2000).

conditions evolve. The decision to change an indicator or change the collection and aggregation methods needs careful review to maintain continuity of data sets and avoid misinterpretations. The OECD advises to proceed with caution and recommends involving staff and stakeholders and pilot-testing new indicators as approaches to managing indicator(s) changes (OECD, 2009).

4.3 Core and Sector-specific Environmental Indicator Sets for Sectors

Not all indicators are appropriate to every industry or sector. There is no unique framework that generates sets of indicators for every purpose (OECD, 1993). The dimensional measurement can be adapted to the facility or the sector level. In addition, priority issues may change over time as scientific understanding of environmental problems increases and as societal values evolve (OECD, 1993). The OECD has developed a core set of 40–50 core environmental indicators that cover 14 major issues (OECD, 2003). Ten key environmental indicators extracted from the core set are used to communicate the overall environmental condition to inform civil society and to support wider communication with the public, e.g. on air quality and biodiversity (OECD, 2003). The OECD has also produced sector-specific sets of indicators, e.g. on energy, transport and agriculture (OECD, 2003). The interaction of the core indicators, sector-specific indicators and key environmental indicators is shown in Figure 4.2.

The UK Department for Environment, Food and Rural Affairs (Defra) produced 22 environmental key performance indicators (eKPIs) to provide guidance to companies on how to report on their environmental performance (Defra, 2006). They produced guidelines identifying the most relevant indicators for sectors in the NACE code. Supply chain and product lifecycle impacts were not included in the analysis, as these aspects were too large to be included in the guidelines, although businesses were encouraged to examine them as well. An analysis of business sectors suggested that around 80% of companies were likely to have five or fewer relevant eKPIs.

4.4 Integrating Environmental and Financial Indicators

Without a system of measurement, the value of natural capital and the benefits of high-quality functioning ecosystems may be omitted from decision-making,

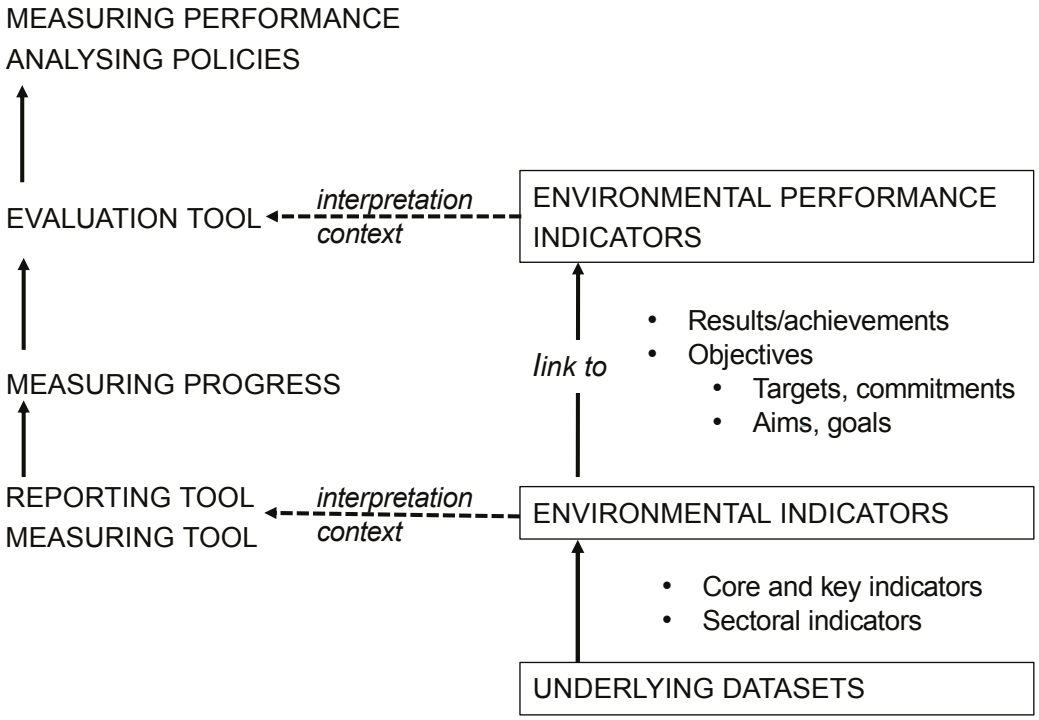

Figure 4.2. The development of environmental performance evaluation from indicators. Reproduced from OECD (2003, p.16).

e.g. the difficulty of incorporating these elements into a cost–benefit analysis. In essence, the value defaults to zero. Integrating environmental and financial indicators or putting monetary values on nature can be problematic. The EU first attempted to introduce standardised non-financial reporting in 2003 with the adoption of the Accounts Modernisation Directive. This directive was not widely adopted. The concept of ecosystem services to attach a value to different aspects of the natural environment has been well developed in the UK. An ecosystem services framework for Ireland is not well developed but there is an Irish Forum[12] on developing the concept of natural capital and ecosystem services for Ireland. The forum brings together individuals from academic, public, private and NGO sectors to ensure that "Ireland's natural capital and ecosystem goods and services are valued, protected and restored."[12]

4.5 Transforming Indicator Metrics into Environmental Performance Measures

Hammond *et al*. (1995) noted the power that a single figure, such as the gross domestic product (GDP) or a stock market index, can have when the implications are understood. The power of an environmental performance score can be considered in the same way. Metrics from the indicators are transformed to reach a single index, a rating band or a balanced scorecard that can communicate environmental performance. A regulator with the ability to license activity and impose sanctions requires a clear methodology for this process to be communicated to inspectors and clients. In addition to absolute values, there needs to be a normalising factor to account for size and production level (Goldstein *et al*., 2011). Commonly used normalising factors are turnover and production output (Olsthoorn *et al*., 2001; Defra, 2006). Goldstein *et al*. (2011) normalised factors according to size (number of employees). Duffy *et al*. (2002) found that there was a lack of economic values for normalising data from Irish licensed sites. However, production output data are now included in AERs. Thus, the decoupling of increased environmental impact from expanding/contracting commercial activity and business size could be captured if the accuracy and the detail of the data are sufficient. Good environmental performance and the capacity for improvement is sector specific. This means that after normalising for size or production levels – "within-sector averaging" – companies can be assessed with respect to their sectors (Goldstein *et al*., 2011).

Once normalised, different suites of indicators can be weighted and aggregated to produce appropriate sector-level environmental performance measures. Pollutants are weighted according to their human and ecotoxicological impacts. Consensus-based reference models exist for characterising human and ecotoxicological impacts of chemicals, e.g. USEtox.[13] A "distance from target" for pollutants with national or sector targets can also be incorporated into weighting the indicators. Generally, an expert ranking procedure is conducted to aggregate the initial indicators. The experience of a number of countries suggests that it is best to focus on a few priority pollutants rather than aggregating a wide range of indicators (OECD, 2015). Three environmental damage endpoints are used: human health, ecosystem quality and resources. This must be evidence-based rather than subject to political or popular influence. The weighting and aggregating system needs to be rigorously tested so that information is not lost in the process (Becker *et al*., 2017).

When sector-specific indicators are selected, the following principles of enforcement policy must be maintained:

- proportionality in the application of environmental law and in securing compliance;
- consistency of approach;
- transparency regarding their operation;
- targeting of enforcement action;
- implementation of "polluter pays principle".

Sector-specific indicators establish the reporting formats for an environmental measure so that poor environmental performance cannot be hidden by bespoke indicators. In addition, specified formats and methodologies within a sector means that companies report their data in a consistent and comparable format, so performance over time and performance

12 https://www.naturalcapitalireland.com/ (accessed 27 January 2020).

13 https://usetox.org/ (accessed 27 January 2020).

relative to other operators in the sector can be evaluated, as well as the current performance of the facility.

4.6 EPA Current Uses of Indexes and Ratings

The OEE and the wider EPA have experience of designing and implementing indices, scoring systems and rating bands. They have also identified environmental priorities for different sectors. The OEE operates a risk-based method of enforcement, based on fixed attributes such as location and class of activity. A risk index is used to target resources (site visits and annual charges) to where they are most effective. There are eight classifications within three levels of risk (EPA, 2014). The components of the risk index are shown in Figure 4.3. Separate to the risk Index, licensed sites are placed on a National Priority Site List based on a score in regard to four components of licence compliance: (1) complaints, (2) incidents, (3) compliance investigations and (4) non-compliances. Data for the previous six months are used to rank all EPA-licensed sites based on enforcement/compliance status (Table 4.2). The Priority Site List is published on a quarterly basis. In total, 22 sites have been identified as National Priority Sites since the end of Q2 2017.[14]

Local authorities are responsible for the enforcement of environmental regulations outside the IPPC and waste licence system. Local authorities enforce over 500 environmental protection obligations arising from more than 100 pieces of legislation (EPA, 2017). The EPA has developed a grading system for the environmental performance of local authorities based on 26 performance indicators. The system is used to assist local authorities to implement programmes of continual improvement in the areas of environmental enforcement and inspection (EPA, 2017).

The EPA has developed an Air Quality Index for Health.[15] The index is a number ranging from “1” (good) to “10” (very poor) and communicates the current air quality and whether or not this might affect human health. The concentration of five air pollutants are monitored.

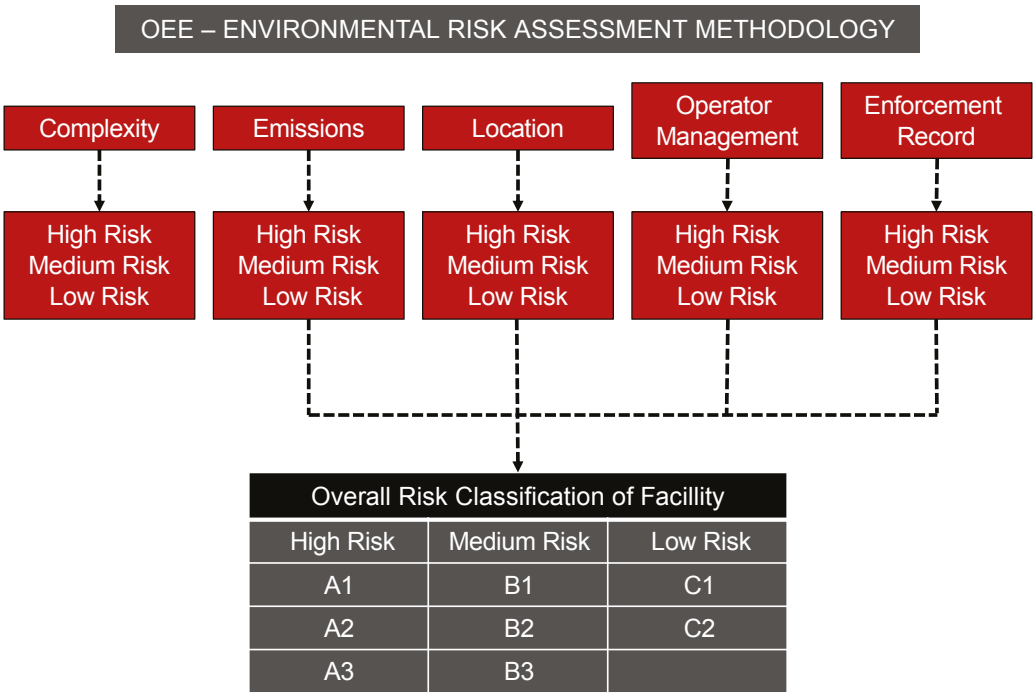

Figure 4.3. Components of the EPA environmental risk assessment methodology. Reproduced from EPA (2014).

14 http://www.epa.ie/industrialwastedata/nationalprioritysites/ (accessed 30 April 2020).

15 https://www.epa.ie/air/quality/index/ (accessed 27 January 2020).

Table 4.2. The scoring system used by the EPA for the classification of National Priority Sites

Scoring component	Score allocation[a]			
Complaints	1 point per complaint (limit 20)			
Incidents	*Category*			
	5. Catastrophic		30 points	
	4. Very serious		20 points	
	3. Serious		10 points	
	2. Limited		5 points	
	1. Minor		No score	
Compliance investigations	*CI response level*	*Status open*		*Status closed*
	High	20 points		4 points
	Medium	10 points		2 points
	Low	3 points		1 point
Non-compliances	Basic non-compliance		1 point	
	For non-notification of an incident		5 points	

[a]A total score of over 30 points with a compliance investigation (CI) score of over 10 points leads to classification as a National Priority Site. A total score of 20–30 points or a total score of over 30 points with a CI score of fewer than 9 points leads to classification as a candidate National Priority Site. Data extracted from "How does the National Priority System Work?", http://www.epa.ie/industrialwastedata/nationalprioritysites/prioritysitessystem/ (accessed 12 March 2020).

5 Environmental Performance in Practice

Environmental performance measurement transforms verified data to produce indicators that are used to produce a performance measure that can be used for benchmarking, identifying best practice, ranking facilities or countries and monitoring performance over time. The potential communication benefits of an environmental performance score must be balanced with the costs of collecting, processing and aggregating data for the composite indices (OECD, 2015). Environmental performance can be applied from product to country level, ranging from in-house systems developed by organisations (e.g. the Ford Product Sustainability Index, FORD PSI;[16] and the Down Jones Sustainability Index, DJSI)[17] to national and international indices such as the Environmental Performance Index.[18] Product and process environmental performance measurement (e.g. LCA) tends to be highly technical (Feng *et al*., 2010). Overall, there is a cluster of environmental performance measures around the facility/organisation level (e.g. Eco Management and Audit Scheme – EMAS, ISO 14031, environmental performance evaluation – EPE) and at the country level (e.g. OECD Environment; Environmental Performance Index, EU), ranging from low to high in technical detail (Feng *et al*., 2010). There is less application of environmental performance ratings at the sector level. A previous study, Styles and Jones (2010), developed the EEI for Ireland and applied it to four IPPC-regulated sectors: food and beverages, power generation, pharmaceutical manufacturing and chemical (non-pharmaceutical) manufacturing. However, to date, this work has not been followed up. Sector approaches to environmental regulation are being developed in other jurisdictions, see the case study evidence presented in Chapter 7.

5.1 Application of Environmental Performance at the Facility/ Organisation Level

Environmental performance at the facility/organisation level is applied to generate sustainable practices. The US Department of Commerce defined sustainable manufacturing as “the creation of manufactured products that use processes that minimise negative environmental impacts, conserve energy and natural resources, are safe for employees, communities and consumers and are economically sound” (Moldavska and Welo, 2017). To summarise previous sections, to derive an overall environmental performance score, metrics must be obtained from a range of dimensions and they must be integrated. The domains will be influenced by the framework employed and the activity of the enterprise. A facility-level environmental performance index provides information for regulatory planning, for risk minimisation purposes and for communication to customers and community. The detail in a facility level environmental performance index can be used internally for company goalsetting, control and surveillance of product performance and performance of manufacturing and administrative processes (Thoresen, 1999). Facility-level environmental performance can also be used externally for benchmarking (Thoresen, 1999).

Organisations should structure their environmental performance exercise into dimensions and sub-dimensions that cover aspects of the organisation’s activities. Trumpp *et al*.’s (2015) review paper finds that most studies fail to properly account for the multidimensional nature of the organisations’ impact on the environment, thus leading to contradictory results. No universally accepted environmental performance structure for manufacturing has emerged and the

16 The Ford PSI is as a sustainability management tool in new product development. The Ford PSI considers environmental, economic and societal aspects. It uses an externally reviewed LCA for environmental analysis. https://corporate.ford.com/microsites/sustainability-report-2017-18/doc/sr17-ford-psi.pdf (accessed 27 January 2020).

17 The RobecoSAM Corporate Sustainability Assessment (CSA) has evolved from the DJSI guide for investors. It is an annual evaluation of companies’ sustainability practices, focusing on economic, environmental and social dimensions covering 60 sectors. Available online: http://www.robecosam.com/en/sustainability-insights/about-sustainability/corporate-sustainability-assessment/review.jsp (accessed 27 January 2020).

18 https://epi.envirocenter.yale.edu/ (accessed 27 January 2020).

number of models proposed continues to increase. We present a few examples from the literature.

After reviewing the literature, Trumpp *et al*. (2015) settled on the ISO definition of environmental performance and suggested a two-dimensional organisation of operation and management: an environmental operational performance dimension and an environmental management performance dimension with five sub-dimensions (policy, objectives, processes, structure and monitoring). The Dragomir (2018) model discussed in Chapter 3 uses five functional dimensions related to the industrial processes. Environmental performance measurement in a manufacturing setting is explained by Huang and Badurdeen (2018). The dimensions for a manufacturing setting include product and process, environmental management and strategic goals applied at different levels (namely at the production line, facility, enterprise and supply chain levels). Wanigarathne *et al*. (2004) organised the manufacturing process into the following six domains, called clusters: manufacturing cost, energy consumption, environmental impact, waste management, operational safety and personnel health. These six domains cover the TBL framework. Khan *et al*. (2004) proposed a life cycle index comprising two major domains of design (product and process) and decision-making and sub-indices of environment, health and safety; cost; technical feasibility; and socio-political factors. Yuan *et al*. (2012) present another study where they consider technology, energy and material as the three major factors to evaluate manufacturing process sustainability. Lu and Jawahir (2015) proposed one of the most comprehensive manufacturing process sustainability performance evaluation tools, called the Process Sustainability Index (ProcSI). Once the metrics are progressively aggregated, it provides the ProcSI as a single score on a scale of 1 to 10, for overall manufacturing process sustainability. While the simplicity of the resulting scale is attractive, the underlying structure and aggregation are complex and ProcSI may be too complicated as a communication tool.

The lack of a universally accepted environmental performance instruments is a challenge for firms and regulators looking for guidance to introduce an environmental performance measurement. While many models, metrics and methods are reported in the literature it can be difficult for manufacturing companies to find a structure or system most relevant to their industry and company goals (Poveda and Lipsett, 2011). On the other hand, rather than an "off-the-shelf" model, this situation provides for the development of tailored environmental performance constructs that address the particular industry profile. The challenge is to develop a meaningful and workable environmental performance system for relevant sectors.

5.2 Indicators for Facility-level Environmental Performance

The OECD has developed a sustainable manufacturing toolkit[19] to assist manufacturing companies in carrying out a self-assessment. The availability of an internationally agreed core and sector-specific indicators identified by working groups of international experts provide a good basis for environmental performance systems for sectors (OECD, 2003).

Dragomir (2018) presents an extensive table of potential indicators based on a review of quantitative indicators for evaluating environmental performance at an industrial facility level. Dragomir (2018) found that there was overreliance on the outputs dimension (GHG emissions, waste generation, etc.) with low use of input and recycling indicators. We used Dragomir's (2008) table of indicators as a base to examine corresponding facility-level indicators and potential sources of these data for Ireland. Table 5.1 presents an extract of our analysis and includes two of the dimensions suggested by Dragomir (2018) – resource efficiency and recycling/clean-up – and some associated indicators. The expanded table is available from the authors on request. Key gaps in the indicators for Ireland with respect to Dragomir's dimensions are in the areas of natural capital, including biodiversity, resource efficiency, and decoupling environmental harm from economic activity, e.g. low-carbon economy, supply chain impacts and people's health and quality of life.

19 http://www.oecd.org/innovation/green/toolkit/aboutsustainablemanufacturingandthetoolkit.htm (accessed on 11 March 2020).

Table 5.1. A sample of facility-level environmental indicators for evaluating environmental performance

Dimensions and indicators[a]	Potential facility-level indicators	Potential data source
Resource efficiency		
Water withdrawn by source	1. Water charges (€) 2. Current expenditure on water charges in year *t* divided by total purchases in year *t* (%)	CSO CIP(F) 2005–2016
	1. Volume usage on site (m^3/year) 2. Volume change from previous year ±% 3. Volume relative to production 4. Source (four sources)	AER resource water (Table R2) 2008–2016
	1. On register for water abstraction 2. Litre/day of registered entities	Started in 2018
Energy consumption by type and source, renewable or non-renewable Fossil fuel consumption: coal, oil, gas	1. Total energy used (MWh) 2. Electricity consumption (MWh) 3. Fossil fuels consumption: • heavy fuel oil (m^3) • light fuel oil (m^3) • natural gas (m^3) • coal/solid fuel (tonnes) • peat (tonnes) 4. Renewable biomass 5. Renewable energy generated on site	AER resource energy (Table R1) 2008–2016 CSO Business Energy Survey SEAI
The energy intensity ratio for the organisation Firm fuel intensity	1. The value of fuel used by firm/the gross value added of the enterprise at time *t*	CSO CIP(F) 2005–2016
Total land owned, leased or otherwise occupied by the company	In licence application or GIS data	EPA
Primary and auxiliary materials used, renewable and non-renewable	1. Value of material resources used in production of output/by the value of production in year *t*	CSO CIP(F) 2005–2016
Recycling/clean-up		
Total amount of recyclable waste generated	Total amount of recyclable waste generated (tonnes)	AER waste stream (Table R3) 2008–2016
Recycling recovery rate	% of total amount of waste is sent for recycling	
Quantity of material sent to landfill per unit of product	% of total amount of waste is sent to land fill	

[a]**Dimensions and indicators extracted from Dragomir (2018).**

CIP, Census of Industrial Production; SEAI, Sustainable Energy Authority of Ireland.

5.3 Indicators of Environmental Performance at Sector Level

Previous environmental performance investigations relate environmental performance to the licensing regimes. The introduction of environmental performance measures for industries needs to be cognisant of the principle of integrated pollution control. In Ireland, facilities are regulated under the IED based on an integrated approach. The use of best available technology conclusions (BATCs) to determine emission limits, emissions to air, water and soil are addressed in one licence; there is flexibility for the installation to choose the form of pollution abatement to achieve the emission limits, inspections and public participation. Many facilities are regulated under several BATCs and site-specific emission limits. The advantage of integrated licensing is that it is flexible, as it allows licensing authorities to consider the technical characteristics of the installation, its geographical location and the local environmental conditions (López Gamero *et al.*, 2009).

Cikankowitz and Laforest (2013) have suggested using BATC performance as an environmental performance assessment methodology, i.e. performance comparison between installation activity and the BATCs. However, disadvantages of using a BATC framework for environmental performance assessments are inconsistent implementation (Daddi *et al*., 2014; De Giacomo and Daddi, 2015), the negotiated aspect between experts and industry when developing the BATCs and the flexibility employed at a local level that allows for adjustment according to site-specific characteristics. The framework environmental performance evaluation using a BATC framework has been applied to the seafood industry (Barros *et al*., 2009) and to fruit and vegetable processing (Derden *et al*., 2002). This approach appears to be best suited to a case study approach. Styles *et al*. (2009a) took a different approach and devised a quantitative science-based and policy-weighted EEI. Emissions vary in their toxicity and potential for harm. Styles *et al*. (2009a) used characterisation factors for AER-reported pollutants to generate emission indicators, grouped according to their contribution to environmental impacts. The most familiar type of such a characterisation is that of GHGs as CO_2 equivalents to compare their contribution to climate change (the environmental impact). The emission indicators were normalised according to their contribution to environmental impacts at the national or EU scale. The normalised emission indicators were then policy-weighted according to a "distance from target" process. Styles *et al*. (2009b) then applied the EEI to conduct an environmental assessment of different sectors in Ireland (Styles *et al*., 2009a). The EEI was also used to estimate the pollution prevention achieved by IPPC licensing (Styles *et al*., 2009c). We have aligned the specific activities regulated by EPA industrial and waste licences (listed in EPA Act 1992, as amended, and Waste Management Act 1996, as amended), broad economic sectors (classified by NACE) and relevant environmental indicators used by Defra (2006) to show how indicators could be assigned to particular sectors (see Table 5.2). The EPA-licensed sectors generally have five or more key indicators associated with their activity.

The EPA has thematic teams that focus on three areas: air, water and waste. These areas are further divided into nine main sectoral groupings. Each year the main environmental issues are identified for each sector and a sector-specific plan is developed:

- air:
  - chemical/pharmaceutical;
  - solvent;
  - cement;
  - incineration and energy sectors;
- water:
  - food and drink;
  - intensive agriculture;
  - timber;
  - metals sectors;
- waste:
  - landfill, including waste transfer stations (hazardous and non-hazardous) and composting sectors.

5.4 Indicators of Environmental Performance at the National Level

Environmental performance at the country level involves key national environmental indicators. A different set of dimensions, compared with manufacturing, is used here, e.g. forest cover and drinking water quality. The sources of information widens as the metrics are obtained from national inventories of pollution discharges and monitoring stations, environmental NGOs (e.g. Birdwatch Ireland) and government agencies (e.g. Sustainable Energy Authority of Ireland – SEAI) in addition to information provided by the monitoring and inspections of licensed premises. These sources of information can be used to build environmental performance measures for regulated sectors at the national level. The environmental status/trend of a number of key environmental indicators for the Irish environment are reported on the EPA website.[20] The CSO produces national environmental indicators covering 79 indicators under nine domains on a biennial basis.

Much of the data for these come from the EPA. The CSO reports its indicator results to Eurostat, where

20 http://www.epa.ie/irelandsenvironment/environmentalindicators/ (accessed 27 January 2020).

they are used for international comparisons.[21] The CSO also compiles the following data:

- environmental taxes – the type of environmental tax paid by NACE sector for the years 2003 to 2017;
- environmental transfers – the amount of environmental transfers by environmental protection/resource management domain for the years 2011 to 2015;
- environmental accounts air emissions – GHG air emissions by NACE 2 sector;
- material flow accounts – all solid, gaseous and liquid material flows (except for bulk water) where the unit of measurement is tonnes per year.

The EEA[22] classifies five types of indicators (A to E in Table 5.3). A 2014 review mapped the EEA indicators in relation to the DPSIR dimensions (Table 5.3). There was an overreliance on the descriptive type of indicators and very little indicators for the other dimensions. Policy effectiveness was poorly covered and there were no indicators for total welfare at that time. Since 2016, the EEA annual *Environmental Indicator Report* has used indicators that measure the EU's progress towards 29 environmental policy objectives and three key welfare priority areas (natural capital, resource efficiency, low-carbon economy) and people's health and wellbeing.

Table 5.2. Eight NACE sectors (denoted by NACE codes), associated licensed activities within the sector and the corresponding reporting eKPIs identified by Defra

NACE sectors	Associated licensed activities	Reporting eKPIs
Manufacture of food products and beverages (NACE 10 and 11)	8.(a), 8.(b) and 8.(c)	• Water abstraction • GHG • Waste • Acid rain and smog precursors • Nutrients and organic pollutants
Manufacture of chemicals and chemical products (NACE 20)	4.(a), 4.(b) and 4.(e)	• Water abstraction • GHG • Metal emissions to land • Waste • Volatile organic compounds • Metal emissions to air • Ozone-depleting substances • Nutrients and organic pollutants • Acid rain and smog precursors
Electricity, gas, steam and hot water supply (NACE 35)	1.(c)	• GHG • Waste • Acid rain and smog precursors • Radioactive waste • Water abstraction • Metal emissions to land • Metal emissions to air • Metal emissions to water

21 https://ec.europa.eu/eurostat/data/database?p_p_id=NavTreeportletprod_WAR_NavTreeportletprod_INSTANCE_nPqeVbPXRmWQ&p_p_lifecycle=0&p_p_state=normal&p_p_mode=view&p_p_col_id=column-2&p_p_col_pos=1&p_p_col_count=2 (accessed 27 January 2020).

22 https://www.eea.europa.eu/data-and-maps/indicators/#c0=10&c12-operator=or&b_start=0 (accessed 27 January 2020).

Table 5.2. Continued

NACE sectors	Associated licensed activities	Reporting eKPIs
Manufacture of coke, refined petroleum products and nuclear fuel (NACE 19)	1.(a)	• GHG • Water abstraction • Metal emissions to land • Acid rain and smog precursors • Waste • Metal emissions to air • Radioactive waste
Manufacture of basic metals (NACE 24)	2.(e) and 2.(f)	• Water abstraction • Metal emissions to land • GHG • Waste • Metal emissions to air • Acid rain and smog precursors
Farming of animals (NACE 01.4) and aquaculture (NACE 03.2):	7.(a)	• Water abstraction • Pesticides and fertilisers • GHG • Acid rain and smog precursors • Agricultural produce
Sewage and refuse disposal, sanitation and similar activities (waste and water management)		• GHG • Metal emissions to land • Water abstraction • Acid rain and smog precursors • Nutrients and organic pollutants • Metal emissions to air • Waste
Paper and wood processing (NACE 17)	6.(c)	• Water abstraction • GHG • Waste • Volatile organic compounds • Acid rain and smog precursors • Metal emissions to land • Metal emissions to water • Nutrients and organic pollutants
Wood processing (NACE 16)		• GHG • Waste • Acid rain and smog precursors • Volatile organic components

Source: the eKPIs were extracted from Defra (2006).

Table 5.3. The focus and type of EEA indicators

Focus/type	Driving force (D)	Pressure (P)	State (S)	Impact (I)	Response (R)	Total
Descriptive (A)	16	22	22	39	10	109
Performance (B)	0	11	2	0	3	16
Efficiency (C)	3	4	0	1	1	9
Policy effectiveness (D)	2	0	0	0	1	3
Total welfare (E)	0	0	0	0	0	0
Total	21	37	24	40	15	137

Reproduced from EEA (2014).

6 The Regulator–Regulated Relationship

Internationally there has been a move to extend enforcement activity to include more co-operative approaches that emphasise the inducement of going beyond basic compliance to good environmental performance, through flexibility and assistance (see Earnhart and Glicksman, 2015). Traditional enforcement activity is of the coercive "command and control" type with compliance monitoring (inspections, surveillance, etc.) and enforcement (prosecutions, fines in response to non-compliant activities). With "command and control" the emphasis is on deterrence by imposing sanctions. The co-operative approach is based on promoting compliance by providing or highlighting incentives available for compliance. Often referred to as environmental "compliance assurance", the co-operative approach adds compliance promotion activities undertaken to (1) increase compliance levels, (2) maintain compliance levels with reduced output from the first two components and/or (3) encourage companies to go beyond compliance in their environmental outcomes.

Compliance is encouraged through economic instruments, flexibility, voluntary approaches, education and assistance. Economic instruments include trading systems, taxes, liability funds and compulsory insurance related to the facility risk level. Flexibility for business is provided when there is a move away from dependence on process standards and businesses decide how best for them to achieve the required environmental performance. Voluntary approaches include incentives for reporting and voluntary disclosure and voluntary participation in environmental management schemes. Some enforcement offices adjust inspection schedules, licence costs or risk evaluation when facilities participate in self-reporting and voluntary disclosure. Education and information tools include campaigns for the general public and for regulated businesses, promoting and rewarding good practices and informing the public of compliance status. Mazur (2012) reports that education programmes seem to work for improved compliance. From comprehensive information-based assistance programmes, enterprises can get advice and informational and methodological materials in one place. Assistance can involve a demonstration of best practise and making it easier for businesses to comply. Incentives can also come from outside the enforcement office, e.g. national awards for environmental performance or good environmental performance used as a marketing tool. However, the development and operation of such programmes require significant funding, mostly from public sources.

The OEE participates in a number of these approaches, such as (1) the requirement for financial provision for environmental liabilities introduced in 2009, (2) guidance on how regulated firms can improve their compliance and (3) encouraging companies to adopt EMSs recognised under the IED through reduced fees. The EPA sponsors environmental awards within the Pakman Awards (for recycling and waste management) and the Green Awards (green business and sustainability). Sectoral approaches adopted include issuing annual sectoral letters outlining findings from the previous years' enforcement activities and planned priorities for the coming year and calculating an index of risk for key industrial sectors as well as for individual installations. Section 6.1 focuses on relevant evidence on the effectiveness of "compliance assurance" approach.

6.1 Reporting and Voluntary Disclosures

Corporate environmental reporting can have a motivating effect on business behaviour, especially if targets are included (Clarkson *et al*., 2011; Braam *et al*., 2016). However, this is difficult to measure (Patten, 2002; Clarkson *et al*., 2011). The motivation, the issues included and the level of detail involved in voluntary environmental reporting varies substantially between companies (Hahn and Kühnen, 2013; Braam *et al*., 2016; KPMG, 2017). The voluntary corporate environmental or sustainability reports from which self-reported environmental performance arise are less influential than formal reporting that uses established guidelines. Voluntary reports may be directed towards shareholders and potential investors and focus on financial issues such as environmental liabilities. Braam *et al*. (2016) find that many companies disclose an incomplete picture of how their decisions and

activities affect the environment. Potoski and Prakash (2005) conclude that more formal reporting, such as ISO 14001, is effective in inducing facilities to invest in progressive environmental action that they would not otherwise undertake. This type of reporting has good standing with external stakeholders and provides a reputational benefit. The US EPA included public disclosure in the NextGen suite of additional tools to drive better environmental behaviour by leveraging pressure from customers, neighbours, investors and insurers (Giles, 2013). The GreenWatch programme in China indicates that, even when reputational benefits have little influence, disclosure has an effect of increased compliance (Wang *et al*., 2004).

There are now several standard reporting frameworks to boost corporate transparency and performance. Standard reporting enables organisations to report their environmental performance using verifiable data for universally defined operational, managerial and social performance indicators. Examples include the Global Reporting Initiative (GRI),[23] the Carbon Disclosure Project[24] (CDP) and ISO 40000.[25] The GRI reporting standards, produced by the Global Sustainability Standards Board (GSSB) in 2016, enable organisations to report publicly on their economic, environmental and social impacts. The CDP is particularly focused on GHG emissions and climate change. In 2017, 220 companies in Ireland reported their carbon emissions to the CDP. The ISO 40000 environmental management scheme sets out an international standard process (EPE). Under the non-financial reporting EU Directive 2014/95/EU,[26] large companies, comprising over 500 employees, and companies identified nationally as being of public interest must publish reports on the policies they implement in relation to several non-financial aspects, including environmental protection and social responsibility policies. Standard reporting templates provide information in a consistent and comparable manner, avoiding á la carte reporting. However, there are some deficiencies, e.g. high-level assessment of environmental management decision-making and effectiveness is not captured (Pryde *et al*., 2005); what is being reported is not compared with what could have been done. In addition, these reports result in long lists of quantitative and qualitative information. It lacks organisation into an overall environmental performance measure. However, the information is useful for the company to measure performance. It is also useful to external stakeholders if they work through the detail. Reports that include agreed sector-specific key performance indicators facilitate like-with-like comparisons.

6.2 Participation in an Environmental Management Scheme

Environmental management schemes provide an external standard of environmental performance. Two of the main environmental management schemes are the international standard ISO 14001, designed by ISO, and the EMAS, regulated by the European Regulation EC 1221/2009 (Testa *et al*., 2014). They provide standards but allow flexibility to adjust the scheme for individual facilities and promote continuous improvements. Some programmes can boost compliance rates for participants (Kwon *et al*., 2002; Giles, 2013; McGuire, 2014). One of the benefits of having an environmental management scheme is that it signals to stakeholders that the organisation is taking environmental commitments seriously, therefore providing a reputational benefit (Potoski and Prakash, 2005; Iraldo *et al*., 2009). Kwon *et al*. (2002) found certificated companies (ISO 14001) had significantly lower violation rates compared with uncertificated companies in South Korea. McGuire (2014) found that ISO 14001 certification enhanced the environmental regulation compliance of manufacturing firms in China. Graafland (2018) found that ISO 14001 promotes participation in learning networks for small to medium-sized enterprises (SMEs), which mediates an improved environmental performance.

Voluntary action has been argued to be less expensive and more efficient than regulation by some authors, although recent studies would suggest that having

23 https://www.globalreporting.org/Pages/default.aspx (accessed 27 January 2020).

24 https://www.cdp.net/en (accessed 27 January 2020).

25 https://www.iso.org/committee/54846.html (accessed 27 January 2020).

26 https://ec.europa.eu/info/business-economy-euro/company-reporting-and-auditing/company-reporting/non-financial-reporting_en (accessed 27 January 2020).

an environmental management scheme in place is far from being a guarantee of compliance (especially since ISO 14001 does not account for compliance). Therefore, there may not be sufficient reason for special treatment of environmental management schemes-certified businesses in compliance monitoring (Mazur, 2012). Strong regulatory pressure is a requirement, with voluntary participation adding a boost rather than driving good environmental performance (Jones, 2010). A study in Ireland ranked EMS accreditation as the least effective driver of pollution reduction (Styles and Jones, 2010). EPA licensing was ranked as the most influential driver. EPA licences require an Environmental Management Plan (EMP) with specific targets for improvements in emissions, waste generation and resource use (Styles, 2009c). Incentives for EMS certification can include reduced inspection schedules (Norway, France and Korea) and fees (England, Denmark). Austria, Germany and a few other European countries make the presence of an EMS an important criterion in public procurement decisions (Mazur, 2012). Several EU countries (e.g. Italy, Slovakia) issue permits with longer validity periods and with reduced reporting requirements to EMS-certified companies (Mazur, 2012). The IED requires a reduction in enforcement for companies that have the EU EMAS accreditation. While the EMAS is popular in some countries, there is only one company in Ireland that holds EMAS accreditation, compared with 571 Irish companies with ISO 14001 in 2014.

There are some contradictory results that do not link environmental management schemes and environmental performance. Nawrocka and Parker (2009) suggest that different conclusions arise as a result of different definitions and measurements of environmental performance used across jurisdictions. Added to this is the lack of agreement about how or why environmental management schemes are expected to increase environmental performance. Shortcomings of ISO 40001 and EMS systems have been acknowledged for a long time. Borial (2002) and Ammenberg and Hjelm (2002) criticise the certification process, citing impartiality, objectivity and rigour issues. Borial (2002) compares the process to passing a predictable exam, therefore lacking a learning aspect. Ammenberg and Hjelm (2002) found that comparison of environmental performance before and after EMS implementation and between companies was varied because the measure was impacted by the selection of indicators, the data quality for the indicators and the weighting of the aggregated indicators.

6.3 Regulation Design

> The most effective way to achieve compliance with the law is to make it easier to comply than to violate. EPA is using new technologies and lessons learned about what drives compliance to reduce pollution and improve results. (Cynthia Giles, Assistant Administrator for the US EPA's Office of Enforcement and Compliance Assurance – OECA – in Giles, 2013, p. 22)

Clear and simple rules to make compliance easier and the reduction of the administrative burden for regulated firms have been adopted as objectives by nearly all agencies, e.g. the US EPA (Giles, 2013). The SEPA has focused more on the quality of regulations and on the policy message than on a quantitative reduction target, e.g. the SEPA's customer focus programme (Mazur, 2012). IMPEL and the Network of the Heads of Environmental Protection Agencies (NEPA) developed the Better Regulation checklist to assess practicability and enforceability of environmental legislation.[27] The Make it Work project[28] provides principles to guide the drafting stage of EU environmental law to improve coherence and consistency. These are:

- Environmental regulation is designed to deliver the outcomes for which it is adopted and refrains from introducing requirements that do not directly contribute to these outcomes.
- The degree of regulation in law should be proportionate to address the problem that the law is designed to address.

27 https://www.impel.eu/wp-content/uploads/2016/11/IMPEL-and-NEPA-Better-Regulation-Checklist-March-2010.pdf (accessed 19 March 2020).

28 http://minisites.ieep.eu/assets/1791/MiW_drafting_principles_on_compliance_assurance_July_2015.pdf. (accessed 19 March 2020).

- Simplicity and clarity should be a continual aim so that laws are designed to deliver the outcomes for which they are adopted and refrain from introducing requirements that do not directly contribute to these outcomes.
- Smart regulation seeks to deliver the benefits of environmental law at the least possible cost.
- Monitoring and reporting obligations should be limited to those that are necessary to ensure compliance and judge progress towards environmental and other objectives.
- Smart regulation should not capture trivial activities.
- Ensuring implementation is achievable.

The Porter hypothesis states that good environmental regulation design can provide flexibility for industry, reduce costs and improve environmental outcomes. Porter's hypothesis contends that properly designed environmental regulation drives innovation and offsets the costs of regulation, resulting in increased business performance (Porter, 1991). This theory is most often associated with the flexibility allowed within market-based strategies. Market-based strategies put a price on the natural capital used by companies and sets a limit on use, but allows companies to decide how best to achieve the limits. The US EPA has introduced several market-based programmes (e.g. Acid Rain Program – ARP – and NO_x Budget Trading Programs – NBTP). The EU Emissions Trading System (ETS) is a market-based cap and trading scheme for GHG in EU. The strategies have been broadly seen as effective in the USA. The EU ETS is struggling with the price aspect, although it has been shown to reduce emissions in some EU countries (Abrell *et al*., 2011).

The BATCs guidelines produced under EU Directive 2010/75/EU are based on the current most effective process techniques and abatement technologies for emission reductions that are practicable to introduce. BATCs are used to determine the improvements possible for an activity and to provide the basis for emission limit values and other permit conditions. The BATC system does not impose technologies and allows space and time for the firm innovation envisaged by Porter.

Product design can be used to make compliance easier and non-compliance more difficult. Design applied early in the supply chain can ensure that only certified, compliance-ready technology is used (Giles, 2013). Therefore, the enforcement effort is concentrated on endorsing technologies at their manufacture or sale. A relevant and simple example from Ireland is the introduction of a ban on the marketing, sale and distribution of coal in Dublin, Cork and 10 other locations from 1990 to 2000 (Goodman *et al*., 2009), rather than the larger population using coal heating systems.

6.4 Sector Benchmarking

Rotating sector-specific campaigns is another strategy for maximising the impact of limited agency resources. Such campaigns can create the impression of a substantial regulatory capability and threat of enforcement, with a very limited regulatory resource commitment. It is advisable to link awareness campaigns and inspection campaigns: the former give businesses information to comply, while the latter, after a certain period, seek to establish a level playing field through compliance monitoring and enforcement. However, there is a challenge of balancing attention to thematic risks with attention to site-specific risks during inspection campaigns (Mazur, 2012).

Sectoral plans represent a global trend in environmental compliance assurance. As mentioned in section 2.4, there is a need to translate between the activity-based regulation of the licences issued and the economic sector of the business (see applied mapping of regulated activities to sectors in Table 5.2). A significant proportion of compliance monitoring/assessment activities is becoming sector based, although it continues to rely on activity-based regulations (OECD, 2009). Sector plans can promote shared problem-solving and efficiency to drive both compliance and environmental performance. It is easier for small businesses to respond to messages adapted to their sector activity. Involving regulated businesses in regulatory mapping engages businesses in a common effort by focusing the regulatory interventions on jointly defined priorities and outcomes. Sector approaches may benefit from spillover effects; companies can see how their peers perform and this can confirm that better performance is possible and provide a competitive incentive to improve (Giles, 2013).

6.5 Rewards and Recognition for Green Businesses

Awards are used in many countries to showcase best practice sustainability leadership and innovation and to provide recognition to organisations for their efforts and achievements in protecting and enhancing the environment. In Ireland, the annual Green Awards[29] are supported by commercial sponsors, the Department of Communications, Climate Action and Environment and the EPA. An international judging team awards in 21 categories. The Irish Business and Employers Confederation (Ibec) organises *The Environment Awards* every 2 years to recognise Irish companies that combine innovation, financial savings and environmental concerns. There is an Overall Environmental Excellence Award, a Process Award, an Environmental Management Award and a Product and Services Award. In 2018, there were 30 entries. The EPA also sponsors an award in the Pakman Awards,[30] which recognise excellence in recycling and waste management.

The annual VIBES – Scottish Environment Business Awards[31] are supported by environmental agencies (e.g. SEPA and Scottish Water), enterprise agencies (Scottish Enterprise, Highland and Islands Enterprise), the Scottish government and business organisations (e.g. the Institute of Directors and the Federation of Small Businesses). The European Business Awards for the Environment (EBAE) is open to winners and runners-up of the Environment Awards (Ireland) and VIBES (Scotland).

The "green tick" logo[32] launched by Scotland's Green Business Partnership in February 2011 is an example of providing corporate environmental management recognition to SMEs. The one to three ticks indicate the progress of the company in terms of its environmental performance towards becoming a sustainable business. One tick indicates that the company has an environmental policy in place. Two ticks indicate that the company manages its compliance, reviews its suppliers and has an environmental action plan. Three ticks signify that an EMS has been implemented (Mazur, 2012).

6.6 Consumer Choices/Reputational Pressure

Some evidence exists that environmental planning is positively influenced by customer pressure, shareholder pressure and neighbourhood and community group pressure (Henriques and Sadorsky, 1996; Huang and Kung, 2010; Kawai *et al*., 2018). However, Williamson *et al*. (2006) found that making a business case for improving environmental performance is not effective in influencing business decisions. Wu (2009) found no evidence to support the green consumer theory and Karpoff *et al*. (2005) provided evidence that legal penalties, not reputation loss, are most important in deterring environmental violations. Brady *et al*. (2019) found that reputational penalties continue to be negligible even in the era of social media. Whereas the magnitude of monetary penalties for non-compliance have been higher in recent decades, the penalties have decreased relative to market valuations (Brady *et al*., 2019).

6.7 Compliance Assurance: Is It the Way Forward?

Building a culture of environmental compliance is an important objective of modern enforcement agencies. Environmental issues are influenced by a large collection of actors, from legislators to individuals. The ability and likelihood of the firm's decision to go beyond basic compliance in response to compliance promotion efforts depend on internal organisational dynamics and capabilities and on sector influences where normalising and conforming pressures are applied (Delmas and Toffel, 2008). It may be that the co-operative approach needed some time to be reciprocated and incorporated into business thinking, especially in the case of businesses that had been operating under a strict command and control regime. The development and widespread use of continuous monitoring and electronic recording must encourage a co-operative attitude from business as their exposure has expanded from passing an inspection visit. Generally, the consensus is that these tools are used to amplify the enforcement activity rather than

29 https://www.greenawards.ie/ (accessed 27 January 2020).

30 https://pakman.ie/ (accessed 27 January 2020).

31 http://www.vibes.org.uk/ (accessed 27 January 2020).

32 https://www.brightgreenbusiness.org.uk/environmental-services/green-ticks (accessed 27 January 2020).

replace stringency. Most enforcers use both strategies (Rechtschaffen, 2004), although the coercive and co-operative functions may be seen as two distinct functions separated within the agency. The preparation of a permit demands technical and negotiating skills and a facilitating and co-operative attitude to the applicant. Enforcement needs straightforwardness, stubbornness and a fair, but non-negotiable, judgement (OECD, 2004).

Research into the merits of the co-operative approach versus the "command and control" approach appears to be more theoretical than empirical. Empirical studies are needed to determine if benefits accrue from extra enforcement output activities such as those described in Chapter 6. If benefits accrue, a cost–benefit analysis would be needed to see if the benefits outweighed the costs. In practice the enforcement agencies tend to rely on compliance assurance indicators for which data are readily available. One study compared compliance in Canada (perceived as co-operative) and the USA (perceived as stringent "command and control") in the paper and pulp sector (Harrison, 1995). Although significantly lower rates of compliance were found in Canada, the US EPA subsequently enthusiastically embraced new co-operative regulatory approaches under the banner *Next Generation Compliance* (Giles, 2013). It is particularly important to assess the effectiveness of both traditional enforcement activity and new trends before changing enforcement policy.

7 Case Studies: Sector-based Approaches to Regulation

Case evidence for Scotland, England and Wales, and Canada are presented in this chapter to provide the experience of other regulatory agencies.

7.1 Scotland: The Scottish Environment Protection Agency

The SEPA's tools and highlights can be found in Box 7.1.

7.1.1 Background

The SEPA operates across a range of environments from urban to highlands and islands and has over 1300 staff. The SEPA is responsible for delivering two core services: environmental regulation and flood risk management. Its philosophy is as follows:

> One Planet Prosperity: environmental success, social success and economic success.[33]

7.1.2 Development

Citizens and governments are looking for better ways to assess national wellbeing. In the globalised world the ability of GDP to measure the health of a country's economy is reduced and, in addition, citizens are looking for more than just economic indicators to assess their national wellbeing. The Scottish government launched the National Performance Framework (NPF) in 2007 to provide a new way to measure national wellbeing through a range of economic, health, social and environmental indicators. The NPF uses an outcomes-based rather than an input-based approach to assess the delivery of public services. There are five strategic objectives and 16 national outcomes contained in the framework. These provide a focus and direction for policy action across the public sector as a whole. The SEPA makes a direct contribution to nine of the national outcomes.

The Regulatory Reform (Scotland) Act in 2014 gave the SEPA a new and expanded statutory purpose with the following three elements: environmental

Box 7.1 SEPA's tools and highlights

Tools:

- searchable compliance index published online;
- green tick merit system administered by third-party non-profit organisation;
- increased range of enforcement measures in the mid-range;
- developing sector plans.

Highlights:

- developments linked to national public service framework;
- statutory basis for expanded remit to include social and economic dimensions;
- new strategy developed with local and global perspectives;
- consultation with stakeholders including general public;
- increased range of enforcement tools provided in national law with clear guidelines;
- performance outcomes assessed annually for operations and every 5 years for corporate objectives;
- partnership approaches of sector plans and sustainable growth agreements to increase compliance and going beyond compliance.

33 See https://www.sepa.org.uk/regulations/how-we-regulate/delivering-one-planet-prosperity/ (accessed 19 March 2020).

success, social success and economic success. This led to a new regulatory strategy published in 2016, namely One Planet Prosperity. Calculations by the Global Footprint Network[34] showed that, if everyone in the world lived like people in Scotland do, we would need three planet Earths to meet resource demand.[35] The objective of the new strategy is to reduce the ecological footprint of Scotland to a point where one planet would sustain living. The prosperity aspect is that, wherever possible, the reduction in ecological pressure should come without impacting the social and economic aspects of the country. The strategy provides a blueprint to tackle environmental crime, support operators in driving up compliance and help those who want to go beyond compliance to realise the many benefits of environmental excellence. The Environmental Regulation (Enforcement Measures) (Scotland) Order 2015 provided new enforcement measures including fixed monetary penalties and variable monetary penalties; enforcement undertakings were also introduced. A framework to decide which enforcement measure or whether to refer the case for prosecution was issued in 2016. The SEPA 2017 Enforcement Report (SEPA, 2017) included information relating to some environmental events (and their response); this improves communication to stakeholders by adding a context narrative to compliance rates and enforcement activity derived metrics.

7.1.3 Compliance tools

The two aims of the SEPA are to get every regulated business into compliance with Scottish environmental regulations and to help businesses to improve their environmental performance beyond the compliance standards. The outcomes of these aims are to create sustainable and inclusive economic and social outcomes for Scotland as well as to further improve the Scottish environment. The SEPA uses a number of compliance tools to achieve these two aims.

Compliance assessment scheme and the compliance matrix

Similar to Ireland, the SEPA uses a risk-based system to allocate resources: the compliance assessment scheme (CAS). The CAS assigns one of the following six categories to each licensee: excellent, good, broadly compliant (compliant), at risk, poor and very poor (see Figure 7.1). The assigned category is based on a degree of non-compliance in both emissions and management components of the licence.

		Environmental Limit Conditions		
		No breaches	Minor breaches or one gross breach	Significant breach, more than one gross breach or repeated minor breach
Environmental Management Conditions	High performance	Excellent	Good	Poor
	Medium performance	Good	Broadly compliant	Poor
	Low performance	At risk	Poor	Very poor

Figure 7.1. The compliance matrix used by the SEPA. Reproduced from SEPA (2018).

34 https://www.footprintnetwork.org/ (accessed 27 January 2020).

35 The current figure for Ireland is 2.8 planets.

The CAS system is part of the agency's performance measurement system. At the end of 2016, 91.7% of the assessed licences were compliant with their licence conditions. The CAS is fairly easy to understand and explain to the public. The annual compliance assessments are published on the SEPA's website and are searchable by activity sector, geographical area and regulatory regime. The compliance rankings usually get attention from the press, which creates public pressure on operators to improve their environmental performance. The compliance assessment also contributes to site-specific risk assessment as part of the Dynamic Regulatory Effort Assessment Model (DREAM), which is used to determine planned baseline inspection frequencies and increased monitoring in response to poor performance. The frequency of site inspections depends on the assigned category.

Expanded range of "enforcement measures"

A wider range of enforcement measures were introduced in 2015 to give the SEPA more scope, especially in the space before court proceedings. An enforcement undertaking is an offer to make amends for non-compliance and to prevent recurrence. An enforcement undertaking may be offered proactively by the responsible person, when reporting the non-compliance incident, or it may be offered reactively by the SEPA after an investigation of non-compliance. The agency is not obliged to accept an offered enforcement undertaking. The proposed undertaking should include appropriate beneficial remedial actions, demonstrate preventive measures to avoid repetition of the violation and provide longer term benefits for the environment or the local community. A fixed monetary penalty is another new enforcement measure. These are fixed financial penalties that the SEPA can impose for certain offences when there is minimal environmental impact or little financial benefit, or when the offence is not based on environmental harm.

Sector plans

The SEPA is moving to a sector plan approach and the initial sector plans have been produced. Sector plans set out how the SEPA intends to work with the sector to ensure that they comply with environmental regulations. To develop a sector plan, the SEPA maps out existing levels of compliance within the sector. This highlights issues that are common across the sector. A sector plan will identify all the levers that influence the specific sector to help improve compliance. Where there are particular compliance issues within a sector, the implementation of the sector plan will include consideration of the types of enforcement action that may be appropriate for that issue in that sector. The plans will address resource efficiency by identifying ways that businesses could reduce water use, carbon-based energy use, materials use and all forms of waste and pollution to beyond compliance standards in ways that improve their profitability and long-term viability. In essence, the objectives of the sector plans are to minimise inputs, waste and emissions and maximise product or service output (Figure 7.2).

Sustainable growth agreements

Sustainable growth agreements are used to help businesses to go "beyond compliance". These voluntary, non-legally binding, but formal, agreements between the SEPA and a business focus on practical

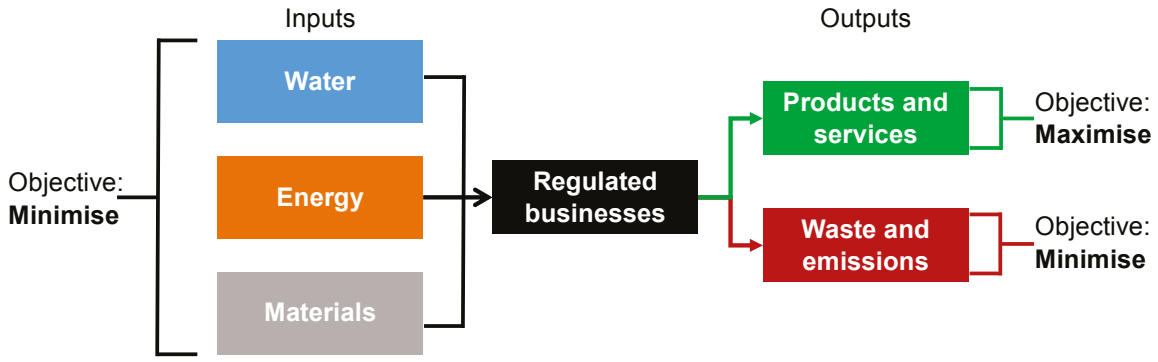

Figure 7.2. The generic environmental flow model applied in SEPA sector plans. Reproduced from SEPA (2019)

actions to deliver environmental outcomes. The SEPA remains the enforcement agency, but it also acts as an advisor and facilitator of improved environmental performance. It does this by helping organisations collaborate with experts, innovators and stakeholders on different approaches that could improve environmental and commercial performance.

7.1.4 Measuring effectiveness

The SEPA includes high-level performance measures in a corporate plan produced every 5 years and it also sets objectives in annual operating plans. There is increased specificity of the measures from corporate plan to annual operating plans. Quarterly reports indicate progress in achieving the performance measures.

7.2 England and Wales: The Environment Agency

The Environment Agency's (EA) tools and highlights can be found in Box 7.2.

7.2.1 Background

The EA in England regulates 14,000 businesses with 10,600 employees. The EA sits within Defra. Regulators are required to take account of businesses' efforts to comply with regulations and to create positive incentives for voluntary compliance and adoption of good practices (Mazur, 2012). Its philosophy is as follows:

> Philosophy: to be the first generation to leave the environment in a better condition than we found it. (HM Government, 2018)

7.2.2 Development

A government White Paper published in 2011 (Defra, 2011), *The Natural Choice: Securing the Value of Nature*, stated the aspiration to be the first generation to leave the environment in a better condition than it inherited. The Natural Capital Committee was set up to devise a 25-year plan[36] based on a natural capital approach (i.e. ecosystem services). Natural capital is defined as those elements of the natural environment that provide valuable goods and services to people. Economic and accounting methods for public and private assets were combined with the best natural science understanding so that natural capital was measured and accounted for in monetary terms. It is an approach that brings human activities and their consequences together into a single strategic perspective. The approach addresses the complexity and long-term nature of making the most of natural capital. The 25-year environment plan, combined with

Box 7.2 EA's tools and highlights

Tools:

- Extensive experience of alternative and complementary measures to regulation enforcement.

Highlights:

- The EA adopted a natural capital approach that applies a monetary value to ecosystem services provided by a good environment. This provides a common language for stakeholders.
- The government ambition is to be the first generation to leave the environment in a better condition than they found it. A 25-year environment plan with associated metrics was devised to guide this course of action.
- Environmental considerations are included in industrial and clean growth strategies so that enhancing the environment is achieved while businesses are supported to generate growth and prosperity.
- The current compliance rating system is under review after consultation with stakeholders.

36 https://www.gov.uk/government/publications/25-year-environment-plan (accessed 27 January 2020).

other policies and strategies, such as the Industrial and Clean Growth Strategies[37] (ensuring an affordable energy supply for businesses and consumers to grow the economy while cutting GHG emissions), are based on enhancing the environment and supporting businesses to generate growth and prosperity.

The following are examples of natural capital and costs:

- Atmospheric pollution costs the economy an estimated £2.7 billion in 2012 as a result of effects on productivity.
- Ammonia emissions from UK farming cost an estimated £440 million to human health and the environment in 2015.
- UK freshwaters are worth £40 billion to the economy through benefits for public water supply, recreational visits and fisheries.
- Recreational visits to coasts and beaches in 2015 were conservatively valued at £1.4 billion.

7.2.3 Compliance tools

The EA pioneered the development of scoring schemes, such as compliance rating and environmental risk scoring schemes. The Compliance Classification Scheme (CCS) aggregates and weights a set of compliance-related parameters to arrive at a measure that places the business in one of six bands. The licence fees are linked to the band rating. Fees for facilities in the worst band are increased by 300%. The current compliance rating system is under review after feedback from stakeholders indicated that they found it too complex. The new system proposed involves the following four bands:

1. Expected. This is the standard for all sites to meet through concise, accessible and reliable advice and guidance. Self-reporting would be encouraged and the operator's approach to addressing minor incidents would be recognised.
2. Exemplary. This is the standard for operators whose behaviour and compliance record show that regulatory effort can be reduced.
3. Improvement needed. This is the standard for operators whose behaviour and compliance record show that regulatory effort should be increased.
4. Significant improvement needed. This standard is used if an operator displays unresponsive, obstructive, abusive or hostile behaviour, such as poor complaint handling, persistent non-payment of fees, unsatisfactory community engagement or unwillingness to comply. Strong enforcement or remediation action applied.

The EA operates under a sector approach, with 5-year strategies and annual intervention plans for a range of economic sectors. For example, the EA uses an annual environmental performance assessment[38] to compare environmental performance between nine water and sewerage companies operating mainly in England. The environmental, strategic and non-metric performance of the companies are reviewed in annual review meetings held with water and sewerage company chief executive officers.

The EA has extensive experience in the application of alternative and complementary measures to regulation in order to deliver environmental objectives. The UK Sustainable Development Strategy 2005[39] suggested that policy instruments can induce changes in behaviour of the targeted group in four ways: engage, enable, encourage and ensure. It is an underresearched area, but generally the approach is to have a mix of instruments for maximum effect. Gouldson *et al*. (2008) reviewed the theory and experience of using these strategies. Gouldson *et al*. (2008) arranged the instruments into three categories: information-based approaches (e.g. targeted knowledge transfer, naming and shaming/faming, registration, labelling and certification), private and voluntary regulation (e.g. self-regulation, voluntary regulation, negotiated agreements) and support and capacity-building measures (e.g. research, demonstration projects). They conclude that alternative measures have significant potential to contribute to the realisation of the Water Framework Directive's objectives, but only where certain preconditions exist, which we have summarised in

37 https://www.gov.uk/government/publications/clean-growth-strategy/clean-growth-strategy-executive-summary (accessed 27 January 2020).

38 https://www.ofwat.gov.uk/wp-content/uploads/2017/12/WatCoPerfEPAmethodology_v3-Nov-2017-Final.pdf (accessed 27 January 2020).

39 https://sustainabledevelopment.un.org/content/documents/1408uk.pdf (accessed 27 January 2020).

Table 7.1. Predictably, many of the preconditions are similar to change management processes.

7.2.4 Measuring effectiveness

The EA publishes an annual report that reports on the regulatory performance of licensed businesses and the effectiveness of the EA's regulatory approach. The report includes the number of incidents, the value of fines imposed, compliance measures and national emission trends of NO_x, SO_x, $PM_{2.5}$ (particulate matter ≤2.5 µm) and PM_{10} (particulate matter ≤10 µm) from regulated sites. The EA uses the World Health Organization emission guidelines, which are stricter than the EU guidelines. Sector reports are also produced.[40] The agency sets long-term objectives and annual intermediate quantitative outcomes. The progress towards the annual metrics are updated quarterly using a traffic light system to provide an early warning if progress is off-course.

7.3 Canada: Environment and Climate Change Canada

The Environment and Climate Change for Canada's (ECCC) tools and highlights can be found in Box 7.3.

7.3.1 Background

The ECCC operates on a federal basis across five regions.

7.3.2 Development

Monies received as a result of enforcement measures are put in the Environmental Damages Fund (EDF). The ECCC administers the EDF, which was set up in 1995 and is used to fund environmental projects. These priority projects are chosen to benefit the natural environment.

Table 7.1. The nine preconditions for successful implementation of alternative measures for regulation

Condition	Actions
Level of commitment	Both the target group and the agency must commit time and resources.
A lead actor	A champion from the agency or the target group to drive the process and maintain enthusiasm.
Timing	Do not introduce change when there are other factors competing for attention.
Speed of effect	Identify quick wins and highlight them. This will build "buy-in".
Durability	Design durability into the process, i.e. behaviour permanently changed.
Clear message	The message should be specific and reasonable.
Continued enforcement	The regulatory role of the agency is maintained.
Media coverage	Used to reward, convince and inform the target group. Inform the public.
Social capital	Trust and mutual understanding build up over time. Do not take it for granted.

The nine conditions are extracted from Gouldson *et al.* (2008).

Box 7.3 ECCC's tools and highlights

Tools:

- strong emphasis on compliance promotion;
- maintains a programme evaluation team;
- uses intermediate and final outcomes in programme reviews.

Highlights:

- Environmental Damages Fund (EDF) set up in 1995.

40 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/656013/Food_and_drink_sector_strategy_LIT_10693.pdf (accessed 27 January 2020).

7.3.3 Compliance tools

Canada has embraced the co-operative approach to compliance promotion communication channels to raise awareness and understanding of environmental issues and regulations. Measures used include workshops, information sessions, presentations, information package emails/mail-outs, articles, phone calls and social media platforms. It is believed that these compliance promotion activities are particularly useful for the many SMEs and indigenous groups that are dispersed throughout this large country. A large database of entities and contact names is maintained. Each year the ECCC focuses compliance promotion activities on a list of priorities activities. Factors that influence the identification of priority activities include new or amended regulations or policies, new requirements coming into force, level of compliance and the need to maintain awareness, understanding or compliance for specific requirements.

Each year, the ECCC develops a national enforcement plan that sets out the enforcement activities to address non-compliance with the Canadian Environmental Protection Act (1999), which aims to contribute to sustainable development through pollution prevention and protect the environment, human life and health from the risks associated with toxic substances. Factors that influence the identification of priority activities include the risk to the environment and human health represented by the regulated substance or activity, governmental and departmental priorities, suspected non-compliance, recent publication of new and amended regulations and domestic and international commitments and obligations.

7.3.4 Measuring effectiveness

Although the number of inspections and enforcement measures are reported, the agency explains that the priority lists and focused actions influence the number and type of measures from year to year. Environment Canada had to abandon the Enforcement Environmental Improvement Index that it tried to introduce in 2010. The index was to measure the mass of regulated substances reduced through enforcement actions. Plans to incorporate over 40 air and water pollutant indicators weighted in accordance with their toxicological impact were planned. Then Environment Canada wished to aggregate the indicators into a composite measure to summarise the environmental impact of these reductions. The approach was complex and costly and was abandoned shortly after its introduction (OECD, 2015).

The ECCC evaluation is similar to the OECD model outlined in section 2.3. The ECCC conducts five to eight programme reviews each year.[41] The evaluation uses logic models with intermediate and long-term outcomes mapped to thematic outcomes, such as “ongoing improvements to environmental indicators”. The programmes are evaluated under the following headings: (1) relevance, (2) performance effectiveness and (3) performance efficiency and economy.

41 The 2015/2016 evaluation of the Sustainability Reporting and Indicators Programme is of interest in this review. Available online: https://www.canada.ca/en/environment-climate-change/corporate/transparency/priorities-management/evaluations/sustainability-reporting-indicators.html (accessed 27 January 2020).

8 Conclusions and Key Recommendations

8.1 Key Findings from the Literature Review

Sectoral plans represent a global trend in environmental compliance assurance. Sectors can be monitored and used to find the best solutions to reduce the environmental impact of business activity at a sectoral level. Sector-specific key performance indicators are used for within-sector comparisons of firm environmental performance, to highlight good and bad behaviour, to compare actual emissions with an ideal target and to assess the impact of different enforcement actions, determining what may be appropriate for that sector in future years.

Generating a composite sectoral environmental performance measure involves indicator selection and validation, weighting and aggregating metrics, normalising and within-sector averaging. The methodology may be a modified version of existing methods or methods developed specifically for Ireland.

A common definition and good measure(s) of environmental performance allow the study of drivers of environmental performance across companies and countries. Sector-level environmental performance is less common and not as well defined. This reflects the fact that environmental performance and determinants tend to be highly context specific (Goldstein *et al*., 2011). Factors such as local environment and size of operation have to be incorporated for fairness and transparency in the application of a composite environmental performance measure across a range of entities operating in a sector.

In developing sectoral measures, the suite of indicators used should be periodically reviewed, as their reliability, relevance and priority will change over time as environmental conditions evolve. The decision to change an indicator or change the collection and aggregation methods needs careful review to maintain continuity of data sets and avoid misinterpretations. We recommend mapping indicators by type and by dimension to ensure that a holistic assessment is developed. Using a framework guides this process.

There is some evidence to support the use of co-operative approaches to garner greater compliance. These methods should be used with strong regulatory pressure. More evidence is required on the effectiveness of co-operative measures to solely rely on these measures.

8.2 Key Recommendations

8.2.1 Sector-specific plans and environmental performance measures

Sector plans using key indicators could be developed in Ireland. Many enforcement agencies are developing sector-specific plans as part of their efforts to assist industry sectors to go beyond compliance. Elements of peer-to-peer learning, competition and normalising good behaviour can be captured in sector-based plans. Sector plans can be developed in association with industry representative groups using key indicators and agreed targets and timeframes.

8.2.2 Construct and test sectoral environmental indicators based on key priority problems for key sectors to develop a sector benchmarking process

Previous research by Duffy (2002), Styles and Jones (2010) and Poveda and Lipsett (2011) highlighted some issues, such as the reporting requirements burden on businesses, the need for economic data for normalising results and methods for developing appropriate performance measures for different sectors. Eight years later more information is included in the annual environmental returns and an electronic reporting system to simplify the process of developing sector-specific indicators and environmental performance measures. Sectoral plans and environmental performance measurement should be a dynamic system based on a few dimensions and relevant indicators. The indicators should change over time as national priorities and sectoral targets change or as sectoral performance in certain areas improve. Sectoral performance indices would be a useful tool in discussions with sectoral representative bodies and in workshops with key stakeholders within sectors in seeking improvements in the environmental performance of their members.

8.2.3 Initiate a system of digital badges

Electronic certificates can be used to indicate compliance (similar to having a tax compliant certificate). The system can be developed to reward significant improvement on environmental performance indices and acknowledge facilities that lead those improvements. This approach will allow the OEE to defend their selected indicators, have a preferred methodology in place for developing new sector-indicators and be able to link their activity to improvements in environmental quality.

8.2.5 Test the impacts of environmental monitoring and enforcement on subsequent pollution discharges and compliance behaviour

There is an opportunity to apply the OECD framework and to look at the intermediate and final outcomes from licence enforcement. This could be conducted through a quantitative analysis of the range of enforcement inputs (e.g. warnings, investigations, fines, court, information and assistance workshops, site visits) and compliance metrics (e.g. monitoring, inspections, site visits, EMP, resource efficiency, green investment and environmental performance rating data) and final outcomes (e.g. air, water quality) presented in Figure 8.1. This would involve the OEE providing access to compliance and enforcement data at a sectoral or facility level. The effectiveness of a variety of enforcement activities can be explored, which could provide useful strategic information to the EPA and the Office of Environmental Enforcement. Data requirements to investigate the impact of licensing and enforcement activity on environmental outcomes are shown in Figure 8.1.

8.2.6 Develop a Licensing, Enforcement, Monitoring and Assessment system data access policy for researchers

The EPA provides a variety of channels for citizens and researchers to access information on the state of the environment and factors affecting the elements of the environment. The EPA has been progressive in relation to following an “open data” philosophy from ambient monitoring and from research (Mooney, 2016). It would be useful for the OEE to develop protocols about access to microdata by researchers so that public good can be derived by analysing these databases for insights into firm behaviour.

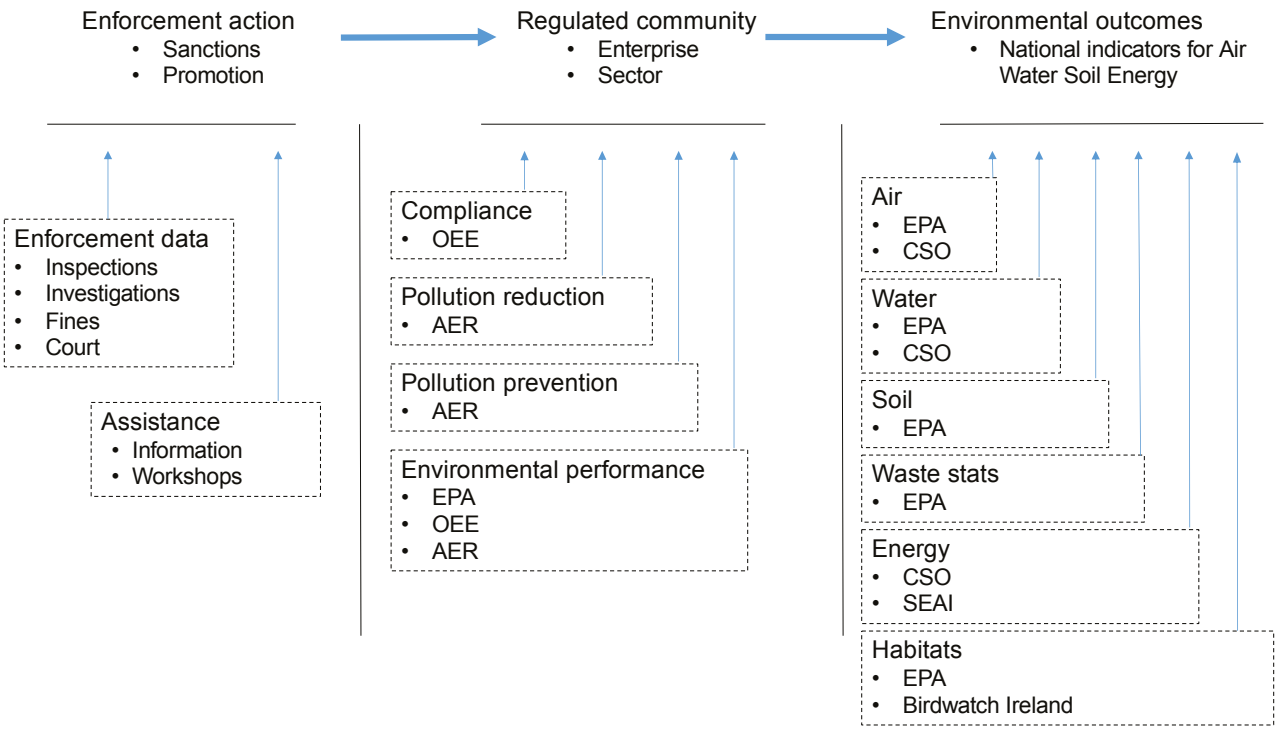

Figure 8.1. Sample data sources for assessing environmental protection and environmental performance.

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Abbreviations

AER	Annual Environmental Report
BATC	Best available technology conclusion
CAS	Compliance assessment scheme
CDP	Carbon Disclosure Project
CSO	Central Statistics Office
Defra	Department for Environment, Food and Rural Affairs
DG	Directorate-General
DSPIR	Driver–State–Pressure–Impact–Response (model)
EA	Environment Agency (England and Wales)
ECCC	Environment and Climate Change Canada
EDF	Environmental Damages Fund
EEA	European Environment Agency - EU
EEI	Environmental Emissions Index
EIR	Environmental Implementation Review
eKPI	Environmental key performance indicator
EMAS	Eco Management and Audit Scheme regulated by the European Regulation EC 1221/2009
EMP	Environmental Management Plan
EMS	Environmental management system
EPA	Environment Protection Agency (Ireland unless specified)
EPE	Environmental performance evaluation
ETS	Emissions Trading System
EU	European Union
GDP	Gross domestic product
GHG	Greenhouse gas
GRI	Global Reporting Initiative
IED	Industrial Emissions Directive
IMPEL	European Union Network for the Implementation and Enforcement of Environmental Law
IPC	Integrated Pollution Control
IPPC	Integrated pollution prevention and control
ISO	International Organization for Standards
LCA	Life cycle analysis
LEMA	The Licensing, Enforcement, Monitoring and Assessment (LEMA) web portal system
NACE	Statistical Classification of Economic Activities in the European Community (nomenclature statistique des activités économiques dans la Communauté européenne
NGO	Non-governmental organisation
NIECE	Network for Ireland's Environmental Compliance and Enforcement
NPF	National Performance Framework
OECD	Organisation for Economic Co-operation and Development
OEE	Office of Environmental Regulation (within the EPA)
ProcSI	Process Sustainability Index
PSR	Pressure–State–Response (model)
SEPA	Scottish Environment Protection Agency
SMEs	Small to medium-sized enterprises
TBL	Triple bottom line

AN GHNÍOMHAIREACHT UM CHAOMHNÚ COMHSHAOIL
Tá an Ghníomhaireacht um Chaomhnú Comhshaoil (GCC) freagrach as an gcomhshaol a chaomhnú agus a fheabhsú mar shócmhainn luachmhar do mhuintir na hÉireann. Táimid tiomanta do dhaoine agus don chomhshaol a chosaint ó éifeachtaí díobhálacha na radaíochta agus an truaillithe.

Is féidir obair na Gníomhaireachta a roinnt ina trí phríomhréimse:

Rialú: *Déanaimid córais éifeachtacha rialaithe agus comhlíonta comhshaoil a chur i bhfeidhm chun torthaí maithe comhshaoil a sholáthar agus chun díriú orthu siúd nach gcloíonn leis na córais sin.*

Eolas: *Soláthraímid sonraí, faisnéis agus measúnú comhshaoil atá ar ardchaighdeán, spriocdhírithe agus tráthúil chun bonn eolais a chur faoin gcinnteoireacht ar gach leibhéal.*

Tacaíocht: *Bímid ag saothrú i gcomhar le grúpaí eile chun tacú le comhshaol atá glan, táirgiúil agus cosanta go maith, agus le hiompar a chuirfidh le comhshaol inbhuanaithe.*

Ár bhFreagrachtaí

Ceadúnú
Déanaimid na gníomhaíochtaí seo a leanas a rialú ionas nach ndéanann siad dochar do shláinte an phobail ná don chomhshaol:
- saoráidí dramhaíola *(m.sh. láithreáin líonta talún, loisceoirí, stáisiúin aistrithe dramhaíola)*;
- gníomhaíochtaí tionsclaíocha ar scála mór *(m.sh. déantúsaíocht cógaisíochta, déantúsaíocht stroighne, stáisiúin chumhachta)*;
- an diantalmhaíocht *(m.sh. muca, éanlaith)*;
- úsáid shrianta agus scaoileadh rialaithe Orgánach Géinmhodhnaithe *(OGM)*;
- foinsí radaíochta ianúcháin *(m.sh. trealamh x-gha agus radaiteiripe, foinsí tionsclaíocha)*;
- áiseanna móra stórála peitril;
- scardadh dramhuisce;
- gníomhaíochtaí dumpála ar farraige.

Forfheidhmiú Náisiúnta i leith Cúrsaí Comhshaoil
- Clár náisiúnta iniúchtaí agus cigireachtaí a dhéanamh gach bliain ar shaoráidí a bhfuil ceadúnas ón nGníomhaireacht acu.
- Maoirseacht a dhéanamh ar fhreagrachtaí cosanta comhshaoil na n-údarás áitiúil.
- Caighdeán an uisce óil, arna sholáthar ag soláthraithe uisce phoiblí, a mhaoirsiú.
- Obair le húdaráis áitiúla agus le gníomhaireachtaí eile chun dul i ngleic le coireanna comhshaoil trí chomhordú a dhéanamh ar líonra forfheidhmiúcháin náisiúnta, trí dhíriú ar chiontóirí, agus trí mhaoirsiú a dhéanamh ar leasúchán.
- Cur i bhfeidhm rialachán ar nós na Rialachán um Dhramhthrealamh Leictreach agus Leictreonach (DTLL), um Shrian ar Shubstaintí Guaiseacha agus na Rialachán um rialú ar shubstaintí a ídíonn an ciseal ózóin.
- An dlí a chur orthu siúd a bhriseann dlí an chomhshaoil agus a dhéanann dochar don chomhshaol.

Bainistíocht Uisce
- Monatóireacht agus tuairisciú a dhéanamh ar cháilíocht aibhneacha, lochanna, uiscí idirchriosacha agus cósta na hÉireann, agus screamhuiscí; leibhéil uisce agus sruthanna aibhneacha a thomhas.
- Comhordú náisiúnta agus maoirsiú a dhéanamh ar an gCreat-Treoir Uisce.
- Monatóireacht agus tuairisciú a dhéanamh ar Cháilíocht an Uisce Snámha.

Monatóireacht, Anailís agus Tuairisciú ar an gComhshaol
- Monatóireacht a dhéanamh ar cháilíocht an aeir agus Treoir an AE maidir le hAer Glan don Eoraip (CAFÉ) a chur chun feidhme.
- Tuairisciú neamhspleách le cabhrú le cinnteoireacht an rialtais náisiúnta agus na n-údarás áitiúil *(m.sh. tuairisciú tréimhsiúil ar staid Chomhshaol na hÉireann agus Tuarascálacha ar Tháscairí)*.

Rialú Astaíochtaí na nGás Ceaptha Teasa in Éirinn
- Fardail agus réamh-mheastacháin na hÉireann maidir le gáis cheaptha teasa a ullmhú.
- An Treoir maidir le Trádáil Astaíochtaí a chur chun feidhme i gcomhair breis agus 100 de na táirgeoirí dé-ocsaíde carbóin is mó in Éirinn.

Taighde agus Forbairt Comhshaoil
- Taighde comhshaoil a chistiú chun brúnna a shainaithint, bonn eolais a chur faoi bheartais, agus réitigh a sholáthar i réimsí na haeráide, an uisce agus na hinbhuanaitheachta.

Measúnacht Straitéiseach Timpeallachta
- Measúnacht a dhéanamh ar thionchar pleananna agus clár beartaithe ar an gcomhshaol in Éirinn *(m.sh. mórphleananna forbartha)*.

Cosaint Raideolaíoch
- Monatóireacht a dhéanamh ar leibhéil radaíochta, measúnacht a dhéanamh ar nochtadh mhuintir na hÉireann don radaíocht ianúcháin.
- Cabhrú le pleananna náisiúnta a fhorbairt le haghaidh éigeandálaí ag eascairt as taismí núicléacha.
- Monatóireacht a dhéanamh ar fhorbairtí thar lear a bhaineann le saoráidí núicléacha agus leis an tsábháilteacht raideolaíochta.
- Sainseirbhísí cosanta ar an radaíocht a sholáthar, nó maoirsiú a dhéanamh ar sholáthar na seirbhísí sin.

Treoir, Faisnéis Inrochtana agus Oideachas
- Comhairle agus treoir a chur ar fáil d'earnáil na tionsclaíochta agus don phobal maidir le hábhair a bhaineann le caomhnú an chomhshaoil agus leis an gcosaint raideolaíoch.
- Faisnéis thráthúil ar an gcomhshaol ar a bhfuil fáil éasca a chur ar fáil chun rannpháirtíocht an phobail a spreagadh sa chinnteoireacht i ndáil leis an gcomhshaol *(m.sh. Timpeall an Tí, léarscáileanna radóin)*.
- Comhairle a chur ar fáil don Rialtas maidir le hábhair a bhaineann leis an tsábháilteacht raideolaíoch agus le cúrsaí práinnfhreagartha.
- Plean Náisiúnta Bainistíochta Dramhaíola Guaisí a fhorbairt chun dramhaíl ghuaiseach a chosc agus a bhainistiú.

Múscailt Feasachta agus Athrú Iompraíochta
- Feasacht chomhshaoil níos fearr a ghiniúint agus dul i bhfeidhm ar athrú iompraíochta dearfach trí thacú le gnóthais, le pobail agus le teaghlaigh a bheith níos éifeachtúla ar acmhainní.
- Tástáil le haghaidh radóin a chur chun cinn i dtithe agus in ionaid oibre, agus gníomhartha leasúcháin a spreagadh nuair is gá.

Bainistíocht agus struchtúr na Gníomhaireachta um Chaomhnú Comhshaoil
Tá an ghníomhaíocht á bainistiú ag Bord lánaimseartha, ar a bhfuil Ard-Stiúrthóir agus cúigear Stiúrthóirí. Déantar an obair ar fud cúig cinn d'Oifigí:
- An Oifig um Inmharthanacht Comhshaoil
- An Oifig Forfheidhmithe i leith cúrsaí Comhshaoil
- An Oifig um Fianaise is Measúnú
- Oifig um Chosaint Radaíochta agus Monatóireachta Comhshaoil
- An Oifig Cumarsáide agus Seirbhísí Corparáideacha

Tá Coiste Comhairleach ag an nGníomhaireacht le cabhrú léi. Tá dáréag comhaltaí air agus tagann siad le chéile go rialta le plé a dhéanamh ar ábhair imní agus le comhairle a chur ar an mBord.

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Environmental Outcomes from Licence Enforcement Activity

Authors: Bernadette Power, Ellen O' Connor, John Eakins, Celine McInerney, Stig Hellebust and Timothy Sullivan

The ultimate objective of environmental regulation is the prevention and reduction of environmental harm from pollution, habitat loss and resource depletion. This desk study reviewed the development of environmental performance measures for the promotion of compliance and the measurement of the impact of and outcomes from enforcement activity. The research also reviewed types of metrics of environmental outcomes available in Ireland and gaps in these metrics. The review examined new approaches that are more collaborative, as well as trends in environmental enforcement activities, coupled with recent developments in the environmental enforcement methods of enforcement agencies in Scotland, England and Wales, and Canada.

The findings from this research provide an update of current practices and recent changes introduced in some jurisdictions, with the target audience being the Environmental Protection Agency (EPA), industrial environmental managers and compliance officers, researchers and policymakers.

Identifying Pressures

Ireland needs to make greater strides in achieving national environmental targets and meeting the international obligations it has committed to under the European Union National Emission Ceilings Directive and the Water Framework Directive, etc. To build a culture of compliance and to deliver a healthy and well-protected environment, regulatory and enforcement agencies need to continue to work with industrial, water and waste sectors to deliver improved environmental performance.

Environmental performance at the national level has been recorded in recent years based on national inventories and monitoring activities, but it is difficult to link national environmental outcomes directly to enforcement activity. The findings from this review suggest that national figures may also mask sector and regional issues that can have severe impacts on the health and wellbeing of individual communities and the quality of the local environment.

Informing Policy

Environmental regulation agencies have limited budgets and strive to deploy resources strategically. Internationally, there has been a move towards using a more collaborative approach (e.g. sector plans, green badges) in environmental regulation, which may appeal to different motivations and push companies to go beyond compliance and embrace more sustainable practices. While popular in some countries, the evidence of the efficacy of this approach is scarce. The findings from this research recommend continuing to use traditional enforcement measures in conjunction with further collaborative measures until there is futher evidence supporting the latter.

Developing Solutions

The EPA has set out a number of key environmental actions and priorities for Ireland, including the need to "integrate resource efficiency and environmental sustainability ideas and performance accounting across all economic sectors". Sectoral plans represent a global trend in environmental licensing and enforcement to promote shared problem-solving and efficiency, to drive both compliance and environmental performance. This research reviewed the frameworks and methods used to develop broad integrated sector-specific environmental performance indicators for different industry and manufacturing sectors and indicates how these can be applied in Ireland. An assessment of performance indicators for Ireland pointed to an overreliance on emission outputs and gaps in the following areas: natural capital including biodiversity; resource efficiency; and decoupling environmental harm from economic activity, including the low-carbon economy, supply chain impacts and people's health and quality of life.

This review of empirical literature on the effectiveness of different types of non-traditional environmental enforcement activity, such as awards and third-party accreditation schemes, shows that strong traditional sanction-based enforcement is critical to environmental protection work. The review suggests that there is some evidence to support the use of co-operative activity in conjunction with strong regulatory pressure. More evidence is required on the effectiveness of co-operative activity to determine a good balance between traditional enforcement and compliance assurance. Notwithstanding this, encouraging a co-operative attitude from business is valuable, as it moves licensees further into the realm of holistically monitoring their environmental performance.

This review provides suggestions for future research and recommends the development of (1) targeted sectoral plans to address key priority problems; (2) sectoral environmental indicators to monitor environmental performance at a sectoral level; and (3) a system of digital badges to communicate the environmental performance of licensed facilities and reward good behaviour.

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