Organisation de Coopération et de Développement Économiques
Organisation for Economic Co-operation and Development

10-Jun-2010

English - Or. English

ENVIRONMENT DIRECTORATE

ENV/WKP(2010)4
Unclassified

ENVIRONMENT WORKING PAPER No. 18

OUTCOME PERFORMANCE MEASURES OF ENVIRONMENTAL COMPLIANCE ASSURANCE: CURRENT PRACTICES, CONSTRAINTS AND WAYS FORWARD

By Eugene Mazur, OECD Environment Directorate

JEL classification: K32, K42, M48, O57, Q56

Keywords: environmental regulation, compliance assurance, compliance and enforcement, environmental authorities, environmental inspections, performance measurement, outcome indicators

JT03285287

English - Or. English

OECD ENVIRONMENT WORKING PAPERS

This series is designed to make available to a wider readership selected studies on environmental issues prepared for use within the OECD. Authorship is usually collective, but principal authors are named.

The papers are generally available only in their original language, English or French, with a summary in the other, if available.

The opinions expressed in these papers are the sole responsibility of the author(s) and do not necessarily reflect those of the OECD or the governments of its member countries.

Comment on the series is welcome and should be sent to either env.contact@oecd.org or to the Environment Directorate, 2, rue André-Pascal, 75775 PARIS CEDEX 16, France.

OECD Environment Working Papers are published on

www.oecd.org/env/workingpapers

ABSTRACT

This report analyses the experience of ten OECD countries in the design and implementation of quantitative indicators used to assess the outcomes of environmental enforcement authorities' efforts to ensure compliance with pollution prevention and control regulations.

To respond to the growing demand for results-oriented work methods and the need for performance management and accountability at the time of severe budget constraints, more and more environmental enforcement authorities are working to develop indicators to characterise improvements in behaviour of the regulated community (intermediate outcomes) or environmental conditions (final outcomes) stemming from their activities.

The report considers six types of intermediate and final outcome performance measures, including compliance rates and indicators of improved environmental management practices and reduced risk. Based on the OECD criteria for the evaluation of environmental indicators – measurability, analytical soundness and policy relevance – the paper identifies key challenges for developing and using specific categories of compliance assurance outcome indicators and suggests several ways to improve their effectiveness.

The review of a "toolbox" of existing outcome indicators and the analysis of their respective strengths and weaknesses suggests that it is not possible to identify a "best practice" approach or a universal optimal set of indicators. The functionality of individual outcome measures ultimately depends on their purpose (e.g. internal performance assessment or external accountability) and suitability for joint analysis with the enforcement authority's resource (input) and activity (output) indicators.

The report identifies several issues for further analysis.

JEL classification: K32, K42, M48, O57, Q56

Keywords: environmental regulation; compliance assurance; compliance and enforcement; environmental authorities; environmental inspections; performance measurement; outcome indicators.

RÉSUMÉ

Ce rapport analyse l'expérience de dix pays de l'OCDE en matière de conception et de mise en œuvre d'indicateurs quantitatifs pour évaluer les résultats des activités menées par les autorités compétentes en vue d'assurer le respect des règlements de prévention et de lutte contre la pollution.

Devant l'exigence croissante de méthodes de travail axées sur l'obtention de résultats et pour répondre au besoin de gestion des performances et de transparence dans un contexte de fortes restrictions budgétaires, de plus en plus d'autorités chargées de faire respecter la législation environnementale s'efforcent de mettre au point des indicateurs permettant de faire apparaître l'amélioration des comportements des entités réglementées (résultat intermédiaire) ou l'amélioration de la situation de l'environnement (résultat final) qui découle de leurs activités.

Ce rapport examine six types de mesure des résultats intermédiaires et finaux, dont les taux de conformité et les indicateurs relatifs aux pratiques améliorées de gestion de l'environnement et à la réduction des risques. Sur la base des critères d'évaluation des indicateurs environnementaux retenus par l'OCDE – mesurabilité, fiabilité analytique et utilité pour l'action –, il met en évidence les principaux enjeux de l'élaboration et de l'application de certaines catégories d'indicateurs de résultats de la mise en application de la législation environnementale, et il propose plusieurs pistes pour améliorer leur efficacité.

Après examen d'une « boîte à outils » d'indicateurs de résultats existants et analyse de leurs forces et faiblesses respectives, il ne semble pas possible de définir une approche « exemplaire » ou un ensemble d'indicateurs optimal universel. La fonctionnalité des différentes mesures de résultats dépend éventuellement de leur objectif (par exemple, évaluation des performances en interne ou réponse à une exigence de transparence vis-à-vis de l'extérieur) et du degré auquel elles se prêtent à une analyse combinée avec les indicateurs portant sur les moyens et les activités des autorités compétentes.

Le rapport met en évidence plusieurs aspects qui appellent des travaux d'analyse complémentaires.

Classification JEL : K32, K42, M48, O57, Q56

Mots-clés : réglementation environnementale ; mise en application de la législation ; surveillance de la conformité; autorités environnementales ; inspections environnementales ; mesures des performances ; indicateurs de résultats.

FOREWORD

This report analyses the current practices of ten OECD countries in the use of quantitative indicators characterising outcomes of activities to ensure compliance with environmental pollution prevention and control regulations. It provides recommendations to environmental enforcement authorities on how to better measure the effectiveness of their efforts, improve their strategic planning and allow policy makers and the public to see the actual impact of compliance assurance programmes.

The report helps implement the Strategic Vision of the OECD Environmental Policy Committee (2006) by assisting governments in effective and efficient implementation of their environmental policies through policy-relevant analysis and cross-country exchange of information and experiences. It is also in line with the objective of the OECD Regulatory Policy Committee to evaluate and improve regulatory management systems via qualitative and quantitative data and indicators.

This report was prepared by Eugene Mazur of the OECD Environment Directorate. The study was financially supported by the governments of Canada, Flanders (Belgium), the Netherlands, Switzerland, the United Kingdom and the United States. The paper was discussed and enriched at an OECD expert meeting in Paris on 18-19 March 2010. It was further considered and endorsed at the 17th meeting of the OECD Working Party on National Environmental Policies on 21 May 2010.

The author is grateful to Brendan Gillespie and Angela Bularga of the Environment Directorate as well as to all country experts involved in the project for reviewing and commenting on several drafts of this document. Assistance from Shukhrat Ziyaviddinov in implementing the project is also acknowledged.

TABLE OF CONTENTS

Tables

Figures

Boxes

EXECUTIVE SUMMARY

This report was developed in collaboration with environmental enforcement authorities of Australia, Belgium (Flanders), Canada, the Netherlands, Switzerland, the United Kingdom (England and Wales) and the United States, with additional inputs from Denmark, Ireland and Poland. It analyses these countries' experience in the design and implementation of quantitative indicators used to assess the outcomes of compliance promotion, compliance monitoring, and enforcement activities. It focuses particularly on compliance with pollution prevention and control regulations.

The performance of environmental enforcement authorities can be measured by reference to several indicator categories: inputs (resources), outputs (activities), intermediate outcomes (measures of knowledge and behaviour of the regulated community) and final outcomes (the programme's ultimate environmental results). Most regulatory agencies in OECD countries have been using activity (output) measures to evaluate their performance. However, an increasing number of environmental enforcement authorities are working to complement input and output indicators by outcome measures characterising improvements in environmental conditions or behaviour of the regulated community. This process is part of the more general tendency of OECD governments to adopt results-oriented policies and work methods and is driven by a number of factors, including:

- Meeting legal and policy obligations on outcome reporting;
- Internal management need for better programme targeting and achieving higher effectiveness and efficiency in accomplishing the enforcement agency's goals;
- Budget justification in terms of showing results that would be purchased with a requested amount of taxpayers' resources; and
- Demand for enhanced external accountability and demonstrating public value of enforcement work to multiple stakeholders.

The report considers the following types of intermediate and final outcome performance measures in relation to compliance assurance activities:

- Compliance rates;
- Measures of recidivism and duration of non-compliance;
- Pollution release indicators;
- Indicators of improved environmental management practices and reduced risk;
- Measures of effectiveness of individual compliance assurance instruments; and
- Environmental quality (final outcome) indicators.

The analysis has identified three approaches to the design of outcome indicators of compliance assurance:

- *Performance assessment focused on the effectiveness of compliance assurance instruments across regulations and environmental problems.* Historically used by the US EPA, this approach allows the competent authority to measure the improved behaviour of the regulated community as a result of compliance assistance, inspections and enforcement actions as well as to assess the ensuing pollution reductions. However, aggregation of intermediate indicators across environmental problems (e.g., measuring the total mass of pollution reduced) may weaken their reliability in assessing final environmental outcomes.

- *Performance assessment focused on specific environmental problems reflecting the competent authority's strategic priorities.* This is the predominant approach in the UK, Denmark and Ireland where the outcome indicators are used to track high-risk industrial incidents, emissions of priority pollutants, etc. These indicators have much stronger ties to final environmental outcomes, provide good support for strategic planning but are less useful in assessing specific compliance assurance tools.

- *Multi-tier performance assessment focused on pollutant-specific results of regulatory actions at the lower level and on the overall programme effectiveness at the higher level.* This approach, used by Environment Canada to design its system of outcome indicators, seeks to combine the strengths of the first two. It starts by looking at reductions of individual regulated pollutants as a result of compliance assurance activities and then aggregates them into a composite measure characterising the environmental impact of these reductions. However, this method is complex and challenging in terms of result-oriented planning and operational management of compliance promotion, monitoring and enforcement activities.

The review of a "toolbox" of existing outcome indicators and the analysis of their respective strengths and weaknesses suggests that *it is not possible to identify a "best practice" approach or a set of "flawless" indicators*. The functionality of individual outcome measures ultimately depends on their purpose (e.g., internal performance assessment or external accountability) and suitability for joint analysis with the enforcement authority's resource (input) and activity (output) indicators.

Based on the OECD criteria for the evaluation of environmental indicators – measurability, analytical soundness and policy relevance – the report identifies the following key challenges for developing and using compliance assurance outcome indicators:

- *Resource limitations* for data collection and treatment, especially for indicators that should be based on statistically representative samples of the regulated community (e.g., compliance rates) and for those that do not use already available pollution data. This is a particular concern for small national and sub-national enforcement authorities with severe capacity constraints;

- *Complexity of scope definition*, including the delimitation of the studied regulated community, accounting for the relative seriousness of violations (e.g., in designing compliance rates), and choosing pollutants to describe emission reductions resulting from enforcement actions;

- *Difficulty of designing statistically-valid indicators* of compliance behaviour while compliance monitoring is increasingly targeted based on risk (random sampling would be required for this because targeted samples cannot be extrapolated to the entire regulated community);

- *Uncertainty in linking outputs with outcomes*, i.e., in demonstrating a causal relationship between compliance assurance activities and improved environmental management practices, pollution release reductions and, especially, improvements of ambient environmental quality;

- *Challenges of interpreting* outcome indicators which requires full consideration of all performance measures, output indicators in particular, as well as a broader economic context; and

- *Low comparability* of indicators due to differences in regulatory requirements and design of specific measures between sub-national jurisdictions (in decentralised governance systems) as well as internationally.

To address these challenges, the report suggests several ways to improve the effectiveness of specific categories of compliance assurance outcome indicators. These recommendations can be broadly summarised as follows:

- *Address specific segments of the regulated community* in measuring compliance rates, improved environmental management practices, and effectiveness of compliance assistance;

- *Focus on particular types of serious environmental violations* (e.g., compliance with emission limit values) in defining compliance rates and indicators of recidivism and duration of non-compliance; and

- *Concentrate on priority pollutants* in assessing the reduction of pollution releases and local environmental quality improvements and linking them to compliance assurance activities.

In general, compliance assurance outcome indicators should be developed to respond to a clear management need, accompanied by a plan on how and by whom they would be used, and regularly reviewed and revised. They should also, to the extent possible, be associated with time-specific targets in order to integrate the strategic planning and performance management processes. Outcome indicators are best analysed across time and in conjunction with the environmental authority's input and output measures as well as in the context of more general environmental and economic indicators.

The report also identifies several issues for further analysis, including improved linkages between compliance assurance activities and final environmental outcomes, adjusting compliance measures to the degree of environmental impact from violations, using composite indices and weighting techniques, defining an optimal number of outcome measures for the agency, and addressing nationwide and international comparability constraints.

1. INTRODUCTION

The 2009 OECD report "Ensuring Environmental Compliance: Trends and Good Practices"[1] provided policy makers, environmental regulators, and other stakeholders with a comprehensive analysis of the design and implementation of government programmes to ensure compliance with pollution prevention and control regulations, particularly in the industrial sector. The report identified "good practices" that were observed in six OECD and two non-OECD countries and pointed to the key trends across the different systems.

One of these key trends in compliance assurance is the increased focus of strategic planning and performance assessment on environmental outcomes. This report is the result of a study of existing practices of the design and implementation of outcome measures of environmental compliance assurance in a number of OECD countries.

1.1 Objectives

Traditionally, regulatory agencies' performance has been managed and evaluated largely by reference to their level of activity rather than the outcomes they accomplish. However, many environmental enforcement authorities (EEAs) recognise that relying on input and output indicators alone does not account for the effectiveness of various enforcement activities. They are, therefore, trying to develop meaningful outcome measures characterising improvements in environmental conditions or behaviour of the regulated community. Such measures also contribute to the increasing accountability of EEAs.

The project's objective is to help environmental enforcement authorities in OECD countries to adequately measure the effectiveness of their efforts and enable policy makers and the public to see the actual impact of their programmes.

Performance measurement is not unique to environmental policy implementation. Driven by new public management approaches, it has evolved from an intra-departmental into a government-wide concern. In consequence, government actors at all levels need to have sufficient terminological clarity to ensure analytical soundness of performance measurement and an adequate response to new challenges of public management.

1.2 Scope and Definitions

This report considers the design and implementation of *quantitative* indicators characterising outcomes of EEAs' compliance assurance activities. Environmental compliance assurance is the application of all available instruments (principally, those of compliance promotion, compliance monitoring, and enforcement against violations) aimed at influencing the behaviour of regulated entities so that they comply with regulatory requirements. The report focuses on compliance with pollution prevention and control regulations.

[1] www.oecd.org/env/policies/compliance

Indicators are defined as measurable pieces of information (parameters, or value derived from parameters) that point to, provide information about, or describe a phenomenon or activity. Indicators of environmental regulatory management and compliance assurance should aim to characterise:

- The efforts of government authorities to reduce the impact of economic activities on the environment and human health through regulation and supporting tools; and

- Changes in compliance (behavioural response) and environmental results associated with these efforts.

This report's conclusions are based on the analysis of compliance assurance indicators used or being developed in the countries that participated in the project.

1.3 Methodology

The work was based on the OECD analytical framework for environmental indicators (OECD, 2003). It was conducted in collaboration with the Department of the Environment, Water, Heritage and the Arts (Australia), the Environmental Inspectorate Division of the Flemish Government (Belgium), Environment Canada, Rijnmond Environmental Protection Agency (the Netherlands), Federal Office for the Environment (Switzerland), Environment Agency (England and Wales, UK) and the US Environmental Protection Agency.

The OECD Secretariat used a targeted questionnaire, research, and interviews to collect information from the partner EEAs. At a *workshop* convened in Paris on 18-19 March 2010, OECD country experts exchanged their experiences with outcome performance measures of compliance assurance programmes and discussed key challenges for the design and implementation of such indicators. The workshop also allowed the Secretariat to draw upon additional examples from the experiences of Denmark, Ireland and Poland, based on inputs of these countries' representatives.

The Secretariat cooperated closely with the EU Network for the Implementation and Enforcement of Environmental Law (IMPEL), which conducted in 2009 a project to define and test performance indicators for the implementation of the EU Recommendation on Minimum Criteria for Environmental Inspections. The OECD project has also drawn on the partnership with the International Network for Environmental Compliance and Enforcement (INECE), started with the 2003 joint workshop on environmental compliance and enforcement indicators[2]. In parallel with this work, the OECD developed a guidance document on measuring results of environmental regulation and compliance assurance for countries of Eastern Europe, Caucasus and Central Asia (OECD, 2009).

1.4 Structure of the Report

The report puts outcome indicators in the overall framework of compliance assurance, describes the current practices of their use in the studied countries, identifies challenges of their design and implementation, and reflects on how to best meet these challenges. It is structured as follows:

- *Chapter 2* looks at the roles and drivers of performance measures in environmental compliance assurance in general and outcome indicators in particular;

- *Chapter 3* reviews the experience to-date with the design and implementation of different types of compliance assurance outcome indicators;

[2] www.inece.org/indicators/workshop.html

- *Chapter 4* analyses the challenges in using outcome indicators in terms of their measurability, analytical soundness, and policy-relevant interpretation; and

- *Chapter 5* concludes the analysis by summarising different approaches to the design of outcome indicators of compliance assurance and provides suggestions on how, in view of the existing challenges, to optimise their use for performance management and accountability purposes.

Finally, Annex 1 contains forms with descriptions of the main aspects of selected outcome compliance assurance indicators in the studied countries.

2. ROLE OF PERFORMANCE MEASURES IN COMPLIANCE ASSURANCE

Performance measurement is the process of developing and using indicators and other tools to assess progress in achieving predetermined goals. Performance measurement is just one element of strategic management that involves an iterative cycle of activity and budget planning, implementation and evaluation. By generating and analysing indicators, performance measurement supports the decision making process. This chapter discusses the place of performance indicators in environmental compliance assurance as well as their types, and shows why EEAs have a particular need for outcome measures.

2.1 Purpose and Target Audience of Performance Indicators

Periodic evaluation of environmental compliance assurance programmes, primarily based on quantitative information in a form of indicators, serves several purposes:

- *Assessment of progress:* Evaluation helps programme managers determine whether the strategies they use to achieve compliance are working. Results of evaluations are used as a basis for identifying problem areas and making changes to improve programme effectiveness. This is usually done via management reports and reviews. The Environment Agency (England and Wales), for instance, establishes a Corporate Strategy and, based on it, a Corporate Scorecard with a wide range of indicators that guide the quarterly management review process across the Agency. The effectiveness of programme evaluation is further enhanced by associating time-bound targets with key indicators.

- *Internal accountability:* Periodic evaluations of performance provide a basis for establishing a system to hold the agency's individual units and staff members accountable for the implementation and effectiveness of the programme. Performance measures can be valuable as an internal tool to motivate staff and to recognise accomplishments. For example, performance results of US EPA's Regional Offices are used as a starting point for an annual dialogue between the headquarters and each regional office to discuss the region's successes and challenges.

- *External accountability:* Programme evaluation also provides the basis for transparency and accountability vis-à-vis legislative and policy-making bodies, budget authorities, environmental interest groups, and the general public. Many countries have legal requirements for government agencies to prove that they are using resources wisely and achieving program results (see Box 1).

- *Programmatic planning and budgeting:* In addition to being an accountability instrument, indicators are used to quantify performance targets and to plan resources and activities. Environment Canada, for example, is developing a series of indicators under its Strategic Enforcement Framework which will be used to guide the annual operational work planning exercise. The Annual Commitment System at the US EPA is an important work planning and benchmarking tool, while the Annual Performance Measures are used to develop the federal government's budget two years in advance.

- *Creating deterrence:* Finally, reporting of programme activities and successes to the regulated community contributes to deterrence by raising awareness that there is a reasonable likelihood that violations will be identified and responded to.

Box 1. Performance Management System in the US and Canada

United States

The 1993 Government Performance and Results Act (GPRA) requires US government agencies to define plans for what they intend to accomplish, measure how well they are doing, make appropriate decisions based on the information they have gathered, and communicate information about their performance to Congress and to the public. Under the GPRA, each agency, including the US EPA, develops:

- A five-year Strategic Plan, which sets out long-term goals and objectives;
- Annual Performance Plans with Annual Performance Measures, which contain annual performance targets toward achieving the goals and objectives presented in the Strategic Plan; and
- Performance and Accountability Reports which evaluate the agency's progress in achieving performance targets and explain whether and why the agency has exceeded or failed to meet any such targets.

In addition to the GPRA budget-level performance measures, the EPA's Office of Enforcement and Compliance Assurance (OECA) develops additional measures and targets, including Key and Senior Management Measures and Annual Commitments, that are used to plan and track actions necessary to achieve the GPRA targets. In addition to the reports required under the GPRA, OECA Annual Accomplishments Reports, National Enforcement Trends reports and annual fact sheets with compliance assistance results contain information on a variety of compliance assurance indicators. OECA has been using performance indicators to measure both outputs and outcomes of national compliance and enforcement programme activities since FY 1998.

OECA, in partnership with the EPA Regional Offices, established the EPA Measures Review Board (MRB) to screen performance indicator proposals for quality and a known management purpose and recommend decisions to introduce new measures or to discontinue tracking a particular indicator. The EPA's Environmental Outcomes Reporting Management Committee addresses proposals on how to calculate environmental benefits from compliance and enforcement responses.

Canada

The Canadian federal government introduced in 1996 a Planning, Reporting and Accountability Structure, which was replaced in 2005 by the Management, Resources and Results Structure policy. All government departments must develop Performance Measurement Frameworks (PMF) – logic models that link activities to outcome-focused performance indicators in all major programme areas. A PMF sets out the strategic outcomes (expected results) to be achieved and specific outputs to be produced by the department's programmes and identifies the following:

- Performance indicators to assess the organization's progress towards achieving its expected results;
- Data sources from which this information is to be collected and the frequency of data collection;
- Targets (or level of success) the programme plans to achieve within a specified time; and
- Actual data collected for each indicator.

In order to keep the amount of performance information to be tracked, collected, and maintained at a manageable level, government departments are expected to provide a maximum of three outcome performance indicators for each strategic outcome and each programme.

Source : Responses to the OECD questionnaire, April 2009

Performance indicators of environmental compliance assurance are usually developed and used by the authorities that exercise direct responsibilities for compliance assistance, monitoring and enforcement. However, these indicators play a particular role in decentralised systems of environmental governance where sub-national environmental authorities have substantial compliance assurance powers. Indicators in such systems become the national authority's *tools of oversight and benchmarking as well as measures of national coherence of non-compliance responses*. At the US EPA, for instance, performance measures form the basis of the State Review Framework, pursuant to which the Agency examines the adequacy of state compliance and enforcement programmes as well as the EPA's direct implementation of programmes not delegated to states.

Environmental compliance assurance indicators can be used by different categories of stakeholders:

- *EEA managers* can use these indicators to assess the agency's performance, adjust compliance assurance strategies to increase their impact, justify the need for, and optimise the use of, human and financial resources, and increase the agency's accountability before the policy makers, the regulated community and the general public.

- *Policy makers* are particularly receptive to quantitative performance indicators which allow them to take measure of the effectiveness and efficiency of compliance assurance activities and substantiate their budget allocation decisions.

- *The regulated community* constitutes a target audience for some compliance assurance indicators in order for the EEA to demonstrate its diligence in detecting and punishing non-compliance, thereby creating a deterrent effect against future offences.

- *The public* primarily wants to know about results of compliance assurance activities, both in terms of behaviour of polluters and the improvement of environmental conditions.

Within a performance measurement framework, different sets of indicators are normally used for different purposes and audiences. Indicators for internal audiences within competent authorities must have performance management value while high-level policy makers and the public may want to see composite outcome measures.

2.2 Categories of Compliance Assurance Indicators

It is possible to evaluate the performance of environmental enforcement authorities by reference to the following ***elements of the logical framework of programme implementation***:

1. *Final outcomes* are improvements of environmental conditions as an ultimate result of compliance assurance activities. Examples of final indicators include improved ambient water or air quality, reduced soil contamination, etc. Final outcome indicators are widely used as environmental quality monitoring parameters, but it is often very difficult to associate them with specific compliance and enforcement actions.

2. *Intermediate outcomes* characterise changes in compliance knowledge and behaviour of the regulated community. They may cover greater understanding by regulated entities of how to comply with environmental requirements, improved environmental management (adoption of best practices), reduced environmental impact (e.g., pollution releases or accidents), or increased compliance.

3. *Outputs* are activities conducted by a competent authority. Examples of output indicators include the number of inspections performed, the number of compliance promotion activities and the number of enforcement actions. Output indicators demonstrate a level of effort toward an outcome but do not reflect the degree to which the outcome is achieved.

4. *Inputs* include time, staff, funding, materials, equipment, and other resources that contribute to an activity. When considered together with outcomes, inputs can be used to determine the level of effort required to achieve an outcome.

A combination of input, output and outcome measures is necessary to manage and improve a compliance assurance programme. By using a combination of output and outcome measures, an enforcement agency should be able to identify patterns between its activities and the occurrence of outcomes and adjust its strategies to ensure that it achieves the right types and extent of outcomes with the resources available. Cost-effectiveness of activities can be assessed by comparing data on inputs (personnel and resources) with information on outcomes achieved.

Although this classification is generally used in most countries with developed performance assessment systems, there are some definitional variations. For example, the US EPA has expanded the notion of outcome indicators to encompass measures of population exposure to pollution (as a factor or environmental risk reduction) and of public health impacts[3]. Environment Canada is developing a performance management system that would measure three levels of outcomes – immediate, intermediate, and final outcomes (the latter being an aggregation of the pollution control and wildlife programme results) – representing annual, medium and long-term results of its activities, with indicators at each level to be tracked at a respective management level of the organisation[4]. Both examples demonstrate the enforcement authorities' desire to orient their planning and reporting systems toward environmental benefits.

Performance indicators can be designed ***to characterise a particular compliance assurance tool or a particular environmental problem*** targeted by the compliance assurance programme. At the US EPA, until recently the strategic planning and management architecture was built around the four primary tools of the compliance and enforcement programme: assistance, incentives, monitoring and enforcement (see Box 2 and Section 3.5).

[3] The EPA currently uses the number of people, single family and multiple family dwellings and schools as metrics for tracking performance of its lead-based paint and asbestos abatement programmes.

[4] Immediate outcomes are to be reported on at the operational level (inspectors), intermediate outcomes at the higher management level, and the final outcome at the level of Environment Canada.

Box 2. Selected US EPA Instrument-related Compliance Assurance Outcome Measures (prior to FY 2010)

Compliance assistance:

- Percentage of regulated entities receiving direct compliance assistance from EPA (e.g., training, on-site visits) reporting increased understanding of environmental requirements as a result of EPA assistance;
- Percentage of regulated entities receiving direct compliance assistance reporting that they reduced, treated or eliminated pollution as a result of EPA assistance;

Compliance incentives:

- Percentage of audit agreements that result in improvements in environmental management practices;
- Pounds of pollutants reduced, treated or eliminated as a result of audit agreements or other actions;

Monitoring and enforcement:

- Percentage of regulated entities taking complying actions as a result of compliance monitoring;
- Pounds of pollution estimated to be reduced, treated or eliminated as a result of concluded enforcement actions;

Dollars invested in improved environmental performance as a result of concluded enforcement actions.

Source : US EPA (2006)

A major advantage of this tool-based approach is that it provides the ability to aggregate outputs and outcomes across all (in the US – 28) distinct compliance assurance programmes. However, after a recent evaluation of the effectiveness of this system, the Agency concluded that it did not fully demonstrate how programme outputs and outcomes were contributing to the reduction or elimination of particular environmental problems. Starting in FY 2010, the US EPA has moved to a problem-oriented strategic architecture which focuses on environmental risks and non-compliance patterns, with performance measures tailored to specific environmental problems. The problem-oriented approach is also the basis of performance management at the Environment Agency (England and Wales).

Compliance assurance indicators may also be used to manage performance with respect to specific pieces of legislation or specific segments of the regulated community. This kind of targeting is particularly relevant in defining compliance rates (see Section 3.1) and other intermediate outcome indicators that measure behavioural changes among regulated entities.

2.3 Drivers for the Development of Outcome Indicators

Traditionally, regulatory agencies' performance and cost-effectiveness have been managed and evaluated largely by reference to their level of activity (outputs), rather than to the outcomes they accomplish. Although outputs alone give some sense of enforcement presence and are relatively easy to measure, they do not enable analyses of the extent to which a programme is achieving its goals, they do not indicate whether compliance is increasing, and they do not address whether environmental conditions have improved.

In recent years, environment agencies are increasingly recognising that relying on input and output indicators alone does not account for qualitative differences in the effectiveness of various enforcement activities. This trend is part of a more general tendency to focus compliance assurance on environmental outcomes (OECD, 2009). Environmental agencies in a number of countries (the US and the UK in particular) have developed useful, and, in some cases, sophisticated outcome indicators. Still, enforcement officials in all the studied countries feel that more needs to be done to improve their measurement of results from environmental compliance assurance programmes.

An additional challenge is to introduce outcome measures and the sub-national and even local levels where these tools are even less developed than at the national level. In the US, where the EPA has been measuring outcomes of its activities since 1998, the use of outcome measures to assess and improve performance or to report to the public has traditionally been rare among state environmental agencies but is increasing[5].

The following are the main driving factors for identifying, designing and using more meaningful outcome performance measures:

- ***Meeting legal and policy obligations.*** In several countries government agencies must report on the outcomes of their activities. The examples include the requirements of the Government Performance and Results Act in the US and the Management, Resources and Results Structure in Canada (see Box 2.1), both of which link activities to outcome-focused performance indicators in all major programme areas.

- ***Internal management needs.*** Outcome indicators help programme managers learn what is working and what is not working and determine what needs to be done differently (e.g., in terms of targeting of activities) to accomplish the enforcement agency's goals. For many, programme performance is the primary reason to invest in the development and use of outcome measures. They also help the agency to implement the principles of better regulation by achieving a more effective, efficient and accountable regulatory system. This is an important driver in the UK, for example, where it is a major cross-sectoral policy initiative, but also in Canada, where the federal government put in place in 2007 a Cabinet Directive on Streamlining Regulation.

- ***Budget justification.*** Funding bodies, parliaments in the first place, want to know what the taxpayers are getting for their money, particularly in the current period of budget deficits. Outcome performance indicators help explain what results will be purchased with a given amount of resources. Even indicators about basic outputs such as the number of inspections conducted can be helpful in justifying the need for dollars and personnel. Budget officers and legislators, however, are demanding more indicators about outcomes or results. This is one manifestation of a worldwide trend toward performance-based management, in which government resources are allocated toward producing preferred outcomes and results. EEAs increasingly feel the need to be able to present compliance assurance programmes in budget deliberations as a source of quantified compliance improvements and environmental benefits.

- ***Demand for enhanced external accountability.*** Environmental enforcement authorities need to demonstrate public value of their work – convince the public and policy makers that the enforcement is done in a proper and professional way and results in a higher degree of compliance and, eventually, in a better environmental quality. Since there are multiple target

[5] For instance, the Northeast Waste Management Officials Association's Common Measures Project leads efforts to design and use common environmental performance measures, including outcome measures, across several states: www.newmoa.org/hazardouswaste/measures/finalreport/CommonMeasuresProjectFinalReport.pdf .

audiences, it is often necessary to use multiple measures to provide a full account of programme performance.

There is strong demand in the environmental enforcement community for both intermediate outcome indicators and final outcome indicators. However, intermediate outcome indicators are widely regarded as a more practical performance management tool for the following two reasons:

- First, most intermediate outcomes (e.g., changes in behaviour) can be directly attributed to the activities of the compliance assurance programme. The causal link between programme activities and intermediate outcomes is much stronger than between these activities and final outcomes (environmental quality improvements).

- Second, intermediate outcomes almost always manifest themselves more quickly than final outcomes which often focus on changes in large-scale environmental conditions. Therefore, they lend themselves better to management response and reporting.

The following chapter describes the experience accumulated so far in the design and implementation of different types of outcome indicators.

3. PRINCIPAL TYPES OF EXISTING OUTCOME INDICATORS OF COMPLIANCE ASSURANCE

As discussed in Section 2.2, outcomes of environmental compliance assurance can be characterised through measures of knowledge and behaviour of the regulated community (intermediate outcomes) or via indicators of improvements of environmental quality (final outcomes). Due to their more direct link to compliance and enforcement activities, intermediate outcome indicators are used more widely. Examples of intermediate outcome indicators are measures of compliance (compliance rates and indicators of recidivism and chronic non-compliance), environmental impact (pollution releases), corporate environmental behaviour, and knowledge (as a result of compliance assistance). To complement these intermediate outcome measures, several EEAs use indicators of environmental quality to measure their performance. This chapter analyses the current practices and lessons learned with respect to each of these categories of measures.

3.1 Compliance Rates

A compliance rate can be a key intermediate outcome indicator because it describes one of the most significant direct impacts of compliance assurance activities: changes in regulated entities' compliance status. A compliance rate can be generally defined as a percentage of a regulated universe (or some portion of it) complying with all or certain specific environmental regulatory requirements over the reporting period. However, EEAs that calculate compliance rates use a variety of different approaches (for example, at least nine definitions of compliance rates are used across US states). Box 3 contains some examples of how compliance rates (or similar indicators) have been defined in the studied countries.

Box 3. Use of Compliance Rates in the Studied Countries

Indicators based on inspection data:

- Percentage of non-compliant facilities out of the number of inspected facilities: US states of Alaska, Colorado (for hazardous waste only), Connecticut (air), Delaware (air);
- Percentage of violation-free facilities during initial routine inspections out of the number of initial routine inspections: US state of North Carolina;
- Ratio between the number of inspections that did not identify violations and the total number of inspections: US state of Pennsylvania;
- Hundred percent minus the number of facilities in non-compliance divided by the number of performed inspections: US state of Michigan (hazardous waste); Australian state of Victoria;
- Hundred percent minus the number of facilities in non-compliance divided by the number of inspected facilities: US states of Minnesota (air), New Jersey (air), Wyoming (hazardous waste);
- Hundred percent minus the number of facilities with significant violations divided by the number of inspected facilities: US state of Maryland;
- Number of facilities with documented non-compliance (inspection-based) divided by the total number of known regulated facilities: US states of Massachusetts, North Dakota;
- Number of violations of core licence conditions over a number of installations inspected: Netherlands (DCMR);
- Number of facilities in compliance with requirements of "best available techniques" under the Environmental Management Act and the Pollution of Surface Waters Act: Netherlands (DCMR);
- Number of breaches of categories 1 and 2 of the Compliance Classification Scheme, based on targeted inspections: UK, Environment Agency (England and Wales).

Indicators based on self-reported data:

- Percentage of major National Pollutant Discharge Elimination System (NPDES) permit holders without significant non-compliance: US state of Tennessee (surface and ground water);
- Percentage of the number of effluent limits in compliance: US state of Washington.

Source : Responses to the OECD questionnaire, April 2009; US EPA (2006).

Compliance rates can be based on information from inspection reports or on self-reported data. To be a meaningful measure of the state of compliance across the regulated community (or a segment thereof), compliance rates must be statistically valid. This requires use of either:

a) Census or near-census inspection rates, as discussed below;

b) Representative samples drawn from random inspections (results can even differ between announced and unannounced site visits); or

c) Accurate self-reported data from either a census (or near census population) or representative samples.

The vast majority of compliance rates presented in Box 3.1 were calculated based on the ratio between the number of facilities with violations and the number of facilities inspected, notwithstanding some variations in definitions. These inspections are usually conducted at far less than half of the facilities in the regulated community (given limited governmental resources), and most of them are not conducted randomly but deliberately target high-risk facilities and respond to incidents or complaints. This means that the inspected populations are not representative, the resulting compliance rates are not statistically valid, and one cannot generalise the compliance status of the uninspected facilities, i.e., the sector as a whole, from these rates.

Risk-based targeting of inspections is indeed one of the main trends of modern compliance assurance systems (OECD, 2009). They are meant to find more non-compliance than the presumed average across the regulated community, thereby making compliance monitoring more efficient. Targeted inspection programmes help deal with specific risks that are already identified, but they cannot provide meaningful estimates of general compliance behaviour. Compliance rates calculated based on targeted inspections are in reality a kind of "hit rate" measuring whether those inspections are succeeding at identifying violations. A lower compliance rate may mean that the agency is simply doing a better job of detecting violations.

In theory, compliance rates can be statistically valid if data can be gathered from at least 80% of the population (a "near census" rate) or if the compliance monitoring sample can be made representative sample of the regulated community (US EPA, 2006). There are several types of statistically valid compliance rates:

- "Universal" (cross-media) facility compliance rate (ratio of the number of facilities with one or more violations to the number of regulated facilities). This rate is difficult to develop given the number of statutory and regulatory requirements involved and the size of the regulated community.

- Specific regulation compliance rate (ratio of the number of facilities violating a specific regulation to the number of facilities to which this regulation applies). Limiting the rate to a specific regulation or a specific compliance requirement can simplify the development of a compliance rate by narrowing the scope and clearly defining the types of compliance assessments to be made.

- Specific regulation, specific population compliance rate (ratio of the number of facilities violating a specific regulation to the number of facilities in a specific population). Compliance rates can be further specified by limiting the rate to a segment of the regulated community (e.g., an industrial sector, a geographic area) as well as a specific regulation or compliance requirement.

Producing representative, statistically valid rates based on inspections is very difficult due to the limited number of inspections that can be conducted with available resources, and the growing need to target those inspections at higher-risk regulated entities. In a way, demand for better outcome performance management comes here into conflict with the major trend of risk-based targeting of compliance monitoring. Still, it is clear that inspections should be primarily used to achieve compliance rather than to measure compliance. Sacrificing targeted inspections in significant numbers to replace them with random ones can have an adverse impact on fulfilling the law enforcement mission.

The US EPA has tested various methods for calculating statistically valid compliance rates for specific segments of regulated communities (e.g., petroleum refining, iron and steel, municipal sewer systems) based on combining targeted and randomly selected compliance inspections. In order not to sacrifice a significant share of targeted inspections, the EPA limited the pilot projects to small populations of regulated entities. As a result, the rates were of limited practical application.

Using self-reported information instead of inspection data may sound like a solution to the issue of statistical validity of compliance rates. The US EPA has done some work in this area with self-reported discharge data under the Clean Water Act (CWA). There have also been attempts to do this in the US states of Tennessee and Washington. Environment Canada is working to produce compliance rates representative of the entire regulated community for each selected regulation based on a combination of inspection data (with a share of random inspection to create a representative sample) and self-reported data. However, the use of self-reported data bears the risk of under-reporting of offences, especially most serious ones, which are intentionally clandestine (e.g., waste dumping). In addition, not every regulation requires self-reporting from all regulated entities, so the necessary data may simply not be available.

There are also other problems of analytical soundness of compliance rates that go beyond their statistical validity. One of them is treating compliance at facilities with different scales of environmental impact: an apparent high compliance rate can be misleading if the most significant pollution sources remain out of compliance. This is why there are examples of counting only serious violations under a compliance rate (defined differently across US states as well as in England and Wales – see Box 3.1). The U.S. EPA's criminal enforcement programme is implementing an indicator of the severity of criminal environmental offences[6].

Also to address differences in environmental impact of violations, several OECD countries (such as Denmark and Poland) have developed categories of non-compliance (usually four): from offences with no direct impact on the environment to those resulting in serious pollution. The share of most serious violations (especially if considered in dynamics) can be a more useful outcome measure than a simple binary (in or out of compliance) rate.

The Ministry of the Environment of Canada's Ontario province has developed and started to use a Compliance Index – a weighted sum of individual facilities' violations of legislative provisions and permit ("certificate of approval") conditions. The Ministry assigns a weight to violations of each of approximately 1,300 legislative provisions. Each violation is classified as one of four "contravention categories" (reporting and recordkeeping, operating standards, monitoring and sampling, or exceedance of emission/discharge limits) and assigned a corresponding weight. These weights distinguish between procedural and substantive non-compliance, thereby reflecting to some extent the level of potential environmental impact from the offence (higher weights represent a larger impact). The data are gathered through inspections, so in order to meaningfully measure compliance by sector or regulatory programme, the Ministry must use a random sample approach to inspection planning. This is not easy to do in practice, as discussed above.

Compliance indexing approaches can capture changes in performance ("extent" of compliance) that are more nuanced than a switch from compliance to non-compliance (or vice versa) and are better suited for comparison of performance across time and across facilities. However, given the significant impact that indicator weights can have on the value of an index, it is critical that the underlying policy and regulatory priorities be transparent. Otherwise, the weighting scheme may obscure the meaning of the index score[7]. In

[6] This indicator helps the EPA to categorise its criminal enforcement cases into three tiers based on the severity of the crime associated with the alleged violation and to assess the management of the national criminal caseload.

[7] See a more detailed discussion of aggregated indices in OECD (2002).

fact, while the weights represent to some degree the significance of a violation, they do not consider the environmental risk posed by a specific case of non-compliance.

Choosing a time period to determine the compliance rate is another challenge. Multi-year rates may be chosen in order to spread the cost of developing rates from a random sample the inspections over more than one year (the US EPA has piloted multi-year rates in the past). A multi-year rate is an average compliance rate over the years when the inspections were conducted. One of the drawbacks of an average compliance rate over a number of years is that as the time period gets longer, there is less confidence that the average represents the current state of compliance (facilities may fail to stay in compliance). This decreases the utility of multi-year rates as a programme management tool.

It is, therefore, difficult to use compliance rates as a truly meaningful indicator of regulatees' behaviour. However, there is still demand for compliance rates from senior management of many environmental enforcement authorities. The main reason for this is that the largest use for compliance rates is in programme targeting. There are indeed certain benefits in their bias toward regulated entities where non-compliance is likely to be found: compliance rates (especially those calculated for specific segments of the regulated community or for specific regulatory requirements) help programme managers to determine whether inspections strategies are succeeding in finding non-compliance and to identify where additional compliance assistance or enforcement might be needed.

3.2 Measures of Recidivism and Duration of Non-compliance

Close to the concept of compliance rates is that of rates of recidivism – the reversion by past offenders to illegal behaviour. Recidivism rates are defined as the percentage of a certain universe of past offenders which violate the law again, and are caught doing so, during a specified observation period.

The US EPA currently uses the rate of recidivism under its criminal environmental enforcement programme. It means the percentage of defendants who, having once been convicted of an environmental crime, are subsequently found guilty, within a given number of years of the conviction, of another criminal or civil environmental offence. This measure reflects an understanding that the primary goal of criminal enforcement is to deter criminal activity. Recidivism rates are widely used in general criminal statistics, but this is the only case in the studied countries that this indicator is applied in the context of environmental compliance assurance.

The US EPA formally reported three recidivism indicators in its Civil Enforcement Program between 1999 and 2002. These measures were two-year recidivism rates at the facility level for "significant non-compliance" under the Clean Water Act and the Resource Conservation and Recovery Act, and "high-priority" violations under the Clean Air Act. A facility was counted as a recidivist if it returned to compliance from significant/high-priority non-compliance status and then, under the same law and within two years, reverted to significant non-compliance. The measures were eventually discontinued for a number of reasons, including that the resulting rates were not statistically valid and had limited utility for programme management (e.g., there was a concern that this indicator would lead to excessive focusing of enforcement on the reduction of recidivism instead of environmental impact of non-compliance).

Although recidivism rates are relatively easy to calculate and to interpret, their definition depends on a number of choices:

- Coverage: The regulated universe could be disaggregated by type of companies or facilities (e.g., by size or industrial sector), by type of violation or by violated statute, etc., thereby significantly affecting the interpretation of a recidivism rate.

- Observation period: A relatively long observation period generally better measures whether changes in attitude and behaviour induced by enforcement responses are long-term and systemic, but it also requires more years for the data to become available. On the other hand, the longer the time period, the more total opportunities a physical or a legal entity will have to return to non-compliance.

- Definition of an act of recidivism: This indicator's focus is usually on serious offences (as defined by law or policy). The repeated and the original violation would also normally refer to the same or similar regulatory provision or share a common root cause.

As with a compliance rate, a measure of recidivism depends on the ability of the enforcement agency to detect violations, which is in turn affected by the degree of targeting of underlying compliance monitoring activities. Because environmental inspections are increasingly targeted to achieve maximum detection of non-compliance, recidivism indicators calculated on the basis of inspection data are not statistically valid measures of the true rate at which past violators return to non-compliance.

What recidivism rates really represent is the percentage of potential recidivists who are caught in a repeated violation. Some entities will be excluded from the data range because their initial violations are not discovered, others because they are missed committing the offence again. Even if the EEA conducts follow-up inspections of every facility with a recent record of non-compliance (thereby getting close to a representative sample), facilities inspected later in their observation periods would be more likely to be caught in recurrent non-compliance, which would distort the indicator's analytical soundness. Since penalties for repeated violations are usually more severe than for first-time offences, self-reported data for this kind of measure may be unreliable.

The EPA has also discussed the potential options for measuring *"chronic non-compliance"* based on the number of quarters or months, during the observation period, that regulated facilities have been in significant non-compliance. The objective would be to ensure that facilities do not remain in non-compliance for extended periods without receiving adequate enforcement responses.

Like a recidivism measure, a chronic non-compliance indicator would track the number of repeat offenders but it covers important offenders that do not return to compliance at all during the observation period (and, therefore, fall outside the scope of recidivism rates). However, it is not a perfect substitute for recidivism rates: recidivism can be high while chronic non-compliance is low and vice versa, causing interpretation problems if these indicators are taken individually. It may, therefore, be more useful to consider a combination of the two types of measures.

Chronic non-compliance indicators can also be defined as the percentage of regulated entities in chronic non-compliance or the average length of time a facility spends in non-compliance. Data about chronic non-compliers may also be used to track facilities by amount and type of non-compliance. Chronic non-compliance measures, however, present essentially the same statistical validity requirements and issues as do compliance and recidivism rates.

In addition, the duration of non-compliance can be characterised indirectly as a percentage of facilities returning to compliance (within a defined timeframe) after receiving a compliance order, as it is done by the Flemish Environmental Inspectorate (Belgium). In this case, the indicator measures the effectiveness of a specific enforcement instrument (compliance order).

3.3 Pollution Release Indicators

Besides the efforts to find an adequate measure to characterise regulated entities' compliance behaviour, several EEAs in the studied countries are measuring reductions of pollution releases as an intermediate outcome of compliance assurance activities. Most pollution release indicators are related to either individual environmental media or specific priority environmental problems.

As mentioned in Section 2.2, the US EPA is shifting its strategic management and measurement focus, starting in FY 2010, away from an accent on the tools used to achieve pollution reductions to a performance-based architecture that presents outcomes by media programmes: air pollution; water pollution; and waste, toxics, and pesticides. The EPA selected several new measures for external reporting that emphasise pollutant reductions in specific environmental media and actions taken that result in environmental benefits in order to more clearly describe the environmental outcomes associated with the Agency's work. The new indicators fall under two categories:

- Total mass (million pounds) of air pollutants (or water pollutants, or toxics and pesticides, or hazardous waste) reduced, treated, or eliminated through concluded enforcement actions; and

- Total number of regulated entities that change behaviour resulting in direct environmental benefits or the prevention of pollution into the environment for air (or water, or waste, toxics and pesticides) as a result of EPA enforcement and compliance actions[8].

The strength of measures such as "pollutants reduced, treated, or eliminated" is that they characterise environmental performance improvements likely to translate into improved environmental conditions (final outcomes). The major weakness of the measures is that they represent aggregations of large numbers of different pollutants with differing toxicity, exposure, and absorption characteristics. For this reason, the EPA is currently exploring pollutant characterisation methods that could be used to weigh different pollutants according to their expected environmental impact levels in order to yield measurements that are more accurate from a risk-based perspective.

Environment Canada also intends to measure quantities (mass) of regulated substances whose release has been prevented as a result of direct enforcement actions. At the "immediate outcome" (operational) level, pollution reductions (estimated over the course of a fiscal year) would be measured individually for each substance, based on provisions of specific regulations, before being aggregated into a pollution reduction index (see Box 4).

[8] "Actions" are defined to include enforcement settlements, compliance incentive audits, direct compliance assistance delivered by EPA staff only, and federal inspections that result in a direct or preventative environmental benefit.

Box 4. Efforts to Account for Relative Impact of Pollutants in Pollution Release Indicators

The US EPA has made several attempts to improve its pollutant reduction indicators by adding a characterisation of pollutant hazard and exposure. For example, it sought to qualify pollution reduction measures with ecological indicators that reflect damage to the environment and provide a more accurate picture of the total impact of each pollutant. In an effort to identify the "most harmful" pollutants, it summarised the human health and ecological impacts of each of the top ten air pollutants reduced in 2005. Each pollutant was characterised with respect to its health impacts (respiratory, cardiac, neurological, reproductive/developmental or carcinogenic) and ecological impacts (contribution to greenhouse effect, acid rain, smog, ozone depletion, impact on vegetation, water quality, etc.). However, the implications for the outcome indicators were too complex to be practicable.

The EPA is currently conducting a Pollutant Characterization Project which seeks to enable the Agency to make more precise statements about pollutant loadings to air, land and water. The project also analyses opportunities for the development of new pollutant loading performance measures using the Agency's fate and transport/exposure models.

In New South Wales, Australia, the Pollutant Load Indicator is calculated separately for air and water pollution and covers 12 types of air pollutants and 17 types of water pollutants released from facilities having licences with load-based requirements. This indicator is adjusted to reflect the relative harm of the pollutants and the sensitivity of the environment based on weightings defined in a regulation[9] for individual pollutants as well as for "critical zones" for air and water pollutants. The "critical zones" for air are selected cities for nitrogen oxides and VOCs, while for water they are catchments for salt, nitrogen and phosphorus, and estuarine and enclosed waters for all other priority pollutants. However, the Pollutant Load Indicator is not directly linked to enforcement actions.

Environment Canada is developing a pollution reduction index that would integrate quantities of over 40 air and water polluting substances weighted in accordance with their toxicological impact (using the inverse values of respective ambient environmental quality standards as coefficients). The indicator would be measured in equivalent metric tons of reduced substance. Specific coefficients have also been set for pollutants with a global impact (such as greenhouse gases and ozone-depleting substances) that do not have toxicity-related standards.

Source : Responses to the OECD questionnaire, April-October 2009.

Another characteristic of EPA indicators measuring the total volume/mass of pollutants reduced is that they are based on an assumption that the concluded enforcement actions will reduce the pollution when the technological and management improvements required by the actions are fully put in place. The pollution reduction is reported in the year when the enforcement action (settlement) took place. However, if the implementation of prescribed pollution control measures is not properly monitored and assured, the expected environmental benefits may not be realised, and the indicator would become inaccurate. For this reason, the EPA emphasises the importance of monitoring the implementation of enforcement settlements.

In order to avoid these bottlenecks, the Environment Agency (England and Wales) tracks problem-oriented indicators that reflect priorities set in the Agency's Corporate Strategy and that relate either to the releases of specific pollutants or to the number of serious pollution incidents. An annual target is assigned to each indicator along with tolerance margins for the deviation from the target in order to colour-code (green, amber or red) the eventual implementation status (see Table 1). The targets link the agency's strategic priorities with its outcome performance measures into one coherent, results-oriented system.

The number of pollution incidents is used as a surrogate measure of environmental impact both in the UK and in the Netherlands. This indicator is heavily dependent on the compliance of regulated entities with an obligation to report significant pollution incidents to competent authorities, since not all incidents

[9] Protection of the Environment Operations (General) Regulation 2009, Schedule 2, New South Wales, Australia, www.legislation.nsw.gov.au.

can be detected by the EEA itself or through complaints by third parties. For example, Rijnmond Environmental Protection Agency (DCMR) in the Netherlands explains the increase of the number of reported significant incidents in the refining and chemical industries between 2006 and 2008 by the operators' better reporting practices rather than more incidents that occurred and sees it as a positive trend (DCMR, 2009). Such interpretation ambiguity is a shortcoming of this indicator.

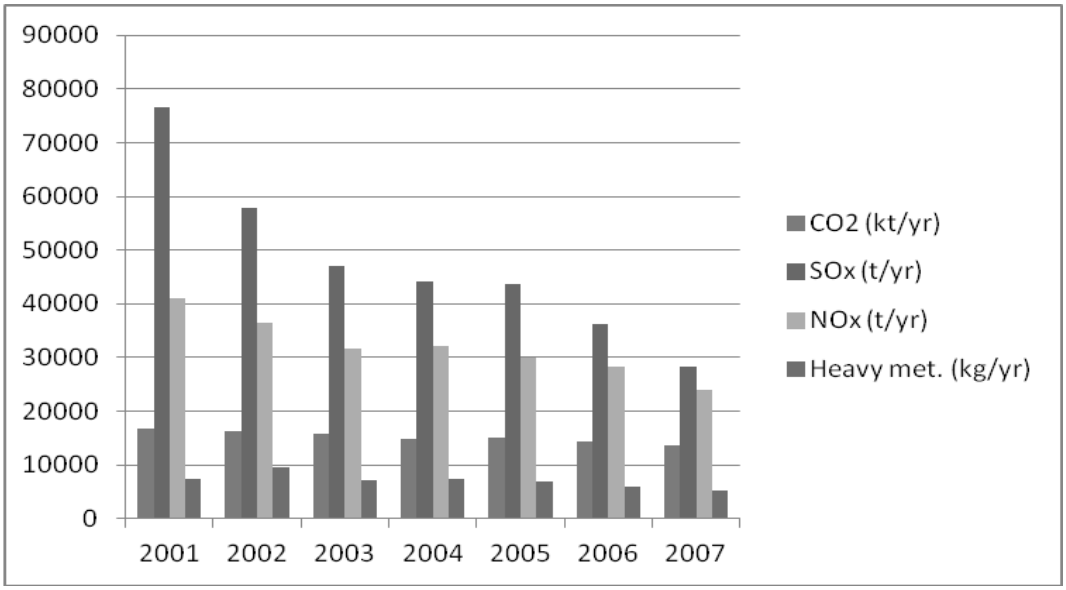
Table 1. Indicators of Reduction of Pollution Releases and Incidents in England and Wales

Objective	Definition of the Measure	Corresponding Annual Target
Emissions of priority pollutants are going down	Reduction of emissions of 8 priority air pollutants: butadiene, benzene, carbon monoxide, lead, NO_x, non-methane VOCs, PM10, SO_2.	Six or more of the 8 pollutants are showing a reduction
We reduce global warming potential emissions	Million tonnes of CO_2 equivalent	Reduction over previous year
We reduce waste disposal from industries we regulate	Million tonnes of hazardous and non-hazardous waste based on the Pollution Inventory covering all sectors except landfills, incinerators and waste treatment installations (to avoid double counting)	3% reduction over previous year
We reduce "big, bad or nasty" illegal waste dumping incidents	Number of serious waste dumping incidents (according to the Agency classification)	5% reduction over previous year
There are fewer serious and significant pollution incidents	Number of category 1 and 2 incidents (according to the Agency classification)	5% reduction over previous year
We stop illegal waste activity at high risk sites	Percentage of reduction of risk scores (based on the national spreadsheet of illegal waste sites) from eliminated sites	10% annual reduction

Source: Environment Agency, responses to the OECD questionnaire, June 2009

The Irish EPA also develops its pollution release indicators for key priority pollutants covered by the National Emission Reduction Plan. Figure 1 demonstrates how this indicator can be further focused on particular industrial sectors.

Figure 1. Priority Air Emission Reductions from the Power and Chemical Industries, Ireland

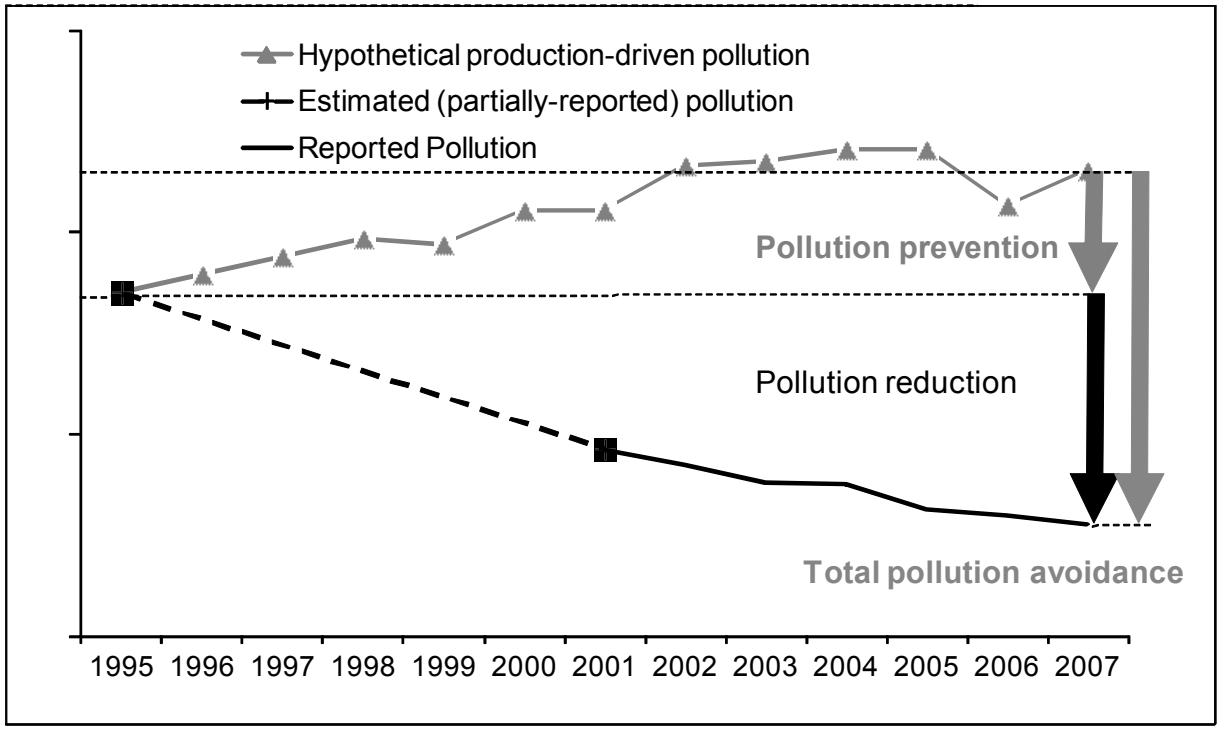


Source: EPA Ireland, 2010

As mentioned in Section 2.2, Environment Canada is developing a three-tier performance measurement system with pollution release indicators at each management level. It intends to track at the "immediate outcome" (operational) level the quantities (mass) of pollutants that have been reduced as a result of enforcement activities[10]. These indicators would cover targeted pollutants under specific regulations administered by Environment Canada (for about 15 priority regulations) and would serve for actual performance evaluation. At the "intermediate outcome" (middle management) level, it is proposed to create a cross-media *pollution reduction index* which would take into account the environmental impact of the regulated polluting substances (see Box 4) and would be used for both high-level programme monitoring and external communication purposes. In its "final outcome" indicator, Environment Canada seeks to combine in one index aggregating the implementation of both pollution control and wildlife protection legislation. Higher-level composite indicators would not be used for performance management purposes.

While indicators of pollution *reduction* characterise a major intermediate outcome of compliance assurance, they do not capture the size of pollution releases *prevented* through compliance monitoring activities. In fact, the more effective a compliance assurance programme is, the greater the ratio of prevented to reduced pollution. Finding a way to measure avoided environmental impact is becoming a priority for many EEAs. In Canada, there is an attempt to interpret the mass of regulated substances monitored and found to satisfy regulatory requirements as the mass of prevented releases. The Irish EPA uses "baseline scenarios" to estimate potential emissions based on production data in order to measure "total pollution emissions avoidance" in a particular sector (see Figure 2).

Figure 2. Pollutant Emission Avoidance in the Pharmaceutical/Chemical Sector, Ireland



Source: EPA Ireland, 2010

[10] Environment Canada will also track the mass of pollutants "controlled" (monitored) by enforcement officers through verification of self-reporting data and on-site measurement. This information, however, does not in itself characterise outcomes of compliance monitoring activities.

3.4 Indicators of Improved Environmental Management Practices and Reduced Risk

In addition to measures of compliance and pollution releases, there are other means to characterise improvements in regulated entities' environmental management practices. The seemingly simplest way to do this is to count *the number of regulated companies that have externally certified environmental management systems* (EMS). The Environment Agency (England and Wales) tracks this indicator for large industrial and waste management facilities (integrated permit holders). However, one can argue that the adoption of an EMS by a company may not be a result of the government's compliance assurance activities but rather a consequence of market pressure. In addition, a facility does not have to be in compliance with environmental requirements to be certified to the ISO 14001 environmental management standard, which compromises this indicator as a compliance assurance outcome measure.

A more complex measure, also used in England and Wales, is the *number of businesses that are "in good standing" with the regulator*. The Environment Agency's Operational Risk Appraisal (Opra) scheme is a risk-based targeting tool that scores large industrial operators on the basis of environmental hazard (the facility's complexity in terms of multimedia impacts, location with respect to urban and environmentally sensitive areas, volume of pollution releases, and potential for accidents) and performance (compliance record and environmental management practices). The Environment Agency aims at a 10% annual reduction in the number of sites in the two highest risk bands for the score's operator performance element. In another example, the Irish EPA calculates an index of risk not just for individual installations but for key industrial sectors. Facility risk scores have also been recently introduced by Poland's Chief Inspectorate for Environmental Protection.

In general, composite risk scores and similar indicators are becoming an increasingly important part of the agencies' performance management as a direct consequence of the overall trend of risk-based targeting of compliance assurance activities. Such indicators also generate positive behavioural incentives for regulated entities whose risk scores become part of their corporate image. However, this indicator's downside may be in the difficulty for the EEA to draw performance management conclusions from the risk score changes without looking at individual components of the score (to try to understand, for instance, whether it is the reduced pollution releases, better compliance or EMS certification that has led to the score's improvement).

The issue of a direct link between compliance assurance efforts and improved environmental management practices has been central to the measures used by the US EPA. For some years, the Agency tracked the percentage of concluded enforcement cases requiring implementation of improved environmental management practices (this share was 70% in FY 2007, for example). However, this indicator did not reflect well the regulated entities' behavioural response. This measure was recently discontinued for external reporting purposes but continues to be tracked internally.

Another EPA indicator, this one describing the impact of particular compliance assurance instruments, is the percentage of audits or other actions in response to EPA compliance incentives[11] that result in improvements in environmental management practices. Valuable from the point of view of tool-based performance assessment, this indicator was also dropped as of FY 2010, as part of the general shift toward problem-oriented measures, from the Agency's external reporting.

Since the start of its performance assessment programme over a decade ago, the US EPA has been measuring the *monetary value of complying actions* of the regulated community – a traditionally important

[11] The EPA's compliance incentive instruments include, for example, the Audit Policy which provides for reductions or waivers of a significant share of civil penalties to facilities that conduct self-assessment audits and promptly disclose and correct discovered violations.

outcome performance indicator for the Agency (see Figure 4.1). The "dollars invested in improved environmental performance or improved environmental management practices as a result of concluded enforcement actions" indicator is unique among compliance assurance outcome measures because it tries to express environmental outcomes of enforcement in monetary terms[12]. This measure covers investments in technology improvements, better management practices, and adding staff and/or hiring contractors for environmental purposes.

Although a financial investment does not necessarily translate into improved facility performance, the "dollars invested" indicator is a legitimate measure of the regulated entities' commitment to pursue improved environmental performance, which in itself is an intermediate environmental outcome. It also indirectly measures the potential for preventing future environmental harm.

Some OECD countries (e.g., Ireland) use the number of citizens complaints against (certain categories of) industrial facilities as a surrogate measure of behaviour of regulated entities. However, the number of people complaining to an EEA about industry-related environmental incidents is not necessarily indicative of their number or seriousness and may have more to do with the location of industrial facilities in densely populated areas or the environmental engagement of local communities.

3.5 Measures of Effectiveness of Compliance Assistance

The US EPA is most advanced among the EEAs in the studied countries in measuring outcomes of environmental compliance assistance to demonstrate the effectiveness of non-compliance prevention. Until recently, as part of its traditional tool-oriented oriented approach to performance assessment, it counted the number of regulated entities reached through two compliance assistance mechanisms:

- Direct compliance assistance is provided by the EPA personnel through on-site visits, workshops, training programmes, and distribution of guidance documents; and

- Assistance provided through 16 web-based interactive Compliance Assistance Centers, each targeted at a specific industry sector.

For both categories of assistance, the EPA measured (prior to FY 2009) three types of intermediate outcomes: increased understanding of regulatory requirements; implementation of improved environmental management practices; and reduction of pollution *as a result of EPA assistance* (see Table 2).

Table 2. US EPA Compliance Assistance Indicators (FY 2008)

	Increased understanding of environmental requirements	Improved environmental management practices	Reduced, treated or eliminated pollution
Percentage of regulated entities receiving direct compliance assistance reporting that they…	88%	82%	49%
Percentage of regulated entities seeking assistance from EPA Compliance Assistance Centers reporting that they…	86%	72%	46%

Source: www.epa.gov/compliance/resources/reports/endofyear/eoy2008/fy2008results.pdf

[12] The Department of Environment, Climate Change and Water of the Australian state of New South Wales uses a similar indicator "estimated value of new pollution reduction programmes negotiated with licensees during the year".

The information for these indicators was collected in two ways. For regulated entities receiving direct assistance, the results were either observed or determined in response to direct questions from the assistance providers about the outcome of the EPA assistance (US EPA, 2002). In the latter instance, the results basically amounted to self-assessment. For regulated entities receiving on-line assistance, the results were obtained from post-assistance voluntary surveys. In neither instance are the results statistically valid.

Post-compliance assistance surveys can be relatively expensive (if they are not web-based) and run a risk of misreporting by regulated entities. Recently, the US Office of Management and Budget challenged the value and analytical soundness of the EPA's compliance assistance indicators, maintaining that the required data could only be obtained by direct observation by the assistance provider in a site visit. As a result, starting in FY 2009, the EPA is tracking only one compliance assistance outcome indicator: percentage of regulated entities receiving direct (person-to-person) EPA compliance assistance that report improved environmental management practices as a result of this assistance.

The EPA/OECA considers this indicator alone to be of very limited value in describing the full impact of the assistance programme. Limited resources do not allow the EPA to conduct many site visits to evaluate the results of its direct compliance assistance. Furthermore, the remaining measure does not capture the value of compliance assistance provided in other forms than during site visits (guidance documents, workshops, websites, etc.). In addition, it may fail to capture "beyond compliance" actions taken by regulated entities in response to receiving compliance assistance. [13]

The underlying issue with measuring the effectiveness of compliance assistance is that it is extremely difficult to demonstrate a causal link between many forms of assistance and quantifiable environmental outcomes. In order to address this concern, the EPA is implementing a pilot project to demonstrate a statistically significant positive correlation between compliance assistance activities and changes in behaviour (i.e., improved environmental management practices and pollution reduction) even after taking into account other factors. The project, whose results are expected in 2011, targets auto body repair shops (primarily small businesses) and uses a combination of phone surveys and site visits to measure compliance assistance outcomes.

3.6 Environmental Quality Indicators

Although there is a multitude of environmental quality indicators which are used to monitor, and report on, the state of the environment, very few EEAs track them as measures of final outcomes of compliance assurance activities. The principal reason for this is the difficulty of demonstrating a cause-and-effect relationship between the activities and the changes in the ambient environmental quality.

In the two of the studied countries that try to measure final outcome indicators of compliance assurance – the UK and the US – three approaches to the design of such indicators can be distinguished.

The first approach is to select environmental quality indicators based on overall agency priorities without explicitly establishing a linkage with compliance assurance activities but assuming that the EEA undertakes targeted efforts in these priority areas. The Environment Agency (England and Wales) tracks several such measures corresponding to the objectives in its Corporate Strategy, for example:

- We protect the high quality of rivers – no reduction in the percentage of length of rivers that have a good or better quality for both chemistry and biology under the national General Quality Assessment Scheme; and

[13] Responses to the OECD questionnaire, April 2009.

- The quality of bathing water is getting better – total number of bathing waters in compliance with the EU bathing water requirements divided by the total number of bathing waters monitored in the bathing season.

Although non-regulatory factors (such as an economic downturn or the general progress of wastewater treatment technologies) are presently not accounted for in the analysis of these measures, the Environment Agency has ordered scientific studies to attempt to confirm a strong correlation between regulatory activities and water quality improvements.

Another approach is to measure local environmental quality in geographic areas which represent compliance assurance priorities for the EEA. For instance, the Environment Agency (England and Wales) does this with respect to designated sites contributing or likely to contribute to exceedances of EU or national air quality standards, whichever is more stringent. The Environment Agency measures the percentage of such sites with air quality improvement conditions in place, the percentage of the sites where their implementation is on target, and where it is completed.

Finally, it is possible to measure results of direct actions to clean up or protect the environment, particularly soil and aquifers, conducted either by a regulated entity responsible for the damage or by an EEA directly (if the responsible party cannot be identified or is insolvent). Examples of such indicators include:

- Area (hectares) of land affected by contamination that is brought back into beneficial use (Environment Agency, England and Wales);

- Area (acres) of wetlands restored or improved (primarily by the regulated community, US EPA);

- Volume (cubic yards) of contaminated media addressed – estimated contaminated soil cleaned or estimated contaminated aquifer cleaned (by responsible parties and by the agency, with subsequent cost recovery, US EPA).

These outcome indicators of direct remediation actions do not pose the problem of cause-and-effect linkage and characterise activities to secure compliance with laws and regulations on environmental liability for damage to natural resources.

In evaluating direct environmental benefits of enforcement actions, the US EPA tries to use indicators reflecting public health impact or population exposure to characterise compliance assurance programmes. For example, the measure "people protected by Safe Drinking Water Act enforcement" is defined as the number of people covered by public water supply and sanitation plants that implement best management practices as a result of the Agency's enforcement actions. The EPA is currently also screening existing pollution fate and transport models to see whether they could incorporate inspection or enforcement case data in order to study possible correlations between enforcement activities and health impacts.

4. CHALLENGES OF MEASURING COMPLIANCE ASSURANCE OUTCOMES

In its work on environmental indicators, the OECD distinguishes several criteria for their evaluation, among which the following are most relevant for compliance assurance measures (OECD, 2003):

- Measurability – indicators must be available at a reasonable cost/benefit ratio and be updated at regular intervals in accordance with reliable procedures;
- Analytical soundness – indicators must be theoretically well founded in technical and scientific terms; and
- Policy relevance – measures must be useful, simple, representative, easy to interpret, show trends over time, and provide a basis for international comparisons.

Based on the analysis of current practices of the use of outcome indicators of compliance assurance in Chapter 3, the following sections identify the challenges associated with these three groups of issues.

4.1 Measurability

According to several EEAs in the studied countries, resource limitations for data collection and management present the greatest barrier in developing outcome indicators. Indeed, significant resources are required to cover the effort, time and expenses necessary to measure and analyse compliance and enforcement-related indicators. While pollution releases and environmental quality are routinely monitored and reported, data for compliance rates and compliance assistance indicators is much more resource-intensive.

For example, US EPA/OECA headquarters staff and managers spend considerable time developing and updating guidance to the regional offices to ensure consistency in counting and reporting into the data system. Once obtained, the data are entered into, and stored in, the EPA's Integrated Compliance Information System for civil enforcement and the Criminal Case Reporting System for criminal enforcement – the general compliance and enforcement databases which are used for a multitude of federal programme management purposes.

However, there is usually no budget allocation of staff or funding specifically for the purposes of performance data acquisition and management. Rather, the information is routinely collected as part of the overall compliance assurance programme. Data entry can be tedious and is often considered less important than doing the compliance and enforcement work that generates the data. With limited (and often shrinking) budgets, data collection management suffers from trade-offs to critical programme needs. As a result, the data on outcomes of compliance assurance activities may be incomplete.

In countries where EEAs are in the process of developing outcome-oriented performance indicator systems, their introduction may imply a significant shift in the organisational culture from the focus on activities toward achieving environmental results. The implementation of new outcome indicators also requires support and engagement from higher managers, especially when it comes to adding new data-related tasks to the agency's ongoing activities.

A reasonable balance must be achieved between the benefits in terms of performance management and costs to the principal EEA functions of compliance assistance, compliance monitoring and enforcement. National-level EEAs in small countries or sub-national enforcement authorities may consider (in the absence of other policy pressures, see Section 2.3) that the investment of time and money in the design and analysis of outcome indicators is excessively high and prefer qualitative performance assessment in a more direct and personal manner. Still, at least a few compliance assurance outcome indicators are likely to prove necessary for external accountability purposes.

4.2 Analytical Soundness

The review of the existing compliance assurance outcome indicators has revealed four principal analytical challenges in their design:

- ***Scope definition.*** Taking account of the relative seriousness of violations of environmental requirements (and of the relative regulatory importance of the violated requirements) – from inflicting major environmental damage to so-called "paperwork" offences – is a key issue in defining and interpreting compliance rates and measures of recidivism and chronic non-compliance. One way to address it is to limit the indicator's scope to "serious" offences (as it is done, for example, in the UK).

  A similar problem arises in weighing the relative impact of pollutants in composite indicators of pollution reduction. Several methods to account for pollutant toxicity have been proposed in the US, Canada and Australia. Focusing on individual priority substances, as practised in England and Wales, may be the most analytically sound way of handling this issue, but doing so can overlook the cumulative or synergistic effects of pollutants.

  Another scope (scale) issue concerns defining the universe or population of concern. As discussed above, the larger and more heterogeneous the universe or population, the fewer the characteristics the facilities will share and the greater the likelihood of exogenous, or confounding, variables, playing a role in the performance of the facilities.

- ***Statistical validity.*** No EEA is currently using sampling approaches to develop representative, statistically valid compliance rates, measures of recidivism or chronic non-compliance (except on a pilot basis). For an indicator to be statistically valid, either a census or near-census population must be monitored (80% or more of a regulated population) or the sample of inspected facilities must randomly assigned. Randomly inspecting facilities to generate statistically valid compliance rates, however, contradicts the concept and current trend of risk-based targeting of compliance monitoring. Reliance on self-reporting by regulated entities only partly addresses this issue due to the limited extent of self-reporting requirements and the need for verification of self-reported data.

- ***Observation periods.*** One of the basic predicaments of outcome indicators of compliance assurance is that the results of compliance and enforcement activities, particularly their environmental impact, are not immediate and may take years to emerge, whereas outcome reporting and performance management is usually annual. This factor affects such measures as pollution reduction following enforcement actions or money spent for environmental improvements, where pollution release or environmental quality outcomes often cannot be related to the activity counts in the same year. Longer measurement periods may partly compensate this problem but lead to other analytical distortions such as "averaging" of the behaviour of the regulated community over extended time periods and increasing the risk of confounding factors influencing the outcomes.

- ***Link between activities and outcomes.*** The uncertainty associated with demonstrating a causal relationship between the programme outputs (compliance assistance, inspections, enforcement actions) and the outcomes affects indicators of improved environmental management practices, pollution release reductions and, especially, improvements of ambient environmental quality. Although there are ongoing studies in the UK and the US on how to take into account the influence of external factors, the cause-and-effect link in each case must be credible enough to persuade policy makers and the public of the decisive role of the EEA in bringing about the positive outcomes. The UK "Review of Enforcement in Environmental Regulation" (Defra, 2006) concluded that the linkage between data on incidents and data on enforcement actions was not adequate to allow the effectiveness of enforcement to be comprehensively assessed.

Each of these analytical challenges complicates the development of meaningful outcome indicators and calls for their more focused use, as further discussed in Chapter 5.

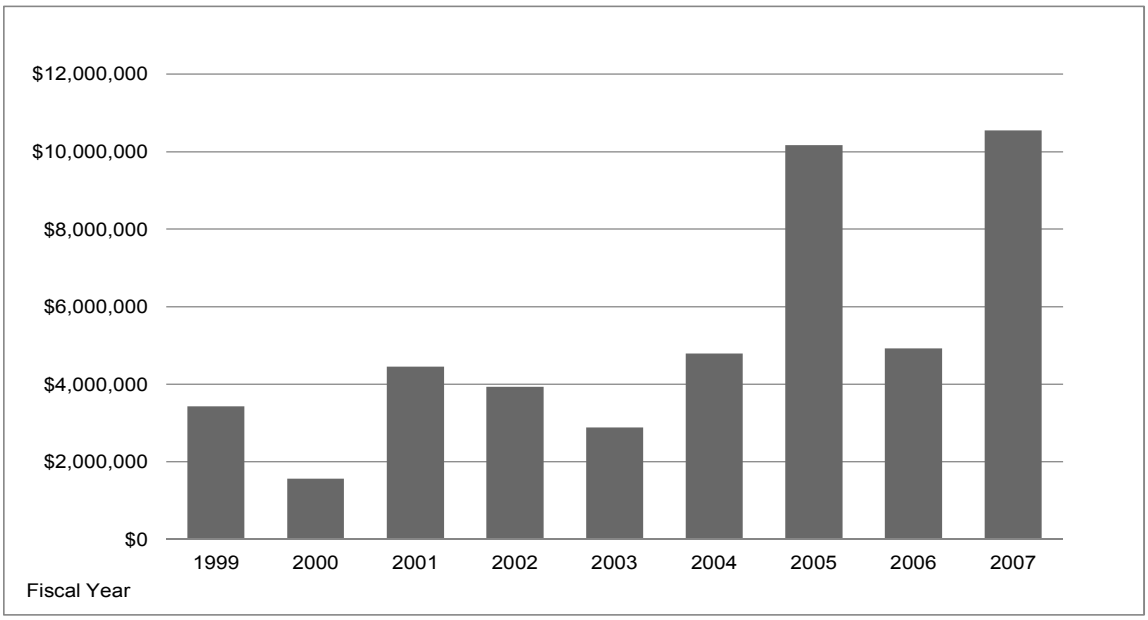
4.3 Policy Relevance

The interpretation of outcome indicators of compliance assurance is fairly difficult for a number of reasons. Although some outcome indicators are in high demand from various stakeholders because of the simplicity of their message (so-called "bumper-sticker numbers" such as compliance rates, reductions of pollution releases or environmental quality improvements), the problems of analytical soundness of their design described in the previous section diminish their utility.

More generally, the analysis of outcome indicators (and of any performance measure) is only meaningful when it encompasses the entire range of performance measures, output indicators in particular, as well as a broader context. For example, a reduction in the number of non-compliance incidents may be interpreted to mean better behaviour of the regulated community, poor detection by the EEA, or a change in the regulator's targeting scheme. The correct interpretation can only be made after comparing improvements in compliance behaviour with the magnitude and nature of the enforcement presence. It is also useful to consider certain outcome measures (e.g., pollution release indicators) in conjunction with economic indicators to check whether there is decoupling between the economic activity and environmental impacts.

The need for broader analysis than the "face value" of outcome indicators is also reflected in the fact that the analysis of trends in compliance assurance outcomes is not always possible. Time fluctuations in such outcomes as pollution reduction or monetary value of environmental improvements (see Figure 3) reflect results of specific enforcement actions which, by their nature, vary from year to year depending on the size of enforcement cases and the strategic focus of the compliance and enforcement programme. For example, some of the largest pollution reductions obtained by the US EPA have historically resulted from a small number of very large cases addressing specific sector priorities such as large petroleum refineries and coal-fired utilities. As these sectors are addressed and new sectors comprised of relatively smaller facilities are targeted, corresponding outcomes would be expected to decrease.

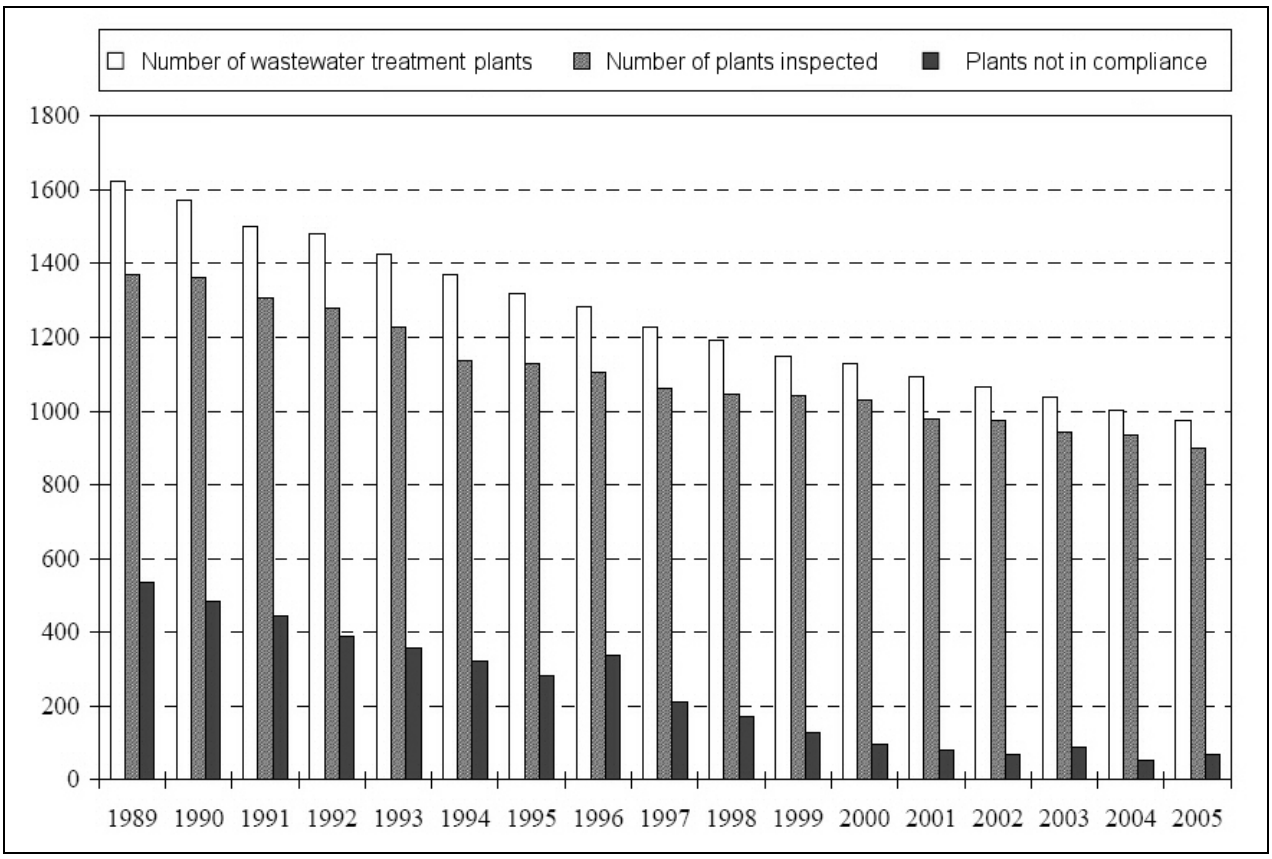
Figure 3. Monetary Value of Complying Actions as a Result of US EPA Enforcement, USD



Source: US EPA National Enforcement Trends, www.epa.gov/compliance/data/results/nets.html

The trends analysis is more feasible and informative when it is targeted at specific sectors and is conducted jointly for outcome, output and input indicators. Figure 4.2 showing the dynamics of non-compliance among Danish wastewater treatment plants over a 17-year period is an example of a persuasive illustration of the impact of compliance assurance on the behaviour of regulated entities.

Figure 4. Compliance of Public Wastewater Treatment Plants, Denmark



Source: Danish EPA, 2010

Another major challenge of the existing outcome indicators is their inability to adequately measure prevention of pollution (discussed in Section 3.3) and prevention of non-compliance across a segment of the regulated community. By focusing on the effects of compliance assurance actions on the inspected or sanctioned firm itself (so-called "specific deterrence"), the currently used indicators do not reflect the impact of these actions on environmental performance of other facilities ("general deterrence"). According to a series of studies ordered by the US EPA to address this issue[14], a statistical model can be used to analyse a statistical correlation between variables of compliance assurance activities and environmental performance (measured in terms of the actual emission or discharge of regulated pollutants relative to permit limits). This statistical analysis would be applied to one industry sector at a time. Results of deterrence measurement may help an EEA identify regulatory instruments within a sector that may induce particularly significant changes in environmental performance, or sectors where compliance monitoring and enforcement have a particularly significant deterrence effect. This could greatly contribute to increasing the efficiency of compliance assurance programmes. Deterrence measurement may also help an EEA establish a link between compliance monitoring and enforcement and measured environmental outcomes. However, as in many other cases of enforcement-related academic research, statistical requirements and data limitations make calculating deterrence indicators, usable in performance measurement, quite challenging (if not impossible) in practice.

[14] See, for example, *Monitoring, Enforcement, and Environmental Compliance: Understanding Specific and General Deterrence, A User's Guide*, www.epa.gov/oecaerth/resources/reports/compliance/research/index.html

Finally, the variety of compliance assurance outcome indicators demonstrated in Chapter 3 complicates their comparison across different sub-national jurisdictions in countries with decentralised systems of environmental governance and especially between different countries. This is mostly due to differences in the design and measurement methodologies of specific indicators as well as differences in the underlying regulatory requirements. The divergence in definitions of basic terms (e.g., 'installation' in the UK and a 'facility' in the US do not necessarily have the same definition) and specific compliance and enforcement instruments (e.g., what constitutes inspections and enforcement actions) makes international comparisons extremely difficult.

5. CONCLUSIONS AND RECOMMENDATIONS

As a result of the conducted analysis, it is possible to identify three approaches to the design of outcome indicators of compliance assurance:

- *Performance assessment focused on the effectiveness of compliance assurance instruments across regulations and environmental problems.* This approach is used in large part by the US EPA, even though some outcome indicators have recently been "split" by medium-specific statute. The advantage of this approach lies in the EEA's ability to evaluate the effectiveness of individual tools. Such indicators can be used, for example, to measure the improved compliance knowledge of the regulated community as a result of compliance assistance or the effectiveness of inspections in identifying violations and triggering complying actions. However, the excessive aggregation of the measures across environmental problems (e.g., pounds of pollution reduced) detaches them from final environmental outcomes.

- *Performance assessment focused on specific environmental problems reflecting the EEA's strategic priorities.* This is the predominant approach in the UK, Denmark and Ireland where the outcome indicators are used to track high-risk industrial incidents, emissions of priority pollutants (including greenhouse gases), waste management offences, etc. The pros and cons of this approach are the reverse of those of the first: strong ties to environmental outcomes (which facilitates strategic planning) but a lower operational management value.

- *Multi-tier performance assessment focused on pollutant-specific results of regulatory actions at the lower level and on the overall programme effectiveness at the higher level.* This approach, used by Environment Canada to design its system of outcome indicators, seeks to combine the strengths of the first two. It starts by looking at reductions of individual regulated pollutants as a result of compliance assurance activities and then tries to aggregate them into a composite measure characterising the environmental impact of these reductions. The complexity of this approach makes it difficult to assess the effectiveness of individual compliance assurance instruments.

Given the analytical challenges associated with the design of compliance assurance outcome indicators (discussed in Section 4.2), it is impossible to identify a "best practice" approach or a set of "flawless" indicators. However, the review and analysis of a "toolbox" of outcome indicators resulted in an evaluation of their strengths and weaknesses which underpin several *key principles* for their implementation:

- Outcome indicators should only be developed after a clear management need has been identified and a plan defined for how and by whom they would be used. It is best to systematically integrate performance measures early into the process of design of new policies and regulations.

- Outcome indicators should, to the extent possible, be associated with time-specific targets in order to integrate the strategic planning and performance management processes.

- Targeting outcome indicators on concrete regulatory priorities (pollutants, sectors, etc.) improves their analytical soundness but reduces comparability from one EEA to another (nationally or internationally), as different agencies have different priorities.

- The dynamic (trends) analysis of outcome indicators, especially when conducted in conjunction with the EEA's resource (input) and activity (output) indicators, substantially increases their policy relevance. It is also advisable to consider outcome measures of compliance assurance in the context of more general environmental and economic indicators.

- Compliance assurance outcome indicators, as any other performance measures, need to be regularly reviewed and revised to maintain their objectivity (as agency staff tend to adjust their work to maximise "positive" indicators) and relevance to the changing regulatory programme.

More specifically, the following considerations may be advisable to incorporate in the design of new, or the improvement of existing, measures, per category described in Chapter 3:

- *Compliance rates.* There is no evidence of any country developing or using statistically valid compliance rates through the use of random inspections or by combining targeted and random inspections. However, EEAs can use "statistically biased" compliance rate information to develop and target inspection programmes, target outreach and technical assistance to the regulated community, target follow-up enforcement, and design industrial sector-specific initiatives. In order to address the issue of different environmental impacts of different offences, compliance rates may be developed by type of violation (rates of compliance with emission limit values, with self-reporting requirements, etc.) or by category of non-compliance defined based on the degree of its environmental impact. It is also possible to track the share of violations involving criminal behaviour. Conducting analysis to identify the correlation between compliance with a certain environmental requirement and the potential for yielding human health and environmental benefits may help discover areas where compliance rates are most useful. In those cases, it may be worthwhile to define and inspect representative population samples to calculate compliance rates for specific segments of the regulated community.

- *Recidivism and non-compliance duration measures.* Similarly to compliance rates, it may be useful to calculate rates of recidivism and chronic non-compliance for specific (particularly serious) types of offences. The use of these two kinds of measures in combination could allow an EEA to get a better picture of how regulated entities move in and out of compliance. Indicators measuring the length of time regulated entities stay in non-compliance can, for example, influence an EEA's penalty policy in how much time a violator should be allowed to take corrective actions before severe sanctions are imposed.

- *Pollution release indicators.* In order to make the environmental outcomes attributable to compliance assurance activities, it makes sense to measure reductions of pollution releases that occurred as a result of enforcement or compliance assistance activities. Focusing on priority pollutants rather than aggregating the data for a wide range of parameters and/or pre-weighting of pollutants via pollutant characterisation methodologies can make the results more meaningful in illustrating progress in achieving EEA goals. The number of pollution incidents associated with violations can be a useful intermediate outcome measure if sufficient and reliable data on pollution incidents is available to the EEA. It may also be important to supplement self-reported incident data with inspections.

- *Indicators of improved environmental management and reduced risk.* The principal challenge of this type of measures is to demonstrate the link between compliance assurance activities and

progress in corporate environmental management. It is difficult to "extract" regulatory factors contributing to EMS adoption by businesses or a reduction in their environmental risk score. The "dollars invested" indicator used by the US EPA (see Section 3.4) better characterises the value of planned corrective actions than sustained environmental improvements, at least in the short term. These indicators may be more useful if applied to selected segments of the regulated community where it is easier to define improved practices and to demonstrate their link to compliance assurance activities.

- *Measures of effectiveness of individual compliance assurance instruments.* Such indicators are useful from an EEA's operational management perspective, especially in assessing concrete tools (e.g., an interactive compliance assistance website) or initiatives (such as sector-specific compliance monitoring and enforcement campaigns). To be meaningful, each measure should be based on a representative sample of regulated entities covered by a respective programme.

- *Final outcome indicators.* The measures of environmental quality improvements can be powerful communication tools for an EEA, if it is able to show that the positive results are due to better regulatory compliance. It is, therefore, advisable to take onboard only those environmental quality indicators that correspond to targeted, problem-oriented compliance assurance efforts. This would make such measures mostly relevant to priority improvements of local environmental quality.

The evaluation of the key categories of indicators according to the OECD criteria (see Chapter 4) and recommendations for maximising their effectiveness are summarised in Table 3.

So far, EEAs in very few OECD countries have developed and used outcome indicators of environmental compliance assurance. As the experience of their implementation broadens, further studies, workshops and other collaborative efforts would be valuable to facilitate the exchange of good practices in this area. In particular, the following issues merit deeper analysis:

- Improving analytical soundness of outcome indicators, including reliable correlations between compliance assurance activities and final environmental outcomes;

- Classifying and measuring of non-compliance based on the degree of its environmental impact;

- Measuring the preventive impact of compliance assurance activities – avoidance of pollution releases (e.g., by using baseline scenarios) and general deterrence of non-compliance;

- Using composite indices and weighting to characterise compliance and pollution reduction outcomes;

- Optimising the size of an EEA's suite of outcome performance measures from the cost efficiency perspective; and

- Feasibility of developing a limited number of comparable outcome measures to track compliance with similar environmental regulatory requirements in different sub-national jurisdictions (in decentralised systems of environmental governance) or internationally (for example, in the context of European Union Directives).

Table 3. Summary of Conclusions and Recommendations for Key Types of Outcome Indicators

Indicator category	Examples	Measurability	Analytical Soundness	Policy Relevance	Recommendations
Compliance rates	Hundred percent minus number of facilities with significant violations divided by number of inspected facilities: (Maryland, US) Number of serious breaches of permit conditions (UK)	**Medium:** Based on inspection data or self-reporting. Requires census, near census, or random inspections for statistical validity.	**Low:** Most existing compliance rates are not statistically representative because of inspection targeting. They do not distinguish between violations with different environmental impact.	**Medium:** Useful in programme targeting but not as a measure of behaviour of the entire regulated community. However, may be politically appealing due to the simplicity of their message.	Develop compliance rates by type of (serious) violation or category of non-compliance depending on degree of its environmental impact. Use sector-specific rates.
Indicators of recidivism and duration of non-compliance	Level of recidivism following criminal conviction (US) Percentage of facilities returning to compliance after receiving a compliance order (Belgium)	**Medium:** Based on targeted inspection data. Chronic non-compliance may be hard to detect.	**Low:** Because of inspection targeting, many initial or repeated violations may not be detected.	**Medium:** Recidivism rates are often insufficient to describe recalcitrant non-compliance: low recidivism may hide chronic non-compliance.	Use combination of rates of recidivism and chronic non-compliance, focus on selected serious offences.
Pollution release indicators	Mass of pollutants reduced, treated or eliminated through enforcement actions (US) Pollutant load indicator (Australia) Emissions of priority air pollutants (UK) Number of serious pollution incidents (UK)	**High:** Based on expected enforcement response outcomes or routine emission reporting and incident notification.	**Medium:** Aggregation of pollutants without regard for their toxicity weakens link to environmental problems; need to prove a link to enforcement or compliance assistance. There is a risk of misreporting by the regulated community.	**High:** These indicators demonstrate tangible environmental results if used in conjunction with economic activity indicators.	Concentrate on releases of priority pollutants and releases following enforcement actions. Number of pollution incidents is a good proxy indicator.
Indicators of improved environmental management practices and reduced risk	Number of businesses with high risk scores (UK) Number of regulated entities changing environmental behaviour as a result of enforcement	**Low:** In most cases, no established reporting mechanism.	**Low:** Difficult to define improved practices; EMS certification or other management improvements may not	**Medium:** Improved corporate environmental management does not necessarily mean better compliance. The	These indicators may be more useful if applied to selected segments of the regulated community where it is easier to

Indicator category	Examples	Measurability	Analytical Soundness	Policy Relevance	Recommendations
	actions (US) Dollars invested in improved environmental performance as a result of enforcement actions (US)		be related to regulatory pressure. Monetary value of complying actions only presumes eventually improved performance.	value of investment may fluctuate depending on large enforcement cases.	define improved practices and to demonstrate their link to compliance assurance activities.
Measures of effectiveness of compliance assistance	Percentage of entities receiving direct compliance assistance reporting that they increased understanding of environmental requirements (US)	**Low:** In most cases, data collection requires user surveys that raise issues of reporting bias. On-site observations are very expensive.	**Low:** Difficult to show a causal link between many forms of assistance and environmental outcomes.	**Medium:** Useful in assessing concrete tools and initiatives but is rarely tied to environmental problems. Could demonstrate effectiveness of non-compliance prevention.	Targeted use for specific instruments and segments of the regulated community.
Environmental quality measures	Number of bathing waters in compliance with requirements (UK) Area of wetlands restored or improved (US)	**High:** Based on routine environmental quality monitoring	**Medium:** Difficult to show a causal link to compliance assurance activities	**Medium:** A powerful evidence of results if a link to compliance assurance programmes can be demonstrated.	Use only those indicators that relate to targeted, problem-oriented efforts; most relevant to priority improvements in local environmental quality.

BIBLIOGRAPHY

DCMR (2009), *The Environment in the Greater Rotterdam Region: 2009*, Rijnmond Environmental Protection Agency (DCMR), Schiedam, the Netherlands.

DECC (2009), *Annual Report 2007-08*, Department of Environment and Climate Change, New South Wales, Sydney, Australia.

Defra (2006), *Review of Enforcement in Environmental Regulation – Report of Conclusions*, Department for Environment, Food and Rural Affairs, London.

Environment Agency (2007), Creating a Better Place – Translating Strategy into Action: Environment Agency Corporate Plan 2008-11, Environment Agency, Bristol, UK.

Environment Agency (2009), *Creating a Better Place: Environment Agency Corporate Strategy 2010 to 2015*, Draft for Consultation, Environment Agency, Bristol, UK.

Environment Canada (2009), *Immediate Outcome Indicators Information Determination Process*, Guidance Document, Environmental and Wildlife Enforcement Indicators Initiative, Enforcement Branch, Environment Canada, Montreal.

Flemish Administration (2008), *Environmental Enforcement Report 2007*, Environmental Inspectorate Division, Department of Environment, Nature and Energy, Flemish Administration, Brussels.

IEC (2010), *Compliance Indexing Project*, report prepared for US EPA, Industrial Economics, Inc., Cambridge, Massachusetts.

INECE (2008), *Performance Measurement Guidance for Compliance and Enforcement Practitioners*, Second Edition, International Network for Environmental Compliance and Enforcement, Washington D.C.

OECD (2002), Aggregated Environmental Indices: Review of Aggregation Methodologies in Use, ENV/EPOC/SE(2001)2/FINAL, Organisation for Economic Co-operation and Development, Paris.

OECD (2003), OECD Environmental Indicators: Development, Measurement and Use, Reference Paper, Organisation for Economic Co-operation and Development, Paris, *www.oecd.org/dataoecd/7/47/24993546.pdf*.

OECD (2004), Measuring What Matters: Proceedings from the INECE-OECD Workshop on Environmental Compliance and Enforcement Indicators, 3-4 November 2003, Organisation for Economic Co-operation and Development, Paris, www.inece.org/indicators/workshop.html.

OECD (2009), *Ensuring Environmental Compliance: Trends and Good Practices*, Organisation for Economic Co-operation and Development, Paris.

OECD (2009), *Measuring Results of Environmental Regulation and Compliance Assurance: Guidance for Countries of Eastern Europe, Caucasus and Central Asia*, Organisation for Economic Co-operation and Development, Paris.

Shimshak, Jay P. (2007), *Monitoring, Enforcement and Environmental Compliance: Understanding Specific and General Deterrence*, State-of-Science White Paper, prepared for the US Environmental Protection Agency, Washington D.C.

Styles, David et al. (2009), "Measuring the Environmental Performance of IPPC Industry: Devising a Quantitative Science-based and Policy-weighted Environmental Emissions Index", *Environmental Science and Policy*, 12 (2009), 226-242.

US EPA (2002), *Guide for Measuring Compliance Assistance Outcomes*, Revised June 2002, US Environmental Protection Agency, Washington D.C.

US EPA (2006), *Expanding the Use of Outcome Measurement for EPA's Office of Enforcement and Compliance Assurance*, Report to OMB, US Environmental Protection Agency, Washington D.C.

US EPA (2008), *Re-evaluation of the Use of Recidivism Rate Measures for EPA's Civil Enforcement Program*, Report to OMB, US Environmental Protection Agency, Washington D.C.

ANNEX 1. INDICATOR FORMS

Australia

Agency	**Department of Environment and Climate Change, New South Wales**
Title of indicator	**Pollutant Load Indicator**
Category of indicator	Pollution release indicator
Definition	Total pollutant load (separately for air and water pollutants) emitted for the reporting year by all facilities required to pay load fees under the Load Based Licensing Scheme, adjusted to reflect the relative harm of the pollutants and the sensitivity of the environment into which they are emitted.
Unit	Kilogram
Parameters to be measured/calculation	Calculated separately for air and water pollutants. Twelve categories of air pollutants: arsenic, lead, fine particulate matter, coarse particulate matter, fluorides, NO_x, mercury, SO_x, volatile organic compounds, hydrogen sulphide, benzene, benzo(a)pyrene. Seventeen categories of water pollutants: total polycyclic aromatic hydrocarbons, total phenols, pesticides and PCBs, mercury, arsenic, chromium, salt, phosphorus, selenium, BOD, total suspended solids, nitrogen, oil and grease, zinc, lead, copper and cadmium. This indicator is adjusted to reflect the relative harm of the pollutants and the sensitivity of the environment based on weightings defined in a regulation for individual pollutants as well as for "critical zones" for air and water pollutants. The "critical zones" for air are selected cities for nitrogen oxides and VOCs, while for water they are catchments for salt, nitrogen and phosphorus, and estuarine and enclosed waters for all other priority pollutants.
Data source	Information gathered from the licensing system, which includes information received from licensees' annual reporting, as well as other weightings for pollutants and "critical zones". The data undergo quality assurance checks which can lead to adjustments for up to two years following the reporting period.
Reporting frequency	Annual
Reporting level	Reported internally to Department Executive and published in the Annual Report
Target	None
Notes	

Belgium

Agency	**Environmental Inspectorate Division, Flemish Government**
Title of indicator	**Effectiveness of compliance orders of restoring compliance**
Category of indicator	Measure of recidivism/duration of non-compliance
Definition	Percentage of facilities returning to compliance after receiving a compliance order ("exhortation")
Unit	Percentage of facilities
Parameters to be measured/calculation	Number of "sanitations" (corrective actions) divided by the number of "exhortations" (compliance orders)
Data source	Database of inspector reports
Reporting frequency	Quarterly (internal only)
Reporting level	Head of local service
Target	None
Notes	The indicator is used as a performance measure of individual inspectors.

Canada

Agency	**Environment Canada**
Title of indicator	**Quantity of substances reduced through enforcement activities**
Category of indicator	Pollution release indicator ("immediate outcome" in Canada)
Definition	Quantity of harmful substances reduced through enforcement activities for priority pollution prevention and control regulations.
Unit	Kilograms of substance
Parameters to be measured/calculation	Substances are designated according to the Chemical Abstracts Service's (CAS) Registry. All the reductions are estimated in terms of absolute quantities and grouped, as desired (ex: substances involved in water or air, total quantities of substances), for the calculation of the indicators. The observation period for which the reduced quantities of polluting substances are calculated varies. For chronic pollution releases, the reduced quantities are calculated for one year from the time of adequate corrective action. In case of a one-time release, the observation period corresponds to the duration of the release.
Data source	Data obtained during enforcement activities and recorded in the Environment Canada enforcement database.
Reporting frequency	Semi-annual proposed, plus ad hoc and real time reports (via the Compliance Analysis & Planning data warehouse)
Reporting level	Reporting format will enable results to be reported at different levels and according to various reporting elements: • At the national and regional levels • By location • By regulation • By sector of activity • By substance or category of substances • By environmental media (air, water, etc.) • For a specific period of time
Target	None
Notes	To be introduced in fiscal year 2010-2011

Agency	**Environment Canada**
Title of indicator	**Enforcement Environmental Improvement Index**
Category of indicator	Pollution release indicator
Definition	Index of environmental improvement resulting from enforcement activities on the priority pollution prevention and control regulations, taking into account the environmental impact of the harmful substances. The index represents the environmental damage prevented or reduced through enforcement activities.
Unit	Kilograms of substance
Parameters to be measured/calculation	The index is based on the quantities of regulated substances reduced through enforcement activities (as measured at the "immediate outcome" level). It applies conversion factors derived from recognized toxicity values and environmental quality criteria associated with each substance in order to weight the harmfulness of the substances. The index is calculated by category of substances, e.g. for substances released to water or air, or for all the substances grouped together.
Data source	Data obtained during enforcement activities and recorded in the Environment Canada enforcement database.
Reporting frequency	Semi-annual proposed, plus ad hoc and real time reports (via the Compliance Analysis & Planning data warehouse)
Reporting level	Reporting format will enable results to be reported at different levels and according to various reporting elements: • At the national and regional levels • By location • By regulation • By sector of activity • By substance or category of substances • By environmental media (air, water, etc.) • For a specific period of time
Target	None
Notes	To be introduced in fiscal year 2010-2011

United Kingdom

Agency	**Environment Agency, England and Wales**
Title of indicator	**Emissions of priority pollutants are going down**
Category of indicator	Pollution release indicator (intermediate outcome)
Definition	Number of "passes" of reduction of emissions of 8 priority air pollutants from regulated industries
Unit	A "pass" is a reduction of actual emissions of the pollutant against the emission target for the year for that pollutant. A pass corresponds to a pollutant whose emissions have been reduced below the target.
Parameters to be measured/calculation	Butadiene, benzene, carbon monoxide, lead, NO_x, non-methane volatile organic compounds, PM10, SO_2
Data source	National Pollution Inventory
Reporting frequency	Annual
Reporting level	Director of Environment and Business
Target	Six or more of the identified pollutants are showing a reduction in their emissions (six or more "passes")
Notes	The indicator helps achieve the standard required by the current Air Quality Strategy and the EU National Emission Ceiling Directive

Agency	**Environment Agency, England and Wales**
Title of indicator	**We reduce the number of businesses with higher risk Opra scores**
Category of indicator	Indicator of improved environmental management practices (intermediate outcome)
Definition	Percentage of industrial sites (installations) moving out of the high risk categories in the operator performance scoring system
Unit	Percentage of sites
Parameters to be measured/calculation	Percentage of sites registered in the Operational Risk Appraisal (Opra) scheme in the D and E bands (high risk scores) of the Operator Performance scoring sheet. The score is based on environmental hazard of the installation (its complexity in terms of multimedia impacts, location with respect to urban and environmentally sensitive areas, volume of pollution releases and potential for accidents) and its operator's performance (compliance record and environmental management practices).
Data source	Opra Operator Performance scoring sheet
Reporting frequency	Annual
Reporting level	Director of Environment and Business
Target	10% annual reduction in the percentage of sites with high risk scores
Notes	In 2007/2008, 5% of sites were classified in D and E bands.

Agency	**Environment Agency, England and Wales**
Title of indicator	**More companies we regulate have environmental management systems**
Category of indicator	Indicator of improved environmental management practices (intermediate outcome)
Definition	Number of Environmental Permit holders who have certified environmental management systems (EMS)
Unit	Number of permit holders
Parameters to be measured/calculation	Total number of EMS certified by accredited certification bodies to ISO 14001, EMAS or BS8555 in relation to the 2006 baseline
Data source	Operational Risk Appraisal (Opra) database
Reporting frequency	Annual
Reporting level	Director of Environment and Business
Target	Overall 25% increase in the five years from 2006 to 2010, i.e. an average 5% increase per year
Notes	The 2006 baseline was 2,327 sites.

Agency	**Environment Agency, England and Wales**
Title of indicator	**More businesses comply with permit conditions**
Category of indicator	Compliance rate (intermediate outcome)
Definition	Number of serious breaches of permit conditions
Unit	Number of breaches
Parameters to be measured/calculation	Number of Category 1 and 2 (most serious) breaches, according to the Compliance Classification Scheme. It covers breaches of environmental permits (which recently integrated pollution prevention and control permits and waste management licences), wastewater discharge consents, water abstraction licences, etc.
Data source	Compliance Classification Scheme
Reporting frequency	Quarterly
Reporting level	Director of Operations
Target	5% reduction of the number of breaches per year
Notes	

Agency	**Environment Agency, England and Wales**
Title of indicator	**We protect the high quality of rivers**
Category of indicator	Environmental quality indicator (final outcome)
Definition	Percentage of length of rivers that have good or better quality for both chemical and biological indicators under the General Quality Assessment Scheme
Unit	Percentage of river length
Parameters to be measured/calculation	Length of river stretches classified in bands A and B in the General Quality Assessment Schemes for chemistry and biology divided by the total monitored length of regulated rivers
Data source	National Data Unit
Reporting frequency	Annual (with a lag of one calendar year)
Reporting level	Director of Operations
Target	No reduction in the percentage of length of "good or better quality" rivers for both chemical and biological indicators.
Notes	In 2007, this indicator was 76% for England and 95% for Wales for chemistry and 72% and 86%, respectively, for biology.

Agency	**Environment Agency, England and Wales**
Title of indicator	**More contaminated land is brought back into beneficial use**
Category of indicator	Environmental quality indicator (final outcome)
Definition	Area of land affected by contamination that is brought back into beneficial use as a result of Agency actions
Unit	Hectares
Parameters to be measured/calculation	
Data source	Groundwater and contaminated land teams of the Agency's area offices
Reporting frequency	Quarterly
Reporting level	Director of Environment and Business
Target	6,000 ha for 2010/2011
Notes	

Agency	**Environment Agency, England and Wales**
Title of indicator	**Site air quality improvements are on track**
Category of indicator	Environmental quality indicator (final outcome)
Definition	Three sub-measures: percentage of designated sites with improvement conditions in place; percentage of designated sites with improvement conditions on target; percentage of designated sites with completed improvement conditions.
Unit	Percentage of sites
Parameters to be measured/calculation	Designated sites are processes or activities which have previously been identified as contributing or likely to contribute to exceedances of air quality standards.
Data source	Environmental permit databases
Reporting frequency	Annual
Reporting level	Director of Operations
Target	100% of sites with improvement conditions in place, on target, and completed
Notes	

United States

Agency	**US Environmental Protection Agency**
Title of indicator	**Improved environmental management**
Category of indicator	Indicator of improved environmental management practices
Definition	Total number of regulated entities that change behaviour resulting in direct environmental benefits or the prevention of pollution into the environment as a result of EPA civil enforcement and compliance actions
Unit	Number of regulated entities
Parameters to be measured/calculation	Enforcement and compliance actions include enforcement settlements, compliance incentive audits, direct compliance assistance delivered by EPA staff only, and federal inspections that result in a direct or preventative environmental benefit. The indicator is measured separately for air, water and land (hazardous waste, toxics, and pesticides).
Data source	Case Conclusion Data Sheets, Integrated Compliance Information System
Reporting frequency	Annual
Reporting level	EPA reporting under the Government Performance and Results Act (GPRA)
Target	FY 2010 targets: Air – 127 entities, water – 608 entities, land – 213 entities
Notes	Under EPA's new Strategic Plan for FY 2009-2014, this performance measure will for the first time be calculated separately for air, water, and land.

Agency	**US Environmental Protection Agency**
Title of indicator	**Pollution reduction**
Category of indicator	Pollution release indicator
Definition	Pounds of pollution reduced, treated or eliminated as a result of concluded civil enforcement actions
Unit	Million pounds
Parameters to be measured/calculation	Concluded civil enforcement actions include enforcement settlements and compliance incentive audits (direct compliance assistance delivered by EPA staff and federal inspections are not included). The indicator is measured separately for air, water, hazardous waste and toxics/pesticides and, within each of the three media, integrated across all pollutants.
Data source	Case Conclusion Data Sheets, Integrated Compliance Information System
Reporting frequency	Annual
Reporting level	EPA to report by media under the Government Performance and Results Act (GPRA)
Target	FY 2010 targets: air – 480 million pounds, water – 320 million pounds, toxics/pesticides – 3.8 million pounds, hazardous waste – 6,500 million pounds
Notes	Under EPA's new Strategic Plan for FY 2009-2014, this performance measure will for the first time be calculated separately for air, water, pesticides/toxics, and hazardous waste. Estimated 890 million lbs. of pollution across all media were reduced or treated in FY 2008.

Agency	**US Environmental Protection Agency**
Title of indicator	**Rate of recidivism**
Category of indicator	Measure of recidivism/duration of non-compliance
Definition	Percentage of defendants who, after having been convicted of an environmental crime, are subsequently found guilty of a subsequent criminal or civil environmental violation
Unit	Percentage of violations
Parameters to be measured/calculation	Recidivism baseline and targets were based on completed prosecutions between 1997-2008
Data source	Criminal Case Reporting System
Reporting frequency	Annual
Reporting level	EPA reporting under the Government Performance and Results Act (GPRA)
Target	< 1% recidivism annually
Notes	This criminal enforcement performance measure is new for FY 2010.

Agency	**US Environmental Protection Agency**
Title of indicator	**Monetary value of complying actions**
Category of indicator	Indicator of improved environmental management practices
Definition	Dollars invested in improved environmental performance or improved environmental management practices as a result of concluded civil enforcement actions
Unit	Dollars
Parameters to be measured/calculation	Enforcement and compliance actions include enforcement settlements, compliance incentive audits, direct compliance assistance delivered by EPA staff only, and federal inspections that result in a direct or preventative environmental benefit. The indicator covers investments in technology improvements, better management practices, and adding staff and/or hiring contractors for environmental purposes.
Data source	Case Conclusion Data Sheets, Integrated Compliance Information System
Reporting frequency	Annual
Reporting level	In FY 2009, EPA reported this performance measure under the Government Performance and Results Act (GPRA). *See* Notes.
Target	FY 2010: n/a The FY 2009 target was 4.4 billion dollars.
Notes	This measure has been eliminated under GPRA for FY 2010, though it will continue to be available for internal management purposes.

Agency	**US Environmental Protection Agency**
Title of indicator	**Outcomes from EPA's Direct Compliance Assistance Provided to Regulated Entities – Environmental Management Practices Adopted**
Category of indicator	Measure of effectiveness of compliance assistance
Definition	Percentage of regulated entities receiving direct (person-to-person) compliance assistance from EPA reporting that they improved environmental management practices as a result of EPA assistance
Unit	Percentage of regulated entities
Parameters to be measured/calculation	A variety of environmental management practices can be credited under this measure. Examples include but are not limited to: conducting a self-audit; contacting state or local regulatory agency or non-regulatory source for additional compliance assistance; correcting monitoring, record-keeping or reporting deficiencies; identifying a pollution prevention opportunity; installing new process equipment; instituting an environmental management policy, system or procedure; instituting training or other communication on environmental requirements;.
Data source	EPA regional staff who conduct site visits for purposes of assistance collect the data and enter them into EPA's national compliance data system
Reporting frequency	Annual
Reporting level	In FY 2009, EPA reported this measure under the Government Performance and Results Act (GPRA). *See* Notes
Target	50% for FYs 2005-2008; 60% for FY 2009
Notes	This measure has been eliminated, for FY 2010, as a discrete GPRA measure and will instead be subsumed in the Indicator of improved environmental management practices discussed in the first table, above. It will continue to be available, however, for internal management purposes. This indicator was 51% in 2005, 74% in 2006, 91% in 2007 and 82% in 2008.