Department for Business, Energy & Industrial Strategy

INFORMATION BASED REGULATION

New roles for regulators in shaping regulatory compliance

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Executive summary

Information-based regulation is becoming popular in many parts of the world beyond its original genesis in the USA and other developed countries. It refers to schemes where information is used to drive behaviour change to achieve social, environmental or public policy objectives. Examples of schemes such as mandatory labelling, certification, ratings, rankings or online pollution inventories are different forms of information-based regulation with their respective design and implementation challenges.

Information-based regulation has the potential to provide a cost-effective set of alternative options to traditional regulation while improving compliance and driving more sustainable business behaviours. However, challenges remain in understanding the types of information-based regulation, when it might be effective and the role of regulators in its delivery.

The focus of this research is on using information-based regulation to influence firm behaviours within the environmental, energy and food policy areas. Our project is the first to collate evidence from academic research, international experience and current UK case examples on roles for regulators in information-based regulation.

Overall, the project addressed the following questions:

1. What are the main types of information-based regulation that may be used to influence firm compliance in the energy, environment and food areas?

2. What are the contemporary trends in information-based regulation, and what challenges do these pose to future regulatory design, delivery and enforcement?

3. What roles can regulators play in using information-based regulation to assure and enforce regulatory compliance?

4. What can policy makers learn from the academic literature, international experience and from contemporary UK pilot schemes on successful information-based regulation in energy, environment and food?

1. Types of information-based regulation

Information-based regulation incorporates a wide range of schemes that encourage firms to generate and share information about their social or environmental performance. Popular examples include labelling schemes such as ecolabels on products or food hygiene scores posted on restaurant doors, audit schemes that provide frameworks for firms to examine and publicise their performance, and registries such as online pollution inventories. All of these schemes have in common the idea that providing more information allows customers, investors, regulated businesses and other regulators to make better-informed decisions. While there is considerable diversity among the schemes, our project identified patterns in the types of information-based regulation.

The report develops a new general typology of information-based regulation based on whether information disclosure is mandatory or voluntary, and on whether disclosure is about compliance or beyond compliance firm behaviours. Mapping schemes within the typology allows regulators to generate regulatory options beyond mandatory disclosures of firm compliance.

To illustrate how the different types work in practice, we present three contemporary cases:

- The Statutory Food Hygiene Rating Scheme (FHRS) in Wales (Type 1: Mandatory and beyond compliance)

- The US Environmental Protection Agency's (EPA) Audit Policy (Type 2: Voluntary and compliance)

- The Environment Agency's EPR Assurance Scheme Pilot (Type 3: Voluntary and beyond compliance)

The voluntary schemes showed evidence of lower costs of enforcement and inspection, while achieving no deterioration on overall average compliance. The mandatory scheme showed evidence of improving compliance standards, but incurred some additional coordination costs to regulators (which were partly offset by cost recovery).

However, all the schemes also faced limitations, including: an unintended focus on minor compliance infractions; firms reporting little or no savings compared with traditional regulation; loss of face-to-face contact between firms and regulators; and standardisation and consistency of auditors, inspectors or certification bodies.

2. Contemporary trends in information-based regulation

We identify three generations in the development of information-based regulation. In the first generation, the focus was on improving government accountability through transparency ('right-to-know'). The second generation focused more on reducing information asymmetry to manage risks to the public and raise the quality of firm behaviours ('targeted transparency'). The current generation, 'smart disclosure', emphasises the potential to generate public value from distributed data. This recent shift has been facilitated by new technologies such as cheap sensors and big data analytics. In the smart disclosure era, regulators face the challenge of how to influence information flows to help consumers and businesses make better-informed decisions.

3. Roles for regulators

The primary contribution of our report is that it draws together the many roles that regulators can play in information-based regulation beyond simply mandating disclosure. Regulators can play an expanding range of roles in information-based schemes that may be used to assure regulatory compliance. These roles include activities such as:

- Setting the regulatory framework (e.g. setting information standards, proposing voluntary guidelines, providing incentives to disclose)

- Making government information widely accessible (e.g. setting standard indicators, maintaining online databases)

- Developing public information programmes (e.g. public education campaigns, technical assistance to firms)

- Delegating authority to a third party standard-setting body (e.g. funding or endorsing standards organisations)

- Assuring others' information (e.g. assuring third-party schemes and data credibility)

- Formatting, displaying and aggregating data (e.g. proposing or endorsing data standards)

The capabilities regulators need to fulfil these roles are evolving as regulatory approaches change from right-to-know through targeted transparency to smart disclosure. The report concludes that for successful information-based regulation, regulators need to develop new capabilities and relationships in intermediation, standard-setting, data and information management, certification and enforcement.

Overall, the study shows the importance of regulatory involvement in IBR, which is usually seen as a deregulatory approach.

4. Key messages for policy makers and regulators

Despite the theoretical potential of information-based regulation, evidence of many types of schemes working is currently inconclusive. There are few well-designed evaluation studies, and the robust studies that have been completed note many weaknesses in information-based regulation in practice. The effectiveness of information-based regulation depends on a wide range of factors including: issue risk, consumer and stakeholder interest, firm incentives, information simplicity, trust and credibility, timing, commitment, and the attitudes of senior managers.

Evidence suggests that small changes in implementation can make a large difference in the effects and effectiveness of information-based regulation schemes. Scheme success depends on assurance and credibility of the process; the most successful schemes are the ones that operate 'in the shadow of the regulator'. Thus while information-based regulation can be used to influence firm behaviours within the environmental, energy and food domains, it is most effective when it is backed by a credible commitment to more direct intervention if necessary.

Acknowledgments

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Introduction

The environment, food and energy policy areas share common policy challenges on how to reduce risks to the public and encourage businesses to raise quality standards at the lowest overall costs to society. Regulators need to find ways to manage public health hazards such as food-borne illnesses from poor restaurant hygiene, obesity from food ingredients or local pollution. They also need to address environmental hazards such as greenhouse gas emissions, waste disposal or water over-use. Since businesses often contribute to these public health and environmental hazards through their industrial processes or final products, regulators have focused on influencing the behaviours of firms.

Traditionally, regulators have regulated firms through one of two routes. First, firm behaviours underlying public risks and quality performance have been altered through direct command-and-control regulation, such as through prohibiting certain practices or mandating that particular technologies be used. Second, firm behaviours have been influenced through altering incentives in market-based schemes, such as imposing a tax on waste to landfill or subsidizing cleaner energy.

Information-based regulation developed as a third alternative as weaknesses emerged in both direct command-and-control and market-based policy instruments. Information-based regulation occurs when information is used as a primary mechanism for driving changes in behaviours to achieve social, environmental or public policy objectives. This so-called 'third wave' of governance emphasises attempts to increase the availability of information to influence individuals' or firms' choices (Tietenberg, 1998). Increased disclosure can reduce risk to the public as stakeholders make better-informed decisions. Disclosure can also raise performance standards as providers compete to signal good reputations on policy issues.

Information-based regulation has the potential to help ease pressure on regulatory burdens while also improving firm regulatory performance and achieving regulatory goals. However, challenges remain in understanding the types of information-based regulation, when it might be effective and the role of regulators in this new set of regulatory alternatives.

Project aims

This project collated evidence from academic research, international experience and current UK case examples on roles for regulators in information-based regulation. We focused on regulations within the environmental, energy and food policy areas to enable a deeper analysis, but generated an analytical description that may be applicable to other areas of non-economic regulation.

More specifically, our project supports the evidence base of the Better Regulation Executive (BRE) and the Regulatory Policy Committee (RPC) through achieving the following aims:

- Aim 1: Collate and evaluate the academic research evidence on the roles of regulators in information-based regulation in compliance assurance and enforcement in energy, environment and food policy.

- Aim 2: Develop general lessons from specific case examples to illustrate the principles of regulatory roles in information-based regulation in these policy areas, and communicate them in a form accessible to regulatory agencies and their stakeholders.

Report structure

This report is organised into five primary sections:

Section 1: Introduction, including project aims and structure

Section 2: Background and literature, including key definitions and an introduction to the history and theory of information-based regulation. This section concludes with the main research questions driving the project.

Section 3: Research method, which outlines the methods used in the two main phases of the research. The project included a rapid evidence assessment of 124 academic articles published between 1976 and 2014 on information-based regulation, and three illustrative case studies.

Section 4: Findings, including an overview of the schemes we identified through the rapid evidence assessment, evidence on the effectiveness of information-based regulation schemes, and an assessment of the roles for regulators. In this section, we develop a new typology of information-based regulation schemes and then provide three illustrative cases of how each type of scheme works in practice.

Section 5: Conclusion and future directions, draws our analysis together and shows how the role of regulators in information-based regulation is changing over time. We also suggest some areas for future academic research and evaluation studies.

Background and literature

In this section, we position information-based regulation within its policy and theoretical context. We begin with a definition of information-based regulation and some common examples to give a sense of the range of the phenomenon. We then outline the history and theory of information-based regulation. We conclude this section with the main research questions driving the project.

What is information-based regulation?

Information-based regulation is using information to drive behaviour change to achieve social, environmental or public policy objectives. While this general definition can incorporate both individual and firm behaviours relating to any public policy area, the focus of this research is on using information-based regulation to influence *firm* behaviours within the *environmental, energy and food policy areas*. Information-based regulation incorporates a wide range of schemes that generate and share information about firms' social or environmental performance.

Examples of information-based regulation included within scope for this report include *mandatory* requirements on firms to provide information about their products on labels (e.g. nutritional information on food products), to disclose ratings about their performance (e.g. restaurant hygiene scores in Wales; Energy Performance Certificates for buildings in Scotland) or to report their performance to government registers (e.g. online pollution inventory). Information-based regulation also includes an ever-expanding range of *voluntary* disclosures that could be used in compliance assurance such as environmental reports, certifications, voluntary disclosures of non-compliance, or other publicly available data that might be aggregated and linked through big data analytic techniques.

Information-based regulation has the potential to help ease pressure on regulatory burdens while also improving firm regulatory performance and achieving regulatory goals. However, challenges remain in understanding the types of information-based regulation, when it might be effective and the roles of regulators in this new set of regulatory alternatives.

History and contemporary trends

In order to understand contemporary trends in information-based regulation, it is worthwhile to consider where this type of regulation came from and how it has evolved over time.

Table 1 outlines three generations in the development of information-based regulation. The trend towards disclosure in regulatory processes began with generic **'*right-to-know*'** policies in the US from the 1960s onwards, requiring general openness in government in order to hold public officials to account (Florini, 2007; Mol, 2010). This changed the dynamics of previously closed information flows between 'expert' firms and regulators to include broader information sharing and deliberation (Gouldson, 2004), but has also been criticized for maintaining power structures (Mason, 2008). The right-to-know frame

emphasizes transparency of governance, with governments and state actors disclosing information to citizens as part of an accountability assurance agenda (Mitchell, 2011).

More open deliberation required information, eventually leading to calls for mandatory disclosure schemes such as the US Environmental Protection Agency's (EPA) Toxic Release Inventory (TRI) in 1986 (Konar & Cohen, 1997). Since then, over 50 countries have launched similar pollutant release and transfer registers (PRTRs), including England and Wales in 1998 (Gouldson, 2004). These schemes are examples of second-generation **'*targeted transparency*'** schemes, where firms are required to disclose specific factual information to support better stakeholder decision-making (Fung, Graham, & Weil, 2007). Targeted transparency shifts from transparency of governance to transparency for governance (Mitchell, 2011). It is more focused than generic right-to-know disclosure, as "government compels companies or agencies to disclose information in standardized formats" (Weil, Graham, & Fung, 2013: 1410). The goal is to mandate simplified information disclosure to 'nudge' consumers at the time that they make their decisions (Ho, 2012). Early successes in PRTRs such as the TRI have encouraged schemes in a wide variety of sectors from food hygiene ratings to building energy efficiency certificates, and beyond to vehicle safety scores, school inspection ratings, research audits at universities and publishing surgeons' success rates.

The most recent shift has been facilitated by new technologies such as cheap sensors, open data standards and big data analytics. **'*Smart disclosure*'** is the 'timely release of complex information and data in standardised, machine readable formats in ways that enable consumers to make informed decisions' (Sunstein, 2011: 2). Simply mandating disclosure through targeted transparency can lead to data overload and confusion, so smarter disclosure involves processing data to generate decision-relevant data (Bae et al., 2010). Further, while targeted transparency emphasises focused, mandatory disclosures to overcome information asymmetries, in the 'smart disclosure' era technology enables the aggregation of distributed data from a variety of sources. Government initiatives such as Obama's 'Open Government' approach in the US and the UK government's appreciation of the value of public sector information encourage making government data readily available and easy to parse an end in itself (BIS, 2013; Weil et al., 2013). Combined with corporate disclosures, customer usage data and distributed sensors, open data standards are shaping a new informational environment and offering new opportunities to information intermediaries (Thaler & Tucker, 2013).

For example, in the environmental area, context-aware technology such as mobile services and location tagging mean that *"we are moving toward a world in which states, regulators, citizens, and industry will have real-time electronic information regarding environmental conditions, emissions and compliance"* (Giles, 2013). The smart disclosure generation of information-based regulation is both more distributed and more personal (Shadbolt, 2013). This poses new challenges to policy-makers and regulators who will need guidance on the types, trends and effectiveness of regulatory interventions, and sound advice on the various roles they might play in harnessing information that they cannot directly control to assure regulatory compliance.

Table 1: The three generations of information-based regulation

	Right-to-Know (1960s onward)	Targeted Transparency (1980s onward)	Smart Disclosure (2000s onward)
Policy objective	Improve government accountability through transparency	Reduce information asymmetry to manage risks to the public and raise provider quality	Generate public value from distributed data
Primary disclosers	Government	Firms	Governments, firms, individual consumers
Primary users	Citizens and other stakeholders (incl. NGOs)	Consumers	Information intermediaries (incl. government, app developers etc.)
Enablers	Legal: Freedom of Information Acts (primarily USA federal act in 1966)	Legal: Freedom of Information Acts introduced in other developed countries in 1980s and 90s Technology: Web-based inventories; cheaper communication	Technology: Cheap and distributed sensors; big data analytics; open data standards
Illustrative references	Florini (2007) Mol (2010)	Fung et al. (2007) Mitchell (2011) Lee (2010) Tietenberg (1998)	Shadbolt (2013) Sigit Sayogo et al. (2014) Thaler & Tucker (2013)

Information flows, social actors and behaviour change

Information-based regulation relies on information flows between different social actors that might influence behaviour change. The primary social actors involved are the set of regulators (policy-makers, government departments and their agencies) and the regulated firms. However, information-based regulation is about more than direct information flows between the regulator and the regulated. Rather, information useful for regulatory purposes flows within and between the regulator, regulated and other social actors, often outside the control of regulators or the regulated firms (see Figure 1). The extent to which information can change behaviour differs according to whether the information is private to

the regulator and regulated, or it is more widely available to other social actors such as a firm's competitors, the media, local communities or NGOs (Delmas & Lessem, 2014). Private information can be useful to generate learning and assurance; public information can trigger reputational effects as firms strive to signal their sound performance.

Figure 1: Information flows in energy, environment and food regulation
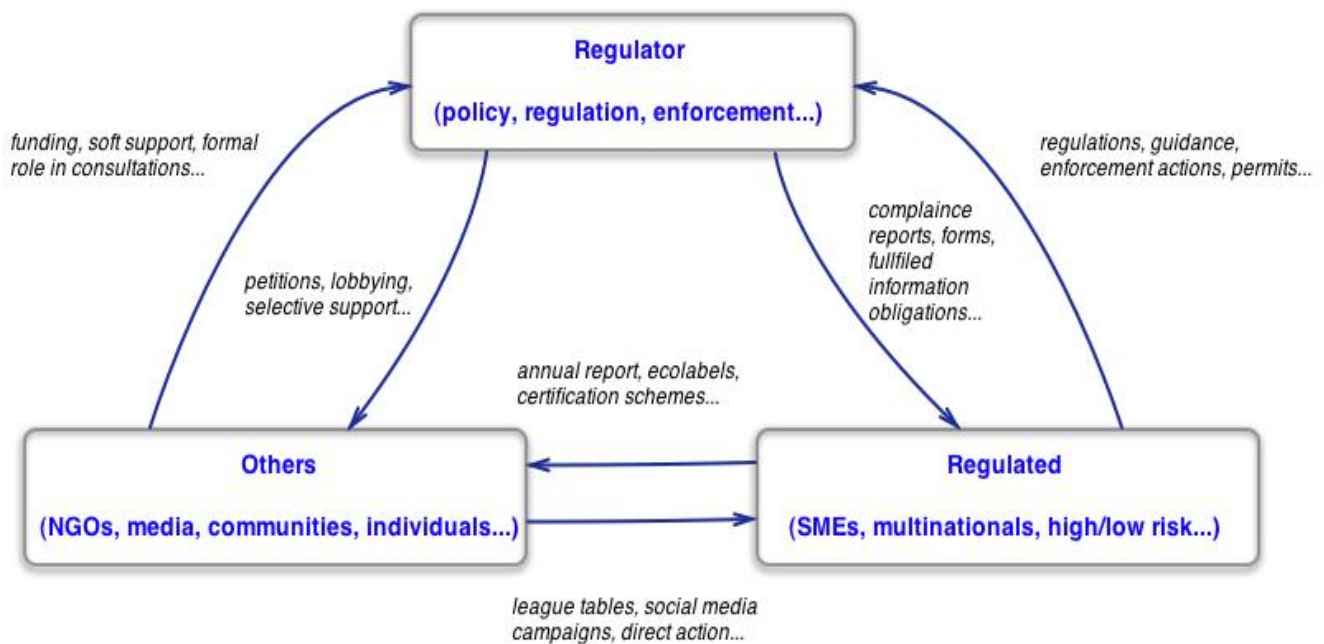
Information disclosure can drive changes in business behaviours either directly or indirectly through the reactions of consumers, investors, media and other social actors. Direct behaviour changes include firms' adaptations to internal processes and procedures to be able to disclose information that was not required before. As regulators place information obligations, guidance and mandatory requirements on firms, firms need to change their internal practices to be able to deliver on these obligations (see flow between regulator and regulated in Figure 1). Simply implementing an internal measurement, reporting and disclosure system can improve managers' awareness of firms' processes and potential efficiencies.

As Banks and Redgrove (2012) demonstrated in the context of energy behaviours and decision-making in businesses, managers do not make efficient resource decisions partly due to lack of information about their own impacts. For example, mandatory energy audits that require firms to collect and analyse energy consumption data can improve firms' own information about their own impacts, ultimately leading to energy efficiency improvements. Energy audit schemes have been introduced in Australia (Martinov-Bennie & Hoffman, 2012), China (Shen, Price, & Lu, 2012), and Germany (Fleiter, Schleich, & Ravivanpong, 2012) to improve firms' own information. However, these schemes have had less success in direct behaviour change than had been hoped because of the social dynamics and political interests around new auditing practices (Martinov-Bennie & Hoffman, 2012; Power, 1996) and other barriers to change such as up-front capital costs for small and medium sized enterprises (SMEs) (Fleiter et al., 2012).

Information-based regulation can also drive indirect behaviour changes within the broader markets and social structures that information flows are embedded (Fung et al., 2007). For example, Lee (2010) highlighted the difference between a direct effect of internal learning from the indirect effects of stakeholders (such as capital markets and NGOs) using information from a pollution disclosure scheme. Others emphasise consumer choice in using disclosures to reward or punish firm behaviours (e.g. Gallastegui, 2002; Horne, 2009). While different stakeholders have different information needs, mandating or encouraging corporate disclosures can assist a range of social actors in determining whether a firm is meeting their expectations (Kolk, 1999). Indeed, as Gouldson (2004) pointed out, new pollution information requirements in the late 1990s in England and Wales led to the emergence of new cooperative alliances between pressure groups and regulators as each sought to improve firms' environmental performance (see links between regulators and others in Figure 1).

The intended outcome of information-based regulation is to reduce risks to the public and/or improve performance quality standards. It is vital to differentiate between whether a scheme has effects – whether direct or indirect – and whether it is ultimately effective. As Fung (2007: 54) put it: *"A policy has effects when the information it produces enters the calculus of users and they consequently change their actions… A system is effective, however, only when discloser responses significantly advance policy aims."* Thus, behaviour change alone is not the ultimate goal of information-based regulation, but rather behaviour change that positively impacts on the regulatory issue at hand. Despite an increasing interest in information-based regulation as an alternative to traditional regulatory approaches, too little research connects information flows with behaviour change effects, and even less research evaluates effectiveness.

Information-based regulation offers the potential to trigger qualitatively different behavioural responses in firms compared with focusing on reducing the transaction costs of information (Fung et al., 2007; Sunstein, 2013). Initial evidence suggests that the potential of using information to shape behaviour change may vary according to:

- The availability of the information - whether the information is private to the firm and/or regulators, or is publicly available to others.

- Whether the scheme is based on mandatory or voluntary information disclosure.

- The role of information in the regulatory process – whether information is used in delivering regulatory commitments or shaping social norms.

- Who provides the information - the firm, the regulator or other third party.

- The informational context - using social or historical reference points for comparison.

- Who assures the quality of the information – first-, second- or third-party assurance, and whether regulators are involved.

However, this evidence base is still dispersed across disciplines, geographical areas and policy domains. Gathering together the evidence on new roles for regulators in

information-based regulation will provide more regulatory confidence and help incentivise alternative approaches among policy-makers and regulators.

Research questions

Given the state of the current academic literature outlined above, this project addressed the research questions:

1. What are the main types of information-based regulation that may be used to influence firm compliance in the energy, environment and food areas?

2. What are the contemporary trends in information-based regulation, and what challenges do these pose to future regulatory design, delivery and enforcement?

3. What roles can regulators play in using information-based regulation to assure and enforce regulatory compliance?

4. What might policy makers learn from the academic literature, international experience and from contemporary UK pilot schemes on successful information-based regulation in energy, environment and food?

Research method

The project was implemented in two phases: a rapid evidence assessment exercise and a more in depth analysis of three illustrative cases of regulatory schemes.

Phase 1: Desk research – rapid evidence assessment

The first step was to conduct a Rapid Evidence Assessment (REA) using established guidelines to provide an overview of the evidence on a constrained topic and an outline synthesis of the evidence. REA's are particularly appropriate when there is extensive research on a subject but critical questions still remain unanswered, as in the case of information-based regulation. A particular challenge is that the phrase '*information-based regulation*' is not used consistently or commonly in the academic literature, so significant work was needed to define and scope the relevant literature to be included in this review.

> **Rapid Evidence Assessment Question**: What roles have regulators and their agencies played in using information to influence firms' behaviours and strategies in the energy, environment and food policy areas?

The formulation of the REA question was agreed with the steering committee in the project inception meeting. We were mindful throughout of the trade-offs inherent in REAs, particularly between comprehensiveness and resources available. Given the invitation in this call to conduct academic research on regulatory issues, we focused on peer-reviewed, rigorous journal articles rather than all the grey literature available. While excluding unpublished or grey literature findings may have introduced some bias into our review, this disadvantage is outweighed by gaining academic legitimacy through focusing on more generalizable, peer-reviewed studies. We also reincorporated some of the grey literature, including government evaluations of particular schemes, when researching the illustrative case studies in phase 2 of the research. A total of 124 academic articles were coded to generate the review findings. Details about this process are provided in the technical appendix.

Phase 2: Illustrative cases and interviews

We complemented our initial desk research on the academic evidence with interviews with key informants on illustrative case studies of contemporary UK pilot schemes and international examples. The goal of this phase was to illustrate and emphasise general points from the Phase 1 REA and provide tangible illustrations of information-based regulation in action. We selected the three case studies to illustrate each of the types of schemes identified in the literature search. The selection rationale is explained in more detail in the study findings. Our case study findings are based on documentary evidence complemented by interviews with key informants for each case (seven interview participants in total).

Case 1: The Statutory Food Hygiene Rating Scheme (FHRS) in Wales

Display of Food Hygiene Rating stickers was made mandatory in all food premises in Wales since November 2013. The focus of our analysis is on the transition to mandatory display in Wales and its impact on all parties involved (consumers, food businesses, local authorities, the Food Standards Agency).

Case 2: The US Environmental Protection Agency's (EPA) Audit Policy

In 1995, the Environmental Protection Agency in the USA launched a voluntary disclosure policy commonly known as the EPA Audit Policy. The EPA Audit Policy has been one of the most visible voluntary compliance disclosure schemes with an accumulated experience of 20 years. The focus of our analysis is on the evolution of compliance and incentives to disclose voluntarily, responses from the firms and future plans about the role of the regulator.

Case 3: The Environment Agency's EPR Assurance Scheme Pilot

In 2012-13, the Environment Agency in England ran a trial of an Assurance Scheme for use in the Environmental Permitting Regulations (EPR) over 30 sites in six main industry sectors. Earned recognition in the scheme was based on firms voluntarily disclosing details of their environmental management system, which could lead to less frequent inspections by the regulator. The focus of our analysis is on lessons learnt from the trial, how it compares to similar international initiatives and the role of a regulator with respect to third party certification schemes.

Findings

In this section, we report the joint findings of our rapid evidence assessment and case studies. First, we begin with an overview of the schemes we identified through the rapid evidence assessment. Second, we identify a variety of contingencies that may impact on the effectiveness of information-based regulation schemes. Third we summarise the roles that regulators can play in information-based regulation schemes identified in the academic literature. We then go on to develop a new typology of information-based regulation schemes. The section concludes with three illustrative cases of how each type of scheme works in practice, including some insights on the roles of regulators in the different types of schemes.

Overview of papers in the REA

Of the 124 papers included in the final REA database, 71 (57%) were published in 2008 or later (see Figure 2). This indicates a growing interest in academic research in information-based regulation over the past few years, with 15 of the papers published in 2014 alone. Of the policy areas considered in this report, the environment is the most represented area (62%), followed by food (23%) and energy (15%). Environment has dominated the literature from the mid-1990s when economists began researching the US EPA's Toxics Release Inventory (TRI). A more recent resurgence of interest in information-based approaches in food policy (12 papers in 2012-14 alone) mostly addresses the potential of labels on food packaging to encourage businesses to formulate and market healthier food options.

Figure 2: Number of papers published each year on information-based regulation (1976 - 2014)
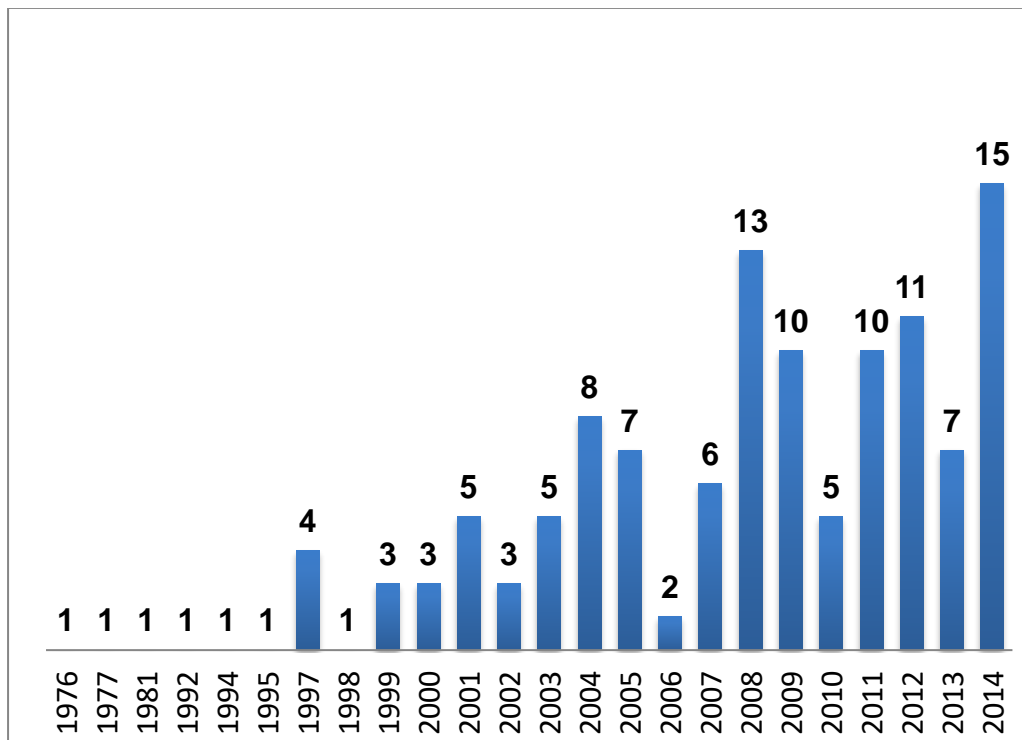

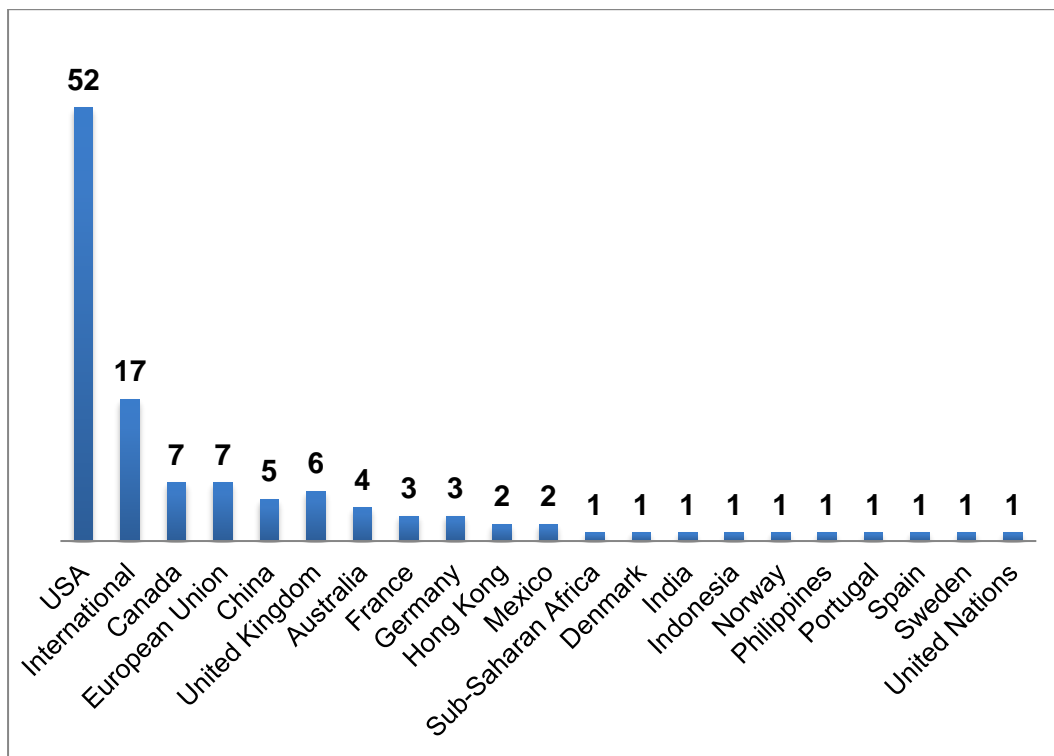**Figure 3: Distribution of empirical papers across countries**

Figure 3 shows that North America dominates the examples and case studies with 52 publications based on US data. Almost all of the studies published before 2000 were based on US schemes. 17 publications attempted comparative analyses of schemes across two or more countries (marked as International). Canada and European Union were identified as the focus in 7 papers each, with 6 studies focusing on the UK. The rest of the countries contributed 5 or fewer examples each in the papers. There is a more recent emergence of research on information-based regulation in Asian countries such as China, Indonesia and the Philippines and even a paper on targeted transparency schemes in oil and gas developments in Ghana.

Overview of schemes

The US EPA's Toxic Release Inventory (TRI) is by far the most researched scheme, with over 10% of the papers addressing this single scheme. As Table 2 shows, the TRI and other pollutant release and transfer registers (PRTRs) are the most frequently researched schemes in the environmental policy area. Also prominent are auditing schemes, where the emphasis is on firms following agreed processes to evaluate their performance and declare their own results to either the regulator or on a public register. These include energy audits aimed at assessing firms' energy efficiency, compliance audits that assess whether firms are currently in compliance with all relevant environmental regulation, and also environmental audits assessing firms' environmental practices and outcomes as part of a broader environmental management system. Audits are particularly common in so-called 'self-policing' regimes such as in the USA and Australia, where compliance enforcement is assured more through firms monitoring their own performance than by frequent inspections. Research investigating corporate reporting and industry-led schemes are also popular in the environmental domain.

Table 2: Types of schemes studied by policy area

	Energy	Environment	Food	Total
Product labels	6	5	21	**32**
Audits	6	15	0	**21**
Pollutant registers (PRTRs)	0	17	0	**17**
Corporate reporting	1	11	0	**12**
Industry-led schemes	2	6	0	**8**
Company ratings	1	0	2	**3**
Management systems	0	2	0	**2**
Total	**16**	**56**	**23**	**95**

Note: Table includes papers based on a single, identifiable information-based regulation scheme only.

The food policy area is dominated by product labeling schemes (21 out of 23 papers with identifiable schemes). These include labels indicating information about the production of the product (e.g. organic, includes GMOs, country-of-origin) and/or nutritional information (e.g. front-of-pack calorie labels, allergen contents). Company rating schemes include restaurant hygiene grading schemes and other schemes that publicly disclose a large set of firms' policy performance (e.g. disclosure of proportion of renewable fuels produced by energy companies). All three of the company ratings scheme papers are recently published studies based on US data.

Examining the trends in methods used over time suggests that the quality of research evidence is improving. All but four of the pre-2000 studies were either conceptual discussions of information-based regulation, or formal theoretical models of how social actors may react to different informational states. Since 2006, the papers demonstrate increasing methodological complexity including formal content analyses of firms' disclosures, robust mixed-method case studies, qualitative analyses of interviews with stakeholders and surveys of both information users and disclosers. While this may signal an increasing academic interest in uncovering the workings of schemes with specific designs, there are still too few formal evaluation studies in the academic literature. As a result, we are currently only able to broadly distinguish several common effects of information-based regulation at the individual, the firm and the society level (see Figure 4). Further research would be required to provide a more nuanced analysis.

Figure 4: Frequently studied effects of information-based regulation

Individual level	Firm level	Society level
• Consumer choice • Willingness to pay a price premium for high quality / low risk firms or products • Community right to know and reassurance • Consumer confusion	• Regulatory compliance • Compliance intentions • Shareholder and market reactions • Firm exit from industry • Changes in non-participating firms' behaviours	• Shift in liability • Change in power dynamics • Welfare gain or loss

Information-based regulation effectiveness

The literature suggests a variety of contingencies when information-based regulation may be appropriate. Caution is warranted in drawing these conclusions, due to the paucity of formal evaluation studies. Having said this, several key themes emerge from across the body of evidence on contexts where information-based regulation may be a preferred alternative to other regulatory approaches such as command-and-control direct regulation or market-based mechanisms. Further details and useful reviews are provided in Mitchell (2011), Fung et al. (2007) and Gouldson et al. (2008). Table 3 summarises the main findings of this section.

Issue risk

Information-based regulation seems to be the preferred approach when the hazard posed by the policy problem – whether it is local pollution, foodborne illness or obesity – presents low to medium risk. Information-based regulation works best when the performance bar is set quite low (Uchida, 2007) and should only be used as a supplementary measure where there is significant risk of environmental harm as it is not as effective as command-and-control in enforcing a given policy goal (Bizer & Julich, 1999). For example, Coestier (2005) shows that if the expected damage arising from the hazard is not too high, then mandatory labeling is more socially optimal than either an outright ban or no regulation.

Consumer and stakeholder interest

Information-based regulation is particularly effective in changing behaviours when the disclosure is highly salient to the information user. Stakeholder interest is a common driver of information disclosure (Huang & Kung, 2010), but stakeholders are not interested in disclosures about different topics to the same degree (Ibanez & Stenger, 2000). For example, consumers are more likely to pay attention to restaurant food hygiene scores when eating out with vulnerable people such as people with health problems (Vegeris & Smeaton, 2014). Although theory suggests that information-based regulation should be more effective when broader stakeholders are interested in the information (Fung et al., 2007), empirical evidence does not show a strong link between stakeholder interest and participation in audit schemes (Darnall, Seol, & Sarkis, 2009). Thus, the extent to which information-based regulation can generate stakeholder pressure on poorly performing firms crucially depends on the extent to which social actors actively pay attention to firm performance (Arora & Cason, 1999; Lee, Lejano, & Connelly, 2013).

Firm incentives

Information-based regulation can work when firms have other incentives to disclose the information aside from regulatory compliance. Such complementary incentives can include a direct willingness-to-pay by consumers for products that are indicated to have a higher social or environmental quality (for a review of willingness to pay for ecolabels, see Gallastegui, 2002). More common are diffuse indirect pressures where information-based schemes tap into reputational and legitimacy effects, particularly for large, visible firms (Brammer & Pavelin, 2008; Gouldson et al., 2008). For example, in their empirical investigation of the US Department of Energy's voluntary greenhouse gas registry, Kim and Lyon (2011) found that large firms with strong regulatory pressure were the most likely to participate. The costs and benefits of information disclosure schemes may mitigate against adoption, and in such cases regulators may have a role to play in better aligning information-based schemes with firm-level incentives to ensure their success (Golan, Kuchler, Mitchell, Greene, & Jessup, 2001).

Information simplicity

Several studies emphasise that information-based regulation works best when key information can be presented simply, succinctly and consistently (Banerjee & Solomon, 2003; Gouldson et al., 2008). In the context of front-of-package nutritional information, for example, simplicity is vital as consumers make quick decisions when shopping for food (Kees, Royne, & Cho, 2014). In their comparative study of five eco-labels Banerjee and Solomon (2003) demonstrated that simple 'seal-of-approval' labels tend to affect consumer

Table 3: Summary of effectiveness factors in information-based regulation

Contingency	Consideration for information-based regulation
Issue risk	– More appropriate for low-medium risk policies. – Should only be used as a supplement for high-risk issues.
Consumer and stakeholder interest	– More effective if stakeholders have a high interest. – Pressure on poorly performing firms depends on how social actors pay attention to firm performance.
Firm incentives	– Works better when firms have incentives to disclose other than regulatory compliance. – The costs and benefits of information disclosure schemes may mitigate against adoption.
Information simplicity	– Works best when key information can be presented simply, succinctly and consistently. – More difficult when the information relates to highly complex or abstract ideas.
Trust and credibility	– Trust and credibility are vital for an information-based scheme to work. – Credibility includes scheme ownership, stakeholder dialogue, traceability, transparency and other features required to satisfy both information providers and users.
Timing	– Most powerful when information is disclosed at the right time and as close as possible to decision-making.
Commitment and involvement	– Commitment to the scheme is needed both by government agencies facilitating the scheme and lead participants. – Sufficient administrative capacity is necessary for government-led schemes.
Senior managers	– Managerial perceptions and responses are a vital part of compliance behaviours. – Firms are more likely to learn when senior managers embrace disclosure as an opportunity rather than a threat.
Decoupling and greenwashing	– Cannot work when information disclosed is disconnected from the underlying firm behaviours or impacts.

choices more than complex information disclosures. Information-based regulation is more difficult when the information relates to highly complex or abstract ideas as consumers struggle with assessing risk (Hadfield & Thomson, 1998). Indeed, the extent to which information conveyed through product labels offers consumer choice or simply fuels consumer confusion is subject to fraught academic debate (Horne, 2009).

Trust and credibility

Both the overall scheme and the specific information provided needs to be trusted by users and credible for an information-based scheme to work. The credibility of the scheme includes scheme ownership, stakeholder dialogue, traceability, transparency and other features that might lead to satisfy both information providers and users (Nilsson, Tunçer, & Thidell, 2004). For example, Fischer and Lyon (2014) modelled the effects of voluntary eco-labels promoted by NGOs compared with industry, showing better social outcomes for the more trusted, NGO eco-labels. Banerjee and Solomon (Banerjee & Solomon, 2003) showed that government-backed energy efficiency labels were far more effective than industry-led schemes in influencing consumer behaviour.

Timing

Information-based regulation is most powerful when information is disclosed at the right time, that is, close to the time of decision-making (Fung et al., 2007). Restaurant hygiene rating schemes, for example, are proposed to be effective because the restaurant score is available to the consumer at the time that they walk in to the restaurant (Ho, 2012). Similarly, Delmas et al. (2013) observed most changes in energy efficiency behaviours if users were provided real-time feedback on their current energy performance. Several disclosure schemes have lacked effectiveness because the relevant information is displayed at a time or place remote from the information user's decision.

Commitment and involvement

Successful information-based regulation requires commitment to the scheme itself by lead actors, whether these are government agencies facilitating the scheme or lead participants (Gouldson et al., 2008). Government-sanctioned schemes require sufficient administrative capacity to maintain its functioning (Lee et al., 2013). Research suggests that schemes that require high involvement from information disclosers (e.g. energy audits) are successful partly because the process of engaging with the scheme increases issue salience for decision-makers (Delmas et al., 2013). When deciding to produce a voluntary corporate environmental report, for example, procedural commitment strengthens the likelihood of firm behaviour change and is ultimately rewarded with higher firm reputation (Philippe & Durand, 2011).

Senior managers

Lewis et al. (2014) demonstrated that firms that are led by general managers with MBAs rather than lawyers are more likely to participate in information-based schemes. This finding may be partly due to the litigious context in USA from where they derived their empirical data. However, it may apply more broadly since managerial perceptions and responses are a vital part of compliance behaviours. One of the primary mechanisms of information-based regulation is to facilitate firms' internal learning (Lee, 2010; Mitchell, 2011), and such learning is more likely to occur when senior managers embrace disclosure as an opportunity rather than a threat (Sharma, 2000).

Decoupling and greenwashing

Information-based regulation cannot work in contexts where there is significant potential for decoupling and greenwashing. One of the biggest problems with information-based schemes is that the disclosure scheme itself becomes the focus of attention rather than the ultimate outcomes of managing risks to the public or increasing quality standards (Bromley & Powell, 2012; Wijen, 2014). Decoupling occurs when the information disclosed has become disconnected from the underlying firm behaviours or impacts, so that the information is 'merely symbolic' (Bowen, 2014). Examples can be found across all three of the policy domains. For example, although the US DOE's voluntary greenhouse gas registry encouraged voluntary reporting of emissions, participating firms increased emissions over time but reported reductions (Kim & Lyon, 2011).

Roles for regulators

One of the primary aims of our project was to collate and evaluate the research evidence on the roles of regulators in information-based regulation. In this section we draw together the roles that regulators can play in this new set of regulatory alternatives. Although we undertook a systematic and thorough review of the literature, very few studies directly addressed regulators' roles. Most emphasized the role of regulators in deciding whether disclosure is voluntary or mandatory, but added little beyond this on the nuances of regulators' roles (but see Esty 2004 for a notable exception).

Overall, the academic literature suggested at least six primary roles regulators might play in information-based regulation (see Table 4). The main role for regulators in information-based regulation is to set the regulatory framework. Regulators can require mandatory disclosure of a firm's performance to be published either in online inventories (as in the TRI and other PRTRs), or displayed on the product or service itself (e.g. FSA Food Hygiene Rating Scheme in Wales). Regulators can also play a role in setting the regulatory framework in voluntary schemes by providing incentives for firms to disclose (Esty 2004). In the case of the US EPA's Audit Policy, the scheme provides explicit incentives for voluntary disclosure through regulatory relief. Softer incentives for disclosure may arise through regulatory support of voluntary pledges. For example, the UK Department of Health's (DoH) *Public Health Responsibility Deal* encourages voluntary disclosure about food products within an implicit regulatory threat that if voluntary disclosure does not alter firm behaviour then mandatory measures might follow.

Regulators can also shape voluntary disclosure schemes by setting information standards. The former UK Department for Energy and Climate Change (part of BEIS since July 2016), for example, has developed guidelines on when firms can legitimately claim carbon neutrality. Similarly, Defra has developed *Green Claims Guidance* to set standards for environmental information about products and firms. More broadly, regulators play a vital function in network governance and information exchange through participating in multi-stakeholder and multi-national agreements to promote international harmonisation (Sheldon & Roe, 2009). Finally, regulators can help set the framework through signalling policy priorities through public policy reports (Ghani, Childs, & Szewczyk, 2007) and other mechanisms such as their own strategic plans (Giles 2013).

The second primary role for regulators is to make government data widely accessible. Public authorities may be able to gain economies of scale in data collection and then share

these informational economies for the broader public benefit (Esty 2004). This role is most obvious in PRTRs such as the TRI or Defra's ambient air quality and other indicators on the UK-AIR website. However, simply collating the data is not enough: there can be considerable technical challenges and time delays in making public data available. In the case of the TRI, for example, data released is typically lagged by a year as data is reported by July 1st based on the previous year's emissions, and then takes a further few months to be released. An example of good practice is the Food Standards Agency's (FSA) online Food Hygiene Ratings database that is presented in the Application Programming Interface (API) format. This separates the role of the FSA in collecting and making the FHRS data available from the role of other information intermediaries such as smartphone app developers in processing and visualising the data for other uses.

Table 4: Main roles for regulators identified in the literature

Main role	Indicative activities
1. Setting the framework	− Require mandatory disclosure − Provide incentives for firms to disclose − Recommending or proposing voluntary guidelines − Set information standards − Participating in multi-stakeholder and multi-national agreements − Signalling policy priority
2. Making government information widely accessible	− Developing standard indicators − Maintaining online databases
3. Developing public information programmes	− Public education campaigns − Providing technical assistance to firms − Developing robust frameworks for audit processes
4. Delegating authority to a third party standard-setting body	− Funding and/or endorsing standards organisations
5. Assuring others' information	− Endorsing others' guidelines − Assuring a third-party scheme − Improving data credibility − Guarding against disinformation
6. Formatting, displaying, aggregating data	− Formatting and merging data − Standard-setting for data formats

A third role for regulators is a traditional role in supporting information and education programmes to augment other regulatory efforts. The role of the regulator in information programmes is to address problems of imperfect information, rather than the more usual

information asymmetry of disclosure programmes (Mitchell 2011). Regulators may have a role in providing social actors with information designed to remedy their lack of knowledge and so influence their behaviours. Such education programmes can be targeted at firms through technical assistance or providing frameworks for audit processes (Reibstein 2008; Anderson 2004). Alternatively, they may be directed at consumers, as was the case with the FSA's *'Look before you book'* campaign, which encouraged consumers to be aware of food hygiene scores as they chose restaurants around Valentine's Day.

A fourth role for regulators is delegating authority to a third-party certification or standard-setting body. In the case of the EPR Assurance Pilot case outlined below, the Environment Agency explored the possibility of delegating assurance for EPR compliance to the ISO, which is responsible for the ISO 14001 environmental management system rules. Expanding such a scheme may require authority to be formally delegated to agencies such as the Chartered Institute of Environmental Health, which currently certifies professionals with a range of vocational qualifications in food safety, environmental management and related areas. Others have suggested that regulators facilitate information-based regulation by setting up credible information clearinghouses, a so-called 'National Institute for the Environment' (Esty 2004), to provide independent guidance and unbiased data, evidence and recommendations. Such an authority could function similar to the National Institute for Health and Care Excellence (NICE) in the health sector in England.

The fifth role for regulators is to assure others' information. Rather than delegate authority to a third-party organisation, regulators could selectively endorse or assure others' guidelines. For example, firms can meet their statutory UK Renewable Transport Fuel Obligation by demonstrating compliance to specific qualifying standards that are advocated, designed and operated by a range of non-statutory organisations (Upham et al. 2011). Another way in which regulators may assure others' information is through improving data credibility. Various studies within our database emphasised new roles for regulators in publishing complaints, finding outliers, making complaints easier to process, ensuring credibility, undertaking public enquiries and setting data accuracy requirements to assure the quality of others' information and to guard against disinformation (e.g. Esty, 2004; Marchi & Hamilton, 2006; Agrell and Niknazar, 2014; Hoek and King, 2008). This role requires regulators to develop new capabilities and relationships in intermediation, standard-setting, testing, certification and enforcement.

Finally, regulators may play a technical role in formatting, displaying and aggregating data from a variety of sources. Bae et al. (2010) demonstrated that how state regulators processed TRI data played a critical role in achieving the TRI's intended policy goal of better information to end users. They argue that simply making more data available can be counter-productive and conclude that state data processing efforts help more than the information disclosure itself. Regulators could help aggregate and visualise data through online energy use calculators, or develop data integration protocols such as the Environment Agency's CLEAR Info project (EA 2014).

Taken together, Table 4 shows that regulators can play an expanding range of roles in information-based schemes that may be used to assure regulatory compliance. A primary contribution of our report is to draw these together into a single framework for the first time.

Types of information-based regulation

Since the academic literature on information-based regulation has only recently begun to gain momentum, few previous studies have been able to synthesise the literature to identify different types. In this section, we introduce a new typology of information-based regulation based on two dimensions: whether the disclosure is mandatory or voluntary, and on whether disclosure is about compliance or beyond compliance behaviours.

First, schemes vary in the target performance standard expected of participating firms. The 'compliance' category indicates whether the information is about firm behaviour at a basic compliance standard, above which no further compliance enforcement activity is required. The 'beyond compliance' category indicates firm performances at a level higher, or sooner, than required by basic regulatory compliance. For example, firms may display environmental permits or chemical hazards labels to demonstrate that they are in compliance with the relevant legislation. Other information schemes such as the ISO 14001 environmental management system, organic food labels or EnergyStar energy efficiency ratings may indicate that a firm's performance is higher than the basic legal compliance bar and current regulatory norms. Some graded schemes include information about different performance levels, ranging from triggering enforcement actions through broadly compliant to very good compliance performance (e.g. the FSA's FHRS).

The vast majority (82%) of the papers addressed compliance-level firm quality standards. Only 20 papers addressed the potential of using information about beyond compliance behaviours in a regulatory context. Examples include using information from the EnergyStar labelling scheme to benchmark minimum energy efficiency performance (Boyd, Dutrow, & Tunnessen, 2008), or participation in an environmental management scheme to provide some regulatory relief (Glachant, Schucht, Bültmann, & Wätzold, 2002).

The relative scarcity of studies on using beyond compliance information for regulatory purposes also reflects that this is a new and emerging policy area with comparatively few schemes currently in operation. Traditionally, regulators have understandably emphasised compliance level behaviours as an indicator of compliance assurance and enforcement. However, considering beyond compliance behaviours can also be useful for compliance assurance and enforcement, as they can indicate firms' pro-social philosophy, positive employee and customer relations, and reputation underlying sound compliance performance (Paddock & Wentz, 2014).

Second, all schemes are based on either mandatory or voluntary disclosures. In a mandatory disclosure scheme, revealing the information is required by statutory instrument, formal regulations or is automatically disclosed by the regulator. In contrast, voluntary disclosure schemes may offer optional participation in the scheme or the possibility of disclosing information though opting in to a broader statutory scheme. In voluntary disclosure schemes, disclosure may be encouraged or collated by regulators or by others, but disclosure is not mandatory within the regulatory framework. For example, businesses may voluntarily disclose their environmental performance through an environmental report, putting an eco-label on their product or revealing non-compliance incidents at their facilities in a compliance audit.

In our set of papers, the same numbers of papers reported on voluntary (47 papers) and mandatory (47 papers) schemes, and 26 papers addressed both. Mandatory disclosure

schemes dominated the earlier literature, with voluntary disclosure schemes only appearing in the academic literature from the late-1990s. A few publications compare the theory and practice of mandatory compared with voluntary schemes (e.g. Golan et al., 2001; Horne, 2009).

Table 5 illustrates a new matrix that helps to identify different types of information-based regulation based on these primary distinctions. The vertical axis represents whether the firms are required to disclose the information. The horizontal axis represents the performance quality standard that the firm is disclosing about. For the purposes of this project, we were most interested in schemes that departed from the mandatory disclosure of compliance-level information to schemes that include some element of raising performance standards (Type 1), using voluntarily disclosed information (Type 2) or both (Type 3).

Table 5: Types of information-based regulation

		Behaviour quality standard	
		Compliance	**Beyond compliance**
Disclosure requirement	**Voluntary**	Type 2: Environmental Protection Agency's Audit Policy	Type 3: Environment Agency's EPR Assurance Scheme
	Mandatory	Traditional: Chemical hazard labels	Type 1: Food Standard Agency's Food Hygiene Rating Scheme in Wales

Illustrative cases

In this section, we present illustrative cases of each of types of information-based regulation identified in Table 5, and how they are operating in practice as revealed through interviews and secondary sources during Phase 2 of our study.

Type 1 in practice: The Food Hygiene Rating Scheme in Wales (mandatory and beyond compliance)

Background

Since November 2010, the Food Standards Agency (FSA) has operated a Food Hygiene Rating Scheme (FHRS) in partnership with local authorities in England, Wales and Northern Ireland (the Food Hygiene Information Scheme (FHIS) operates in Scotland). Following inspection by a food safety officer from the local authority, food businesses are given a 'hygiene rating' ranging from 0 (urgent improvement necessary) to 5 (very good). The top end of the scale reflects levels of confidence in management, hygiene standards and cleanliness beyond those that might usually trigger a regulatory enforcement action (**beyond compliance**).

The FSA hosts a website listing the detailed ratings for all food outlets and makes the ratings available to developers and other third parties via a specialised Application Programming Interface (API). Overall evidence about the scheme in England and Wales within the period 2011-2014 suggests that it has stimulated an increase in compliance amongst food businesses; it is however difficult to conclude about its impact on numbers of food-borne illnesses (Salis et al. 2015). The finer-grained scale than a simple compliance-based pass/fail standard has been popular with consumers, since they appreciate that "hygiene standards are not black and white" (Vergeris and Smeaton, 2014: 33).

Scheme Operation

Display of food hygiene ratings is currently voluntary in England and Northern Ireland with food businesses encouraged to display a sticker and/or certificate showing their rating in a publically visible location. Display of food hygiene ratings has been **mandatory** in Wales since November 2013. From the date of this change, food businesses in Wales received a new FHRS sticker that had to be displayed in a prominent place such as the front door, window or entrance to the premises. The legislation also introduced a new requirement for food businesses to confirm their hygiene rating verbally when asked, ensuring that this information is shared with all employees.

The FSA in Wales has a duty to oversee and evaluate the implementation of the scheme including promoting the scheme to consumers and food businesses and providing support to local authorities to comply with their new responsibilities. The implementation of the statutory scheme also included requirements for an appeal process, a right to reply by food businesses that can be published on the FSA website and an opportunity to request a rerating inspection at a cost of £150. Motivation for the statutory scheme came from observations that ratings below 4 or 5 were simply not

displayed in the FSA's voluntary scheme so consumers were missing this information unless making an effort to search for it in the online database. Being required to display the sticker would also provide an important incentive for business to improve their standards.

Effectiveness

A review of the scheme's first 12 months of operation (FSA Wales 2015) suggests that there has been significant increase in hygiene rating scores across the country: 56% of Welsh food businesses had a rating of 5 (from 45% prior to the introduction of mandatory display) with 93% having a rating of 3, 4 or 5 (up from 87%). The scheme is almost unanimously visible amongst consumers who are in their great majority in favour of mandatory display. Appeals against ratings were made in 0.5% of cases and 21% of appeals resulted in changes to food hygiene ratings. There were 50 incidents of non-compliance with mandatory display of stickers with fines in the range of £150 - £200. Following 718 requests for re-rating inspections, 94.8% of businesses resulted in a higher ratings, 3.8% stayed the same and 1.4% resulted in a lower rating. More recent updates about the scheme outline similar effects. Therefore, there is good evidence to suggest that mandatory display of FHRS stickers increase efforts to achieve higher compliance scores while leading to wide-reaching consumer awareness. However, there remains a risk that standards at individual businesses might slip after they have achieved good ratings, or that the scheme may be subject to grade inflation over time (Salis et al. 2015).

Roles of Regulators

The scheme required new roles and expectations from both the Food Standards Agency, which designed the scheme, and Local Authorities, who had a new statutory duty to implement it. For example, the underlying IT platform for the rating scheme was developed and provided by the FSA, but individual local authorities needed to manage the database of inspection results (Thompson, 2011). Since local authorities were required to notify food businesses and input the results of all inspections into the database within 14 days, they needed to become "slicker and quicker" in their internal admin processes (Thompson, 2011: 3). The FSA took the lead in consultations with business and in raising consumer awareness through public information campaigns during the launch of the scheme.

A significant challenge was consistency in training and inspections. The implementation of the scheme requires coordination to ensure that a consistent inspection approach is in place by local authorities. This coordination effort did impose some administrative costs on local authorities, but was kept at reasonable levels given that there are 22 local authorities (councils) in Wales compared, for example, to England's 269 non-metropolitan districts, metropolitan and London Boroughs. In terms of inspection resources, the scheme implementation requires that all facilities have to be inevitably and periodically inspected. However, the new scheme gave an option to food businesses to pay for voluntary re-inspections, hence enabling local authorities to recover part of the cost.

Future Developments

Overall, this positive experience from Wales builds on the work of the FSA to design and implement the scheme since 2010 across the UK. The Northern Ireland Assembly has plans to make the display of FHRS stickers mandatory (Northern Ireland Assembly 2014).

It will be important to assess the longer-term impact of both schemes with regards to impacts on public health and the economic performance of food businesses.

Type 2 in practice: The Audit Policy of the US Environmental Protection Agency (voluntary and compliance)

Background

In 1995, the Environmental Protection Agency (EPA) in the USA launched a policy on 'Incentives for Self-Policing: Discovery, Disclosure, Correction and Prevention of Violations', commonly known as the EPA Audit Policy. The policy provides guidelines for waiving or reducing penalties for compliance violations if firms **voluntarily** and promptly disclose non-compliance discovered through a systematic auditing programme and cooperate with the US EPA throughout. Other policy conditions that need to be met include prompt correction and remediation, measures to avoid re-occurrence and no repeat violations. The EPA's Audit Policy has been one of the most visible 'self-policing' schemes with an accumulated experience of 20 years. It complements other well-known information-based schemes by the US EPA such as the Toxic Release Inventory.

Scheme Operation

The policy's guidelines apply to whether the firm is in **compliance** with current regulatory requirements (e.g. hazardous waste regulations; Clean Air Act). There are three main incentives for disclosure: (1) significant penalty reductions, (2) no recommendation for criminal prosecution when all conditions are met and (3) no routine requests for audit reports to trigger enforcement investigations. There is a network of ten different regions across the country where the scheme is implemented under the oversight and coordination of the federal EPA. Individual states might have slightly different approaches to the specifics of disclosures and managing the process as long as they comply with the broader federal policy framework.

Since the introduction of the policy, the EPA has received disclosures from over 7,700 entities at over 21,000 facilities. The majority of disclosures have resulted in compliance with reporting requirements that assure community right-to-know. All compliance issues are made available through the Enforcement Compliance History Online database once they are resolved.

Effectiveness

The EPA has not conducted its own formal evaluation of the policy since the required 3-year review in 1999, which led to the issuance of the 2000 Audit Policy that updated the 1995 policy in a number of respects. However, as arguably the most famous self-policing audit scheme internationally, the EPA's Audit Policy has been the subject of several academic papers. In a large-scale empirical study using data from 19,983 facilities in 1991-2003, Toffel and Short (2011) conclude that firms that voluntarily disclosed regulatory violations under the Audit Policy improved their regulatory compliance and environmental performance. Stretesky and Lynch (2008) find that facilities that use the Audit Policy have similar subsequent emissions trends as those that do not use the policy,

showing that self-policing neither improves or deteriorates environmental performance in the chemical and allied products industry. Others have noted the tendency to only disclose minor infractions through the Audit Policy scheme. Studies have also found that firms are more likely to disclose under the Audit Policy if they face a higher probability of inspection (Stafford 2007), or only after regulators had already committed a disproportionate amount of enforcement resources to inspect and prosecute them (Short and Toffel 2008). Thus, the policy appears to be most effective when it operates 'in the shadow of the regulator'.

Roles of Regulators

Since disclosures are voluntary, the regulator does not have direct control of the flow or format of information received from firms, so the staff at the EPA's Office of Enforcement and Compliance Assurance (OECA) have needed to develop routines to cope with inconsistent and unpredictable information disclosures. In general, engagement around the implementation of the policy tends to come from the industry itself and the surrounding legal experts, rather than other stakeholders like environmental or consumer groups. Thus OECA staff also developed relationships with networks of corporate legal counsel who have experience of managing disclosures under the scheme. Such relationships have been useful to gain informal feedback on the operation of the Audit Scheme and to disseminate information about scheme changes.

Administrative costs to the EPA remain reasonably high since every disclosure has to be evaluated; there are also additional enquiries from firms about meeting the requirements and understanding the disclosure process. Having said this, the interview respondents at the EPA implied that the emphasis on encouraging companies to monitor their internal processes and providing incentives to cooperate may have lowered the overall cost of enforcement.

Future Developments

Future plans about the Audit Policy are in accordance with the Next Generation Compliance Agenda (Giles, 2015). The so-called "Next Gen" agenda emphasizes the use of advanced monitoring tools, independent third party verification of compliance with settlement regulations, electronic reporting and increased transparency of compliance data. Feedback from industry suggests high interest in approaches that are based on advanced monitoring tools and a good level of commitment from good environmental performers. For more details on "Next Gen" at the US EPA, see Paddock and Wentz (2014).

Type 3 in practice: Environment Agency's EPR Assurance Scheme (voluntary and beyond compliance)

Background

The Environmental Permitting System in the England covers permits for 19,000 industrial facilities. This single regulatory framework covers permits related with waste management, pollution prevention and control, water discharge consents, groundwater authorisations and the regulation of radioactive substances. In 2012-13, the Environment Agency in England ran a trial of an Assurance Scheme for use in the Environmental Permitting

Regulations (EPR) across 30 sites in six main industry sectors over 18 months (including food and drink, waste, chemicals and cement and minerals).

Scheme Operation

One of the components of the scheme was to allow firms to demonstrate **beyond compliance** performance levels through an existing, certified environmental management scheme (e.g. having an ISO 14001 certification). Earned recognition was based on firms **voluntarily** disclosing details of their environmental management system, which could lead to less frequent inspections by the regulator. This was achieved via the introduction of an Annual Compliance Statement signed by the CEO (or equivalent) confirming that environmental performance and compliance is led at the highest level within companies.

Effectiveness

The Environment Agency commissioned a report to evaluate the scheme in May 2014 (Environment Agency 2014). During the trial, there was no deterioration in overall average site compliance performance compared to the preceding two years or an increase in substantiated complaints. There was also an overall net reduction in the time that inspectors spent on audit and advice under the Assurance Scheme, indicating lower overall cost of inspection.

There were wide variations in business responses on the scheme depending on the different industries that firms came from. All firms taking part were interested in earned recognition with almost all participants successfully completing the Annual Compliance Statement. However, firms were not able to clearly identify a reduction of administrative burden although it was widely stated that familiarity under a full scheme could improve this. Furthermore, firms that took part tended to have good prior compliance levels, suggesting that this scheme is not appropriate for poorly performing firms.

Roles of Regulators

The Assurance Scheme trial suggests a shift in the traditional role of regulators in earned recognition schemes. Traditional inspections present opportunities for inspectors to interact with and build relationships with firm representatives. The trial participants noted that they highly value the learning in these relationships, but that the pilot scheme did not offer informal assistance from inspectors during their visits. Instead, in an earned recognition scheme, regulators need to maintain good working relationships with certification bodies like the UK Accreditation Service. The skills and experience of certification bodies and third-party auditors might vary widely compared to a single inspection regime. Regulators play a vital role in ensuring that there is a unified approach to earned recognition that could gain acceptance by both firms and regulators.

In the longer term, if earned recognition can work independently, then the regulator would face the challenge of redefining their role beyond assuring others' standards. In this case,

there may be alternative regulatory roles beyond enforcement like consultation services and advice, at least for groups of consistently top environmental performers.

Future Developments

The Environment Agency decided not to roll out the EPR Assurance Scheme at scale because of the mixed experiences of businesses in different sectors in the pilot, and is continuing to explore the possibility of similar schemes in specific industries. The agency remains committed to the principle of earned recognition, and continues to develop their Future Regulation strategic programme.

Lessons from the illustrative cases

Comparing the workings, effectiveness and challenges faced by each of the three illustrative schemes suggests several lessons for regulators (see Table 6). Clearly, caution is warranted in generalising these insights due to the small sample of cases and the relatively limited data we accessed on each. Having said this, comparing the cases can give some starting points for future work on the roles of regulators in information-based regulation.

First, the cases suggest that the underlying mechanism driving performance improvement is different in each case. For the mandatory, beyond compliance scheme (Food Hygiene Ratings), firm behaviour change is driven though the social and consumer pressure of making current performance highly visible. Stickers influence consumer awareness and choices; firms respond by striving for a high score and applying for re-inspection if their score is not high enough. In contrast, in the voluntary compliance scheme (EPA Audit Policy), compliance behaviours improve as firms audit their own activities and processes. The key mechanism here is internal learning, rather than an external driver from customers or other stakeholders. Indeed, in the EPA case, the scheme administrators were not aware of any interest from consumer or pressure groups in the scheme. In the voluntary, beyond compliance scheme (EA EPR Assurance), the goal is not so much to change current compliance behaviours, but rather to provide earned recognition and administrative relief for prior improvements. This highlights the importance of understanding which mechanism may drive behaviour change in a given context and designing the implementation of the scheme accordingly.

The two voluntary schemes showed evidence of lower costs of enforcement and inspection, while achieving no deterioration on overall average compliance. The mandatory scheme showed evidence of improving compliance standards, but incurred some additional coordination costs to regulators (which were partly offset by cost recovery). While it is not possible to generalise these findings on costs and benefits to all voluntary or mandatory schemes, this pattern is worthy of further investigation in future studies. The preliminary lesson is that voluntary approaches may incur lower direct costs to the regulator, but also are less effective in improving compliance behaviours. Voluntary schemes are thus only appropriate in contexts where compliance performance is already quite good.

Table 6: Summary of the three illustrative cases

	Type 1: The Food Hygiene Rating Scheme in Wales	Type 2: The Audit Policy of the US Environmental Protection Agency	Type 3: Environment Agency's EPR Assurance Scheme
Disclosure requirement	Mandatory	Voluntary	Voluntary
Quality standard	Beyond compliance	Compliance	Beyond compliance
Improvement mechanism	Social pressure for improvement through naming and shaming	Self-improvement through audit and learning	Earned recognition for prior performance improvement
Effectiveness	− Evidence of improving compliance standards − Efficient focus on lowest performers, highest risk − Possibility to recover part of the cost	− No deterioration in overall compliance levels − Lower overall cost of enforcement	− No deterioration in overall site average compliance − No increase in complaints during the trial − Lower cost of inspection
Challenges	− Effort to maintain a standardised and consistent inspection approach with local authorities − Periodic inspection of all facilities required − Hard to measure public health outcome effectiveness	− Minor infractions tend to be the ones that get disclosed − The policy works as a guideline, not as an enforceable promise − Only works well 'in the shadow of the regulator'	− Firms reported little or no savings in the trial − Some firms value face-to-face contact with inspectors − Skills and experience of certification bodies and third-party auditors may vary widely

However, all the schemes also faced challenges. First, in both of the voluntary schemes, there is little scope for significant compliance improvements. For example, under the

EPA's Audit Policy, it is minor infractions that tended to be disclosed rather than major ones. Similarly, in the EPR Assurance Scheme, participating businesses tended to already have a strong compliance record. This can lead to an unintended focus on relatively minor compliance infractions and/or good performers, which is counter to the usual desire to expend more regulatory effort on the highest risk, worst performers.

Second, both beyond compliance schemes struggled with standardisation and consistency. In the FSA's Food Hygiene Rating Scheme considerable effort was required to train 200 local authority inspectors to evaluate the performance of food businesses against the FSA scheme's criteria. The low number of businesses that requested a re-inspection (0.5%) suggests that regulators coped with the consistency challenge well, but it did take considerable learning and effort as the scheme was launched. The EA's EPR Assurance scheme also raised the issue of consistency, but this time in the skills and experience of certification bodies and third-party auditors. In a mandatory scheme, the consistency problem remains within the regulator; whereas in voluntary schemes the regulator must take a more active external role developing relationships and consistency with third-party auditors.

Third, as in the rapid evidence assessment above, all three schemes work best 'in the shadow of the regulator'. Direct involvement, or a credible commitment to direct intervention, is vital to underpin compliance performance. In the mandatory scheme this involvement is in the form of periodic inspections for all facilities to award new food hygiene stickers and scores. For the voluntary schemes, firms are more likely to participate if they face a higher probability of inspection, or only after regulators had already committed a disproportionate amount of enforcement resources to inspect and prosecute them. Indeed, in the EPR Assurance Scheme, some participating businesses stated that they would miss the face-to-face contact with inspectors that a more hands-off, information-based approach would provide.

Finally, firms reported little or no savings compared with traditional regulation in the EPR Assurance trial. This is a common problem in information-based schemes. Information-based schemes do not necessarily reduce overall administrative burden on firms because they still need to collect, assure and disclose information.

Overall, the three illustrative cases provide some pointers for future research. Examining more schemes in action could help establish whether the initial findings here are generalisable. In particular, we would encourage further research on the links between types of information-based regulation and (1) whether performance improvements are driven by external social pressure or internal learning; (2) the relative costs and benefits of different scheme designs, including administrative burden on firms; and (3) credible regulatory commitments and the effectiveness of information-based regulation schemes.

Conclusion and future directions

This is the first systematic review of information-based regulation in the environment, food and energy policy areas. We reviewed a set of 124 academic papers that have been published internationally, mostly since the 1990s. We outlined the trends in the information-based regulation literature by discipline, country, policy domain, method and strength of evidence. Our report develops a new typology of information-based regulation based on whether disclosure is voluntary or mandatory, and whether the reported performance standard is based on the compliance or beyond compliance level. We outlined three case studies illustrating these types in practice.

The roles of the regulator are evolving over time through the three generations of information-based regulation (see Table 7). Traditionally in the right-to-know era, the role of the regulator was primarily limited to making government information available and to disseminating public education programmes. The targeted transparency era challenged regulators to a range of new roles, primary among them setting the regulatory framework. Targeted transparency schemes such as the EPA's TRI and the Audit Policy both required regulators to learn when to make firm disclosure mandatory, collating and maintaining official databases, and providing standardised guidelines for data quality and audit processes.

Table 7: The changing roles of the regulator in information-based regulation

Right-to-know (1960s onward)	Targeted transparency (1980s onward)	Smart Disclosure (2000s onward)
– Making government information available – Public information programmes	– Setting the regulatory framework – Collating and maintaining official databases – Improving data credibility – Developing audit processes	– Delegating authority – Assuring others' information – Formatting, displaying, aggregating data

However, the new era of smarter disclosure requires a different set of regulatory capabilities. Sayogo and Pardo (2013) summarise the roles of regulators in the smart disclosure era as the identifier of opportunity, challenger for the industry and promoter of the initiative. The EPR Assurance Scheme is an example where regulators have needed to shift from controlling internal consistency within official inspections (as with the FSA's FHRS) to developing relationships and consistency with delegated third part auditors. This implies striking a delicate balance between ceding direct control of gathering, collating and publishing firm performance data on the one hand, and providing sufficient assurance that information-based schemes are credible on the other.

The most consistent finding across the studies in our database is that information-based regulation works best 'in the shadow of the regulator'. However, there is very little current research on how regulators can achieve this as they shift to shaping the decision context for firms, rather than directly collecting information from them. The new role for regulators in smarter disclosure is intermediary facilitation – regulators need to make it easier for consumers, investors, media, NGOs and others to access information they need to pressure and reward firms for good performance. More research is needed on how regulatory information can create public value in the smart disclosure era, and how regulators can harness others' information to change firm behaviours and meet regulatory goals.

Overall, despite theoretical enthusiasm, evidence that information-based regulation actually works is weak. There are too few formal evaluation studies, and even among a broader set of empirical papers, the effects and effectiveness of information-based regulation is not always clear. In particular, academic research is still vague about detailed antecedents and consequences of information-based regulation, with many opportunities for future evaluative and empirical research to test the various contingencies identified in this review.

Our report is the first to explicitly address the roles of regulators in information-based regulation and how these are evolving. Future research should seek to integrate findings from the targeted transparency literature (where the regulatory goal is to decrease risk to public or raise performance standards) with contemporary research on open government (where emphasis is on adding public value through smarter disclosure). Drawing these together will help understand how regulators can best use information-based approaches as part of a broader suite of alternatives to direct regulation.

Technical appendix

This section provides further details on the rapid evidence assessment conducted as phase 1 of this research.

> **Rapid Evidence Assessment Question**: What roles have regulators and their agencies played in using information to influence firms' behaviours and strategies in the energy, environment and food policy areas?

Given that the literature on 'information-based regulation' spreads across several disciplines and policy domains, we sought to identify all relevant academic sources that addressed the intersection between regulatory theory, information and behaviour change and corporate social strategy. We began with a 'review of reviews approach' to generate a list of core concepts. We then developed a list of keywords and variants to search for relevant journal articles. The EBSCO Business Source Complete database was selected as the primary source. The database contains the full text of nearly 2,000 peer-reviewed academic journals and is recognised as the most definitive scholarly, full-text business database. Given the wide literature base, we experimented with several variants of keywords to generate a manageable number of relevant sources.

Figure 5: Search terms used in the Rapid Evidence Assessment

Concept terms	Domain terms
•information disclosure	•enviro*
•corporate disclosure	•pollution
•mandatory disclosure	•food
•information-based	•energy
•reporting	
•rating*	
•audit	
•scorecard	
•label*	
•screen*	
•social regulation	
•soft law	
•transparency	
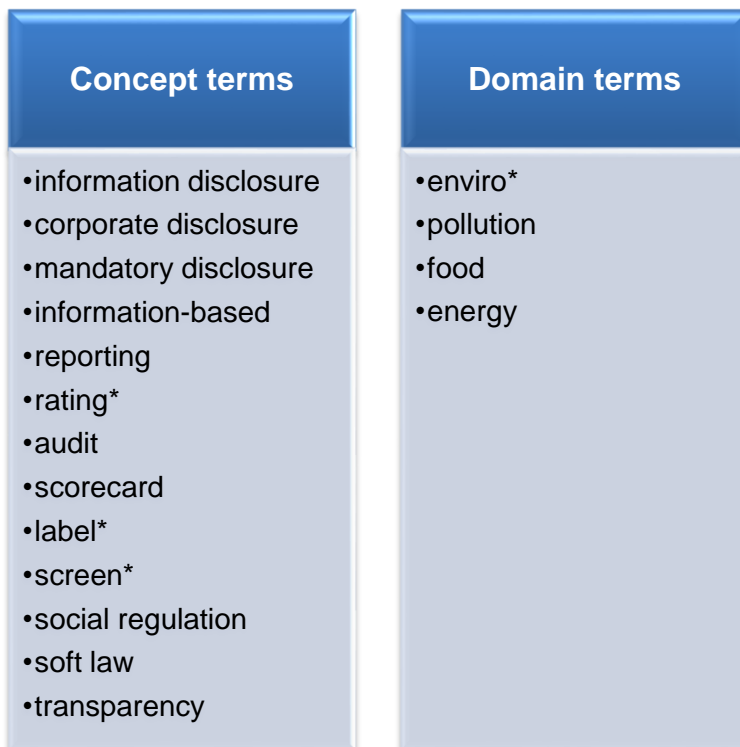
Figure 6: Flowchart of the selection and screening process

Academic literature citation search → **9,716 papers**

Screen abstract for relevance → **211 papers**

Screen full paper for relevance → **124 papers**

Content coding for selected papers
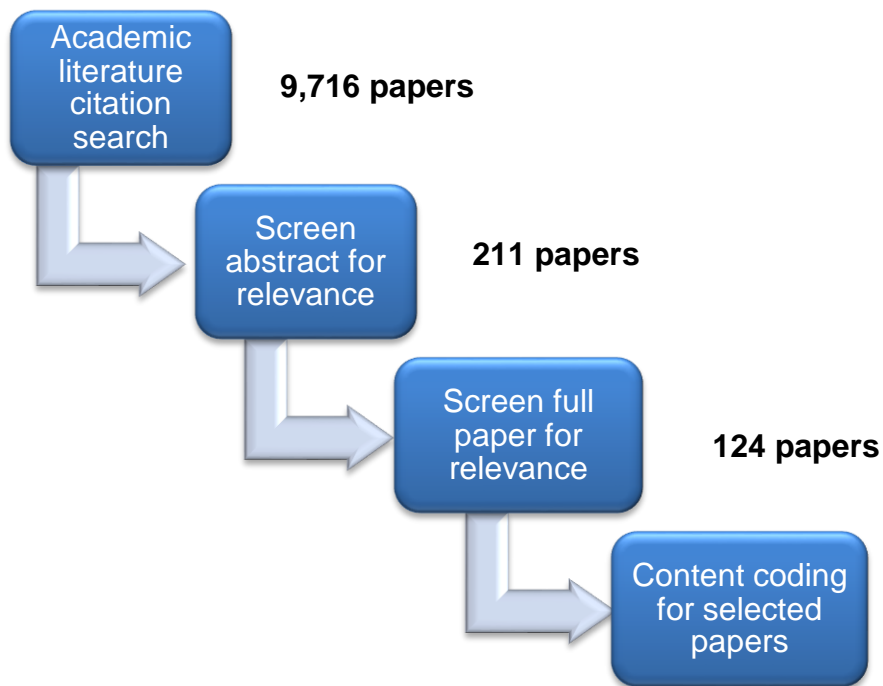
Table 8: Coding primary and secondary themes in academic papers

Primary Theme	Secondary Theme
Theory used	Disciplinary base (economics, law, marketing, environment & planning etc.)
	Theoretical frame (information asymmetry; socio-political legitimacy; norms and nudges etc.)
Empirical features	Country focus
	Policy area (food, energy, environment)
Scheme features	Name
	Disclosure mode (mandatory or voluntary)
	Quality standard (compliance or beyond compliance)
	Role of the regulator
	Context and primary drivers
	Effects and effectiveness
Other	Rigour and strength of evidence

We searched all scholarly journals within the EBSCO Business Source Complete database in English for papers with the search terms in the title or abstract. The search terms included each combination of a concept term and a domain term from Figure 5. Initial searches generated a list of 9,716 abstracts, which were manually screened for relevance to our questions based on the paper abstract, yielding 211 full text papers. We then screened these based on full text, yielding a final sample of 124 papers (see Figure 6). This set of papers was then coded based on the dimensions outlined in Table 8.

The starting point in our analysis is to overview the titles of the 124 eventually selected in the database, which gives a first indication of their content. The word cloud in Figure 7 provides *prima facie* evidence that the 124 papers addressed topics of relevance to our REA question. Words mentioned over 10 times in paper titles included: "Environmental" (48 papers), "Disclosure" (26 papers), "Information" (24 papers), "Food" (19 papers), "Regulation" (16 papers), "Energy" (15 papers), "Labelling" (15 papers), "Policy" (15 papers), "Evidence" (13 papers) and "Mandatory" (11 papers).

Figure 7: Word cloud of 124 paper titles

**Figure 8: Distribution of 124 papers across policy areas and base disciplines**

Business and Management (including Accounting) and Economics are the most common base disciplines of the papers (see Figures 8 and 9). In recent years, there has been broad cross-disciplinary interest in information-based regulation, for example, papers from 2014 were published in journals specializing in all but one of these disciplinary areas (public health). However, too few papers extend beyond their own narrow disciplinary focus and most rely on their core home discipline for theoretical guidance.

Figure 9: Distribution of base disciplines of the papers
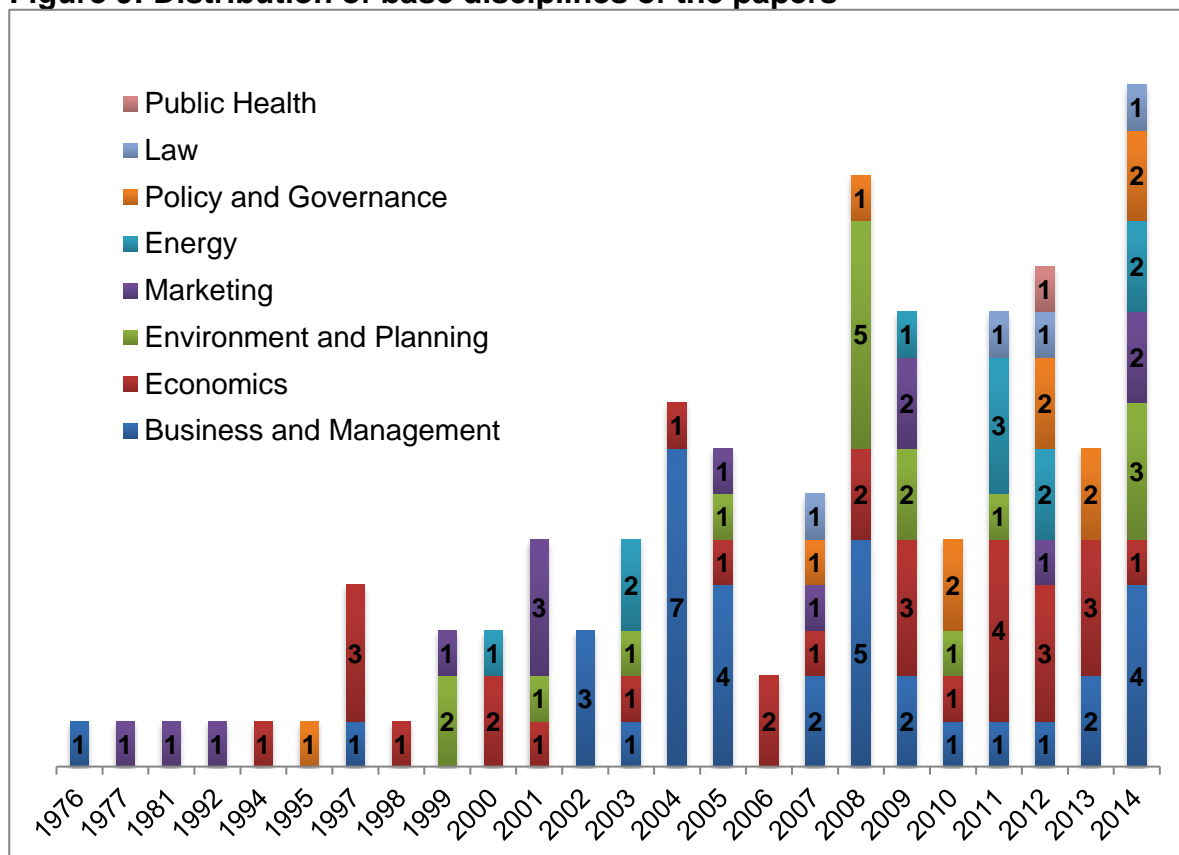
Almost 40% of the papers are either conceptual discussions (27 papers) or descriptive case studies of the operation of particular schemes (20 papers), with little firm evidence of the scheme's effects or effectiveness (see Figure 10). While a third of the papers are based on generating and then testing hypotheses (39 papers), these are more likely to test for drivers of participation in the first place than to test for performance outcomes. Most of the hypothesis-testing papers (29 out of 39) are based on US data, which offers large-scale tests of facility-level TRI data and from the EPA's Audit Policy. Only 11 studies contain relatively formal evaluation studies of information-based regulation schemes in practice – 8 from the USA and 3 from the EU. There are currently too few well-designed evaluation studies to be able to draw confident conclusions on when information-based regulation is effective.

Figure 10: Primary method deployed in each of the papers
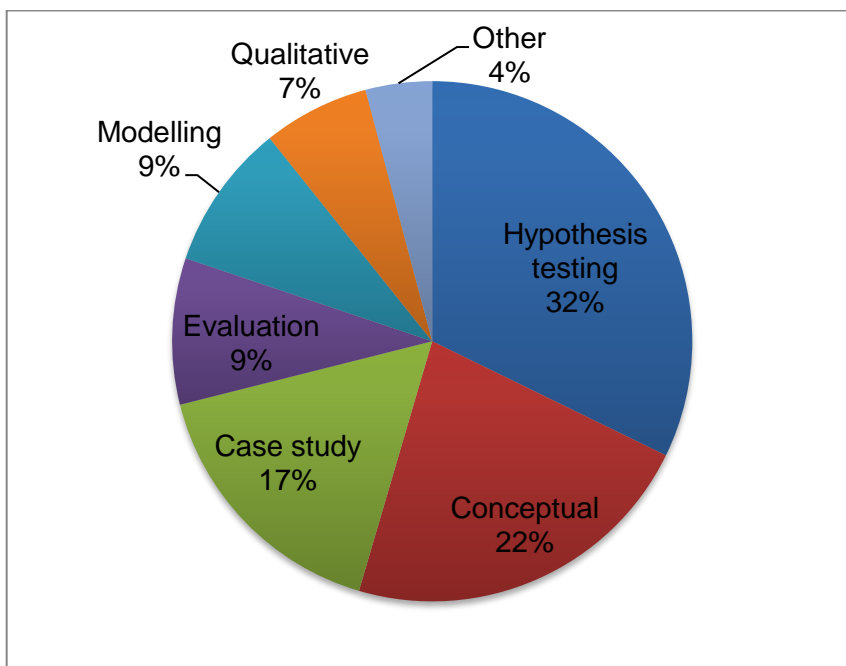
References

Agrell, P. J. & Niknazar, P. (2014). Structural and behavioural robustness in applied best-practice regulation, *Socio-Economic Planning Sciences, 48*(1): 89-103.

Anderson, S. T. & Newell, R. G. (2004). Information programs for technology adoption: The case of energy-efficiency audits. *Resource & Energy Economics, 26*(1): 27.

Arora, S. & Cason, T. N. (1999). Do community characteristics influence environmental outcomes? Evidence from the toxics release inventory. *Southern Economic Journal*, 691-716.

Bae, H., Wilcoxen, P. & Popp, D. (2010). Information disclosure policy: Do state data processing efforts help more than the information disclosure itself? *Journal of Policy Analysis & Management, 29*(1): 163-182.

Banerjee, A. & Solomon, B. D. (2003). Eco-labeling for energy efficiency and sustainability: A meta-evaluation of US programs. *Energy Policy, 31*(2), 109.

Banks, N., & Redgrove, Z. (2012). What are the factors influencing energy behaviours and decision-making in the non-domestic sector? A rapid evidence assessment: Department of Energy and Climate Change (DECC).

BIS. (2013). The Shakespeare Review: An independent review of public sector information (May 2013 ed.): Department for Business, Innovation and Skills (BIS).

Bizer, K., & Julich, R. (1999). Voluntary agreements - trick or treat? *European Environment: The Journal of European Environmental Policy, 9*(2), 59.

Bowen, F. (2014). *After greenwashing: Symbolic corporate environmentalism and society*: Cambridge University Press.

Boyd, G., Dutrow, E. & Tunnessen, W. (2008). The evolution of the Energy Star® energy performance indicator for benchmarking industrial plant manufacturing energy use. *Journal of Cleaner Production, 16*(6), 709-715.

Brammer, S. & Pavelin, S. (2008). Factors influencing the quality of corporate environmental disclosure. *Business Strategy & the Environment, 17*(2), 120-136.

Bromley, P. & Powell, W. W. (2012). From smoke and mirrors to walking the talk: Decoupling in the contemporary world. *Academy of Management Annals, 6*(1), 483-530.

Coestier, B., Gozlan, E. & Marette, S. (2005). On food companies liability for obesity. *American Journal of Agricultural Economics, 87*(1), 1-14.

Darnall, N., Seol, I. & Sarkis, J.(2009). Perceived stakeholder influences and organizations' use of environmental audits. *Accounting, Organizations & Society, 34*(2), 170-187.

Delmas, M. A., Fischlein, M. & Asensio, O. I. (2013). Information strategies and energy conservation behavior: A meta-analysis of experimental studies from 1975 to 2012. *Energy Policy, 61*, 729-739.

Delmas, M. A., & Lessem, N. (2014). Saving power to conserve your reputation? The effectiveness of private versus public information. *Journal of Environmental Economics & Management, 67*(3), 353-370.

Environment Agency (2014). *EPR Assurance Trial,* Environment Agency, Bristol, UK, May 2014

Esty, D. C. (2004). Environmental protection in the information age. *New York University Law Review,* 79 (115)

Fischer, C. & Lyon, T. P. (2014). Competing environmental labels. *Journal of Economics & Management Strategy, 23*(3), 692-716.

Fleiter, T., Schleich, J. & Ravivanpong, P. (2012). Adoption of energy-efficiency measures in smes—an empirical analysis based on energy audit data from Germany. *Energy Policy, 51*, 863-875.

Florini, A. (2007). *The Right to Know: Transparency for an open world*: Columbia University Press.

Food Standards Agency Wales (FSA Wales) (2015). *Review of the implementation and operation of the Statutory Food Hygiene Rating Scheme in Wales and the operation of the appeals system,* Report for the National Assembly for Wales, Cardiff, February 2015.

Fung, A., Graham, M., & Weil, D. (2007). *Full disclosure: The perils and promise of transparency*. Cambridge: Cambridge University Press.

Gallastegui, I. G. (2002). The use of eco-labels: A review of the literature. *European Environment: The Journal of European Environmental Policy, 12*(6), 316.

Ghani, W. I., Childs, N. M., & Szewczyk, S. H. (2007). Food marketing practices and anti-obesity policy: Impact on shareholder wealth. *Marketing Management Journal, 17*(1), 123-135.

Giles, C. (2013). Next Ceneration compliance. *Environmental Forum*(Sept - Oct), 22-26.

Giles, C. (2015). Use of Next Generation compliance tools in civil enforcement, United States Environmental Protection Agency (US EPA), Washington, DC, January 2015

Glachant, M., Schucht, S., Bültmann, A. & Wätzold, F. (2002). Companies' participation in emas: The influence of the public regulator. *Business Strategy & the Environment, 11*(4), 254-266.

Golan, E., Kuchler, F., Mitchell, L., Greene, C. & Jessup, A. (2001). Economics of food labeling. *Journal of Consumer Policy, 24*(2), 117-184.

Gouldson, A. (2004). Risk, regulation and the right to know: Exploring the impacts of access to information on the governance of environmental risk. *Sustainable Development, 12*(3), 136-149.

Gouldson, A., Lopez-Gunn, E , Van Alstine, J., Rees, Y., Davies, M., & Krishnarayan, V.. (2008). New alternative and complementary environmental policy instruments and the implementation of the water framework directive. *European Environment: The Journal of European Environmental Policy, 18*(6), 359-370.

Hadfield, G. K. & Thomson, D. (1998). An information-based approach to labeling biotechnology consumer products. *Journal of Consumer Policy, 21*(4), 551-578.

Ho, D. E. (2012). Fudging the nudge: Information disclosure and restaurant grading. *Yale Law Journal, 122*(3), 574-688.

Hoek, J. & King, B. (2008). Food advertising and self-regulation: A view from the trenches, *Australian & New Zealand Journal of Public Health, 32*(3): 261-265.

Horne, R. E. (2009). Limits to labels: The role of eco-labels in the assessment of product sustainability and routes to sustainable consumption. *International Journal of Consumer Studies, 33*(2), 175-182.

Huang, C-L, & Kung, F-H (2010). Drivers of environmental disclosure and stakeholder expectation: Evidence from Taiwan. *Journal of Business Ethics, 96*(3), 435-451.

Ibanez, L. & Stenger, A. (2000). Environment and food safety in agriculture: Are labels efficient? *Australian Economic Papers, 39*(4), 452.

Kees, J., Royne, M. B., & Cho, Y-N. (2014). Regulating front-of-package nutrition information disclosures: A test of industry self-regulation vs. Other popular options. *Journal of Consumer Affairs, 48*(1), 147-174.

Kim, E-H, & Lyon, T. P. (2011). Strategic environmental disclosure: Evidence from the DOE's voluntary greenhouse gas registry. *Journal of Environmental Economics & Management, 61*(3), 311-326.

Kolk, A. (1999). Evaluating corporate environmental reporting. *Business Strategy & the Environment, 8*(4), 225-237.

Konar, S. & Cohen, M. A. (1997). Information as regulation: The effect of community right to know laws on toxic emissions. *Journal of Environmental Economics & Management, 32*(1), 109.

Lee, E. (2010). Information disclosure and environmental regulation: Green lights and gray areas. *Regulation & Governance, 4*(3), 303-328.

Lee, E., Lejano, R. P., & Connelly, R. J. (2013). Regulation-by-information in areas of limited statehood: Lessons from the philippines' environmental regulation. *Regulation & Governance, 7*(3), 387-405.

Lewis, B. W., Walls, J. L., & Dowell, G. W. S. (2014). Difference in degrees: CEO characteristics and firm environmental disclosure. *Strategic Management Journal, 35*(5), 712-722.

Martinov-Bennie, N. & Hoffman, R. (2012). Greenhouse gas and energy audits under the newly legislated australian audit determination: Perceptions of initial impact. *Australian Accounting Review, 22*(2), 195-207.

Mason, M. (2008). Transparency for whom? Information disclosure and power in global environmental governance. *Global Environmental Politics, 8*(2), 8-13.

Marchi, S. & Hamilton, J. (2006). Assessing the accuracy of self-reported data: An evaluation of the Toxics Release Inventory, *Journal of Risk and Uncertainty, 32*(1): 57-76.

Mitchell, R. B. (2011). Transparency for governance: The mechanisms and effectiveness of disclosure-based and education-based transparency policies. *Ecological Economics, 70*(11), 1882-1890.

Mol, A. P. J. (2010). The future of transparency: Power, pitfalls and promises. *Global Environmental Politics, 10*(3), 132-143.

Nilsson, H., Tunçer, B., & Thidell, Å. (2004). The use of eco-labeling like initiatives on food products to promote quality assurance—is there enough credibility? *Journal of Cleaner Production, 12*(5), 517.

Northern Ireland Assembly (2014). *Food Hygiene Rating Bill,* 5 February 2014.

Paddock, L. C., & Wentz, J. A. (2014). *Next Generation Environmental Compliance and Enforcement.* Washington, DC: Environmental Law Institute.

Philippe, D., & Durand, R. (2011). The impact of norm-conforming behaviors on firm reputation. *Strategic Management Journal, 32*(9), 969-993.

Power, M. (1996). Making things auditable. *Accounting, Organizations & Society, 21*(2/3), 289-315.

Reibstein, R. (2008) Does providing technical assistance for toxics use reduction really work? A program of evaluation utilizing Toxics Use Reduction Act data to measure pollution prevention performance, *Journal of Cleaner Production, 16*(14):1494-1506.

Salis, S., Jabin, N. & Morris, S. (2015). Evaluation of the impact of the Food Hygiene Rating Scheme and the Food Hygiene Information Scheme on food hygiene standards and food-borne illnesses (final report). Food Standards Agency.

Shadbolt, N. (2013). Midata: Towards a personal information revolution. *Digital Enlightenment Yearbook*, 202-224.

Sharma, S. (2000). Managerial interpretations and organizational context as predictors of corporate choice of environmental strategy. *Academy of Management Journal, 43*(4), 681-697.

Sheldon, I. M., & Roe, B. E. (2009). Public vs. Private eco-labeling of environmental credence goods: Maximizing the gains from international integration. *Journal of Agricultural & Food Industrial Organization, 7*, 1-27.

Shen, B., Price, L. & Lu, H. (2012). Energy audit practices in China: National and local experiences and issues. *Energy Policy, 46*, 346-358.

Short, J. L. & Toffel, M. W. (2008). Coerced confessions: Self-policing in the shadow of the regulator, *Journal of Law, Economics & Organization, 24*(1): 45-71.

Sigit Sayogo, D., Zhang, J., Pardo, T. A, Tayi, G. K, Hrdinova, J., Andersen, D. F, & Luna-Reyes, L. F. (2014). Going beyond open data: Challenges and motivations for smart disclosure in ethical consumption. *Journal of Theoretical and Applied Electronic Commerce Research, 9*(2), 1-16.

Stretesky, P. B. & Lynch, M. J. (2009). Does self-policing reduce chemical emissions? *Social Science Journal 46*(3): 459-473.

Stafford, S. L. (2007). Should you turn yourself in? The consequences of envrironmental self-policing, *Journal of Policy Analysis & Management, 26*(2): 305-326.

Sunstein, C. R. (2011). *Informing consumers through smart disclosure.* Office of Management and Budget, Executive Office of the President, 8 September, 2011.

Sunstein, C. R. (2013). *Simpler: The future of government.* New York, USA: Simon & Schuster.

Thaler, R. H, & Tucker, W. (2013). Smarter information, smarter consumers. *Harvard Business Review, 91*(1), 44-54.

Tietenberg, T. (1998). Disclosure strategies for pollution control. *Environmental and Resource Economics, 11*(3-4), 587-602.

Thompson, L. (2011). *Case study: Welsh National Enforcement Priorities: The Food Hygiene Rating Scheme,* Local Better Regulation Office (LBRO), Cardiff, UK

Toffel, M. W. & Short, J. L. (2011). Coming clean and cleaning up: Does voluntary self-reporting indicate effective self-policing? *Journal of Law & Economics 54*(3): 609-649.

Uchida, T. (2007). Information disclosure policies: When do they bring environmental improvements? *International Advances in Economic Research, 13*(1), 47-64.

Upham, P., Tomei, J. & Dendler, L. (2011) Governance and legitimacy aspects of the UK biofuel carbon and sustainability reporting system. *Energy Policy, 39*(5): 2669-2678.

Vegeris, S., & Smeaton, D. (2014). Evaluation of the Food Hygiene Rating Scheme and the Food Hygiene Information Scheme: Process evaluation - final report.

Weil, D., Graham, M., & Fung, A. (2013). Targeting transparency. *Science, 340*, 1410-1411.

Wijen, F. (2014). Means versus ends in opaque institutional fields: Trading off compliance and achievement in sustainability standard adoption. *Academy of Management Review, 39*(3), 302-323.

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