



## ENVIRONMENTAL PROTECTION AGENCY

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

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

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

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

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

## Our Responsibilities

### Licensing

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

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

### National Environmental Enforcement

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

### Water Management

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

### Monitoring, Analysing and Reporting on the Environment

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

### Regulating Ireland's Greenhouse Gas Emissions

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

### Environmental Research and Development

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

### Strategic Environmental Assessment

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

### Radiological Protection

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

### Guidance, Accessible Information and Education

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

### Awareness Raising and Behavioural Change

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

### Management and structure of the EPA

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

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

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

**EPA RESEARCH PROGRAMME 2014–2020**

**Current Status and Potential Role of Eco-labels in  
Informing Environmentally Friendly Purchases  
and Behaviours**

**(2015-SE-DS-4)**

**EPA Research Report**

Prepared for the Environmental Protection Agency

by

Trinity College Dublin

**Authors:**

**William Brazil and Brian Caulfield**

**ENVIRONMENTAL PROTECTION AGENCY**  
An Ghníomhaireacht um Chaomhnú Comhshaoil  
PO Box 3000, Johnstown Castle, Co. Wexford, Ireland

Telephone: +353 53 916 0600 Fax: +353 916 0699  
Email: [info@epa.ie](mailto:info@epa.ie) Website: [www.epa.ie](http://www.epa.ie)

## **ACKNOWLEDGEMENTS**

This report is published as part of the EPA Research Programme 2014–2020. The programme is financed by the Irish Government. It is administered on behalf of the Department of Communications, Climate Action and Environment by the EPA, which has the statutory function of co-ordinating and promoting environmental research.

The authors would like to acknowledge the members of the project steering committee, namely Dr Dorothy Stewart (EPA), Dr Damien O’Tuama and Oonagh Monahan (EPA), for their advice and direction, which have overall added value to the project as a whole.

## **DISCLAIMER**

Although every effort has been made to ensure the accuracy of the material contained in this publication, complete accuracy cannot be guaranteed. The Environmental Protection Agency, the authors and the steering committee members do not accept any responsibility whatsoever for loss or damage occasioned, or claimed to have been occasioned, in part or in full, as a consequence of any person acting, or refraining from acting, as a result of a matter contained in this publication. All or part of this publication may be reproduced without further permission, provided the source is acknowledged.

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

**EPA RESEARCH PROGRAMME 2014–2020**  
Published by the Environmental Protection Agency, Ireland

ISBN: 978-1-84095-756-3

December 2017

Price: Free

Online version

# Project Partners

**William Brazil**

Department of Civil, Structural and  
Environmental Engineering  
Trinity College Dublin  
Dublin 2  
Ireland  
Email: [wbrazil@tcd.ie](mailto:wbrazil@tcd.ie)

**Brian Caulfield**

Department of Civil, Structural and  
Environmental Engineering  
Trinity College Dublin  
Dublin 2  
Ireland  
Email: [brian.caulfield@tcd.ie](mailto:brian.caulfield@tcd.ie)



# Contents

<b>Acknowledgements</b>	<b>ii</b>
<b>Disclaimer</b>	<b>ii</b>
<b>Project Partners</b>	<b>iii</b>
<b>List of Figures</b>	<b>vii</b>
<b>List of Tables</b>	<b>viii</b>
<b>List of Boxes</b>	<b>x</b>
<b>Executive Summary</b>	<b>xi</b>
<b>1 Introduction</b>	<b>1</b>
1.1 Background and Objectives of the Project	1
1.2 Scope of this Report	1
1.3 Methodology	1
<b>2 Review of Eco-labelling Approaches and Research</b>	<b>2</b>
2.1 Type of Eco-labels	2
2.2 Classification of Eco-labels	2
2.3 Theoretical Role of Eco-labels	3
2.4 The History of Eco-labels	4
2.5 Legislation Regarding Eco-labels	4
2.6 Evidence of Effectiveness of Eco-labels	5
2.7 Framing and Rating Scales	8
2.8 Eco-labels in the Marketplace	8
2.9 Conclusions	10
<b>3 Economic Assessment of Eco-labels in Purchases</b>	<b>14</b>
3.1 Introduction	14
3.2 Research Methodology	14
3.3 Results	19
3.4 Discussion	27
3.5 Conclusions and Implications	29

<b>4</b>	<b>Assessment of Eco-labels Using Eye-tracking Technology</b>	<b>30</b>
4.1	Introduction	30
4.2	Background	30
4.3	Methodology	30
4.4	Results	34
4.5	Discussion	44
4.6	Conclusions and Implications	47
<b>5</b>	<b>Conclusions and Recommendations</b>	<b>48</b>
	<b>References</b>	<b>50</b>
	<b>Abbreviations</b>	<b>53</b>



# List of Figures

Figure 2.1.	Sample eco-labels	2
Figure 2.2.	Mandatory eco-labels	5
Figure 2.3.	Examples of energy labels: (a) white goods; (b) light bulbs	9
Figure 2.4.	Online white goods sales	10
Figure 2.5.	Online white goods sales	11
Figure 2.6.	Energy ratings filters	12
Figure 2.7.	BER ratings online	12
Figure 3.1.	Sample conjoint card	18
Figure 3.2.	Sample card ranking	19
Figure 3.3.	Word cloud analysis	22
Figure 3.4.	Fridge-freezer eco-labels	26
Figure 3.5.	Motor eco-label	28
Figure 4.1.	Choice scenario	33
Figure 4.2.	Scenario AOIs	33
Figure 4.3.	Complex labels	34
Figure 4.4.	Scenario heat maps	35
Figure 4.5.	Option-specific AOIs	37
Figure 4.6.	Appliance AOIs	40
Figure 4.7.	Car label AOIs	41
Figure 4.8.	White goods heat maps	42
Figure 4.9.	Car label heat maps	45

## List of Tables

Table 3.1.	Sample properties	16
Table 3.2.	Respondents' purchasing habits	16
Table 3.3.	Respondents' responses to environmental statements	17
Table 3.4.	Experimental cards	18
Table 3.5.	Respondents' sources of information on white goods	19
Table 3.6.	Respondents' sources of new car information	20
Table 3.7.	Factors involved in respondents' new car purchases	20
Table 3.8.	Factors involved in respondents' second-hand car purchases	20
Table 3.9.	Factor importance	20
Table 3.10.	Attribute levels	21
Table 3.11.	Respondents' motivation for using eco-labels	21
Table 3.12.	Respondents' use of eco-labels in purchases	22
Table 3.13.	Effect of respondents' gender on eco-label use	24
Table 3.14.	Effect of respondents' environmental attitudes on eco-label use	24
Table 3.15.	Effect of respondents' age on eco-label use	25
Table 3.16.	Effect of respondents level of education on eco-label use	25
Table 3.17.	Influence of BER certificates on respondents' property decision-making	26
Table 3.18.	Respondents' interpretation of power consumption	27
Table 3.19.	Respondents' understanding of symbols	27
Table 3.20.	Respondents' understanding of eco-labels	27
Table 3.21.	Respondents' experience of eco-labels in the motor industry	28
Table 3.22.	Importance of label elements to respondents	28
Table 4.1.	Sample properties	31
Table 4.2.	Scenario selections (%)	36
Table 4.3.	Scenario results	37
Table 4.4.	Attribute statistics for scenario 1	37
Table 4.5.	Attribute statistics for scenario 2	38
Table 4.6.	Attribute statistics for scenario 3	38
Table 4.7.	Attribute rankings	38

Table 4.8.	Participants' white goods fixations	41
Table 4.9.	Participants' white goods recollection	42
Table 4.10.	Participants' car label fixations	44
Table 4.11.	Participants' car label recollections	45

## List of Boxes

Box 3.1.	Respondent's comments	23
Box 4.1.	Participants' comments	39
Box 4.2.	Participants' comments on the white goods label	43
Box 4.3.	Participants' comments on the car label	46

# Executive Summary

Eco-labels are a widely used means of providing consumers with information regarding the environmental and energy impacts associated with various products and services available to them on the market. In a number of industries, such as white goods and automobile sales, the provision and display of eco-labels is required by both Irish and European legislation. Eco-labels represent a means of providing consumers with information that they might not otherwise have been able to access and which it is hoped will help to influence their decisions towards more sustainable options. Given the opportunity that such labels represent, and the resources devoted to creating them, there is a need to ensure that they are effectively communicating the relevant information to the general public.

The research undertaken during this project can be divided into three distinct sections: (1) a review of existing approaches in information provision via eco-labels, (2) an online survey to assess the role of eco-labels in consumer choices, and (3) a number of eye-tracking experiments designed to provide further insight into how eco-labels inform decision-making processes. Specific focus has been placed both on how eco-labels compete with other product attributes, for example price, for the attention of consumers, and an investigation into the design of eco-labels, specifically assessing how various environmental impacts of products are communicated. A number of techniques were employed, including the use of conjoint analysis scenarios, information recollection tasks and tests of consumer understanding based on a number of stimuli developed by the research team.

The results from the review of existing approaches highlight the differences in labelling approaches taken and the growth of voluntary labelling schemes. This section of the research also outlines problems that may occur with appliance comparability in online retail environments, as well as potential issues of non-compliance with legislation. Furthermore, a review of existing literature outlines the role that eco-labels can play in terms of informing consumers decisions, while also outlining potential problems that may arise with

such schemes, specifically with regard to the format in which energy information is displayed.

The findings from the online survey, specifically the conjoint analysis experiment, suggest that consumers consider eco-labels to be very important when purchasing white goods. However, this section of the research also highlights the differences in consumers' use of eco-labels in a number of sectors where they are employed, with eco-labels being consulted most often in industries where their provision is legally mandated. The research findings arising from this survey also suggest that eco-label use is not strongly correlated with traditional socio-economic variables such as gender, education and age, but it is related more to the stated environmental beliefs and values of the consumer. Specifically, higher levels of stated environmental concern are correlated with higher levels of stated eco-label consultation during purchases across the markets examined.

The results of the eye-tracking portion of the research highlight the complexity involved in the information search process in consumer choices, even within the simplified and controlled experimental settings used for this study. The results of a simplified choice scenario showed that consumers find eco-labels to be important, as they attended to the information such labels provided; however, the results also indicate that their importance was secondary to price information. An analysis of the role of the individual elements that constitute eco-labels clearly demonstrates that such labels are much more effective at communicating some aspects of their information than others; specifically, colour-coded ratings information was found to be much more effective than simple numerical and textual information. The results of an information recollection task also showed that certain aspects of the information that eco-labels provide are much easier for consumers to recall, and therefore to use in their decision-making, than other information.

Overall, the results of this research indicate that eco-labels contain information that consumers consider to be relevant when they are weighing up the options

available to them. This suggests that eco-labels are fulfilling one of their stated goals, specifically to allow consumers to make informed comparisons based on environmental and energy information. While eco-labels appear to be effective at highlighting energy

impacts associated with certain products, it is apparent that there is scope for them to improve how they display information about other aspects of the product, such as water use, noise pollution and the impacts of driving styles on fuel use.

# 1 Introduction

## 1.1 Background and Objectives of the Project

This project was undertaken with the objective of assessing the role that eco-labels play in influencing consumer purchases and to understand consumers' understanding of, and interaction with, the information that eco-labels supply. Eco-labels are designed to provide consumers with information regarding the energy and environmental impacts of goods and services available to them on the market. These labels come in a wide variety of formats, across a number of sectors and industries, and can be either voluntary or legally mandated in nature. Eco-labels represent an opportunity to provide consumers with information that can enable them to make more sustainable purchasing decisions; however, if these labels are to work effectively, it is important that consumers engage with the labels and understand the information that they provide. The fundamental aim of this research is to increase understanding of consumers' interaction with and understanding of eco-labels and their component information within the Irish retail market.

## 1.2 Scope of this Report

This report outlines the research undertaken during the period of this project and presents the findings arising from it. This report provides a description of the current legislative requirements and market conditions in which eco-labels operate and provides a review of approaches undertaken by information suppliers, such as manufacturers and retailers, to make consumers aware of the environmental and energy impacts of their choices. Recommendations and implications for policymakers based on the findings of this project are also provided.

## 1.3 Methodology

The work undertaken in this project can be divided into three distinct but complementary research approaches:

1. A review of existing eco-labelling approaches and research that has been undertaken in this area. This part of the research was designed to provide an overview of the regulatory environment in which eco-labels operate, an assessment of the approaches to information provision currently being undertaken in the marketplace, and a review of the literature regarding the role that labelling and environmental information can play in influencing consumer choices across a number of sectors.
2. A survey-based assessment of the role of eco-labels in consumer choices, based on methods such as conjoint analysis. This element of the research was designed to use a large sample size to gain insight into the role of eco-labels in purchasing decisions using a choice modelling approach, specifically the application of conjoint analysis, via an online questionnaire. This survey also examined the frequency with which eco-labels are used within various retail sectors and assessed how this usage relates to the characteristics of the sample.
3. An eye-tracking experiment designed to assess how individuals assimilate the information provided by eco-labels. This part of the research was designed to apply emerging eye-tracking technologies to track the gaze of individuals as they assessed a number of choice scenarios where information was provided via eco-labels. This research was undertaken to gain a better understanding of how such labels compete for information with other product attributes such as unit price, as well investigating the effectiveness of the various design elements that constitute the labels.

## 2 Review of Eco-labelling Approaches and Research

There are a wide variety of information provision schemes that could justifiably be considered to be eco-labels. While the experimental component of this project places greater focus on legally mandated schemes, such as the European Union (EU) energy labels and the Building Energy Rating (BER) certificates, this chapter presents a review that includes a wider range of approaches to take advantage of the large number of studies that exist in this area. For the purpose of this review, eco-labels are defined as any label or seal that provides consumers with information not previously available to them about the environmental and energy impacts of the products and services that they are considering purchasing.

### 2.1 Type of Eco-labels

Eco-labels can take a number of forms, such as a simple seal that demonstrates that the product meets the standards of an independent third party or a more complex label with detailed numerical information provided, such as an energy label.

In the case of simple seals, no specific information is available to the consumer at the point of purchase; rather, they are simply made aware that the product

meets the standards of a third-party certification agency. A slightly more complex version of this may consist of a graded eco-label, whereby products may be awarded different levels (such as gold, silver or bronze) depending on their ability to meet the various standards associated with each grade. More complex labels – such as the Monroney sticker, which provides information on the environmental impact of various cars in the USA (US EPA, 2011), or the EU's energy label programme (EC, 2016) – can contain quite complex information, which, while in theory increasing the consumer's ability to make informed choices, may also lead to information overload. This approach has also spawned a number of similar schemes in the private sector that utilise the same graphical approach. Figure 2.1 demonstrates examples of each of the approaches outlined above.

### 2.2 Classification of Eco-labels

While eco-labels can be classified in terms of the information that they provide, categorisation can also be undertaken according to whether or not participation is voluntary or legally required within a given sector and also in terms of the organisation that provides certification. The effectiveness of such

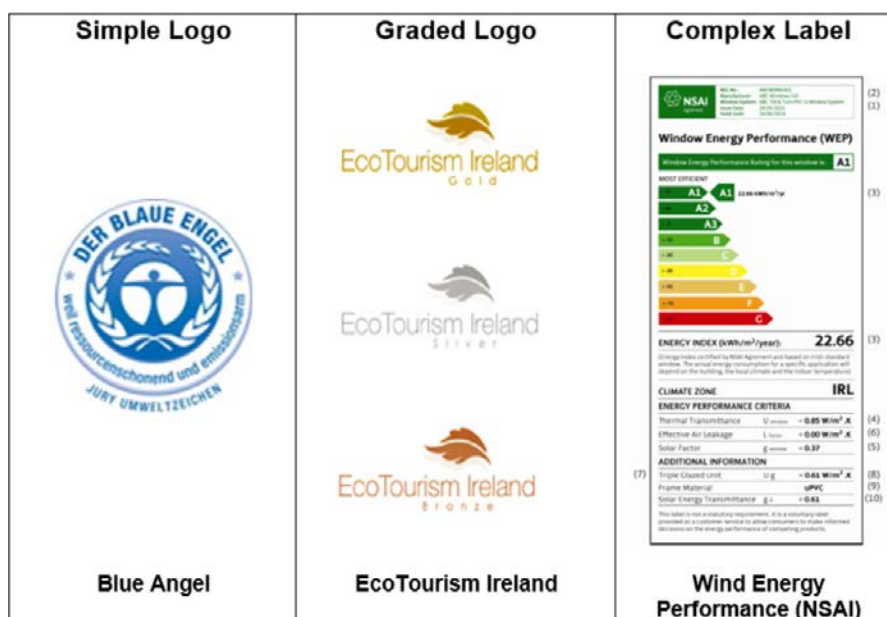


Figure 2.1. Sample eco-labels.



schemes as instruments of behaviour change appears to vary widely with respect to the organisation that is verifying the claims. Banerjee and Solomon (2003) conducted a review of eco-labels in the USA and found that government programmes were, in general, more successful than private ones, and that government support was the most important factor for schemes relating to appliances.

### 2.3 Theoretical Role of Eco-labels

To understand the effectiveness of eco-labels, it is first important to understand the context in which they exist. Eco-labels are designed as instruments to provide individuals with information about the environmental impacts of their purchasing decisions; as such, environmental consequences are often “non-salient” or hidden from the consumer’s view (Whitmarsh *et al.*, 2011). If anthropogenic climate change is taken as an example, it becomes clear that consumers do not have easy access to the relevant information without the provision of labels. There are likely to be carbon emissions and other environmental consequences associated with both the manufacture and operation and then final disposal or recycling of any piece of electronic equipment or device that are very difficult to quantify. Even during application operation, with the exception of motor vehicles, emissions often take place far from the place of operation, at the site of some electricity generation facility rather than in an individual’s dwelling. This can lead to emissions being a practically invisible phenomenon, and hence the purpose of eco-labels is to raise awareness of these consequences.

Eco-labels are based on an information provision approach. This approach assumes that individuals do not have the appropriate information to hand to make informed decisions in line with their environmental values. The logical outcome of such a view is that the provision of appropriate information will enable consumers to better understand the options that are available to them and their associated environmental and energy impacts. On being provided with such information, consumers should then be able to alter their choices accordingly. Indeed, this thinking regarding the assumed role of information in consumer choices is most clearly seen in the statements on the websites of eco-label providers and within the relevant legislation regarding the

desired outcome of such schemes. For example, the highly respected Nordic Ecolabel considers itself to be “a practical tool for consumers to help them actively choose environmentally-sound products” (Nordic Ecolabel, 2016), whereas the website of the voluntary EU Ecolabel states that the label “helps you identify products and services that have a reduced environmental impact throughout their life cycle, from the extraction of raw material through to production, use and disposal” (EC, 2016). This thinking is also reflected in EU law, as Directive 2010/30/EU states:

The provision of accurate, relevant and comparable information on the specific energy consumption of energy-related products should influence the end-user’s choice in favour of those products which consume or indirectly result in consuming less energy and other essential resources during use, thus prompting manufacturers to take steps to reduce the consumption of energy and other essential resources of the products which they manufacture (EU, 2010a).

While such schemes may have value, in terms of educating the public, the value of information campaigns as standalone measures to promote sustainable consumption has been questioned (Gardner and Stern, 1996). While individuals may be operating in a choice environment in which they are not in possession of full information about the options available to them, this does not necessarily mean that increased information would produce a significant impact on their behaviours.

When examining factors that impacted household energy consumption, Abrahamse *et al.* (2005) found that “Information tends to result in higher knowledge levels, but not necessarily in behavioural changes or energy savings.” Research has also outlined criticism of information deficit approaches, highlighting the need to take into account consumers’ physical, social and institutional contexts (Owens and Driffill, 2008). Similarly, factors such as the support of family members or significant others can play an important role in either supporting (or not) decisions that may lead to lower energy consumption (Bartiaux, 2008).

It must also be acknowledged that environmental information does not exist in a vacuum, and ordinary individuals have numerous other concerns that they

must deal with as part of their daily lives. There is only a “finite pool of worry” available to individuals (Columbia CRED, 2009), and concerns about other issues, such as financial pressures and health issues, may erode away at this, therefore reducing the amount of time and cognitive energy that individuals have to focus on issues such as the environment (Lorenzoni *et al.*, 2007; Whitmarsh *et al.*, 2011). Even if individuals do have environmental concerns, they may only be vaguely aware that their purchasing actions produce negative impacts on the environment, and evidence points to this understanding being quite weak (Whitmarsh *et al.*, 2011). Within an Irish context, EPA research (Pender *et al.*, 2007) has shown that “Awareness amongst Irish consumers of environmental issues and the impact of their purchasing decisions remains quite low.” Indeed, consumers were found to pay little attention to the environmental information that they were presented with, and the study highlights the lack of education schemes available to help both consumers and retailers to utilise the information that is currently being provided (Pender *et al.*, 2007).

Even when environmental information is available to the consumer, it is likely that such information will have to compete for the consumer’s attention with attributes such as price, quality and a price–quality trade-off, with the latter taking precedence (Gaspar and Antunes, 2011). However, EPA-funded research undertaken as part of the Trinity College Dublin CONSENSUS project found that 65.8% of survey respondents agreed with the statement “I trust ecolabels”, suggesting that eco-labels are viewed as a reliable source of information by the Irish population (EPA, 2016). Therefore, while eco-labels, and information provision to promote sustainable consumption in general, may succeed in drawing attention to environmental issues associated with various products and services, such an approach does face a number of limitations.

## **2.4 The History of Eco-labels**

Eco-labels are not a new phenomenon, with the first example of mandated energy information provision traced back to France in 1976 (Wiel and McMahon, 2003), which saw the introduction of labelling to allow consumers to compare between the relative energy performances of a number of household items, such as televisions, water heaters and dishwashers. Similar schemes followed shortly thereafter in Canada, the

USA and Japan, with Australia introducing energy labelling in 1987 (Wiel and McMahon, 2003). Since the mid-1990s, a number of directives have been introduced by the European Commission to legislate for the provision of environmental information for a number of household appliances. These directives have been transposed to Irish legislation via statutory instruments, such as S.I. No. 261/2013. At present, the website *Ecolabel Index* lists 465 eco-labels across the globe within a wide range of sectors (Ecolabel Index, 2016).

## **2.5 Legislation Regarding Eco-labels**

Within the EU, the provision of environmental information to consumers is mandated by a number of pieces of legislation. These cover energy use in the retail sector and housing market. Directive 2010/31/EU on the energy performance of buildings is the most current piece of EU legislation on the topic. The legislation states that Member States should ensure that when buildings are sold, constructed or rented, an energy certificate is made available to the prospective buyer or tenant to inform their decisions (EU, 2010b). In Ireland, this directive is implemented by S.I. 243/2012 via the creation of BER certificates. Similarly, Directive 2010/30/EU, on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products, outlines the need for energy and resource consumption labelling for household appliances in order to help meet the EU’s energy consumption reduction targets (EU, 2010a). This directive is implemented in Irish law by S.I. No. 263/2013. Examples of BER certificates and energy labels (in this case for a television) are provided in Figure 2.2.

### **2.5.1 Certification of eco-labels**

One of the primary advantages of eco-labels is that they provide information to the consumer that would otherwise be unavailable to them on the environmental impact of the products they may choose from. For this information to be of value it must be accurate and adhere to some common standard with which the consumer can compare it. In the case of voluntary schemes, organisations tend to apply to a certification body and meet the standards required to be awarded the label. In the case of legally mandated labels, there are a number of means of certification, and there are

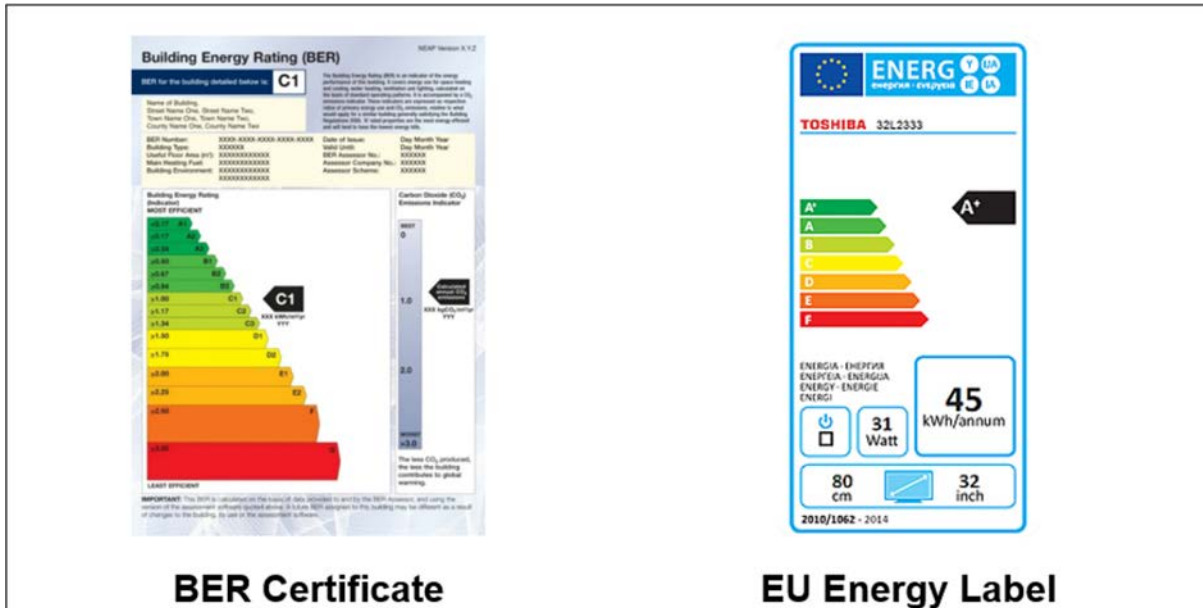


Figure 2.2. Mandatory eco-labels.

also a range of penalties that can be imposed when an organisation fails to comply with legislation.

### 2.5.2 Energy labels

The EU energy label scheme, S.I. No. 366/2011 (Government of Ireland, 2011), places the responsibility for testing and generation of relevant labels and values on the product supplier. In this case, the supplier is generally the manufacturer rather than the retailer. The supplier is required to produce technical documentation, which must be available for 5 years after the product has ceased production, and which must be made available to representatives of the Irish government and the European Commission on request. In cases where it has been deemed that a supplier is not complying with regulations, an offence is deemed to have occurred, and the product may be required to be withdrawn from supply. In addition to this, a responsibility is placed on retailers to display the information that they have been provided with by the supplier.

### 2.5.3 Building Energy Rating

BER certificates are provided to landlords and those wishing to sell property by a number of private sector BER assessors. It is the responsibility of landlords and sellers to contact and employ these assessors. Assessors are registered with the Sustainable

Energy Authority of Ireland (SEAI), have been trained under the National Framework of Qualifications and have passed the SEAI BER Assessor examination (SEAI, 2016). Reports are provided by assessors in conjunction with an advisory report, which outlines steps that can be taken to improve the (energy) performance of the property. In addition to these schemes, there are a number of voluntary participation schemes that are certified by government agencies, such as the National Standards Authority of Ireland (NSAI).

## 2.6 Evidence of Effectiveness of Eco-labels

If eco-labels are considered to be a visual means of indicating the environmental and energy impacts associated with a given product or service, there are a wide range of sectors in which we can assess the effectiveness of this form of intervention on consumer behaviour.

### 2.6.1 Building industry

Within the building industry, there are a number of schemes that provide information to indicate the estimated environmental impacts associated with a given property. In Ireland, the BER certificate is legally mandated for all properties available for sale or rental. Research examining the role of BER certificates on

Irish house prices has found that there is a positive and significant relationship between the BER rating associated with a property and its value, in both the sale and rental markets (Hyland *et al.*, 2013). This study also reported an increase in the presence of BER certificates in online property advertising, suggesting that such information may be considered to increase the attractiveness of a given property. When examining the role of energy ratings information in the Dutch commercial rental sector, Kok and Jennen (2012) reported that properties with a rating of D or worse yielded, on average, a 6.5% reduction in rent, compared with their better rated equivalents. Within the Japanese housing market, a small, but significant, price premium was observed for buildings with the green eco-label; however, this study also found that the willingness to pay for green features was greater within higher income households (Fuerst and Shimizu, 2016), suggesting that the effectiveness of such information may not be evenly distributed across the population.

### **2.6.2 White goods and light bulbs**

The provision of environmental information in the form of the EU energy label is legally required within the Member States of the EU, and it has also been adopted by a number of neighbouring nations, such as Switzerland. Sammer and Wustenhagen (2006) utilised a discrete choice modelling approach applied to washing machines to demonstrate that there is a willingness to pay for more energy-efficient white goods. However, research (Winward *et al.*, 1998) also suggests that there are significant differences between nations and regions, specifically between southern and northern European countries, in terms of their willingness to purchase energy-efficient goods. This suggests the need for research within individual Member States, as research in this area does not appear to be generalisable across cultures. Research undertaken across seven European countries, including Ireland, examining the factors that determine consumer choices in the electronic appliances market, found that energy efficiency was the fourth most important attribute after cost, quality and the price–quality trade-off (Gaspar and Antunes, 2011). This suggests that, while eco-labels are providing desired information, such information is still less important than more traditional product attributes. The same study examined the role of information-seeking

behaviour in appliance purchases and found that, while 67% of those surveyed stated that they sought information before buying a product, only 16.7% sourced information on energy consumption, 13.5% on power rating and 12.2% on efficiency class. Research in the USA (Ward *et al.*, 2011) found that the award of an Energy Star label could create a premium ranging from US\$249.82 to US\$349.30 for refrigerators. Within the developing world, research examining the role of energy labels within the Chinese air conditioner and home refrigerator markets has shown that consumers are aware of the labels being provided and that they tended to pay more for products displaying this information (Shen and Saijo, 2009). Research on the role of information in light bulb purchases in the USA has observed a greater willingness to pay for lower energy consumption and longer life where cost information is provided at the point of sale. This research also showed that individuals with liberal leanings (as defined by the paper) are more likely to buy energy-saving light bulbs, suggesting that information alone is not the only factor in product choice (Min *et al.*, 2014).

### **2.6.3 New car sales**

Motorised personal transport is one of the largest producers of carbon dioxide (CO<sub>2</sub>) emissions across the globe (Sims *et al.*, 2014). Transport is the second largest source of emissions in Ireland, after agriculture, accounting for 19.1% of all emissions (EPA, 2016). Research into the role of CO<sub>2</sub> labelling of new cars within the EU noted that, while all Member States have implemented labels in line with Directive 1999/94/EC, there are still a wide range of inconsistencies in design in terms of how the required information is presented to consumers (Haq and Weiss, 2016). This research also highlighted that the fuel consumption reported by labels associated with various models may be underestimated. Within the UK car sales industry, issues have been identified regarding how lifecycle metrics are currently displayed by labels and recommendations for design alterations further highlighting vehicle fuel efficiency information are proposed; however, the risk of information overload is acknowledged (Lane and Banks, 2010). Research by Noblet *et al.* (2006) has shown that, while eco-labels may be considered by consumers in the purchase of new cars, the impact of such information may be limited, as this consideration occurs at the vehicle level

rather than at the class level. One result of this is that individuals may consider emissions only once they have decided on what type of vehicle to buy [sport utility vehicle (SUV), small car, etc.]. This can create major limitations with regard to the effectiveness of the eco-labelling approach, as major reductions in emissions are more likely to occur through reduction in engine size, as a result of choosing smaller vehicles, than by considering emissions only within a class. With emerging trends in both hybrids and electric cars, there is now a much wider range of vehicles in terms of per-kilometre emissions available on the market.

#### 2.6.4 *Airlines*

Within the airline industry, there are a number of resources, mainly digital, that individuals can use to gain an understanding of the emissions associated with their trips. While there is currently no legal requirement to provide information to consumers, the carrier Flybe (2016) has introduced its own eco-label, the design of which is based on the European energy label.

#### 2.6.5 *Food*

The food and agricultural industry is one of the largest sources of greenhouse gas emissions in Ireland (EPA, 2017), accounting for 29.2% of total greenhouse gas emissions. Unlike the housing industry, the automotive sector and white good sales, there are currently no statutory requirements to provide consumers with information about the environmental impacts associated with food products, and hence the ability to make informed sustainable choices may be compromised. While there may currently be no legal requirements to provide environmental information, there are a wide range of certification processes (organised at a transnational level) that produce eco-labels. Examples of this include schemes such as the Rain Forest Alliance and the EU organic eco-label.

Within the fishing industry, concerns have been raised regarding what is considered to be sustainable by label certification bodies, and issues have also arisen from the ability of small-scale operators to meet certification requirements (Hadjimichael and Hegland, 2016). The issue of product substitution has also been highlighted, with suggestions that, with regard to labels for all foods, consumers may choose lower cost non-labelled

alternatives, as participation in such schemes is currently not mandatory (Shewmake *et al.*, 2015). Unlike other sectors, such as white goods or transport, where there are clear links between reduced energy consumption and monetary savings for the consumer, the decision to buy food products that conform to the standards laid down by eco-label certification bodies may actually penalise consumers financially. It must be noted that in the food sector in particular there is often a wide range of information competing for consumers' attention. This may include information about country of origin, organic or biodynamic farming practices, nutritional informational and calorific claims, or indications of free-range animal rearing. Consumers therefore may require a sophisticated understanding of the meaning and regulations associated with the various terms to make truly informed decisions.

#### 2.6.6 *Furniture*

A number of studies have been undertaken to understand the impact of eco-labels within the furniture industry. When examining the role of eco-labels in the home lighting sector, Sorqvist *et al.* (2015) observed a curious placebo effect whereby individuals stated that lamps carrying eco-labels provided more comfortable lighting and performed better than identical lamps without such labels. In terms of product attractiveness, Veisten (2007) examined the willingness to pay for eco-labelled furniture in both Norway and England, reporting significant premiums in each country.

There have also been suggestions that EU energy labelling schemes should be expanded to include items such as windows, which, while not directly consuming energy, do have an impact on the overall energy consumption of dwellings or business premises (Trzaski and Rucinska, 2015).

#### 2.6.7 *Tourism*

Within the tourism industry there are a wide range of voluntary schemes that tourism providers, such as hotels and visitor attractions, can sign up to (Gossling and Buckley, 2016). In Ireland, schemes such as Ecotourism Ireland (EcoTourism Ireland, 2016) and the Green Hospitality Awards (GreenHospitality.ie, 2016) provide labels to assure potential guests of the sustainable nature of their businesses. However, international research has shown that eco-labelled

businesses often fail to outperform traditional accommodation on account of a myriad of factors (Warnken *et al.*, 2005).

### **2.6.8 Problems with and limitations of eco-labels**

One commonly raised problem (Lane and Banks, 2010) is the issue of information overload, whereby the consumer deems the information provided to be too in-depth or complex, or both, and therefore discards it completely. Another issue is the ability of consumers to understand the information they are given or to compare it with a point of reference. Research within the transport sector (Brazil and Caulfield, 2014) has shown that individuals lack an accurate knowledge of CO<sub>2</sub> emissions and their relative values. Research examining the current EU energy labelling approach has highlighted issues such as consumer confusion between items such as energy consumption and energy efficiency (Waechter *et al.*, 2015) across a range of services. Appliances that have been awarded high energy efficiency ratings, expressed as letters and colour coding, may actually have higher energy consumption than other similar products, but such products may not be in the same product group used for the assignment of labels, so such a comparison is not valid. For example, a large television may receive an A rating within its class, while a smaller set receives a B rating in its class, but the larger set actually consumes more energy, making a comparison of ratings counter-intuitive.

## **2.7 Framing and Rating Scales**

One very common approach to the design of eco-labels is the inclusion of rating scales for contextual purposes. While these scales, especially when colour coded, can be very effective in terms of providing both information and points of reference to the consumer (Thorndike *et al.*, 2014), the design of such scales, and more importantly the allocation of codes (A, B, C, etc.), can have a major impact on the effectiveness of such a scale. Again, using the EU energy label as an example, significant concerns have been raised relating to the potentially diminished effectiveness of the scale as a result of the addition of values above A (Heinzle and Wustenhagen, 2012). When the scheme was initially introduced, the ratings available ranged from A to G, with A denoting the

most energy efficient and G the least. However, improvements in product design have enabled the majority of products to fall into the A range (Heinzle and Wustenhagen, 2012.), effectively rendering the bottom half of the scale meaningless. Unlike other industries, in which improvements must be made each year to simply retain a standard and in which the scale remains consistent but improvements are made to the underlying required standards, improvements in appliances have been reflected by the addition of A+ and A++ and the removal of the F and G categories. One ramification of this change in label categorisation is that the vast majority of appliances now fall within one of the A categories, reducing consumers' perception of relative differences between the available products. It could be argued that this also reduces the incentive for manufacturers to improve products, as they are already meeting A standards.

## **2.8 Eco-labels in the Marketplace**

While suppliers and manufacturers may either have a duty to provide environmental information, or simply believe that it makes their product more desirable, this does not immediately result in the display of eco-labels in a uniform manner in the marketplace.

Under Directive 2010/30/EU, appliance dealers are required to "display labels properly, in a visible and legible manner"; however, it is apparent that there is scope for variation in how retailers actually implement this. Retailers and suppliers exist in a competitive market and must use effective marketing to promote their product or service in such a manner that it appears more desirable than that of their competitors. One means of doing this is to highlight the various attributes associated with the product or service. Taking, for example, a household appliance such as a washing machine, there is a wide range of features that a consumer may consider. Attributes such as price, brand, quality, appliance warranty and reviews from previous buyers are likely to compete for consumers' attention with environmental information and hence to be considered by consumers when they are making their purchasing decision. It is therefore important to examine the context in which eco-labels (or the information that constitutes them) are presented in order to understand their effectiveness. For the purpose of this review, the authors examined

how information is displayed in store and online to consumers for a number of industries.

### 2.8.1 Energy labels in store

Eco-labels, and specifically energy labels for appliances sold in showrooms, tend to be displayed on the appliances themselves. As part of this review, a number (four) of showrooms in the Greater Dublin Area were visited to gain an understanding of how eco-labels are currently displayed by Irish white goods retailers. Figure 2.3a provides an example of how energy labels are presented on white goods. In this example, the energy information (provided on the bottom right) is as prominent as pricing and other information. For smaller items such as lightbulbs, the required information may be incorporated into the packaging, as the information provided can often be quite simple in nature, such as just an energy rating. An example of this is shown in Figure 2.3b.

### 2.8.2 New car sales

While emissions information is required to be displayed at the point of sale, or in close proximity to the new vehicle, visits to a number (four) of car showrooms in the South Dublin region indicated that such information is often not clearly displayed to the consumer. This would appear to be both a breach of the relevant legislation and also in stark contrast to

the white goods sector. Although the visits undertaken cannot be considered to be audits, as they were simply exploratory in nature, they would suggest the need for further investigation into compliance rates with the relevant legislation within the motor industry.

### 2.8.3 Internet based

While there is a legal obligation for retailers in certain industries to provide energy information in a clearly displayed manner at point of sale, many consumers now have the ability both to gather information on a product and also to purchase it using retailers' websites. Given that website design is likely to vary from one retailer to another, there are considerable differences regarding how such information is provided online. The following sections outline some of the approaches to providing environmental information being undertaken by retailers within the Irish digital marketplace.

### White goods

Some retailers provide an initial indication of the energy rating associated with a set of similar options when comparing products [see Figure 2.4a; DID Electrical (2016)] and more detailed information once the consumer clicks on a given product [see Figure 2.4b; DID Electrical (2016)].

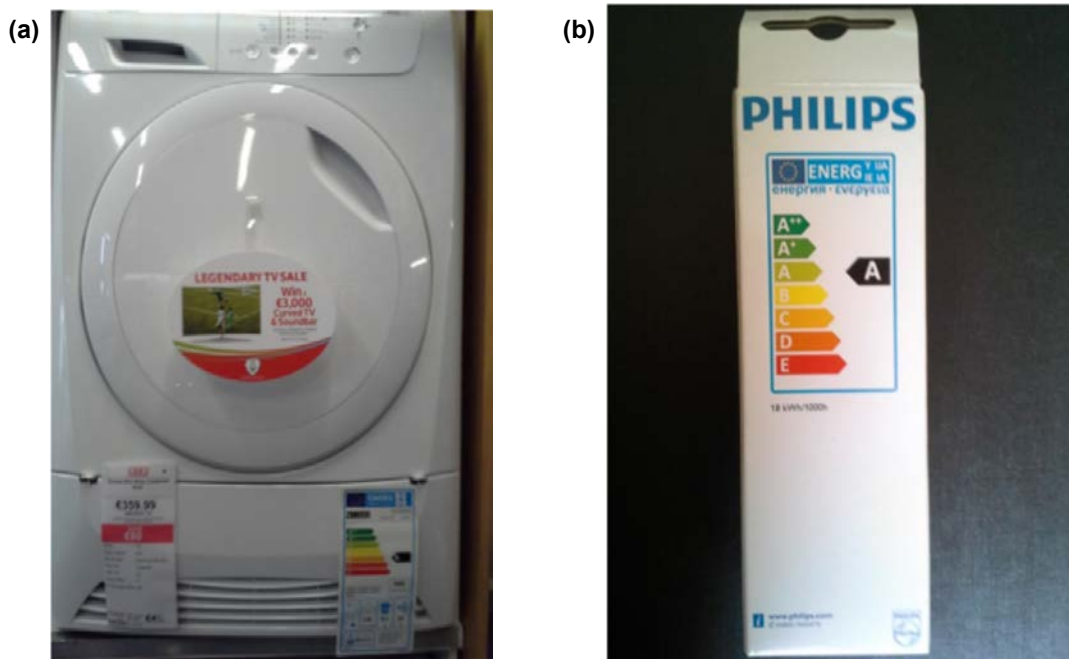


Figure 2.3. Examples of energy labels: (a) white goods; (b) light bulbs.

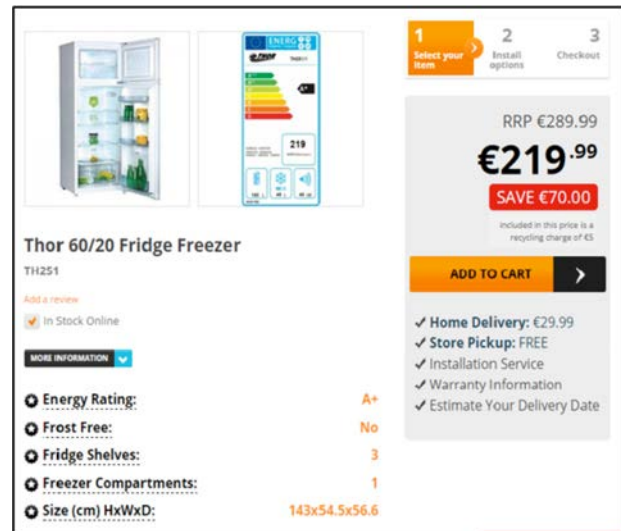


Figure 2.4. Online white goods sales.

Other retailers provide no information regarding the energy performance of a given machine as part of an appliance comparison screen [see Figure 2.5a; Harvey Norman (2016)] and provide this information only once the consumer has clicked on a given product and scrolled down the page to the relevant information [see Figure 2.5b; Harvey Norman (2016)]. While this second form of presentation may meet the requirements laid out in legislation, it could be argued that this is likely to have the effect of reducing the role of environmental information in the consumer's decision-making process.

In some cases, retailers even provide visitors with the option to filter the appliances available to them by the associated energy rating [see Figure 2.6; Power City (2016)], making this product attribute especially prominent.

#### 2.8.4 Housing

Within the housing market, there is a requirement to provide a BER certificate for any property that is for sale or rent. This information can be displayed on the property and relevant literature, but it may also be available online on property comparison websites. This information is likely to be of considerable value to potential consumers, as it will be an indication of how much they are likely to have to spend to heat the

property. Websites such as Daft.ie provide information about the BER rating [see Figure 2.7; Daft (2016)], where available, associated with the property to allow comparison. Some websites also provide a "learn more" page, where users can get a detailed breakdown of how the scheme works and what it means in their context.

While internet-based retail accounts for an increasing share of the market, the authors could identify very little research carried out to examine what effect the design of websites and the placement of eco-labels can have on consumers' consideration of the various attributes of each product.

## 2.9 Conclusions

Eco-labels are designed to provide consumers with information on the environmental and energy consequences of their decisions, which would otherwise be unavailable to them. Such labels can play a role in both increasing awareness and changing consumer behaviours.

Eco-labels are present in a number of formats across a wide range of industries. While many of these labels are not required by legislation, the popularity of these voluntary schemes and the widespread stakeholder involvement demonstrate that there is a demand within the population for the information that they contain and



**Harvey Norman**

SHOP > HOME APPLIANCES > LAUNDRY > WASHING MACHINES

REFINE RESULTS

What are you looking for?

Read about Washing Machines

35 Products

20 PER PAGE

0

**HOT DEAL**

**Whirlpool 9kg Washing Machine | WWDC9200/1**

**€369** ~~WAS €649~~

BIG SALE

SELECT OPTIONS

FIND IN STORE

**Zanussi 8kg Freestanding Washing Machine | ZWF81243W**

**€319.90** ~~WAS €354.90~~

BIG SALE

SELECT OPTIONS

FIND IN STORE

**Zanussi 8kg 60cm Washing Machine | ZWF81440W**

**€329.90** ~~WAS €449.90~~

BIG SALE

ADD TO CART

FIND IN STORE

**Bosch VarioPerfect Washing Machine 8Kg | WAQ28351GB**

**€449.90** ~~WAS €699.00~~

BIG SALE

SELECT OPTIONS

FIND IN STORE

Whirlpool 9kg **€369**

+

Whirlpool 8KG 6th **€369.90**

More options

**€738.90**

ADD TO CART

**Description**

The Whirlpool WWDC9200/1 washing machine offering a generous 9kg wash capacity. Combined with a 1200rpm spin rate, this washing machine is an excellent choice for the medium sized family.

The Quick Wash function allows you to wash that essential outfit when you're under time pressure.

**Product Features:**

- 9kg Capacity
- 1200rpm Spin Speed
- Quick Wash Option
- **A++ Energy Rating**

Included in this price is a contribution to recycling costs of €5.

Figure 2.5. Online white goods sales.

Sort By Price  
Low-High

Sort By Brand  
All Brands

Filter by Feature

- Spin Speed
  - 1200
  - 1400
  - 1600
- Capacity
  - 6kg
  - 7kg
  - 8kg
- Energy Rating**
  - A+
  - A++
  - A+++
- Average Annual Water Consumption (in Litres)
  - 8000 - 8999
  - 9000 - 9999
  - 10000 - 10999
  - 11000 - 11999

CLICK & COLLECT IN STORE OR ORDER BEFORE 8PM FOR

Category: All Brands - Built\_in Washing Machine -  
Pages: 1 2

Click & Collect Delivery Info

**BEKO**  
1000 7kg a+ washer  
MPN:WMI71641  
2 Years Parts and Labour  
Registration Required  
Warranty  
€399.95  
\* Bonus Warranty  
Limited Time Offer\*

100+ Buy 1600 SPIN 7

**INDESIT**  
1200 7kg washer  
MPN:WME127  
1 year Labour and 10 years  
Parts Warranty  
€399.95  
Limited Time Offer\*

100+ Buy 1200 SPIN 7

**CANDY**  
1400 8kg washer  
MPN:CWB814DN1-S  
1 year Labour and 10 years  
Parts Warranty  
Click & Buy For  
EXTRA Sale Discount

11 Buy 1400 SPIN 8

Figure 2.6. Energy ratings filters.

2. [Serpentine Terrace, Sandymount, Dublin 4 - House to Rent](#) **BER E2**

**€2,800 Monthly**  
House to Rent | 2 Beds | 1 Bath

FIRST LETTING of this delightfully, two bedroom furnished terraced house, consisting of approx. 88 sqm of accommodation. Available 1st July This beautifully presented ...

[Add to saved ads](#) | Agent: [Sherry FitzGerald Lettings](#)

3. [Herbert Avenue, Ballsbridge, Dublin 4 - House to Rent](#) **BER D2**

**€5,000 Monthly**  
House to Rent | 4 Beds | 3 Baths

Fine period style detached 4 bedroom family home in an excellent location close to St. Vincent's Hospital, The Japanese Embassy and Merrion Shopping Centre. The property is also within walking distance to St. Michael's College, The Teresian Girls School and a short drive away from St. Andrews College and Blackrock & Willow Boys S...

[Add to saved ads](#) | Agent: [Sherry Fitzgerald Lettings](#)

[View more details & 14 more photos](#)

Call: Sherry FitzGerald Lettings Stillorgan at **01 2784282**

4. [Bayview Drive, Killiney, Co. Dublin - House to Rent](#) **BER D1**

**€2,100 Monthly**

Figure 2.7. BER ratings online.

a perceived advantage to particular organisations in highlighting compliance with such schemes.

The research outlined in this chapter has shown that eco-labels have a role to play in increasing consumer awareness of environmental impacts but also that there are a number of constraints on their effectiveness as behaviour change interventions. For any good or service that is the product of mass production and extended international supply chains, there will always be an imbalance between what the manufacturer knows and the information available to consumers when they are making their purchasing choices. Even for more locally produced products, it is nearly impossible for consumers to make comparisons between items based on environmental impacts, such as associated greenhouse gas emissions and energy usage, unless this information is presented to them. Within such a context, eco-labels have the ability to provide a simple and visually striking method of helping to overcome an information deficit barrier to sustainable consumption.

It is also clear that there is a wide range of approaches being undertaken across industries to provide this information, with the design and scope of eco-labels varying greatly. The majority of schemes examined appear to simply provide a graphical seal of approval to products. Such seals indicate that some standard necessary for certification has been met by the manufacturer. The information regarding how such a seal is awarded may be available to the public (most likely via the certifier's website). However, such an approach can at best be seen to be providing binary information, in terms of it being present or not, at the point of sale. This approach also assumes that consumers are aware that some products have not been certified. As many of these schemes are voluntary in nature, producers are only likely to apply for certification if they are confident that their products will gain approval. Even if products fail to be

approved, such schemes, because of their voluntary nature, cannot impose a penalty on the manufacturer or a negative seal. In contrast, eco-labels and energy labels that are both compulsory and provide gradation allow for a much more accurate comparison between goods and services, and they can also penalise manufacturers by forcing them to display labels that contrast poorly with those earned by their competitors.

However, difficulties also exist with more complex labelling schemes. These tend to relate to information overload and the presentation of metrics that may be viewed as quite similar to someone lacking specialised scientific information but which may be transmitting quite different information in reality (energy consumption vs energy efficiency, etc.). While eco-labels may be effective in raising consumer awareness of environmental issues, it is much less clear whether this information is playing a significant role in consumer choices. The effectiveness of eco-labels is also likely to vary from sector to sector, depending on whether the consumer's running costs are related to the product's energy efficiency. It has been seen in a number of industries that, while eco-labels alone may not be able to affect large-scale changes in consumption behaviour, they can place premiums on items that have been awarded either seals of approval or high ratings. The effectiveness of eco-labels appears to be linked both to the product under examination and to the culture in the country in which the purchase occurs. While some research on compliancy and trust has been carried out, there is still very little information about the impact that eco-labels have on various purchasing decisions within the Irish market. Little is understood about the role of either voluntary or mandatory labels in terms of both information provision and influencing consumer choices. With regulatory requirements to implement labelling across a number of major economic sectors, there is a clear need for more research in this area.

# 3 Economic Assessment of Eco-labels in Purchases

## 3.1 Introduction

Eco-labels are designed to highlight the environmental and energy impacts associated with various goods and services. While eco-labels may be able to bring information regarding environmental impacts to consumers' attention, it is far from clear whether this information actually has an impact on their decisions to pick one product or service over another, or whether it is simply discarded, as it is not as valuable to them as other product features. Research has shown that the role of eco-labels in consumer choices can vary significantly with regard to the culture in which they are presented, and that there are notable differences in their effectiveness between EU Member States (Winward *et al.*, 1998). At present, it is by no means clear to what extent eco-labels may influence the purchasing decisions of consumers, and specifically how this may vary with regard to different sectors and segments of society. As such, labels are often mandated by EU directives and transposed into national legislation and there is a need to understand whether they are operating as desired. Specific research is also required within an Irish context, as little has been carried out to date.

With this in mind, this chapter addresses the following research questions:

- What role do eco-labels play in terms of informing individuals' purchases and choices?
- How well do eco-label users currently understand the information provided to them in eco-label formats?

This chapter presents an examination of these research questions in the Irish market via the use of an online questionnaire. The survey represents the first experimental stage of this project, and it was designed to provide a large sample to complement the more in-depth eye-tracking research presented in Chapter 4.

## 3.2 Research Methodology

For the purposes of addressing the research questions outlined in the previous section, an online questionnaire was created for distribution among the

general population. This questionnaire was designed to collect as much information as possible regarding levels of understanding of eco-labels, and their role in purchasing decisions, while also collecting important ancillary information. To ensure that the questionnaire was easily understood and enabled the collection of all required information, a number of piloting rounds and iterations of the survey were undertaken. The finalised survey was divided into a number of distinct sections, each designed to assess the role of eco-labels and their components in environmental information transmission.

### 3.2.1 Survey design

#### *Outline of section 1: purchasing questions*

The first section of the questionnaire contained questions on recent purchases made by respondents. This section was included both to enable sample classification and segmentation and to provide respondents with a warm-up for the more complex tasks contained in the next section. This section contained questions regarding how individuals seek information before making purchases, as it was deemed important to understand where environmental information is most likely to reach potential consumers. Neither these questions nor the questionnaire introduction contained any references to eco-labels or environmental information to ensure that a pro-environmental bias was not introduced when recruiting participants or before they moved on to the comparative sections of the survey.

#### *Outline of section 2: conjoint analysis*

The second section of the survey contained the conjoint analysis choice experiment section of the research. This section was specifically designed to assess the role that eco-labels play in consumer choices, and in particular how important they are in comparison with other features of the product. In this case the product under consideration was a washing machine. This product was selected, as it has a mandatory eco-label, in this case the EU energy label.

Based on an examination of this market, including a review of online retailers and visits to white goods showrooms, it was decided to include the following additional features in the experiment: price in euros, warranty in years and a user review indicated by a star rating, which could also be considered to be a proxy for product quality. More details on this analysis are provided in section 3.2.4. This section was designed to gain an understanding of the relevant importance of the factors associated with the options available to the consumer. As the process of weighing up information and information trade-offs can be quite complex (for the consumer), this section also contained a comment box where survey respondents were invited to provide more details of how they made their rankings.

#### *Outline of section 3: eco-label testing*

Whereas the conjoint analysis exercise presented in the previous section was designed to gain an understanding of how eco-labels compete with other product factors for consumers' attention, section 3 of the questionnaire represented the first set of questions designed to address whether or not individuals could understand the information that they were provided with by eco-labels. This section involved two distinct tasks: the first related to the white goods sector, while the second related to the motor industry.

In the white goods task, participants were presented with three eco-labels for different fridge-freezer options, and were then asked a number of questions related to the information the labels presented. The first question required them to state which fridge-freezer had the lowest associated energy demand, based on the information supplied. The second question asked respondents to identify the meaning of the various symbols contained in the labels, while the final question in this exercise asked respondents to provide their level of agreement with a number of Likert scale statements regarding the ease with which they understood the information provided by the label.

The motor industry element of this exercise was designed to assess the effectiveness of eco-labels in this sector in transmitting the required information to the consumer when purchasing a new vehicle. Such labels may be considered to be some of the most complex eco-labels currently in use, as they contain a large amount of information presented in differing

metrics and scales. In this section, respondents were presented with only one eco-label and were asked about both the ease of understanding and the importance of the various types of information that it presented. Respondents were also asked about their level of familiarity with the label format.

#### *Outline of section 4: attitudes and demographics*

The final section of the questionnaire was designed to collect information regarding both the respondents' attitudes towards environmental issues and their demographic information. Questions regarding environmental attitudes were left until after the questions addressing the research questions so as not to prime respondents and introduce a pro-environmental bias that might not be representative of their true opinions.

#### **3.2.2 Survey distribution**

The survey was distributed via a number of channels previously established by the research team. These included the internal message boards and mailing systems within Trinity College, public distribution via sites such as boards.ie and posting on the internal message boards of a number of large public and private sector employers. While it was hoped to produce a sample that was as representative as possible of the Irish consumer population, it is acknowledged that, as with all surveys, it is likely that certain biases occurred. Therefore, as it was impossible to practically control for all relevant factors, the survey collected a large amount of auxiliary information concerning the participants' demographics, such as age, gender and highest level of education, as these affect their environmental views, to allow for sample segmentation and demographic analysis. As well as standard demographic and socio-economic questions, the survey also collected data regarding the respondents' environmental preferences, as such information is very hard to infer from indirect means. Therefore, while results for the overall sample are presented, the analysis also provides a number of breakdowns based on the data collected. The survey was promoted as a consumer choice questionnaire, with no mention of environmental issues or eco-labels, to ensure no pro-environmental bias in respondent recruitment.

### 3.2.3 *Sample properties, characteristics and properties*

The survey was distributed to a wide range of organisations. In total, 511 individuals accessed and began the survey; however, because of the complexity and length of the survey, which was designed to collect as much information as possible, only 337 responses were considered to be complete enough for the purposes of analysis. Responses were considered to be incomplete, and were therefore discarded, if no socio-economic or demographic information (the last section of the questionnaire) was provided.

Table 3.1 outlines the socio-economic characteristics of the sample. It is clear from an examination of these results that there is a higher proportion of women than men within the sample, with a ratio of approximately 2:1. This was seen in all organisations and distribution methods used for the survey. The sample also displays an overrepresentation of younger respondents; however, with the expectation that over 65s were unlikely to be contacted on account of the survey's distribution methods, there appears to be a good distribution across the defined age ranges. The lack of responses from individuals over 65 can be explained by the principal means of survey distribution involving places of work, and this demographic is generally likely to have retired. Similarly, the education level of the respondents appears to have shifted towards the higher end of the scale, with more individuals with postgraduate qualifications than might be expected

**Table 3.1. Sample properties**

Property	Percentage
<i>Gender</i>	
Male	34.3
Female	65.7
<i>Age range (years)</i>	
18–29	34.9
30–39	21.6
40–49	22.2
50–65	19.8
Over 65	1.5
<i>Education level</i>	
Second level	17.5
Third level	44.2
Postgraduate	35.6
No details	2.7

within the general population. While these categories are a simplification and do not map onto the census categories one to one, the sample underrepresents those without a third-level education (approximately 50% of the Irish population) (CSO, 2015).

As this survey deals with the subject of consumption, specifically the role of eco-labels in consumer choices, it was also deemed important to collect information regarding how often respondents made purchases for their households. This analysis was undertaken for a number of sectors. The following scoring system was used: 3=Always, 2=Sometimes and 1=Never. The results displayed in Table 3.2 suggest that the average respondent falls somewhere between “Sometimes” and “Always” on the defined scale. This would suggest that the sample contains a large number of individuals who make purchasing decisions and who therefore may be influenced by the presence of eco-labels. The results indicate that purchases are most common within the entertainment devices sector and least common in the motor sector.

For the purposes of categorising respondents based on environmental attitudes, a number of Likert statements were created and presented to survey participants. For these statements the following scoring system was used: Strongly Agree = 5, Agree = 4, Neutral = 3, Disagree = 2, Strongly Disagree = 1. Table 3.3 presents the aggregate scores and standard deviations for each of the statements.

While these scores are only representative of differences within the sample, it was possible to perform a cluster analysis (a grouping of respondents based on their common attributes) based on these scores and therefore to create clusters of respondents

**Table 3.2. Respondents' purchasing habits**

Sector	Score
Televisions, computers, tablets, etc.	2.62
White goods, cookers, washing machines, dryers, etc.	2.24
House, apartment, etc.	2.32
Cars, vans, motorbikes, etc.	2.15
Travel accommodation, hotel, bed and breakfast, hostel, etc.	2.45
Food and drink	2.43
Household items, cleaning products, shower gels, soaps, etc.	2.38
Furniture	2.22

**Table 3.3. Respondents' responses to environmental statements**

Statement	Score	Standard deviation
Climate change is a priority issue	4.40	0.73
Environmental issues are more important to me than money	3.07	1.02
Energy efficiency is more important than quality	2.84	0.92
Economic growth is more important than protecting the environment	2.21	0.88
We need a lower standard of living to reduce our environmental impacts	2.97	1.02
We do not need to reduce our energy use, as new alternatives will be found	2.09	0.94
I have gone out of my way to learn about environmental issues	3.30	1.04
Humans should adapt to nature rather than try to change it	3.77	0.92

for the purposes of segmentation for other questions. The results of this analysis are presented in section 3.4.

### 3.2.4 Conjoint analysis

One of the main objectives of this element of the research was to gain an understanding of how eco-labels interact with other information, when consumers are making their product choices, and what their relative importance is compared with the other attributes on display. Typically, eco-labels have to compete with other product features, such as price, perceived quality or brand, for the attention of consumers in modern marketplaces. While it is preferable, from a sustainability standpoint, that consumers select the product with the lowest energy use and environmental impact, this is not always the case because of constraints imposed by the other features. For example, an individual may choose a lower rated, cheaper appliance over a higher rated, more expensive one because of financial pressures. Understanding this internal process of weighing attributes during decision-making is a complex task for the analyst, as it is rarely effective to simply ask respondents to rank these features; rather, it is preferable to present them with a comparative exercise and infer preferences from the arising results. One method of gaining greater insight into the relative importance of features is known as conjoint analysis.

For the purposes of this approach, it is necessary to consider a product in terms of the features associated with it. If it is considered that each product a consumer assesses is likely to have a number of features or "attributes" that define it, it is possible for an analyst to assess the impact of these attributes on how a

potential customer views that product. Changes in the values of certain attributes, such as increased quality, will positively affect the consumer's view of a product, whereas increases in other factors, such as cost, may reduce the likelihood of the consumer picking that option. When these attributes are bundled together, it is assumed that they define how attractive a given product is to consumers, and the changes in the values of component attributes will contribute to altering the attractiveness of the product. Examples of such attributes may include the price of the product, its perceived quality, its volume or capacity, the warranty associated with it or the environmental impacts arising from its manufacture or use. Using this approach, the product itself is considered to be a bundle of composite attributes, each of which may vary in importance across the population.

While individuals may consider all the attributes associated with a product to be important, it is normal for this perceived importance not to be evenly distributed across all attributes. Certain attributes may not be considered at all in a decision-making process, especially in situations where large amounts of information exist. In the case of white goods sales, eco-labels and the information they transmit may be considered to be an attribute of a given product, and therefore it is important to gain an understanding of their relative importance with respect to the other attributes.

One means of addressing such a research question is via the application of conjoint analysis techniques. Conjoint analysis involves presenting the survey respondents with a number of hypothetical products (or cards) that differ in terms of the values associated with the various attributes under examination, and then asking them to rank the options in order of

preference, based on this information. An example of such a card is provided in Figure 3.1. This card displays information regarding the price, energy rating, warranty and user review associated with a hypothetical washing machine. While such a card does not contain all the information that may be relevant for such a purchase, it does contain the information that the analyst is interested in and that they will use to construct their model.

*Orthogonal design*

To ensure that a ranking is meaningful, respondents must be presented with cards in which the levels of the attributes vary within realistic limits to enable them to make trade-offs based on the information supplied. Using the orthogonal design function available in the statistical analysis suite Statistical Package for Social Sciences (SPSS), it was possible to create a nine-card design for this experiment. This design is outlined in Table 3.4. It can be seen in this table that each level occurs three times for each attribute. For more details of the specific process, please see D3.1.

Once the respondents provide their rankings of the cards, conjoint analysis provides insight into the underlying preference function that is assumed to be

made up of the product attributes under examination in the study (Rao, 2014). This provides the analyst with an estimate of how much each attribute of the product contributes to its overall attractiveness. This is carried out by statistical software based on an ordinary least squares modelling framework (Karniouchina *et al.*, 2009). For the purposes of this modelling, a vector point approach was taken. This approach assumes a linear relationship (either positive or negative) between the attributes under examination and the utility of the product. For example, this could be said to be valid if an increase in quality leads to an increase in attractiveness (linear positive), or an increase in costs leads to a decrease in attractiveness (linear negative). For more details on this approach, please see Rao (2014). It must also be noted that, as with any preference modelling approach, conjoint analysis is forced to sacrifice some level of complexity in terms of totally reflecting consumer decision-making processes to allow for effective computation.

For the purposes of this survey, respondents were presented with a scenario containing nine cards. These cards covered various attribute configurations for a hypothetical purchase of a new washing machine. For the purposes of this experiment, four attributes were chosen for examination. These were price, warranty, eco-label and user review. For the eco-label attribute, a simplified version of the EU energy label (similar to that used for light bulbs) was used. This simplification was created to address both considerations inherent with the inclusion of nine cards and fears that, if the label contained multiple metrics, it would not be possible to distinguish which component of the label had, or had not, influenced the respondent's ranking. A sample card is presented



**Figure 3.1. Sample conjoint card.**

**Table 3.4. Experimental cards**

Card	Price	Review	Eco-rating	Warranty
1	Low	Low	Low	Low
2	Medium	High	Medium	Low
3	High	High	Low	High
4	Low	Medium	Medium	High
5	Medium	Medium	Low	Medium
6	Low	High	High	Medium
7	Medium	Low	High	High
8	High	Medium	High	Low
9	High	Low	Medium	Medium



in Figure 3.2. While in reality the majority of washing machines fall within the A ratings section of such a scale, values of A++, B and E were presented to allow for greater generalisability across other ranking schemes and to present the respondent with a more meaningful contrast.

Following the collection of responses, the rankings were analysed using a conjoint script in IBM SPSS 22. The results of this analysis are presented in section 3.3.

### 3.3 Results

This section presents the results of the questionnaire in the order in which the questions were displayed to respondents.

#### 3.3.1 Sources of information

The first questions presented in the survey examined where respondents sourced their information when making purchasing decisions for household appliances. Sources of information were considered to be a very important factor in terms of the effectiveness of eco-labels, as environmental information cannot be effective if it is not displayed where individuals source their information. Table 3.5 outlines the results of information gathering for purchases involving white goods. It is clear from examining the results in Table 3.5 that, in the household appliance sector, the number one source of information is the internet, in all forms, with nearly 85% of respondents stating that they sourced information there. This has a major implication for eco-labels, as it appears that any legislation regarding environmental information needs to take into account the importance of online information. These results also show that a majority of respondents also seek information at traditional showrooms, where eco-labels must be displayed prominently. This would suggest that a complex information retrieval process is occurring, in which a number of sources are consulted before a decision is made. This appears to make intuitive sense, as white goods are often expensive purchases, so in-depth research may be undertaken before choosing a specific appliance. It is interesting to note the reduced role of more traditional advertising sources such as radio, television and print media, with less than 10% of respondents seeking information from these outlets.



Figure 3.2. Sample card ranking.

Table 3.5. Respondents' sources of information on white goods

Source	Respondents (%)
Showroom or shop	61.7
The internet	84.9
Friends or family	35.3
Adverts on television or radio	7.7
Adverts in print media	8.9

Table 3.6 contains the answers to the equivalent question for new car sales. In this case, the internet is again the most popular source of information; however, the differences between the internet and more traditional information sources, such as showrooms or recommendations from friends and family, is less pronounced. Again, traditional media are seen to be only a very minor source of information.

#### 3.3.2 Car-related questions

Questions 6 and 7 followed the information retrieval section and related to the importance that respondents put on various factors when purchasing a car, either

new or second hand. Table 3.7 contains a list of the factors and their relative importance according to respondents for a brand new car purchase. Three rating options were available, with the following scoring scheme being used: 2=Very Important, 1=Somewhat Important and 0=Not Important At All. When assessing these values, it is perhaps most appropriate to compare the scores relative to each other, and from this it is clear that price and fuel efficiency are the most important factors, with environmental efficiency being one of the least important factors.

Based on the same rating scale, Table 3.8 contains the results for second-hand car purchases. Environmental impact is again one of the least valued factors, while fuel efficiency is second only to price in importance. This would suggest that, of the information presented by eco-labels, factors with a financial impact for respondents are more significant than those with societal costs.

### 3.3.3 Conjoint analysis results

The next section of the questionnaire dealt with the ranking of attributes based on the conjoint analysis experiment. This was designed to gain a better understanding of the role of eco-labels relative to the

other attributes of white goods, specifically with regard to washing machine sales.

Using the participants' rankings as the input, the responses were analysed using the conjoint function available in SPSS22. The primary output of this analysis was the production of relative importance ratings for the four attributes under consideration, namely price, warranty, eco-label rating and user review. These scores are provided in the form of percentages and are outlined in Table 3.9. This information allows the analyst to determine the relative role of each of the factors in achieving the rankings observed in the data set. If it is assumed that these factors account for 100% of the respondents' motivation to give the card a ranking relative to the other cards, the results in Table 3.9 outline what percentage of this motivation is allocated to each of the attributes under consideration. This output is very easy to interpret and use for direct attribute comparisons. Based on these results, it would appear that the energy ratings provided by the eco-labels are the most important factor in terms of the rank assigned to a given card, with a score of 38.11%. Review and price appear to be very closely matched, with scores of 24.48% and 24.16%, respectively. This suggests that respondents considered these attributes

**Table 3.6. Respondents' sources of new car information**

Source	Respondents (%)
Showroom or shop	51.3
The internet	69.7
Friends or family	42.7
Adverts on television or radio	6.8

**Table 3.7. Factors involved in respondents' new car purchases**

Factor	Rating
Price	2.90
Brand	2.25
Engine size	2.33
Road tax	2.47
Class	2.31
Environmental impact	2.27
Fuel efficiency	2.76

**Table 3.8. Factors involved in respondents' second-hand car purchases**

Factor	Rating
Price	2.89
Brand	2.22
Engine size	2.31
Road tax	2.53
Class	2.27
Environmental impact	2.20
Fuel efficiency	2.75
Kilometres on the clock	2.70
Service history	2.67
Age	2.59

**Table 3.9. Factor importance**

Attribute	Score (%)
Eco-label rating	38.11
Review	24.48
Price	24.16
Warranty	13.24

equally when undertaking their rankings. Finally, it is clear that warranty is the least important of the factors examined in terms of contributing to the attractiveness of the product, with a score of 13.24%.

The results arising from the conjoint analysis also provide a breakdown of each of the attribute levels and their role in creating the rankings, in terms of their contribution to the relevant attractiveness of the product. These values are presented in Table 3.10. Positive scores indicate that an attribute level promotes a higher ranking for a given card, whereas negative scores produce a lower ranking. The first thing to note regarding these scores is that they appear to be intuitively correct with regard to the sign of the coefficients. For eco-labels, warranty and review, these values increase with respect to the attribute values. This would suggest that, as these attribute values increase, the attractiveness of the product also increases. This would appear to make sense, as increased energy rating values, better user reviews and a longer warranty should be of value to the consumer, as they indicate that the product is of better quality and will have lower long-term running costs. The inverse is true for price, where, as expected, an increase in price leads to a decrease in the attractiveness of the product.

With regard to the specific values, there appear to be a number of interesting findings. For the eco-labels attribute, it is notable that both high and medium ratings associated with a product increase its attractiveness, with values of 1.172 and 0.389, respectively. This means that ratings of A++ and B both increase the chances of the product/card receiving a favourable rating. Only low ratings (E) decrease the attractiveness of the product, with an associated score of -1.561. This may suggest that the real value of this information is to warn consumers away from highly inefficient devices, as the other values are seen as positive. The same is true for both warranty and review, while high prices appear to be linked to lower ratings.

It must be noted that the results arising from this analysis are specific to this experiment and the attribute values and combinations presented to respondents. The results do not provide information regarding the role of attributes outside the upper and lower bounds; however, the results of this analysis indicate that eco-labels are very important to respondents when rating the washing machine

options available to them. While there may be some bias introduced based on the card design, where the energy ratings are highlighted prominently, the results do indicate that this information plays a very important role in consumer considerations.

Unlike the other attributes for which consumer motivation is quite simple to discern, the interaction with eco-labels may be motivated by a number of different factors. In an effort to gain a greater understanding of the motivation of respondents' use of the information on eco-labels, respondents were asked why they considered this information. The results of this question are presented in Table 3.11, and they suggest that there is a dual motivation associated with the use of eco-labels in purchasing decisions.

In order to attempt to capture the complexities of decision-making that may not emerge from the conjoint analysis, a comment box was included in which users were asked to provide information regarding how they made their choices. Respondents provided fewer comments in the comment box than they did answers for other questions in which respondents were asked to pick from a predefined list; however, the responses provide an interesting

**Table 3.10. Attribute levels**

Attribute level	Score
Eco-label rating low	-1.561
Eco-label rating medium	0.389
Eco-label rating high	1.172
Review low	-0.998
Review medium	0.241
Review high	0.757
Price low	0.791
Price medium	0.151
Price high	-0.942
Warranty low	-0.550
Warranty medium	0.151
Warranty high	0.399

**Table 3.11. Respondents' motivation for using eco-labels**

Reason	Respondents (%)
Long-term financial savings	18.4
Reduced environmental impact	13.8
Both	67.8

insight into the decision-making processes of the respondents. A sample of these responses selected to capture the range of answers is provided in Box 3.1. The first thing that emerges from an analysis of these comments is the trade-offs that respondents appear to have made between the different factors provided. There is clearly an attribute interplay occurring, as individuals weigh up the options available to them. From an eco-label/energy rating perspective, it is clear that energy information is very important to respondents and that this importance can be linked to cost issues associated with highly rated appliances. For more comments, please see D3.1.

Based on these comments it was possible to use the online word cloud generator Wordle (Wordle, 2014) to analyse the frequency with which certain words appeared. This approach provides the reader with a very quick and easily understood method of identifying what was of importance to respondents. For the purposes of this analysis, the greater prominence of a given word indicates the frequency with which it occurs within the comments. These results are displayed in Figure 3.3. It is clear that terms such as “price”, “energy” and “rating” occur frequently, as do the other attributes, warranty and review. The term “important” is also highlighted, as it was used frequently by respondents when describing which factors influenced them the most. This word was left in the text as the research team wished to assess respondents’ responses in full, rather than engage in response editing, where some meaning may be altered.

**3.3.4 Eco-labels in purchases**

This section of the survey was designed to gain an understanding of how respondents’ use of eco-labels varied with respect to the different sectors in which labelling occurs. In each of the sectors examined, eco-labelling initiatives are currently being implemented, but this implementation is not uniform across sectors in terms of either requirements or display methods. Respondents were asked if they looked for eco-labels or environmental information when making purchases (or renting in the case of property) for a number of goods and services. These sectors are outlined in Table 3.12 and the following scoring system was used: 3=Always, 2=Sometimes and 1=Never.

The results displayed in Table 3.12 demonstrate a considerable range of values for each of the products

**Table 3.12. Respondents’ use of eco-labels in purchases**

Good or service	Score
Televisions, computers, tablets, etc.	1.91
White goods, cookers, washing machines, dryers, etc.	2.58
House, apartment, etc. – buying	2.46
House, apartment, etc. – renting	2.19
Cars, vans, motorbikes, etc.	2.39
Travel accommodation, hotel, bed and breakfast, hostel, etc.	1.43
Food and drink	1.74
Household items, cleaning products, shower gels, soaps, etc.	1.89
Furniture	1.52



**Figure 3.3. Word cloud analysis.**

### Box 3.1. Respondent's comments

- A combination of all four that would determine my decision. I would settle for a lower review if the other three were very good, for example, or pay a higher price if the other three were very good.
- Price and energy efficiency were my main criteria. For similarly placed ones, I used warranty as my decider.
- As a student with limited funds price and reliability insured by warranty and reviews are the most important. Energy rating comes last simply on the fact it will be little used as it is only [me] in the apartment.
- I just went through the four factors in the order indicated above – first looking at the energy rating, then warranty, then price and finally the review.
- Energy efficiency is more important in the long run than price. Warranty is usually more hassle than it is worth.
- Review is certainly important, but I'd be looking at how many people reviewed it at a certain star rating, etc. Where obviously the more reviews there are, the better.
- Being sensitive to ecological matters, I could not pick a machine with a bad energy rating. Then, being a student on a reduced budget, I would look at the price, then at the warranty that tells me how long I can use the washing machine. I don't think I would really consider the review unless to choose between two identical products.
- Energy rating is important because a low energy rating means a larger financial burden in the future, thus there are hidden costs.
- Even though environmental efficiency is important to me, I consider it to be worse for the environment to replace the washing machine because it was poor quality. I reckon that companies who give a warranty tend to be more confident that you won't need to use it.
- Related price to warranty and energy rating, so if rating was good price would be extended to a higher limit.
- I felt that after the energy rating reached B or less I was less concerned as to where that rating sat and more concerned with the price.
- Because these are items only bought occasionally, and expected to last for a few years, price is less of an issue. Warranty is important because it ties in to how long the item might last, but can be offset to some extent if the item has received good reviews. Energy efficiency is the most important criterion, partly because of environmental considerations, and partly because it is an investment in lower running costs.
- I always look at the review then the rating, as this is the ongoing cost going forward, then price and finally warranty.
- I would be happier paying more for an A++ energy rating for the long-term savings, though poor reviews would make me less interested.
- Energy rating is probably the most important since the price of the good will only be paid once and the energy bill will be continuous.
- Price and review are joint third really; the content of the review would be important to help decide whether paying more for something would be worth it or not. For a longish-term investment in something like a washing machine, the importance of price is lessened, whereas price for something like an annual bill such as motor tax is more important to me.

and services examined. Each of these sectors have eco-labels of some sort associated with them; however, it is interesting to note that scores above 2 are observed only for sectors in which such labels are mandated by legislation. Specifically, this relates to

housing, white goods and the motor vehicle sector. It should also be noted that only electronic devices such as televisions and computers have mandated energy labels associated with them, but these do not receive a high use score in the results. These devices are less

utilitarian than white goods, so it is likely that other factors are more important.

As it was deemed that the cross-sectoral impact of eco-labels was a specific area of interest (AOI) for this project, an examination of the role of demographics was undertaken on cross-sectoral label use, based on factors including age, education, gender and environmental attitudes. Table 3.13 outlines the results of an analysis of eco-label usage with respect to gender. These results display very little difference between male and female respondents.

The next step in this analysis was an examination of the role that respondents' environmental attitudes were likely to play in their use of eco-labels. For the purposes of respondent categorisation, the environmental statements outlined in section 3.2.3 were used. Based on the scores arising from these statements, it was possible, using a two-step clustering technique in SPSS, to create clusters of

respondents with similar environmental attitudes. It must be noted that these clusters are valid only within the sample and cannot be generalised to the rest of the population; however, they help to examine how environmental attitudes correlate with the use of eco-labels in purchases. The clustering process produced three groups within the sample: C1 ( $n=95$ ) had the lowest environmental attitudes scores, C2 ( $n=185$ ) represented moderate attitudes and C3 ( $n=56$ ) included the most environmentally concerned respondents. Table 3.14 presents the frequency of eco-label use for each of the relevant sectors. An examination of these results shows that the frequency of eco-label use in processing decisions increases as environmental concerns increase, with C3 displaying scores of greater than 2 for all sectors other than the tourism industry. In each of the groups, higher label use is observed in the sectors in which such labels are legally mandated.

While environmental attitudes may be a strong indicator of eco-label use, it was also deemed

**Table 3.13. Effect of respondents' gender on eco-label use**

Good or service	Gender	
	Male	Female
Televisions, computers, tablets, etc.	1.95	1.89
White goods, cookers, washing machines, dryers, etc.	2.55	2.60
House, apartment, etc. – buying	2.47	2.46
House, apartment, etc. – renting	2.18	2.20
Cars, vans, motorbikes, etc.	2.37	2.40
Travel accommodation, hotel, bed and breakfast, hostel	1.40	1.5
Food and drink	1.67	1.76
Household items, cleaning products, shower gels, soaps, etc.	1.76	1.95
Furniture	1.48	1.53

**Table 3.14. Effect of respondents' environmental attitudes on eco-label use**

Good or service	Environmental attitude score		
	C1	C2	C3
Televisions, computers, tablets, etc.	1.71	1.90	2.31
White goods, cookers, washing machines, dryers, etc.	2.46	2.60	2.72
House, apartment, etc. – buying	2.40	2.46	2.58
House, apartment, etc. – renting	2.15	2.15	2.37
Cars, van, motorbike, etc.	2.16	2.41	2.70
Travel accommodation, hotel, bed and breakfast, hostel, etc.	1.17	1.45	1.85
Food and drink	1.40	1.75	2.22
Household items, cleaning products, shower gels, soaps, etc.	1.63	1.91	2.29
Furniture	1.24	1.51	2.02

important to assess the role of more traditional demographic characteristics. Table 3.15 outlines the relationship between use of eco-labels and the age of respondents. While some sectors display increases in label usage with respect to increases in age, this is not very pronounced and does not appear to be consistent across industries. This suggests that age is not an important factor in the likelihood of an individual using an eco-label and its information as part of their purchasing decisions.

The final characteristic under examination in this section was the stated highest level of education of the respondents. Table 3.16 provides an analysis of the role of education in eco-label use in each of the sectors examined. E1 contains all respondents with secondary-level education, E2 all respondents with third-level education and E3 all respondents with postgraduate qualifications. No obvious trends emerged from the data, suggesting that education is a not a major factor in stated label use.

Using the same scoring scheme, the next question asked respondents if they looked for BER certificates when buying or renting a property. The results are displayed in Table 3.17. It is apparent from an examination of the relevant scores that, in both renting and buying properties, the information represented by BER ratings has an important role to play. This is especially true when purchasing a property. This would appear to be an intuitive finding, as individuals are likely to spend longer in a property they own and therefore will be affected to a greater degree by the energy performance of the building.

### 3.3.5 White goods eco-label testing

Survey results presented to this point have concentrated on the role of eco-labels within purchasing decisions and how they interact with other factors. The next section of the survey examined the effectiveness of the various constituent parts of eco-labels for white goods. This was undertaken by

**Table 3.15. Effect of respondents' age on eco-label use**

Good or service	Age			
	18–29	30–39	40–49	50+
Televisions, computers, tablets, etc.	1.66	1.90	2.12	2.11
White goods, cookers, washing machines, dryers, etc.	2.41	2.56	2.68	2.76
House, apartment, etc. – buying	2.43	2.59	2.35	2.48
House, apartment, etc. – renting	2.11	2.39	2.12	2.21
Cars, vans, motorbikes, etc.	2.44	2.29	2.25	2.57
Travel accommodation, hotel, bed and breakfast, hostel, etc.	1.35	1.45	1.40	1.59
Food and drink	1.78	1.62	1.64	1.86
Household items, cleaning products, soaps, shower gels, soaps, etc.	1.79	1.80	1.91	2.13
Furniture	1.43	1.38	1.52	1.78

**Table 3.16. Effect of respondents level of education on eco-label use**

Good or service	Highest education level		
	E1	E2	E3
Televisions, computers, tablets, etc.	1.84	1.87	2.02
White goods, cookers, washing machines, dryers, etc.	2.49	2.58	2.63
House, apartment, etc. – buying	2.36	2.41	2.58
House, apartment, etc. – renting	2.23	2.15	2.23
Cars, vans, motorbikes, etc.	2.44	2.34	2.43
Travel accommodation, hotel, bed and breakfast, hostel, etc.	1.46	1.44	1.40
Food and drink	1.63	1.75	1.76
Household items, cleaning products, shower gels, soaps, etc.	1.84	1.89	1.91
Furniture	1.53	1.49	1.55

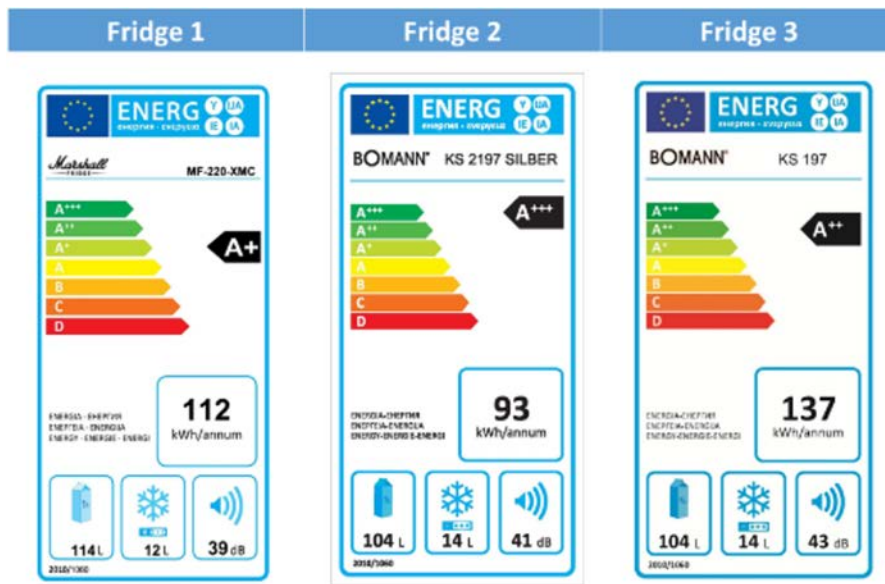


Figure 3.4. Fridge–freezer eco-labels.

providing the respondents with an image of three fridge–freezer eco-labels (see Figure 3.4) and asking them to answer questions based on this information. The labels picked for this question were designed to be somewhat complex to interpret; although fridge 3 has a higher energy efficiency rating (A++) than fridge 1 (A+), its actual electricity consumption is higher. This was purposefully done to gather data about respondents’ ability to correctly interpret the information provided and to make accurate comparisons, as per the goal of such labels. These labels contained information on energy efficiency, annual energy consumption, volume and noise.

The questions in this section were designed to test the respondents’ ability to understand the information displayed by the labels, and therefore to examine the effectiveness of the labels as means of effectively conveying or communicating the relevant information. The first question in this section simply asked the respondents to identify the fridge–freezer that consumed the largest amount of electricity, which in this case is fridge 3. The results of this question are displayed in Table 3.18 and demonstrate that a large majority of respondents was able to successfully identify fridge 3. However, 15% of respondents selected fridge 1, which may be due to it having the lowest efficiency rating. This result suggests that eco-labels such as these are effective as a means of transmitting energy consumption information.

Table 3.17. Influence of BER certificates on respondents’ property decision-making

Service	Score
Buying a property	2.69
Renting a property	2.25

The final question in this section asked the respondents to state what they understood the symbols at the bottom of each of the labels to mean. For the purposes of these questions, answers did not need to be uniform to be deemed correct; rather, they had to show only an understanding of the information provided. For example, “fridge capacity” and “how much the fridge holds” were deemed to be the same response for this analysis and were both considered to be correct answers. The results of this question are displayed in Table 3.19. These results show that, with the exception of freezer capacity, the meanings of these symbols are quite well understood. Once again, this finding suggests a good understanding of the information provided by the individual label elements.

The next question presented the respondents with a number of statements regarding the labels that they had just seen and asked them to state their levels of agreement. The following scoring scale was used: Strongly Agree = 5, Agree = 4, Neutral = 3, Disagree = 2, Strongly Disagree = 1. The responses to this question are presented in Table 3.20.



**Table 3.18. Respondents' interpretation of power consumption**

Option 1	Respondents (%)
Fridge 1	15.7
Fridge 2	4.2
Fridge 3	75.9
All the same	4.2

The results displayed in Table 3.20 indicate that, while there is a general level of agreement with the statement that the labels were easy to understand, this score is not very pronounced and only slightly above an aggregate neutral score of 3. Respondents appear to slightly disagree with regard to the statement that the labels contained too much information. It is notable that very high scores are associated with the utility of the labels as sources of information for individuals making purchasing decisions. The findings appear to indicate that, while there is some disagreement regarding label design and ease of understanding, the information transmitted by eco-labels would seem to be valuable to the consumer, as they provide important information.

**3.3.6 Eco-labels in the motor industry**

The next section of the survey was designed with a purpose similar to that of section 3.3.5; however, in this case, rather than examining white goods, the focus was on the role of eco-labels in the motor industry. Although the previous section had presented respondents with three labels, on account of the complexity of the information provided by the labels used in the motor vehicle sector, it was decided to focus on just one label and the elements within it. The image used for this task is shown in Figure 3.5.

The first question in this section asked the respondents whether or not they had ever seen this label before. It is clear from the results displayed in Table 3.21 that the vast majority of respondents had not encountered this label before. This result may reflect the demographics of the sample; however, it does still raise questions about the effectiveness of eco-labels in the motor vehicle sector and appears to echo concerns about label prominence in this industry raised in D2.1.

The next question asked respondents to rank how important they perceived to be the information

**Table 3.19. Respondents' understanding of symbols**

Symbols	Correct (%)
Symbol 1	83.1
Symbol 2	57.6
Symbol 3	85.5

**Table 3.20. Respondents' understanding of eco-labels**

Statement	Score
The labels were easy to understand	3.6
The labels contain too much information	2.4
The labels contain information that I find to be important	4.1
I would use a label like this when making purchases	4.1

presented to them by the label. In this case, scores closest to 1 indicate the highest levels of importance, and scores closer to 5 indicate lower levels of importance. The results outlined in Table 3.22 show that the fuel use information is considered to be by far the most important vehicle attribute communicated by the label. This is followed by motor tax and then by emissions. This result suggests that, while eco-labels may be able to present purely environmental information, the most important factors to the consumer are those that impact on their operating costs, although these are often linked to environmental impacts. In this regard, these findings appear to very much reflect those generated in the conjoint analysis section of the survey.

**3.4 Discussion**

The results presented in the previous sections provide a large amount of information regarding the role of eco-labels in consumer choices. These results are quite diverse and cover a wide range of questions regarding the effectiveness of eco-labels as methods of promoting environmental concerns in consumer choices. The results of the conjoint analysis, and the questions accompanying it, suggest that, in the white goods sector at least, energy ratings as supplied by eco-labels have a very significant role to play in consumer product choice. The motivation for using the labels appears to be linked to both environmental and long-term financial considerations, as appliances that

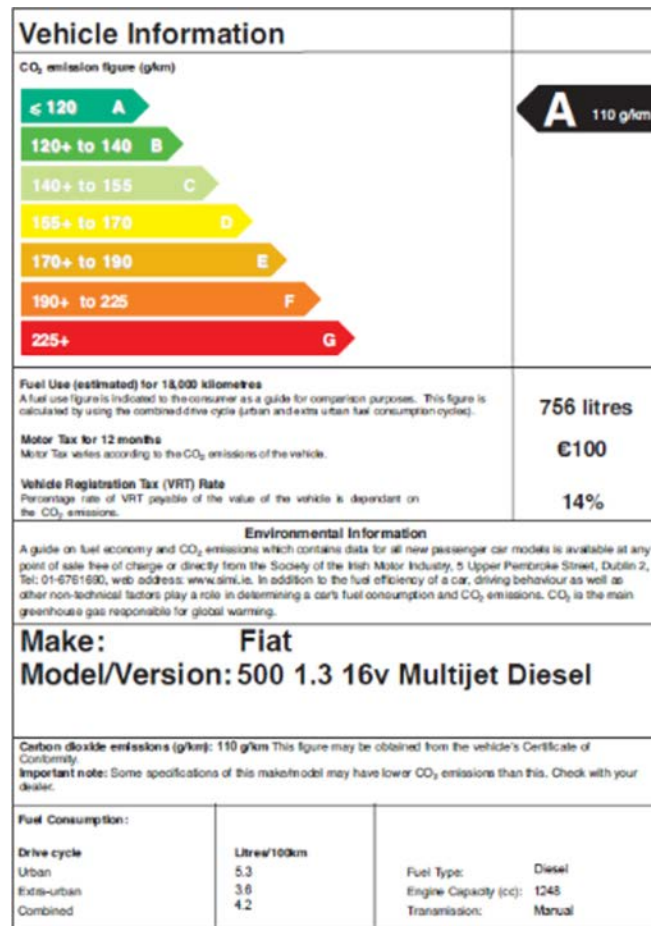


Figure 3.5. Motor eco-label.

Table 3.21. Respondents' experience of eco-labels in the motor industry

Option	Respondents (%)
Yes	8.9
No	91.1

are more energy efficient consume less energy, which therefore reduces running costs. This suggests that eco-labels are successful in highlighting the energy issues associated with white goods. While the exact percentages attached to the attributes in this analysis may change with respect to different experimental designs and should therefore only be treated as a guide, these results, in tandem with the comments provided by respondents, demonstrate that eco-labels are an important instrument in shaping consumers' decision-making processes.

With regard to the analysis of the role of eco-labels in different sectors, the results suggest that such labels are effective in the sectors where they are legally

Table 3.22. Importance of label elements to respondents

Information element	Importance score
CO <sub>2</sub> emissions per kilometre	2.87
Fuel use	1.62
Motor tax	2.50
VRT	3.76
Emissions and driving style (urban, extra urban, combined)	4.00

**VRT, vehicle registration tax.**

mandated. The only area where legislation requires the provision of energy information and respondents provided low scores was for the sale of media devices, such as televisions, tablets and personal computers. It could be argued that these devices are less utilitarian than other items and that therefore other factors are more important to consumers. No significant differences appear to exist with regard to label use and the demographics of the sample. The

one area where significant differences are observed is with regard to the stated environmental attitudes of the respondents. For all sectors examined, increased stated environmental concerns were associated with increased eco-label use, suggesting a pro-environmental motivation for paying attention to these labels.

The results of this experiment appear to indicate that eco-labels have a very important role to play in consumer choice, in particular in sectors where such labels relate to the operating costs of a product.

### **3.5 Conclusions and Implications**

The survey was designed with the goal of collecting data from a sample group to gain an understanding of the role that eco-labels play in purchasing decisions and how well the information they display is understood by consumers. The results outlined in this chapter provide a detailed insight into the role that eco-labels can play in consumer choices. While it is clear that environmental information alone is not the sole determinant of the likelihood of an individual purchasing a specific product or service, the results outlined previously indicate that eco-labels and energy information have an important role to play in consumer choices, both for environmental reasons and because

of the long-term financial savings associated with products with lower levels of energy consumption.

The provision of eco-labels represents a mandated allocation of resources to comply with legislation, and, based on the results of this study, it is clear that eco-labels are an effective means of communication. The results of this survey, bearing in mind that the survey sample cannot claim to be representative of the entire Irish population, suggest that consumers do indeed both understand and consider the information being provided to them by such labelling approaches, although not all information that such labels provide is regarded as being of equal importance.

In terms of implications for policy, the results of this research appear to confirm that eco-labelling is an effective means of information transmission within the sectors where it is currently applied. The authors suggest that there is scope to further extend such schemes; however, it is important to consider that a large motivation for consumers to consider such information relates to the long-term savings information that such labels can indirectly communicate. Therefore, the effectiveness of eco-labels is likely to be reduced in sectors in which financial savings are not tied to reductions in energy consumption and environmental impacts.

# 4 Assessment of Eco-labels Using Eye-tracking Technology

## 4.1 Introduction

Eco-labels represent a highly visual means of presenting environmental information to consumers when they are making purchasing decisions. While the provision of eco-labels is legally mandated within a number of sectors within EU Member States, such labels also compete for consumers' attention with other features and attributes of a given product, such as cost, quality and technical features. Even when considered in isolation, the more complex eco-labels associated with sectors such as white goods and new car sales contain large amounts of quite complex information provided via a number of metrics. The use of such labels is one the most commonly utilised means of providing environmental information, and while significant efforts have been made to make the relevant information as easily accessible and as intelligible as possible for consumers, there is limited research into the effectiveness of the various elements that make up complex eco-labels, especially within an Irish context. As these labels are so commonly used and as legislation places obligations for their provision on retailers and manufacturers, there is a need to ensure that the opportunity they present for information dissemination is being effectively utilised.

This chapter presents the results of using emerging eye-tracking technology to gain a better understanding both of the role of eco-labels with respect to other product attributes and of the individual elements of the labels.

## 4.2 Background

This section outlines the results of a number of experiments that applied emerging eye-tracking technology to capture the gaze path of respondents when undertaking a number of tasks involving eco-labels. It was hoped that, by using this approach to assess where consumers focused their attention when presented with certain stimuli, it would be possible to provide more insight into the mechanics of decision-making, specifically with regard to the role that eco-labels can play in promoting more sustainable choices.

As the information provided by eco-labels is not always presented in a uniform manner, with some of the data provided given greater prominence because of the design and layout of the label, it is important to understand what impact these label design choices may have on how consumers assimilate information. For example, text size may vary within a label, certain information may be presented in the form of alphabetical colour-coded scales to provide context and allow for ease of comparison with other products, and other information may be provided in a purely numerical format, with no additional contextual information included. For more details on these approaches, see D2.1.

Eco-labels, particularly those in the white goods, motor vehicle and housing sectors, often use very visually striking formats with graded colour schemes to indicate the energy performance of the item relative to similar options. While these rankings may provide consumers with easily digestible and comparable information, the prominence of certain information, for example energy efficiency within class, may impact consumers' ability to recall other product attributes communicated by the label, such as water consumption or overall per annum energy usage. Section 4.3 outlines the technology behind eye-tracking, the design of the eye-tracking experiments within an eco-labels context and the design of the stimuli presented to the participants.

## 4.3 Methodology

This study was designed to utilise a combination of the Eye Tribe (2017) portable eye-tracker, a number of images designed specifically for this study (stimuli) and an accompanying survey, the last two of which were designed by the research team. An eye-tracking analysis operates by reflecting beams of near-infrared light off the pupils of the test participant; following a calibration exercise, it is then possible to map the path of their gaze across the computer screen. By analysing the results of these gaze movements, it is possible to determine where the participants have been focusing their attention in relation to the stimuli provided. Based on these results, it is possible for

researchers to gain a better understanding of the effectiveness of the stimuli, in this case the eco-labels, and their component elements, in terms of transmitting the relevant information. To address the project's research questions, two distinct experiments relating to eco-labels were undertaken using the eye-tracker. The first experiment was designed to assess how eco-labels compete for consumers' attention with other factors and product attributes, and the second experiment examined the role of the elements that make up eco-labels in communicating information. In addition to this, a number of recollection and ranking tasks were undertaken, in conjunction with the collection of user comments, to help to contextualise the results arising from this analysis.

#### 4.3.1 Sample

For the purposes of this research, a sample of 43 study participants were recruited. As a large number of these were recruited from Trinity College Dublin, there is a bias within the sample, with younger individuals and those with higher levels of education being overrepresented. However, as the results reported in Chapter 3, while not being representative of the overall population, do contain a considerable number of respondents from different age groups and educational classes, and suggest that neither age nor education are major factors in eco-label use in Ireland, this bias need not be considered a major concern. For the purposes of reducing priming effects, no individuals who had taken part in the survey outlined in D3.1 were included in the sample. The characteristics of the sample are outlined in Table 4.1.

#### 4.3.2 Eye-tracking technology

Eye-tracking technology in and of itself is not a new technology; however, recent advances in manufacturing and software have drastically reduced the costs of this technology, while also increasing its portability. In this study, the stimulus used was the laptop screen displaying the relevant images of eco-labels and other product attributes. The advantage of this technology is that it provides a means of tracking eye movements without resorting to the intrusive step of attaching equipment to the participants, while providing highly insightful and easily interpretable results.

**Table 4.1. Sample properties**

Age (standard deviation) (years)	29.5 (9.96)
Gender ( <i>n</i> )	
Male	26
Female	17

One of the advantages of adopting an eye-tracking approach is that there are a number of different metrics that can be applied to gain an understanding of where study participants were focusing their attention. Analysis techniques available to researchers include heat maps, AOIs and scan path maps. These outputs are constructed via underlying measurement metrics, such as relative fixation duration, total fixation duration and time to first fixation.

#### Heat maps

Heat maps are a visual representation of aggregate metrics such as relative fixation duration. One of their key advantages is that they provide highly intuitive representations of where respondents have been focusing their attention while looking at a given set of stimuli. Heat maps such as these often use colour spectra to denote the intensity of a participant's gaze in a given area. From this image, it can be determined that individuals focus their attention principally on the centre of the screen. One advantage of heat maps is that they can easily be produced to display either the results of one individual's gaze or an aggregate image for all individuals in the study.

#### Fixations

Fixations refer to a period of time, usually defined as 50 milliseconds or more, when a participant's gaze appears to rest on a given point. Fixations form the basis for outputs generally used in eye-tracking analysis. The transitions between such fixations are known as saccades, and these tend to be excluded from analysis. The analysis of fixations forms the underlying basis of the statistical examinations generally undertaken in eye-tracking research, and heat maps may be considered to be a two-dimensional representation of an underlying fixation intensity landscape. While there are a wide range of fixation metrics available to researchers, this research concentrates on the relative duration of fixation (what

proportion of the time a participant spent on a given area) and time to first fixation (how long from initially seeing the image it took them to focus their attention on a given area). These metrics were picked because they align most closely with the research questions under examination.

#### *Scan paths*

Scan paths refer to graphics that link fixation points as they occurred in time. This provides a means of graphically representing the path of a given participant's attention as it moves across the image from one element to another. Scan paths are particularly good at identifying when participants return to certain areas, perhaps to check or confirm information that they may not have fully understood or taken in at first sight. The main advantage of scan paths is that they can create highly intuitive graphics and animations, which can provide detailed insight into the underlying participant's behaviour. The main limitation of such an approach is that it analyses the sample as a whole, rather than the behaviour of single individuals. Therefore, its use was limited in this study.

#### *Areas of interest*

Within any image there are likely to be certain elements that are of more interest to researchers than others. It is possible to define specific AOIs within an image and, based on these, collect statistical data that then enable a formal comparison between such areas. AOIs should be independent and non-overlapping to achieve the best results, and this approach was important in the design of the scenarios used in this experiment.

#### **4.3.3 Stimuli**

This research can be considered to comprise two distinct parts: the first examining the role of eco-labels in relation to other features of the product; and the second analysing the role of the various visual components of the label.

#### *Choice scenarios*

For the first part of the experiment, participants were provided with information regarding a number of potential washing machines and were asked to

pretend that they were making a choice based on this information. This information was displayed in the form of images with each option's relevant attribute levels contained within a vertical column. To ensure the comparability of the results of this experiment with those recorded as part of the survey undertaken in Chapter 3, the same attributes – namely cost, user review and eco-label rating – were included. Warranty was excluded because of space constraints identified in piloting, and as it was identified by survey respondents as the least important attribute. To allow for ease of analysis, the options and attributes were surrounded by large amounts of white space so that gaze fixations were less likely to overlap. For validation purposes the participants were each shown three similar images, with the relevant attributes varying in value between the images. An example of one of the images presented to the study participants is displayed in Figure 4.1. For the purposes of this experiment, the image was displayed in a full-screen format on a laptop, and participants were asked to imagine that they were making a choice between washing machines based on the information provided. This stage of the experiment was undertaken prior to the analysis of the more complex labels to reduce the potential for bias that may have arisen if they were already concentrating on environmental information.

A number of AOIs were defined within each of the images. These AOIs were designed to allow analysis of the role of each of the attributes under consideration. Figure 4.2 presents an outline of the AOIs for one of the choice scenarios. It can be seen that there are four distinct areas, one for each of (1) the options labels, (2) the prices associated with each option, (3) the stars/review associated with the options, and (4) the eco-labels associated with the options. These AOIs formed the basis for a statistical comparison of the product attributes.

#### *Complex labels*

The second part of the experiment was designed to look at the role of the individual elements that constitute eco-labels, as in many cases eco-labels attempt to provide consumers with information relating to more than one attribute of the product.

To gain a better understanding of how these individual label elements compete for consumers' attention, sample labels were examined in isolation, rather than



Figure 4.1. Choice scenario.

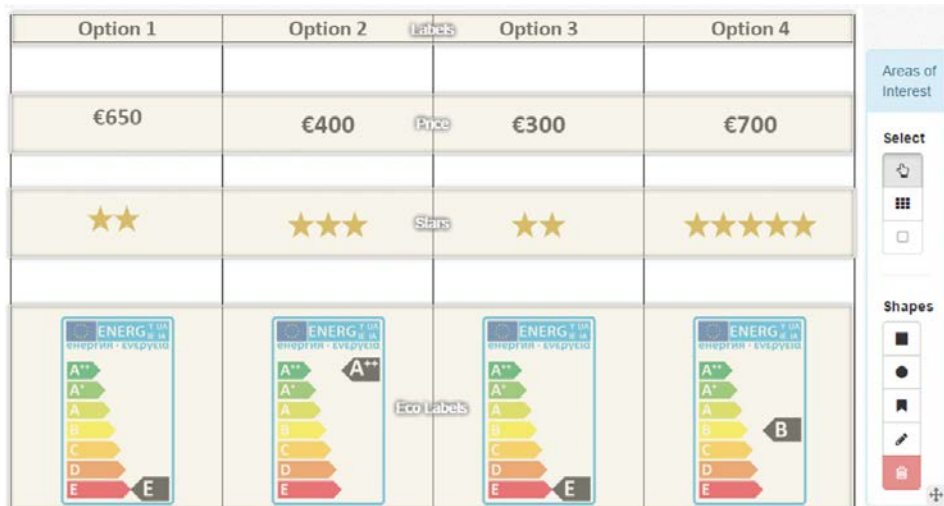


Figure 4.2. Scenario AOIs.

in a choice scenario, as piloting highlighted that the inclusion of other attributes could overcomplicate the analysis. Two labels were selected for the purposes of this analysis, one for an appliance in the white goods sector and one for a new car (see Figure 4.3). These labels were selected because, while they contained different information and metrics, the display formats were very similar. Both can be seen to contain colour-coded scales relating to a given metric and information on other metrics associated with the performance of the product.

Unlike the previous section of the experiment, participants were not asked to undertake a choice task while viewing the labels; rather, they were

asked to simply assess the images and to move on once they were happy that they had assimilated the relevant information.

#### 4.3.4 Accompanying survey

While eye-tracking technology has the ability to create quite impressive and interesting results, particularly with regard to visual outputs, there are limitations to the use of such analysis in isolation. For example, an area of high activity on a heat map may suggest that an individual is very interested in the information it contains; however, they might also be very confused by it. Therefore, when collecting such data, it is always important to ask accompanying questions

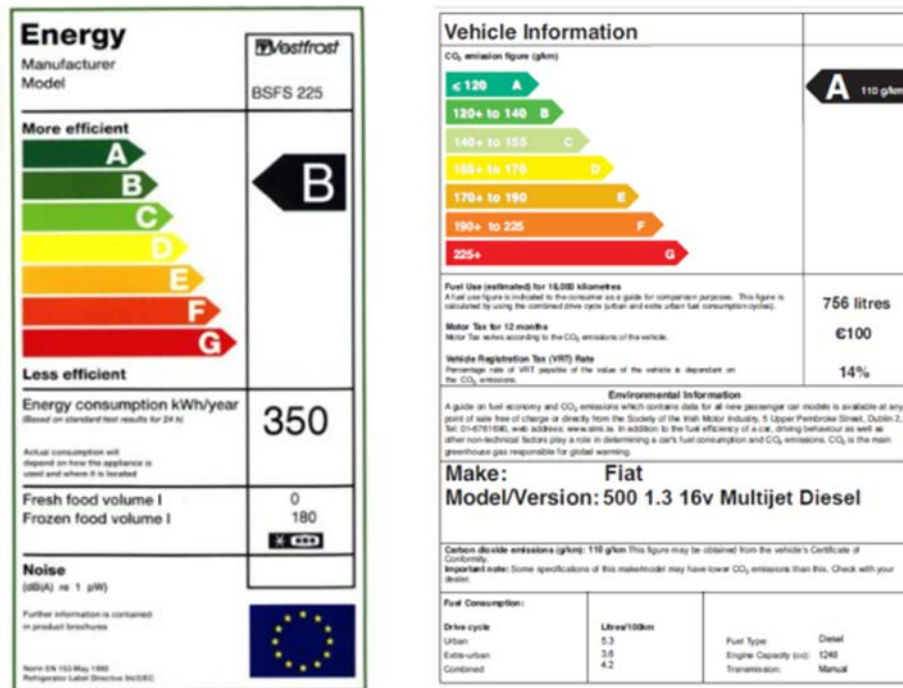


Figure 4.3. Complex labels.

to gain a better understanding of what the outputs actually mean in terms of addressing the research question.

*Recollection tasks*

In addition to the application of the eye-tracking, the analysis of the role of the component elements of the eco-labels contained an information recollection task. This task was designed to assess how well the participants remembered the information that was presented to them. This was designed as a means both to allow for a comparison of the elements and to enable a better understanding of the results arising from the eye-tracking. In addition, participants were asked to provide comments on their experiences of interrogating the labels, specifically which elements caught their attention and what information they found easiest or hardest to understand.

**4.4 Results**

The results arising from the eye-tracking experiments are provided first in terms of the choice scenarios and then in terms of the more complex labels. Section 4.4.1 outlines the results arising from an analysis of the choice scenarios.

**4.4.1 Choice scenarios**

The choice scenarios were designed to gain an understanding of how eco-labels compete for consumers' attention with other forms of information, in this case user reviews and unit price. The images used were designed to replicate the type of information that a consumer may be presented with in an online retail environment, as this appears to be the most popular source based on the survey results outlined in D3.1. These images include simplified eco-labels, similar to those associated with products such as light bulbs, as more complex images could not be provided at the necessary resolution and many retailers provide only eco-label grades on their comparison pages, requiring consumers to click on a given option to gain more information.

*Heat maps*

The first method of analysing the data is the application of heat maps, based on the participant's gaze. Figure 4.4 presents the heat maps generated for each of the three choice scenarios presented to the participants. These heat maps represent the aggregate distribution of relative fixation for each of the images. Relative fixation refers to the proportion of total viewing time that participants spend on a given section of the



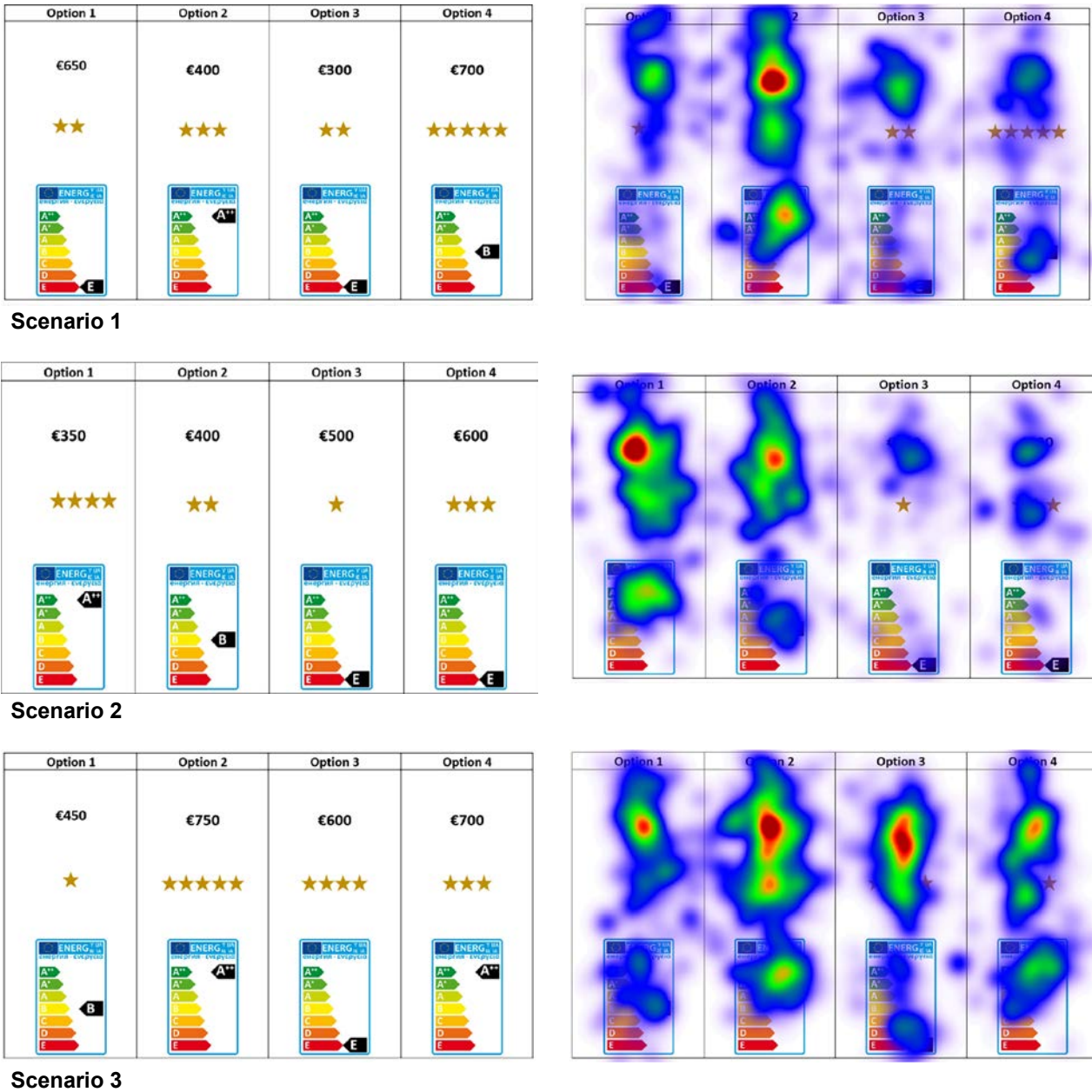


Figure 4.4. Scenario heat maps.

image relative to the total time they viewed an image. In the case of these images, the information relating to the energy consumption of the product is provided in a horizontal line across the bottom of the image, while price information is shown at the top, and the user review rating is shown in the middle of the image. An initial examination of the results presented in each of the heat maps reveals that the design of the stimuli does indeed enable an assessment of each of the elements. In terms of the role of the product attributes in participants' decision-making, these results indicate that the largest amount of participants' attention is

focused on the price information displayed in the upper section of the image. An examination of gaze fixation on the eco-labels component of the image shows that, while there is some fixation on all labels, this varies considerably between the options provided. To better understand what is occurring in these images, it is helpful to consider the stated choices of the participants for each of the scenarios. These results are presented in Table 4.2.

An examination of the participants' stated choices demonstrates that, for the first two scenarios, the vast majority of participants were agreed on their

**Table 4.2. Scenario selections (%)**

	Option 1	Option 2	Option 3	Option 4
Scenario 1	0	93	2.3	4.7
Scenario 2	97	3	0	0
Scenario 3	30	51	2.3	16.7

selections, and it can be seen how the increased levels of fixation intensity present on the heat maps is related to the selection of options. The third scenario displays a larger amount of variance in participant selection than the first two, and the third scenario also shows the greatest distribution of attention across the four eco-labels. This suggests that, in situations where consumers are more uncertain about their selection, eco-labels play a greater role in terms of informing their choice. This suggests that eco-labels are an attribute of secondary importance, to be considered when price comparisons do not yield a clearly preferred option.

#### *Areas of interest*

The spatial definition of specific AOIs by the research team represents the most effective means of collecting comparative statistics in eye-tracking experiments. For the purpose of these scenarios it was decided to define three AOIs to capture information regarding the attributes under examination. The attributes under consideration were:

- price;
- stars (user review);
- eco-labels.

For each of these areas and all scenarios, statistics were generated for both number of fixations and time to first fixation. These metrics were selected, as they provided insight on the elements of the image that participants refer to most often and the element that first attracts their attention. Table 4.3 presents the results arising from each of the AOIs associated with the attributes under examination.

An examination of the time to first fixation shows that, for each of the scenarios, the price attribute was the first to be fixated on, followed by the user review represented by the stars, and finally the energy information provided by the eco-labels. However, when examining the number of fixations associated with the respective attributes, it can be seen that in all

scenarios the largest number of fixations is on the eco-labels. This suggests that, while price information may be receiving the greatest level of attention (as also reflected in the heat maps), the energy information displayed in the eco-labels is consistently being referred back to. This suggests that such information is important to consumers when weighing up the options available to them.

#### *Areas of interest further analysis*

By redefining the AOIs and adding additional areas, it is possible to examine the relationship between the product attributes for each of the options presented. In Figure 4.5 it can be seen that 12 AOIs are defined, one for each of the product attributes for each option. Based on the results arising from these AOIs, it was possible to compare the participants' choices with where they focused their attention.

Tables 4.4–4.6 present the results generated from the AOIs for a number of different statistical analysis approaches. Table 4.4 provides the results for the first choice scenario. This table outlines results arising from the following five attention variables:

1. total fixation duration (TFD): the sum of the durations of all fixations within an AOI;
2. fixations count: the combined number of fixations within an AOI;
3. visit count: the number of times an AOI has been visited;
4. total visit duration (TVD): the sum of the duration of all visits within an AOI;
5. percentage fixated: the percentage of participants who fixated within the AOI.

The tables also detail the percentage of participants that selected a given option; in the case of scenario 1 93% selected option 2. For the purposes of labelling, the following approach was taken: P1 = price for option 1, R1 = review for option 1, and E1 = eco-label

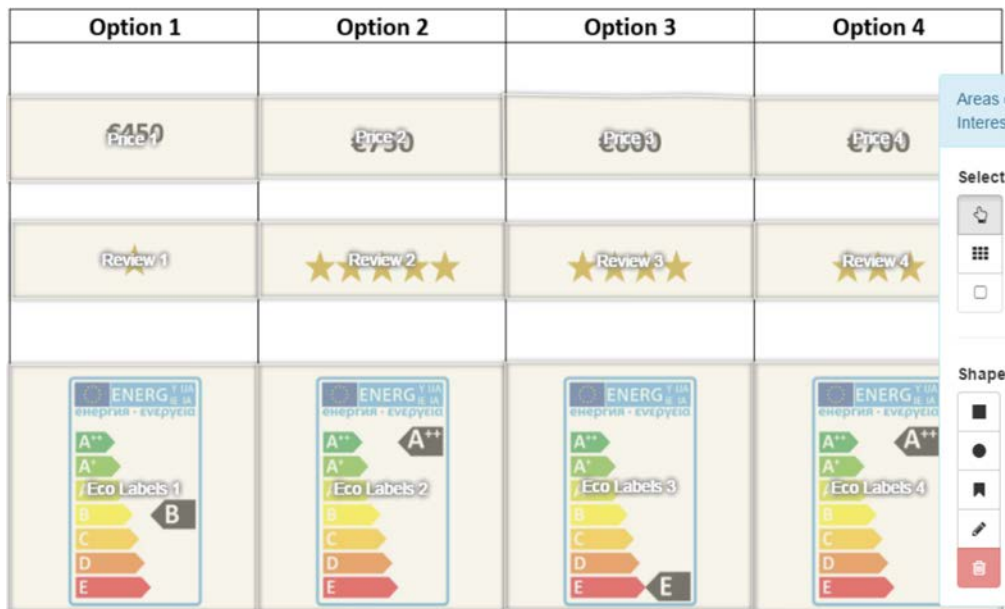
**Table 4.3. Scenario results**

	Price	Stars	Eco-labels
<i>Scenario 1</i>			
First fixation (milliseconds)	1181	1853	2012
Number of fixations	11.5	9.79	18.33
<i>Scenario 2</i>			
First fixation (milliseconds)	1526	1569	1797
Number of fixations	7.43	6.29	9.46
<i>Scenario 3</i>			
First fixation (milliseconds)	768	1677	1786
Number of fixations	10.45	10.3	14.21

**Table 4.4. Attribute statistics for scenario 1**

	P1	P2	P3	P4	R1	R2	R3	R4	E1	E2	E3	E4
TFD (ms)	575	<i>1258</i>	627	567	484	899	430	496	842	<i>2169</i>	974	1033
Fixations count	2.6	<i>5.07</i>	2.71	2.24	2.08	3.85	2.14	2	3.9	7.37	4.46	3.82
Visit count	2.3	<i>4.71</i>	2.44	2.09	1.85	3.54	1.83	1.79	2.45	4.9	2.76	2.47
TVD (ms)	747	<i>1552</i>	805	708	588	124	564	688	1136	<i>2689</i>	1258	1367
% Fixated	92	<i>100</i>	82.9	80.49	63.4	95.1	70.7	70.7	75.6	100	90.2	82.9
Choices (%)	0	93	2.3	4.7	0	93	2.3	4.7	0	93	2.3	4.7

Numbers in italic indicate the most popular option.



**Figure 4.5. Option-specific AOIs.**

for option 1. To allow for ease of interpretation, the statistics associated with the most popular option are highlighted in italic. The results show that, in all areas and for all metrics, the greatest levels of aggregate participants' attention are focused on the option that

was selected by the majority of the participants. This includes longer levels of total fixation duration and total visit durations, more fixations and visits, and the joint highest levels of percentage fixation. From the point of view of eco-labels, it is perhaps best to consider the

percentage of participants who fixated on each label. It can be seen that these values varied between 100% for option 2 and 75.6% for option 1.

Table 4.5 provides the same results for the second scenario. In this case the vast majority of respondents (97%) selected the first option. As with the first scenario, higher levels of attention are observed for all the metrics used for the selected option. Levels of eco-label fixation show a similar pattern to those observed for the first scenario.

Table 4.6 provides the same results for the third choice scenario. While this scenario displayed reduced levels of participants' agreement with regard to their preferred choice, these results still exhibit the same patterns displayed in the two previous tables, where higher levels of attention are associated with a higher likelihood of a given option being selected. From the perspective of the percentage of eco-label fixation, this scenario displayed the highest average values of the three scenarios presented. These findings suggest that eco-labels may become more important when consumers are presented with more difficult choices.

*Validation and additional information*

For the purposes of internal validation, and to ensure that the results arising from the eye-tracking analysis are correctly interpreted, participants were asked to rank the appliance attributes in terms of how important they were in the decision-making process. Scores are presented in Table 4.7, in which higher scores indicate greater levels of importance being attached to an attribute. These scores are coded on a 1–3 scale, with 1 being the least important and 3 being the most important. An examination of these results suggests that, while price is clearly the most important attribute in the participants' decision-making, eco-labels are more important than user reviews, suggesting that such information is an important factor in consumer choices. These results confirm the findings emerging from the analysis of the participants' gaze paths.

Participants were also asked to provide additional information regarding their choices in the form of comments. Not all participants provided comments, but the comments of those who did are presented in Box 4.1. These comments provide some insight into

**Table 4.5. Attribute statistics for scenario 2**

	P1	P2	P3	P4	R1	R2	R3	R4	E1	E2	E3	E4
TFD (ms)	826	640	391	368	627	396	213	364	<i>1184</i>	916	570	452
Fixations count	3.4	2.94	2.12	1.72	<i>2.61</i>	1.82	1.24	1.79	4.28	3.82	2.37	2.56
Visit count	3.0	2.79	2.08	1.62	2.33	1.76	1.24	1.62	2.9	2.44	1.73	1.52
TVD (ms)	102	813	547	482	774	501	278	455	<i>1446</i>	1193	753	617
% Fixated	95	80.4	63.4	70.73	<i>80.4</i>	<i>80.4</i>	41.4	58.5	<i>95.1</i>	82.9	73.1	65.8
Choices (%)	97	3	0	0	97	3	0	0	97	3	0	0

Numbers in *italics* indicate the most popular option.

**Table 4.6. Attribute statistics for scenario 3**

	P1	P2	P3	P4	R1	R2	R3	R4	E1	E2	E3	E4
TFD (ms)	763	997	671	588	317	726	582	479	1019	<i>1291</i>	675	850
Fixations count	3.1	<i>4.45</i>	3.39	2.85	1.75	3.22	2.59	2.36	4.08	<i>5.28</i>	3.6	3.73
Visit count	2.8	<i>4.13</i>	3.19	2.68	1.71	2.97	2.38	2.28	2.41	3.6	2.14	2.62
TVD (ms)	967	<i>1296</i>	898	785	440	893	727	622	1298	<i>1669</i>	895	1122
% Fixated	87	<i>92.6</i>	75.6	82.93	58.5	<i>87.8</i>	70.7	60.9	90.2	<i>97.5</i>	85.3	90.2
Choices (%)	30	<i>51</i>	2.3	16.7	30	<i>51</i>	2.3	16.7	30	<i>51</i>	2.3	16.7

Numbers in *italics* indicate the most popular option.

**Table 4.7. Attribute rankings**

Attribute	Price	Eco-label	User review
Score	2.5	2.07	1.47

#### Box 4.1. Participants' comments

- Looked at price first, then energy rating, if similar energy ratings, go for lower price.
- It's a long-term item, worth investment, long term energy reductions save money.
- If price was really high for a good rating, it would put you off.
- Don't want to choose very expensive options, number of stars was important, would never buy the worst energy rated option.
- Look first at price, then energy and try to find a balance there, only barely looked at reviews.
- First look at rating, then price.
- First look at ratings, then price, get the best out of all them.
- Once the price was high, went for reasonable price and then considered energy.
- First checked price and then energy, look for good mix, price too high means won't buy A++.
- The gap between price and performance was important.
- If it was too cheap and low star rating, it would be suspicious, wouldn't go for something with the lowest energy rating.
- When it was close between price, took user review into account.
- Always go for the prices, who cares, just commodities.
- Energy rating and user review are on par.
- Ideally high energy rating, with low cost, if it's over a certain amount of money, it seems a bit too much.
- Just thinking how reliable it would be, if other users like it, it's probably easy to use.
- Stayed away from bottom three energy ratings, bad review doesn't matter because of warranty.
- Energy rating was top, then trade-off between prices and user review.
- The environment is important, the price relative to quality.
- They are all linked, look for average price €400–600, cheap would be worse, looked more at energy rating than user review, looked for B+ before looking at user review.
- A combination of the three, in general if there is not much difference in price, look at stars and energy rating, two very similar energy rating helps you to decide.
- Energy efficiency important, spend money for quality, efficient also means quality.
- Trade-off between the three.
- Trade-off between, first look at price, then it's a trade-off between user rating and eco-rating, it's a complex trade-off, the eco-label is also the cost of running.
- Took all of them into account, so there was a trade-off.
- Energy rating, then price, then stars.
- Looked at price first – combination of all.

the complex trade-offs involved when making choices. In general, the comments show that participants tended to first assess options based on a single attribute, usually price, and then engage in a trade-off between the remaining information.

#### 4.4.2 Complex labels

While the first section of the eye-tracking focused on how eco-labels interact with other types of information on appliance attributes, the second part of the experiment was designed to gain an understanding of the role of the elements within individual labels.

This section of the research focused on two specific eco-labels, in both the white goods and motor vehicle sectors. The specific focus is on the attention given to individual elements of the labels. Figures 4.6 and 4.7 outline the two labels and the AOIs used for the purposes of the study. Unlike the previous images, unique AOIs are defined for each of the labels.

For the purposes of this section of the experiment, participants were asked to look at an eco-label associated with a refrigerator and to simply take in the information it provided and to move onto the next image when they were happy that they had assimilated all the relevant information.

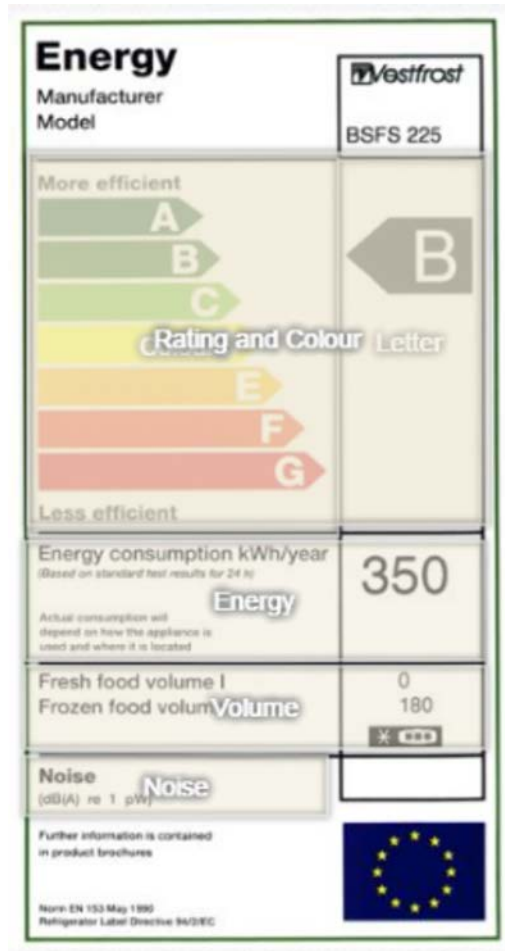


Figure 4.6. Appliance AOIs.

For the white goods image, there were six defined AOIs, including one for energy rating, one for colour and one that encompassed both of these areas.

*White goods image: heat maps*

Figure 4.8 provides the heat maps, both in the traditional and burn-through formats, for the white goods image. For the traditional image, areas with red and yellow overlays represent the highest levels of fixation, followed by green and blue. For the burn-through format, areas of increased transparency correspond to areas that received greater levels of attention. It is clear from these images that participants' attention is focused on a number of distinct locations within the image, with the greatest levels of fixation falling on the energy information, specifically the information provided by the coloured scale in the upper left section of the image. It can also

be seen that, while the areas did not receive uniform attention, each of the relevant information sections were attended to. This suggests that, while certain information is clearly being prioritised, all sections received some degree of attention, suggesting that they may be considered when the consumer assesses such goods.

*White goods AOIs*

Table 4.8 outlines these AOIs and both the mean time to first fixation and the mean relative fixation times for the sample. These results clearly demonstrate the differences between the AOIs, with regard to the metrics used for analysis. In terms of first fixation, it can be seen that the colour-coded rating scale grabs participants' attention before any of the other elements. This is likely to be due to both its highly visual presentation style and its location in the

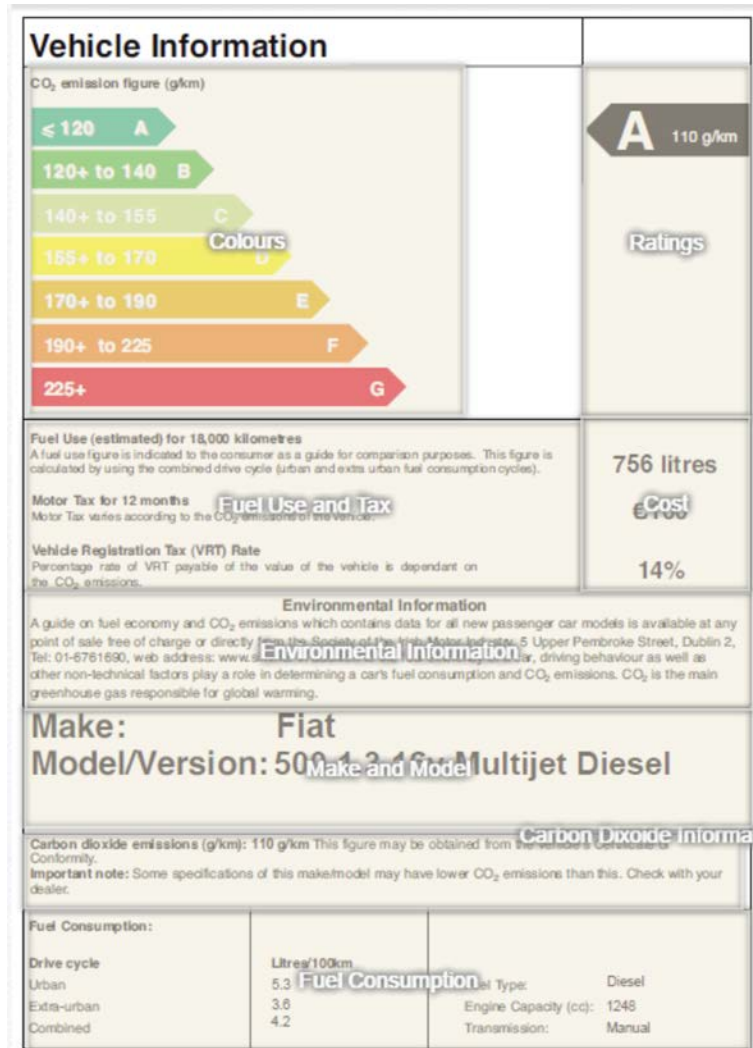


Figure 4.7. Car label AOIs.

Table 4.8. Participants' white goods fixations

	First fixation (ms)	Number of fixations	% Fixated
Rating (letter)	2715	10.5	96.55
Colour	154	10.92	100
Rating and letter in colours	154	5.52	100
Energy	2706	11.7	96.55
Volume	5889	5.73	93.1
Noise	9170	3.56	75.86

upper-left corner of the image. This is followed, in turn, by the rating (provided in the form of a bold letter in the upper-right corner), and the energy information in the middle of the label. The information on food volume and noise, provided in the lower parts of the label, are fixated on much later. It is also clear that the number of fixations for the ratings and energy information is considerably higher than for the other elements.

Table 4.8 also includes information on the percentage of respondents that fixated on a given AOI. It can be seen from these results that all those who took part in the study fixated on the colour-coded scale, while nearly all paid attention to both the rating and the energy information. The noise information provided by the label is the least fixated on section of the image, suggesting that it may be of least importance to participants.

Recollection tasks

Questions were designed to better understand and interpret the results arising to assess how well the participants had retained the information provided to them by the labels. These questions were asked after both images had been shown to ensure that participants were not pre-informed of the fact that they were to be tested.

For the white goods (fridge) eco-label, Table 4.9 outlines the presented questions and the percentage of respondents who correctly remembered the value or colour associated with the appliance. In the case of the colour, answers that include “Green”, such as

“Greenish” or “Dark Green”, are all considered to be correct. The results presented in this table show that the highest levels of recollection are associated with the alphabetic energy ratings, whereby three-quarters of participants could recall that the appliance received a B rating. In comparison, only 30% of participants could accurately recall the energy consumption of the appliance in kilowatt hours per year. Finally, the majority of participants were able to identify the colour code associated with the appliance. These results suggest that there is a considerable difference in the effectiveness of the various elements that make up the eco-label.

Table 4.9. Participants’ white goods recollection

Question	Value	Correct (%)
What was the energy rating (A–G)?	B	76
What was the energy consumption (numerical)?	350 kWh/year	30
What was the colour code for this product?	Green	60

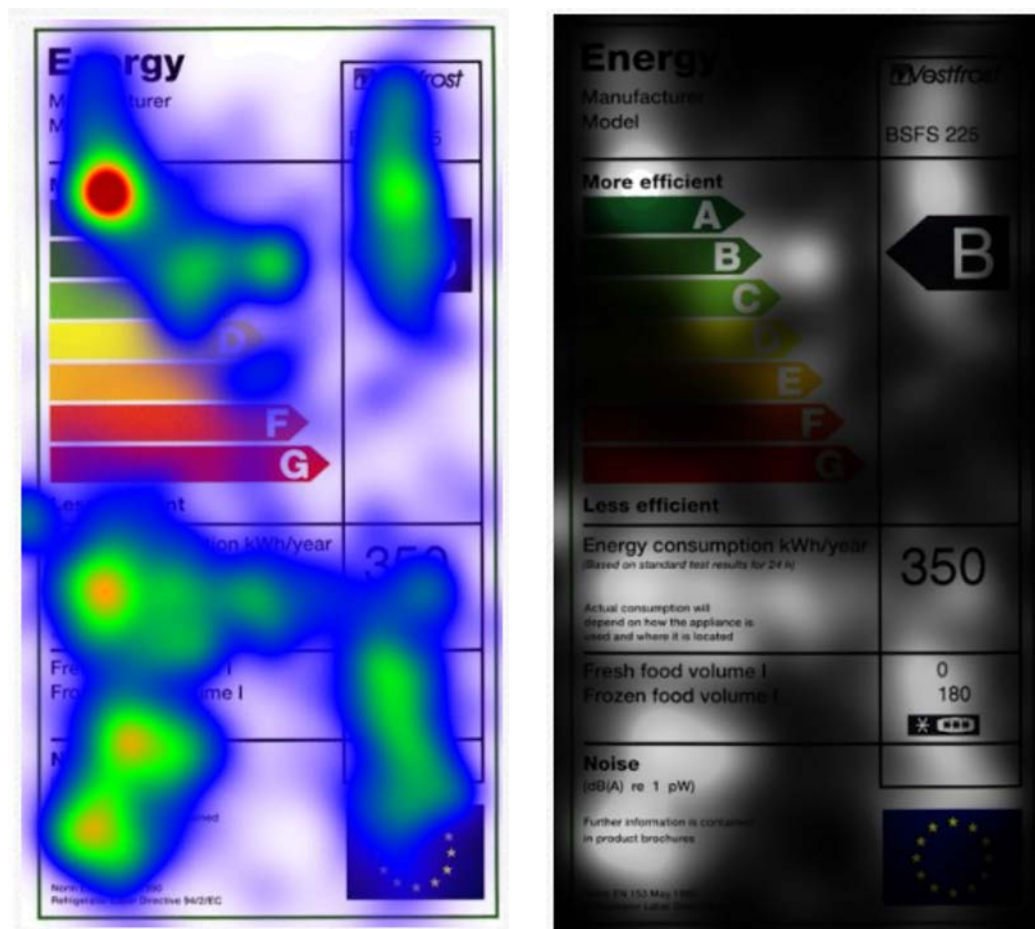


Figure 4.8. White goods heat maps.



### Comments

Following the eye-tracking experiment, participants were also asked to provide some comment on the aspects of the labels that they found easiest to understand, and the elements that drew their attention. While not all respondents had comments to provide, those comments provided are outlined in Box 4.2. It is clear from an examination of these comments that the respondents found the colour-coded scale and the letter, in this case B, the easiest item to understand, while the other information was either not fixated on or was found to be too small. A number of participants also commented about the lack of context relating to the figure of 350 kilowatt hours per year.

### Car image

As with the white goods eco-label, the image used for the car label had unique AOIs defined specifically for it. These AOIs were defined to capture the main elements of the image and are outlined in Figure 4.7.

These AOIs can be seen to line up with the main design elements present within the label.

Based on these AOIs, it was possible to create a statistical analysis of the role of each element. Table 4.10 outlines the results arising for both time to first fixation and the number of fixations on the AOI. The results of an analysis of the time to first fixation shows the participants' gazes progressing from the top-left section of the image to the bottom right. This suggests a systematic reading of the information, in line with what would be expected from western reading styles. An examination of the number of times respondents fixated on the different AOIs reveals that significantly more attention was paid to the colour scale, the make and model of the vehicle, and most notably the fuel use and tax information provided by the label. This appears to reflect the findings concerning the importance of financial information that emerged from the choice scenarios. As with the white goods image, this analysis also examines the percentage of respondents that fixated on a given

#### Box 4.2. Participants' comments on the white goods label

- Presented well, only four main things, not too many.
- Don't know if energy number is high.
- The energy consumption, and read something about the noise but didn't pay much attention to it.
- The energy scale was the first thing I saw.
- It had an EU flag, the energy rating chart stands out the most,
- The B is big so is the first thing I noticed.
- I didn't understand the freezer/frozen food numbers and generally beyond the top it wasn't very understandable.
- The kwh doesn't have a great relation to cost.
- Some of the decibel information was too small.
- The energy bar chart.
- The energy rating was the easiest to understand, then information about fresh and frozen food volume was unclear.
- Easy to see where it fell on the energy scale, the visuals are handy.
- Understood the letter, the rest didn't mean anything.
- The colour gradient was easiest visually, the rest of the information was hidden below, if you were interested but wouldn't see at a glance.
- The picture of the letter was what drew attention, 350 means nothing.
- Difficult to read the smaller print, more colourful and bigger font drew more attention.
- The colour chart makes it easy to see where it is on the scale, I didn't look at all the small print at the bottom.
- The only thing was a B rating.
- The colours really draw your attention.
- The energy rating, energy consumption.

**Table 4.10. Participants' car label fixations**

	First fixation (ms)	Number of fixations	% Fixated
Rating (letter)	2036	5.64	89.29
Colour	1129	10.74	96.43
Fuel use and tax	5658	13.44	96.43
Cost	6588	6.08	89.29
Environmental information	11,680	6.08	92.86
Make and model	15,474	10.58	92.86
CO <sub>2</sub> information	30,072	9.81	75
Fuel consumption	28,124	4.19	89.29

AOI. Results show that no single AOI was fixated on by all participants, although scores are high and quite consistent across the areas. A notable exception is the section providing explanatory information about how CO<sub>2</sub> estimates are produced, which received much less attention.

#### *Car heat maps*

As with the white goods image, both traditional and burn-through heat maps were generated to investigate the participants' interaction with the label. An examination of Figure 4.9 highlights the distribution of the participants' gazes across the label. It can be seen that all the major elements of the label have been fixated on to some degree, with clearly distinct centres of attention emerging. Particular hotspots appear centred on the emissions rating denoted by the coloured scale, as well the financial costs associated with operating the vehicle.

#### *Recollection tasks*

As with the previous label, a recollection task was associated with this label to assess participants' ability to remember the information provided. As this label contains more information and metrics than the refrigerator label, more answers were required. The results of this task are outlined in Table 4.11.

These results show a wide range of scores associated with the various items of information provided to the participants by the label. As with the white goods label, the item with the highest associated recollection score is the letter rating, which in this case was accurately recalled by 90% of participants. Only two other values, the make of the car and the motor tax associated with it, were accurately recalled by the majority of

participants. The estimate for the CO<sub>2</sub> emissions associated with the vehicle was recalled by 36.5% of respondents, while fuel use received a score of 39%. It is notable how few participants were able to recall the figures relating to the three driving styles displayed in the bottom of the image. It could be argued that this is likely to be due to the placement of this information and the small text used.

#### *Comments*

As with the white goods label, participants were asked to provide comments regarding which elements of the label caught their attention and were the easiest to understand. These comments are provided in Box 4.3. As with the other label, only a subset of participants provided comments; however, these comments also reflect similar feelings on the effectiveness of rating scales, issues regarding the inability to contextualise the information the label presented and information displayed in smaller text or at the bottom of the label being assumed to be of less importance than the information displayed in larger font at the top of the label.

## **4.5 Discussion**

The results provided in Chapter 4 provide considerable insight into consumers' decision-making processes and, specifically, the role that eco-labels and the information they provide may play in informing these decisions. This section provides a discussion of these results and how they may be interpreted.

### **4.5.1 Eco-labels and other information**

The first set of tasks undertaken in this experiment set out to examine how eco-labels compete with other

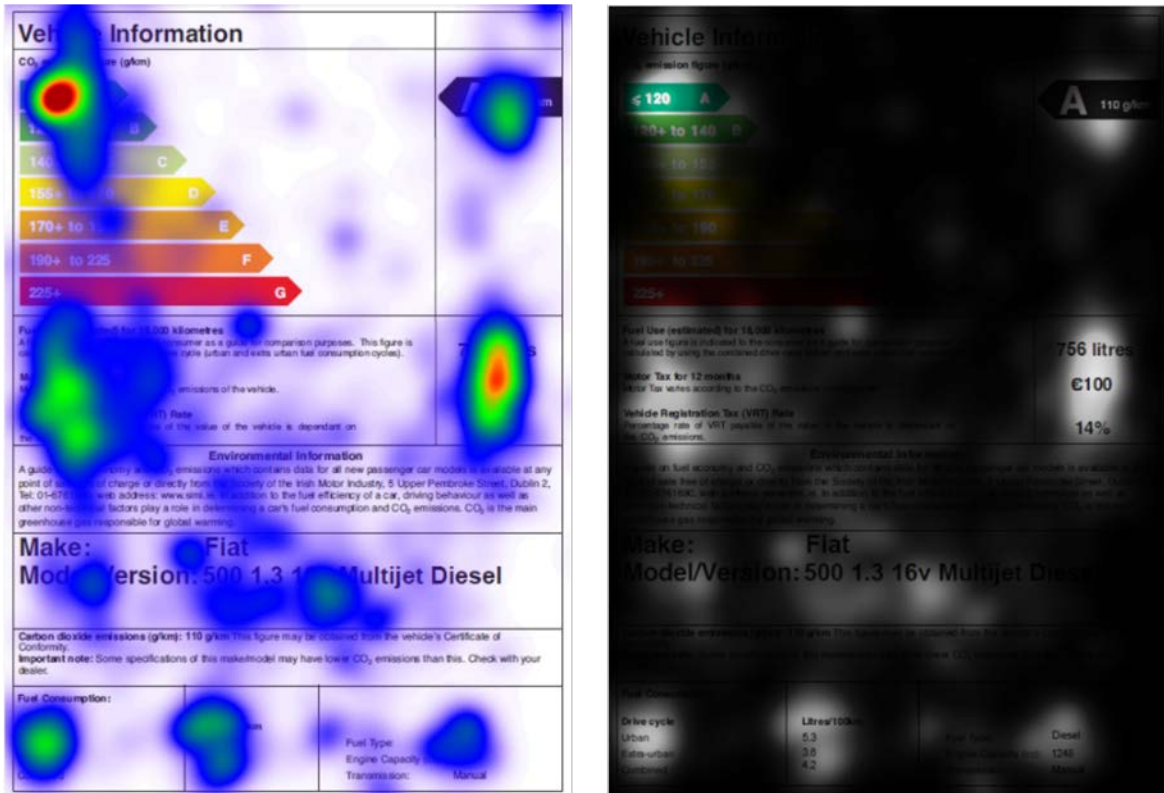


Figure 4.9. Car label heat maps.

Table 4.11. Participants’ car label recollections

	Correct value	% Correct (	10% of value)
Letter rating	A	90	
Emissions	110 g/km	36.5	
Fuel use	756	39	
Motor tax	€100	68.3	
VRT	14%	34.9	
Make and model	Fiat	67.4	
Urban fuel/100 km	5.3	9.3	
Extra-urban	3.6	4.6	
Combined	4.2	6.9	

**VRT, vehicle registration tax.**

relevant information for the participants’ attention via choice scenarios. The results provided by the aggregated heat maps suggest that the unit price associated with a given appliance drew the greatest amount of attention; however, in nearly all cases, the eco-labels were also examined by participants when assessing the available options.

As one of the purposes of eco-labels is to make individuals aware of the energy use of the appliance relative to other product options, these results suggest that eco-labels are fulfilling that part of

their role, at least within the white goods context. Statistical data emerging from the AOIs also show that price information was of paramount importance to participants, with both eco-labels and user reviews only being considered afterwards.

The comments provided by participants following the eye-tracking choice experiment also illuminate the complex information assessment process that occurs when they consider the options available to them. In general, these comments appear to show that price information is the most important factor,

#### **Box 4.3. Participants' comments on the car label**

- The colour scheme was easiest to understand, but there was nothing to compare against, there was nothing to relate emissions to.
- The visual energy ratings work well – simple information.
- The colours and the scale.
- The colour scale, obvious green is better, letter rating scale is easy to interpret.
- The energy rating (letter), I read from top to bottom, some of the writing was too small, there was too much information.
- I read about the CO<sub>2</sub> emissions but know it's related to the ranking, motor tax is associated to CO<sub>2</sub> emissions.
- The colour scale.
- The rating and the 100 g of CO<sub>2</sub>, the make/model of the car and that it used diesel.
- Everything on the right-hand side was the biggest information.
- The brand and the model and the fuel consumption.
- The letter rating was powerful, I don't know that much about cars, the motor tax figure stood out, the urban/extra/combined was a useful detail.
- The energy rating was easy to understand (A–G), the letter rating is very crude.
- Having the figures easily displayed on the right made it easier, if the text on the left was bigger it would be easier to see.
- Colours played a big factor and it was easy to see scales, easy to see from far away. If I was only browsing I wouldn't wear glasses so I would only see the big information. Whatever is stressed I assumed is the most important information.
- The ratings the letters and the grade, if this was something I was going to buy I would put more attention into it. There's a lot of smaller text that I skimmed over.
- The colours grabbed my attention, the bits at the end didn't.
- Everything on the top half very in bold print so easy to see, too much information with no context given, lots of technical information.
- The colours drew attention and easy to understand, the tax was the other thing that would affect me.

with the energy consumption represented by the eco-labels also being an important concern. These comments mirror some of the findings highlighted in D3.1, in which an association between the energy rating of a given appliance and the long-term financial savings arising from reduced energy consumption was recognised.

The results of the attribute ranking exercise that followed the choice scenarios once again highlighted the importance of unit price as the primary concern for consumers, as it was the highest valued attribute. However, from the perspective of an environmental and energy reduction standpoint, it is encouraging that the information provided by eco-labels was also considered to be important, ranking as it did above the user reviews.

Overall, it can be seen that, while eco-labels are not as important to consumers as financial outlays, they do play an important role in terms of allowing more informed choices to be made, thereby meeting one of the goals of their design.

#### **4.5.2 Elements of eco-labels**

The second set of tasks in this experiment were concerned with the role of the individual elements that make up more complex eco-labels, such as those typically displayed in the white goods and motor sectors. These labels often provide a large amount of information to the consumer; however, it is clear from the design of such labels that certain elements are prioritised in terms of the visual prominence that they are afforded. The results from this analysis indicate

that consumers' attention is initially drawn to the colour-coded alphabetical scale presented in the top-left corner of the images. Both heat maps and AOIs show a concentration of interest on the upper sections of the images.

Scan path analysis showed that the gaze generally moves down and across the image, in a left-to-right pattern, as would be expected for reading patterns in western scripts. However, it was also observed that individuals returned to elements of the image repeatedly to confirm information that they had already seen.

The results of the recollection task are a means of rating the effectiveness of the various elements within the labels at conveying specific information. If participants are unable to recall the values that they have been presented with by the label immediately after viewing it, it is highly unlikely that such information will be able to properly inform their choices. In the case of both labels, it was seen that the alphabetical ranking system was the most effective means of transmitting information that could subsequently be recalled. In general, these results show that there is a wide disparity in terms of participant engagement with the various component elements of the labels.

#### **4.6 Conclusions and Implications**

This study set out to use eye-tracking technology to gain a better understanding of the role that eco-labels play in consumer choices, while also assessing the role that individual elements play within these labels.

The eco-labels investigated as part of this experiment are required to be provided by EU legislation, and therefore an examination of their effectiveness may also be considered to be an examination of the effectiveness of such policy. It can be considered that such labels have two distinct functions, namely to relay the environmental and energy impacts

associated with various products and also to nudge consumers towards purchasing more sustainable products. If these labels are to be successful, in terms of informing and encouraging sustainable consumer choices, it is important that the information that such labels contain is considered by individuals. Therefore, the principal focus of this study was to examine whether or not consumers focused their attention on such labels and, if they did, which elements of the labels attracted the most attention. The results of this study show that, while not being the most important attribute, eco-labels are considered by consumers when weighing up the information available to them in white goods choices. As the scenarios used for this study were designed to closely mirror approaches used in online retail websites, the findings suggest that information such as energy ratings, if properly displayed, has an important role to play in informing consumer choices. In this respect, eco-labels are an effective means of making consumers more aware of product attributes that may be of interest to them, and therefore enabling them to make choices more in-line with their preferences.

With respect to the complex eco-labels examined in this study, it was observed that different elements and concerns are given prominence over others in terms of the manner in which the information is presented. The results of such a design approach on consumer engagement with the information can be seen emerging from the results of the analysis and recollection tasks. Environmental impacts presented in colour-coded scales with alphabetical values received more attention than other elements of the labels, while the ratings scales displayed the highest levels of participant recollection, suggesting that label designers should ensure that information prominence is in line with the stated objectives of such a labelling process. Overall, the results of these experiments suggest that eco-labels are an effective means of at least highlighting the energy and environmental impacts associated with consumer products.

## 5 Conclusions and Recommendations

The research presented in this report sought to gain a better understanding of the role that eco-labels can play in enabling consumers to make more informed purchases, based on the environmental and energy impacts of the products and services available to them. Specifically, it was designed to examine two areas: the role of eco-labels in purchases and the ability of consumers to understand and process the information that they provide.

Eco-labels are designed both as a means of enabling more informed comparisons between products and as a method of driving sustainable innovation in their respective industries. With the information provided by eco-labels, it is possible for consumers to alter their behaviours and therefore reward manufacturers and retailers that offer products with reduced environmental impacts. This, in theory, should enable such labels to play a role in driving market developments towards more sustainable consumption patterns, albeit based on the view that sustainable consumption, if possible, is achievable through consumer choices.

The results of this research show that eco-labels, at least in the industries examined, are considered by consumers when weighing up the options available to them. This is reflected in both experimental stages of the research, although the relative importance of eco-labels with respect to other product attributes was seen to vary between the conjoint analysis and the eye-tracking sections. These results suggest that eco-labels therefore have a value to the consumer and that they provide the consumer with utility when making decisions. The use of eco-labels as a means of informing decisions was seen to vary considerably across sectors, with their use being most prevalent in sectors in which the provision of such labels is required by legislation. Feedback from survey participants in the form of respondents' comments, in both experiments, highlighted the perceived link between items with higher efficiency ratings and long-term financial savings, linked to reduced consumption of electricity or fuel. It was seen that this served as a motivating factor for basing decisions on the information provided by eco-labels. Regarding the

likelihood of a given consumer interacting with an eco-label, this appears to be best predicted by the individual's underlying environmental concern, rather than by traditional demographic markers such as age or gender.

When examining consumers' understanding of the information provided to them by eco-labels, while it must be acknowledged that labels often contain large amounts of complex information provided in multiple metrics and units, there does appear to be a wide variation in the effectiveness with which different values and product attributes are being communicated. Information presented in the form of easily comparable metrics was found to have the highest retention levels, while other information contained within the label received little attention. This research highlights the need for simple and easily comparable information, and we would recommend that further work be undertaken to clarify for consumers what information ratings are communicating.

This report has highlighted a number of research areas that may be worth examining regarding the role of eco-labels. Specifically, the research team would suggest further work on current levels of compliance with legislation, the role that eco-labels play in online retail, the role of factors such as education on engagement with environmental information in an Irish setting, and the sectors to which eco-labelling legislation may successfully be extended.

Overall, the results of this research suggests that eco-labels play an important role in providing consumers with information that is of value to them. Eco-labels are being used by consumers when weighing up consumption options in a number of sectors and are therefore enabling them to make more informed choices in line with their personal tastes and preferences. Based on these results, current policies in sectors such as the white goods industry can be said to be effective in allowing comparisons between products; however, they may be considered sub-optimal in terms of providing easily understood information. Examining the research

question underlying this study, specifically “Does too much information on labels cause confusion and do eco-labels influence purchasing choices?”, it can be concluded that, while labels may include information

that either confuses individuals or at least does not engage them, eco-labels still appear to have the ability to influence consumer choices.

# References

- Abrahamse, W., Steg, L., Vlek, C. and Rothengatter, T., 2005. The review of intervention studies aimed at household energy conservation. *Journal of Environmental Psychology* 25: 273–291.
- Banerjee, A., and Solomon, B.D., 2003. Eco-labeling for energy efficiency and sustainability: a meta-evaluation of US programs. *Energy Policy* 31: 109–123.
- Bartiaux, F., 2008. Does environmental information overcome practice compartmentalisation and change consumers' behaviours? *Journal of Cleaner Production* 16: 1170–1180.
- Brazil, W., and Caulfield, B., 2014. Testing individuals' ability to compare emissions from public transport and driving trips. *Journal of Public Transportation* 17(2): 27–43.
- Columbia CRED (Center for Research on Environmental Decisions), 2009. The Psychology of Climate Change Communication. Available online: <http://guide.cred.columbia.edu/guide/sec4.html> (accessed 1 February 2017).
- CSO (Central Statistics Office), 2015. *Statistical Yearbook of Ireland 2015*. CSO, Cork.
- DID Electrical, 2016. Thor 60/20 Fridge Freezer. Available online: <http://www.did.ie/thor-60-20-fridge-freezer-th251-prd> (accessed 17 June 2016).
- EC (European Commission), 2016. Energy Label. Available online: <http://ec.europa.eu/energy/en/topics/energy-efficiency/energy-efficient-products> (accessed 17 June 2016).
- Ecolabel Index, 2016. Ecolabel Index. Available online: <http://www.ecolabelindex.com/ecolabels/> (accessed 12 July 2016).
- EcoTourism Ireland, 2016. EcoTourism Ireland. Available online: <http://www.ecotourismireland.ie/> (accessed 1 February 2017).
- EPA (Environmental Protection Agency), 2016. *Ireland's Final Greenhouse Gas Emissions in 2014*. EPA, Johnstown Castle, Ireland. Available online: <http://www.epa.ie/pubs/reports/air/airemissions/> (accessed 1 February 2017).
- EPA (Environmental Protection Agency), 2017. What are Ireland's greenhouse gas emissions? EPA, Johnstown Castle, Ireland. Available online: <http://www.epa.ie/climate/communicatingclimatescience/whatisclimatechange/whatareirelandsgreenhousegasemissionslike/> (accessed 29 November 2017).
- EU (European Union), 2010a. Directive 2010/30/EU of the European Parliament and of the Council of 19 May 2010 on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products. OJ L 153, 18.06.2010, p. 1–12.
- EU (European Union), 2010b. Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings. OJ L 153, 18.06.2010, p. 13–35.
- Flybe, 2016. Ecolabelling Scheme. Available online: [http://www.flybe.com/corporate/sustainability/eco\\_labelling\\_scheme.htm](http://www.flybe.com/corporate/sustainability/eco_labelling_scheme.htm) (accessed 12 July 2016).
- Fuerst, F. and Shimizu, C., 2016. Green luxury goods? The economics of eco-labels in the Japanese housing market. *Journal of the Japanese and International Economies* 39: 109–122.
- Gardner, G.T. and Stern, P.C., 1996. *Environmental Problems and Human Behavior*. Allyn and Bacon, Boston, M.A.
- Gaspar, R. and Antunes, D., 2011. Energy efficiency and appliance purchases in Europe: consumer profiles and choice determinants. *Energy Policy* 39: 7335–7346.
- GreenHospitality.ie, 2016. Green Hospitality Awards. Available online: <http://www.ghaward.ie/> (accessed 17 June 2016).
- Gosling, S. and Buckley, R., 2016. Carbon labels in tourism: persuasive communication? *Journal of Cleaner Production* 111: 358–369.
- Hadjimichael, M. and Hegland, T.J., 2016. Really sustainable? Inherent risks of eco-labeling in fisheries. *Fisheries Research* 174: 129–135.
- Haq, G. and Weiss, M., 2016. CO<sub>2</sub> labelling of passenger cars in Europe: status, challenges, and future prospects. *Energy Policy* 95: 324–335.
- Harvey Norman, 2016. Washing machines. Available at: <http://www.harveynorman.ie/home-appliances/appliances/washing-machines/> (accessed 17 June 2016).
- Heinzle, S.L. and Wustenhagen, R., 2012. Dynamic adjustment of eco-labeling schemes and consumer choice – the revision of the EU energy label as a missed opportunity. *Business Strategy and the Environment* 21: 60–70.
- Hyland, M., Lyons, R. and Lyons, S., 2013. The value of domestic building energy efficiency – evidence from Ireland. *Energy Economics* 40: 943–952.



- Government of Ireland, 2011. European Union (Energy Labelling) Regulations 2011. S.I. No. 366/2011. Available online: <http://www.irishstatutebook.ie/eli/2011/si/366/made/en/print> (accessed 1 February 2017).
- Karniouchina, E.V., Moore, W.L., van der Rhee, B. and Verma, R., 2009. Issues in the use of ratings-based versus choice-based conjoint analysis in operations management research. *European Journal of Operational Research* 197: 340–348.
- Kok, N. and Jennen, M., 2012. The impact of energy labels and accessibility on office rents. *Energy Policy* 46: 489–497.
- Lane, B. and Banks, N., 2010. *Low CVP Car Buyer Survey: Improved Environmental Information for Consumers*. Low Carbon Partnership, London.
- Lorenzoni, I., Nicholson-Cole, S. and Whitmarsh, L., 2007. Barriers perceived to engaging with climate change among the UK public and their policy implications. *Global Environmental Change* 17: 445–459.
- Min, J., Azevedo, I.L., Michalek, J. and de Bruin, W.B., 2014. Labeling energy cost on light bulbs lowers implicit discount rates. *Ecological Economics* 97: 42–50.
- Noblet, C.L., Teisl, M.F. and Rubin, J., 2006. Factors affecting consumer assessment of eco-labeled vehicles. *Transportation Research Part D: Transport and Environment* 11: 422–431.
- Nordic Ecolabel, 2016. The Nordic Swan Ecolabel – the official Ecolabel in the Nordic countries. Available online: <http://www.nordic-ecolabel.org/about/> (accessed 17 June 2016).
- Owens, S. and Drifill, L., 2008. How to change attitudes and behaviours in the context of energy. *Energy Policy* 36: 4412–4418.
- Pender, A., Dunne, L. and Convery, J., 2007. The use and regulation of environmental claims as a means for promoting sustainable consumption in Ireland. Environmental Protection Agency, Johnstown Castle, Ireland.
- Power City, 2016. Power City. Available online: [http://www.powercity.ie/index.php?par=45-01&cat=Built\\_in%20Appliances&action=brandstory](http://www.powercity.ie/index.php?par=45-01&cat=Built_in%20Appliances&action=brandstory) (accessed 17 June 2016).
- Rao, V.R., 2014. *Applied Conjoint Analysis*. Springer.
- Sammer, K. and Wustenhagen, R., 2006. The influence of eco-labelling on consumer behaviour-results of a discrete choice analysis for washing machines. *Business Strategy and the Environment* 15: 185–199.
- Shen, J. and Saijo, T., 2009. Does an energy efficiency label alter consumers' purchasing decisions? A latent class approach based on a stated choice experiment in Shanghai. *Journal of Environmental Management* 90: 3561–3573.
- Shewmake, S., Okrent, A., Thabrew, L. and Vandenbergh, M., 2015. Predicting consumer demand responses to carbon labels. *Ecological Economics* 119: 168–180.
- Sims R., Schaeffer, R., Creutzig, F., Cruz-Núñez, X., D'Agosto, M., Dimitriu, D., Figueroa Meza, M.J., Fulton, L., Kobayashi, S., Lah, O., McKinnon, A., Newman, P., Ouyang, M., Schauer, J.J., Sperling, D. and Tiwari, G., 2014. Transport. In Edenhofer, O., Pichs-Madruga, R., Sokona, Y., Farahani, E., Kadner, S., Seyboth, K., Adler, A., Baum, I., Brunner, S., Eickemeier, P., Kriemann, B., Savolainen, J., Schlömer, S., von Stechow, C., Zwickel, T. and Minx, J.C. (eds), *Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge.
- Sorqvist, P., Haga, A., Holmgren, M. and Hansla, A., 2015. An eco-label effect in the built environment: Performance and comfort effects of labelling a light source environmentally friendly. *Journal of Environmental Psychology* 42: 123–127.
- SEAI (Sustainable Energy Authority Ireland), 2016. BER FAQ. Available online: [http://www.seai.ie/Your\\_Building/BER/BER\\_FAQ/FAQ\\_BER/General/What-is-a-BER-.html](http://www.seai.ie/Your_Building/BER/BER_FAQ/FAQ_BER/General/What-is-a-BER-.html) (accessed 17 June 2016).
- Thorndike, A.N., Riss, J., Sonnenberg, L.M. and Levy, D.E., 2014. Traffic-light labels and choice architecture: promoting healthy food choice. *American Journal of Preventative Medicine* 46: 143–149.
- Trzaski, A. and Rucinska, J., 2015. Energy labeling of windows – possibilities and limitations. *Solar Energy* 120: 158–174.
- US EPA (United States Environmental Protection Agency), 2011. *A New Generation of Labels for a New Generation of Vehicles*. Available online: <http://www.epa.gov/otaq/carlabel/index.htm> (accessed 1 February 2017).
- Veisten, K., 2007. Willingness to pay for eco-labelled wood furniture: choice-based conjoint analysis versus open-ended contingent valuation. *Journal of Forest Economics* 13: 29–48.
- Waechter, S., Sutterlin, B. and Siegrist, M., 2015. Desired and undesired effects of energy labels – an eye-tracking study. *PLoS One* 10(7): e0134132.
- Ward, D.O., Clark, C.D., Jensen, K.L., Yen, S.T. and Russell, C.S., 2011. Factors influencing willingness-to-pay for the ENERGY STAR® label. *Energy Policy* 39: 1450–1458.

- Warnken, J., Bradley, M. and Guilding, C., 2005. Eco-resorts vs. mainstream accommodation providers: an investigation of the viability of benchmarking environmental performance. *Tourism Management* 26: 367–379.
- Whitmarsh, L., Seyfang, G. and O'Neill, S., 2011. Public engagement with carbon and climate change: To what extent is the public 'carbon capable'? *Global Environmental Change* 21: 56–65.
- Wiel, S. and McMahon, J.E., 2003. Governments should implement energy-efficiency standards and labels-cautiously. *Energy Policy* 31: 1403–1415.
- Winward, J., Schiellerup, P. and Boardman, B., 1998. *Cool Labels – The First Three Years of European Energy Label*. Environmental Change Unit, University of Oxford, Oxford.

# Abbreviations

<b>AOI</b>	Area of interest
<b>BER</b>	Building Energy Rating
<b>CO<sub>2</sub></b>	Carbon dioxide
<b>EU</b>	European Union
<b>SEAI</b>	Sustainable Energy Authority of Ireland
<b>SPSS</b>	Statistical Package for Social Sciences
<b>TFD</b>	Total fixation duration
<b>TVD</b>	Total visit duration

## AN GHNÍOMHAIREACTH UM CHAOMHNÚ COMHSHAOIL

Tá an Gníomhaireacht um Chaomhnú Comhshaoil (GCC) freagrach as an gcomhshaoil a chaomhnú agus a fheabhsú mar shócmhainn luachmhar do mhuintir na hÉireann. Táimid tiomanta do dhaoine agus don chomhshaoil a chosaint ó éifeachtaí díobhálacha na radaíochta agus an truaillithe.

## Is féidir obair na Gníomhaireachta a roinnt ina trí phríomhréimse:

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

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

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

## Ár bhFreagrachtaí

### Ceadúnú

Déanaimid na gníomhaíochtaí seo a leanas a rialú ionas nach ndéanann siad dochar do shláinte an phobail ná don chomhshaoil:

- saoráidí dramhaíola (*m.sh. láithreáin líonta talún, loisceoirí, stáisiúin aistriúcháin dramhaíola*);
- gníomhaíochtaí tionsclaíocha ar scála mór (*m.sh. déantúsaíocht cógaisíochta, déantúsaíocht stroighne, stáisiúin chumhachta*);
- an diantalmhaíocht (*m.sh. muca, éanlaith*);
- úsáid shrianta agus scaoileadh rialaithe Orgánach Géinmhodhnaithe (*OGM*);
- foinsí radaíochta ianúcháin (*m.sh. trealamh x-gha agus radaiteiripe, foinsí tionsclaíocha*);
- áiseanna móra stórála peitрил;
- scardadh dramhuisece;
- gníomhaíochtaí dumpála ar farraige.

### Forfheidhmiú Náisiúnta i leith Cúrsaí Comhshaoil

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

### Bainistíocht Uisce

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

## Monatóireacht, Anailís agus Tuairisciú ar an gComhshaoil

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

## Rialú Astaíochtaí na nGás Ceaptha Teasa in Éirinn

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

## Taighde agus Forbairt Comhshaoil

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

## Measúnacht Straitéiseach Timpeallachta

- Measúnacht a dhéanamh ar thionchar pleananna agus clár beartaithe ar an gcomhshaoil in Éirinn (*m.sh. mórfheananna forbartha*).

## Cosaint Raideolaíoch

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

## Treoir, Faisnéis Inrochtana agus Oideachas

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

## Múscaill Feasachta agus Athrú Iompraíochta

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

## Bainistíocht agus struchtúr na Gníomhaireachta um Chaomhnú Comhshaoil

Tá an ghníomhaíocht á bainistiú ag Bord Iáinimseartha, ar a bhfuil Ard-Stiúrthóir agus cúigear Stiúrthóirí. Déantar an obair ar fud cúig cinn d'Oifigí:

- An Oifig um Inmharthanacht Comhshaoil
- An Oifig Forfheidhmithe i leith cúrsaí Comhshaoil
- An Oifig um Fianaise is Measúnú
- Oifig um Chosaint Radaíochta agus Monatóireachta Comhshaoil
- An Oifig Cumarsáide agus Seirbhísí Corparáideacha

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

## Current Status and Potential Role of Eco-labels in Informing Environmentally Friendly Purchases and Behaviours



Authors: William Brazil and Brian Caulfield

### Identifying Pressures

Managing our energy use, and the environmental impacts associated with it, is essential to both sustainable development and the protection of our ecosystems. Eco-labels provide a means of informing members of the general public about the energy use and environmental impacts associated with a number of products available to them. Legislation requires the provision of information in sectors such as white goods, housing and new car sales across the European Union. As many of the impacts associated with the operation of goods and properties are not highly visible to owners and operators, eco-labels provide one of the very few methods available to inform consumers about the effects of their behaviours and choices. Specifically, information on factors such as carbon dioxide emissions, energy use, noise pollution and water use may not be readily available to consumers, and therefore such labels are needed both to inform consumers and to nudge them towards products with more sustainable operational lifecycles. In light of this potential to inform consumer behaviour, it is important that such labels are operating as desired and that an important opportunity to highlight environmental issues is not being lost. This research found that while consumers appear to be engaging with energy labels and using them to inform their purchases, individuals are not successfully retaining all the information such labels contain. This indicates that while labels may be considered to be playing an important role, there is scope to undertake redesign efforts to ensure all the required information is being transmitted in a more effective manner.

### Informing Policy

The provision of environmental information, either in the form of European Union energy labels, or Building Energy Certificates is mandated across a number of sectors by multiple European Union directives such as Directive 2010/30/EU and Directive 1999/94/EC. Such directives place a responsibility on suppliers and retailers to create and display such information, and failure to do so is considered to be an offence. To ensure that the resource expenditure associated with eco-labels is justified, it is important to examine their effectiveness as a means of informing and promoting sustainable consumption. The consumer engagement research undertaken by this project, both in the form of the ranked preference experiment and the eye-tracking studies, highlights that current policy, specifically with regard to the provision of information via EU energy labels, appears to be effective in terms of informing consumer choices and making energy information more salient to consumers, however there is a need to examine potential improvements, specifically with regard to information display techniques.

### Developing Solutions

The research examined the role of eco-labels in consumer choices via the use of both an online survey and a series of novel eye-tracking experiments. Multiple analysis and data collection techniques were used, including the modelling of consumer choices via conjoint analysis, hypothetical choice scenarios and information recollection tasks. The research included an examination of the role of environmental information in tandem with other product attributes in informing consumers' purchases, as well as an assessment of the individual components of labels, and the means they employ to transmit information. The report provides recommendations on the current approaches in eco-labelling and the potential expansion of such schemes.