CONSumer Energy Efficiency Decision making

REPORT ON FIELD TRIAL EVIDENCE ON THE EFFECTIVENESS OF PROVIDING INFORMATION ON ENERGY COSTS ON ENERGY RELATED DECISIONS IN HOUSEHOLDS

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Executive Summary

The general aim of the CONSEED Project is to examine how different consumer groups interact with existing Energy Efficiency (EE) policies that aim to influence consumer investment decisions, and to make policy recommendations based on the empirical evidence collected. This deliverable presents the results of the field trials implemented in work package 4 (WP4). We carried out three field trials in three countries for three different product categories. The field trials all address the same core research question, but with important variation in terms of exact implementation:

Can displaying monetary energy information in addition to the mandatory EU energy labels convince consumers to purchase more energy efficient products compared to the EU labels on their own?

The focus groups and in-depth interviews carried out in WP2 (see Deliverable 2.1) provided essential input to the specific design of the three trials. Implementation of the three field trials varied considerably due to the different nature of the implementing organizations, with the strongest similarities between the car and household appliances field trials.

The online property field trial in Ireland explores how adding annual energy cost forecasts (based on the property's energy rating, size, and energy prices) to property advertisements influences sales prices and rents. For the final sales price (final prices in Ireland are the result of a bidding process), results show a significant increase in the efficiency sales premium in the treatment group – €2,608 for each categorical increase in property energy efficiency (fifteen-category scale).[1] For advertised sales prices and rents, we do not observe a significant treatment effect. The results suggest that long-run energy cost labelling for property sales increases the demand for more EE properties.

The household appliances field trial in Spain explores how sales of EE fridges, dishwashers and washing machines are influenced by three different interventions: providing an additional lifetime energy savings label; training of sales staff to emphasize energy efficiency; and the combination of the two. We find a positive and statistically significant impact on the probability that consumers purchase the most energy efficient appliance (A++ or better) for all treatments for the case of fridges, and for providing an additional savings label for the case of washing machines. Other combinations of treatments and product categories do not produce statistically significant results. The differences in results across product categories are broadly consistent with the degree of control consumers have over energy use during the usage phase. For fridges, options to influence energy use are very limited beyond changing the thermostat setting, whereas the energy use of dishwashers and washing machines depends heavily on frequency of use and the program selected (e.g. temperature). Interventions proving information about energy savings thus seems to be most effective when applied to products where consumer choices during the usage phase plays a limited role. It should be noted, however, that even for the cases where impacts are statistically significant, the increases in the probability of buying the most EE models are small compared to the impact of appliance specific attributes such as capacity.

The new cars field trial in Norway explores how providing an additional operating cost label, combined with training of sales staff and an online operating cost calculator (that can be tailored to individual driving patterns), influences the average energy use of the cars sold. An external factor caused severe interference in this field trial as supply problems lead to rapid growth in waiting times for new cars, reducing incentives to promote electric vehicles (which was the primary intention of the treatment). Due to this there are no clear treatment results to report from the car field trial. The trial does, however, provide valuable lessons for the planning and implementation of field trials, and the required tools (labels and an online cost calculator) are in place for

[1] This result is observed when Dublin is excluded from the analysis. Dublin was excluded as it is currently experiencing a severe and increasing supply shortage.

potential rapid relaunching of a new field trial when conditions are more favourable. We are also exploring options for secondary usages of the collected data.

The results from the two field trials with properties and household appliances generally support the hypothesis that displaying monetary energy information can lead consumers to purchase more EE products, albeit with noteworthy caveats, and with important differences across the two field trials.

1 Terms of Reference

The objective of CONSEED Work Package 4 (WP4) is to obtain experimental data (stated and revealed preferences) on the effectiveness of providing information on energy costs for energy related decisions for households, specifically to:

- Conduct field trials in the three markets with mandatory energy efficiency (EE) information requirements (household appliances, properties and cars) to analyse whether providing explicit information about energy costs (or savings) can induce more consumers to make EE decisions.
- Conduct choice experiments to explore whether the importance assigned to energy use in purchasing decisions varies across different labelling schemes. We will focus particularly on the effectiveness of explicit information about energy costs. Separate but coordinated experiments will be conducted for housing, appliances, and cars.

This deliverable concerns the first of the two bullet points. Deliverable 4.2 reports on the results from the choice experiments. Based on previous research by the project team and others (for example, Kallbekken, 2013; Carroll *et al*, 2016, Tigchelaar et al. 2011), we hypothesized that household consumers do not fully make use of the existing EU energy efficiency labels displayed on appliances, cars and properties in their decisions. The aim of the randomized controlled field trials in CONSEED is therefore to test whether displaying monetary usage labels would further encourage household consumers to purchase more efficient appliances and properties compared to the EU labels on their own. We do so through three field trials focusing on purchases of:

- Properties in Ireland (responsible: TCD)
- Household appliances in Spain (responsible: BC3)
- New cars in Norway (responsible: CICERO)

This deliverable is part of a series from the CONSEED project. Table 1.1 shows the completed and forthcoming academic deliverables from CONSEED.

Table 1.1. Research deliverables from the CONSEED project.

No.	Title	Date submitted
1.1	Understanding Consumer Decision Making in the Context of Energy Efficiency	28.06.2017
2.1	Report on the focus groups and in-depth interviews on consumer's energy efficiency choices	31.07.2017
3.1	Consumer survey based empirical evidence on consumer's energy efficiency choices across different consumer groups and geographical locations: survey results	31.05.2018
4.1	Report on field trial evidence on the effectiveness of providing information on energy costs for energy related decisions in households	30.11.2018
4.2	Report based on choice experiments on the effectiveness of providing information on energy costs on energy related decisions in households	03.11.2018
5.1	Report on the validated energy investment model	Due June 2019
5.2	Report on implicit discount rates for energy investment decisions	Due June 2019
6.1	Report on the estimation of the impact of existing EU energy efficiency policies and recommendations on potential alterations new policies	Due November 2019

2 Methods and design

A natural field experiment is an experiment with "field context in either the commodity, task or information set that subjects can use" and where "the environment is one where the subjects naturally undertake these tasks and where the subjects do not know that they are in an experiment" (Harrison and List 2004).

Field trials, or using the Harrison and List's classification, natural field experiments, are used to experimentally examine interventions in the real world (as opposed to the lab). Ideally, only one variable of interest is changed at a time, while other variables are kept constant, to facilitate drawing causal inferences about the impact of that variable on some outcome of interest. In all three field trials in CONSEED we vary the information provided about the energy usage or energy cost of certain products and observe how this influences sales of the targeted products. There will always be a range of variables influencing the outcome that lie outside the control of the researchers. In the case of household appliances, for instance, electricity prices might change over time due to change in taxation or variability in energy supply. In the case of cars, sales might change because of the introduction on new car models, or new local or national regulations. Our key strategy to control for the variability of factors outside our control is to employ control groups. This enables us to use difference-in-difference approaches whereby any general trend affecting sales in both control and treatment groups can be accounted for. We also collect a range of information on other factors that could influence our results, such as variability across control and treatment groups, which we can control for statistically in the econometric analyses.

The focus groups and in-depth interviews carried out in WP2 (see Deliverable 2.1) provided essential input to the specific design of the three trials. Implementation of the field trials varied considerably due to the different nature of the implementing organizations, with the strongest similarities between the car and household appliances field trials. Table 2.1 below summarizes key information about each field trial.

Table 2.1: Key design features of the three field trials

Product	**New cars**	**Properties**	**Household appliances**
Country	Norway	Ireland	Spain
Implementation level	Individual car dealerships	Centralized online property portal	Individual electronics retailers
Allocation to treatment	Stratified randomization	Random at county level with one exception	Stratified randomization
Experimental design	Control + Treatment with 3 elements	Control + treatment	Control + 3 sequential treatments
Treatment	Monthly operating cost label; online cost calculator; training of sales staff	Annual energy cost label	Lifetime energy savings label; training of sales staff; combination of label and training

3 Results

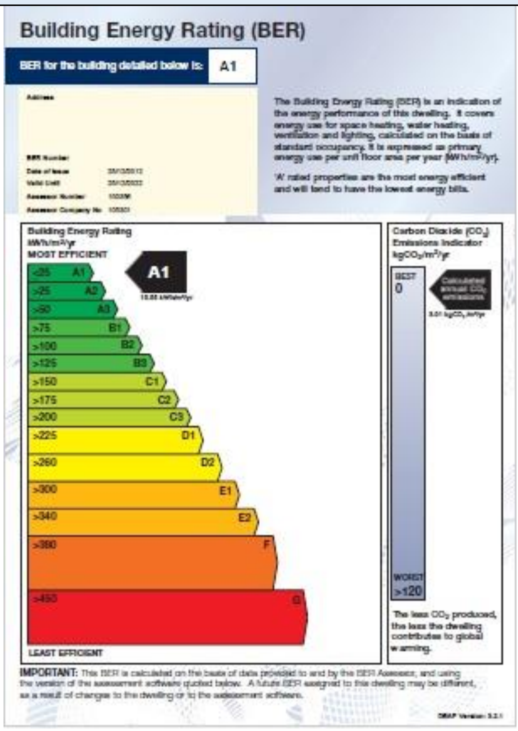
The next three sections report on the findings from the three field trials individually. All sections follow the same structure: We explain the treatments and experimental design, provide details of the implementation, analyse the effect of providing energy cost (or savings) information on behaviour in the field trial, and discuss policy and research implications for the specific field trials.

3.1 Property field trial in Ireland

In collaboration with Ireland's largest online property sales website, daft.ie, TCD created a new annual energy cost label based on each property's EE, size and the price of energy. This new monetary label is motivated by assumed informational/behavioural biases which could negatively affect household demand for EE: we expect that many buyers do not understand how energy ratings affect their bills. If the monetary savings of higher efficiency levels (on our new label) are larger than household expectations, we would expect to see an increase in demand for more efficient properties (observed through higher sales prices and rents).

Since 2013, all property advertisements in Ireland are required to include a *Building Energy Rating* (BER) certificate. The key component of the BER is a property's kWh/m^2/annum, which is displayed on a 15-grade colour-coded scale (left panel of Figure 3.1.1). Advertisement regulations stipulate that a property's BER category is required (only, without comparative scale) for all sale or rental advertisements (right panel of Figure 3.1.1). The BER estimates the energy used for standard occupancy for space and hot water heating, ventilation and lighting using software developed by the *Sustainable Energy Authority of Ireland* (SEAI).[2] While we have no reason to expect this estimate is biased, the BER does not account for any behavioural changes associated with higher efficiency (rebound effects for example).[3]

[2] The *Dwelling Energy Assessment Procedure* (DEAP).
[3] Rebound effects refer to an increase in consumption due to the lower price of energy services resulting from energy efficiency upgrades.

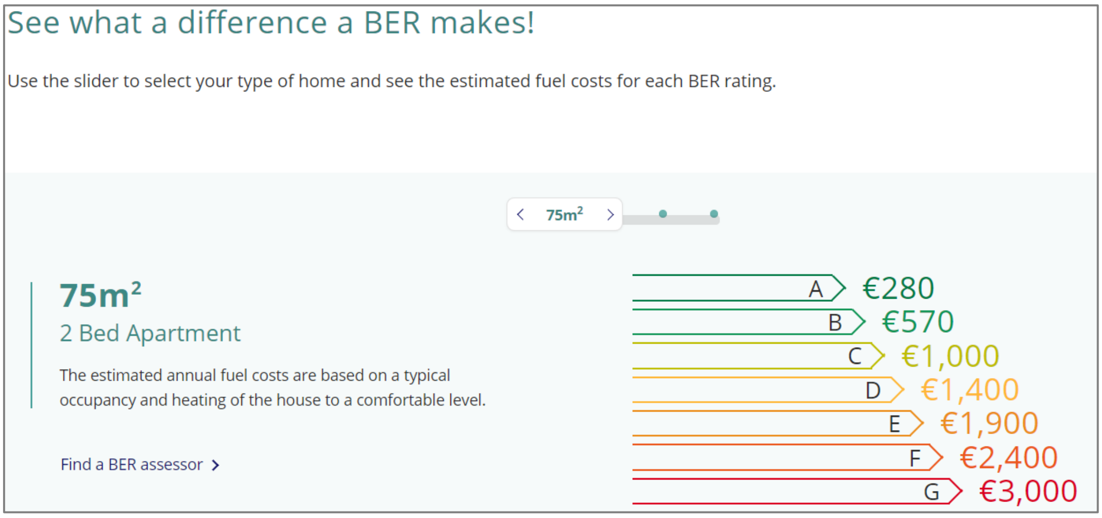
BER certificate example	BER advertisement examples
	

Source: www.seai.ie

Figure 3.1.1: Current EE Labelling – the Building Energy Rating (BER)

Treatment and experimental design

The monetary label is created using three components: the property size (from advertisements), the energy consumption per year (kWh/m^2/annum from the BER) and the price of energy (from Sustainable Energy Authority of Ireland (SEAI) monthly energy price tables). This follows the SEAI's online energy cost tool "*See what a difference a BER makes!*" (see Figure 3.1.2). We provide an example of our calculations in Table 3.1.1.



Source: www.seai.ie

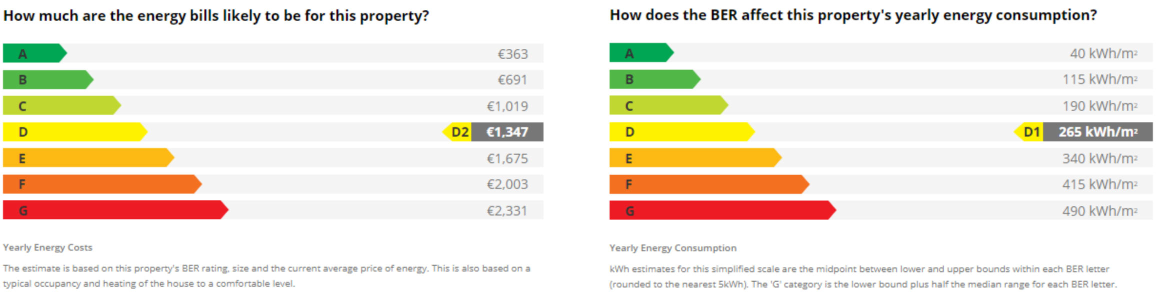
Figure 3.1.2: SEAI Online Energy Cost Calculator (Screenshot)

Table 3.1.1: Energy Cost Calculations for Monetary Label (example) in Daft.ie-TCD Trial

Description	**Values**	**Code**	**Formula**
BER (kWh/m^2/yr.)	350	a	
Size (m^2)	100	b	
Cost of electricity (€)	0.1992	c	
Cost of Gas (€)	0.0678	d	
Cost of Oil (€)	0.0582	e	
Energy for light and pumps (kWh/m^2/yr.)	20	f	
Delivered energy for lights and pumps (kWh/m^2/yr.)	8	g	
Cost of lights and pumps (€/m^2)	€1.59	h	g * c
Cost of heating (€/m^2)	€20.79	i	(a - f) * ((d + e)/2)
Total annual energy cost	€2,238.36	j	(h + i) * b

Source: calculations based on the methodology used for the SEAI energy cost calculation online tool www.seai.ie/energy-ratings/building-energy-rating-ber/
Notes: energy prices are available from www.seai.ie

The monetary label was designed by TCD and daft.ie and is displayed in Figure 3.1.3 (left panel). Relative to the pre-trial advertisement format (right panel of Figure 3.1.1), our new label contains two new and separate components that could change buyer behaviour: monetary information *and* a categorical and graphical scale. Therefore, to isolate the independent effects of monetary information, we included an identical categorical scale in the control group that is based on kWh/m^2/annum information only (right panel of Figure 3.1.3). While this implies that there has been a change in control group information, this was carried out to remove any effects of a visual graphical scale, leaving only the effects of monetary information.



Source: designed by TCD and Daft.ie

Figure 3.1.3: Label Examples from daft.ie-TCD trial

Implementation

The labels were displayed from early February 2018 in addition to existing BER advertising requirements (at the bottom of the advertisement). However, as there were a number of implementation issues during February, our analysis of treatment effects is from March 1st onwards (February is excluded from the analysis entirely, for simplicity). For treatment allocation, we split Ireland into 26 property markets, in line with the traditional administrative counties within the Republic of Ireland. While a larger number of markets would be preferable for randomisation, we were constrained by buyer search patterns which is generally within counties. This split would therefore help to reduce treatment contamination, that is, buyers learning about energy costs from a treatment county and applying this new knowledge to a control county. Each market was randomly allocated, with one exception – we combined the capital city Dublin with its surrounding counties (Meath, Kildare and Wicklow) and imposed this aggregate group to treatment. We did so as many Dublin workers reside in these counties, and we expected that such buyers would search for properties across this wider geographic area. The final county allocation is displayed in Table 3.1.2 with county numbers and shares (of total dataset). County shares generally range between 1% and 6% with two exceptions – Cork with 11% and Dublin with 34%.

Table 3.1.2: Control and Treatment County Allocation for Daft.ie-TCD trial

Control			Treatment		
County	**N**	**%**	**County**	**N**	**%**
Cork	29,778	11.25%	Carlow	2,772	1.05%
Galway	14,758	5.58%	Cavan	3,743	1.41%
Kerry	7,059	2.67%	Clare	5,352	2.02%
Kilkenny	3,628	1.37%	Donegal	6,267	2.37%
Laois	4,209	1.59%	Dublin	91,668	34.65%
Leitrim	2,343	0.89%	Kildare	10,918	4.13%
Limerick	10,034	3.79%	Louth	7,262	2.74%
Longford	2,458	0.93%	Mayo	7,422	2.81%
Roscommon	3,708	1.40%	Meath	8,366	3.16%
Tipperary	6,231	2.35%	Monaghan	1,555	0.59%
Westmeath	5,559	2.10%	Offaly	2,805	1.06%
Wexford	8,551	3.23%	Sligo	3,780	1.43%
			Waterford	8,217	3.11%
			Wicklow	6,148	2.32%

Source: own calculations based on daft.ie dataset

Notes: data are from January 1st 2017 to January 3rd 2019 which include rental and sales. There are no data exclusions in this table.

Results

We estimate the following hedonic difference-in-differences regression using standard Ordinary Least Squares (ignoring subscripts, constant and error term):

$$\log(Y) = \beta_1 E + \beta_2 P + \beta_3 T + \beta_4 (E * P) + \beta_5 (E * P * T)$$

where Y is price or rent, E is energy efficiency, P is the trial period dummy and T is the treatment dummy. The key coefficients of interest are β_1 (the pre-trial relationship between efficiency and price in the control group), β_4 (the change in this relationship during the trial) and β_5 (how this change differed for the treatment group).

The following data transformations/exclusions were applied prior to analysis:

- A property is in the pre-trial period if it was advertised from January 1st 2017 (the start date of data we received from Daft.ie) and sold before 31st January 2018
- A property is in the trial period if it was advertised from March 1st 2018
- February 2018 is excluded from the analysis due to implementation issues in labelling
- Exclude properties with no EE information
- Exclude properties with more than ten bedrooms or bathrooms
- Exclude properties with zero price/rent
- Exclude sales properties with prices above €2,000,000, following the Daft.ie reporting methodology
- Exclude rental properties with rents above the 99th percentile (assumed to be errors in the data)
- Exclude new developments from sales model
- Exclude properties with duplicate price/rent, advertised date and sold date (combined)

The above specification is estimated for three dependent variables: asking sales price (what the sales agent advertises initially), closing sales price (what the property eventually sells for after a bidding process) and advertised rents. Table 3.1.3 displays descriptive statistics for the three datasets (for ease of exposition, we have aggregated the fifteen BER sub-letter categories into seven, “A” through “G”). Properties with “C” and “D” BER ratings make-up about two-thirds of the datasets. It is evident that the main difference across control and treatment groups is price and number of observations, which is due to the inclusion of Dublin in the treatment group.

For closing sales prices, we merged data from the Irish Property Price Register (PPR) onto the daft.ie database using address and county.[4] In doing so, we imposed a condition that the PPR closing date is within one year after the daft.ie sales date.[5] Differences in addresses (format, spelling and order) in the daft.ie data (normally added by the estate agent) and the PPR (normally added by the solicitor), unsold properties in the daft.ie dataset (and therefore no corresponding record in the PPR), and delays between sale date and PPR registration date, all led to a significant reduction in sample size: 66% reduction in the control group and a 60% reduction in the treatment group for the closing sales analysis (Table 3.1.3). Furthermore, we note that the mean PPR sales prices in the treatment group are 2% higher (than asking prices) and 8% lower in the control group. These control/treatment differences are smaller if Dublin is excluded from the treatment group (treatment sample decline changes to 66% (same as control) and mean prices are 5% lower (instead of higher).

Table 3.1.3: Descriptive Statistics for all Datasets

	Asking Price				***Closing Price***				***Rents***			
	Control N = 24,711		*Treatment* N = 41,279		*Control* N = 8,382		*Treatment* N = 16,400		*Control* N = 10,106		*Treatment* N = 21,937	
	M	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**
Price/rent	228,692	141,483	329,801	225,563	210,526	117,884	336,762	214,529	1,016	390	1,589	748
Bedrooms	3.390	0.998	3.092	1.065	3.284	0.914	3.008	0.978	2.789	1.017	2.427	1.028
Bathrooms	2.187	1.048	2.026	1.006	2.118	0.966	1.974	0.933	1.965	0.896	1.755	0.823
BER A	0.024	-	0.026	-	0.013	-	0.018	-	0.038	-	0.052	-
BER B	0.103	-	0.093	-	0.098	-	0.092	-	0.175	-	0.185	-
BER C	0.411	-	0.376	-	0.434	-	0.376	-	0.436	-	0.394	-
BER D	0.235	-	0.250	-	0.249	-	0.261	-	0.230	-	0.229	-
BER E	0.096	-	0.127	-	0.091	-	0.130	-	0.073	-	0.087	-
BER F	0.052	-	0.060	-	0.046	-	0.065	-	0.022	-	0.031	-
BER G	0.079	-	0.068	-	0.069	-	0.058	-	0.025	-	0.023	-

Source: own calculations based on Daft.ie and PPR data

Notes: data are from January 1st 2017 to January 3rd 2019. "M" indicates mean and "SD" indicate standard deviation

The OLS results for each dataset are displayed in Tables 3.1.4 through 3.1.6, respectively. EE is included in two ways: first, as a continuous fifteen-grade BER scale from category “G” to “A1” (see Figure 3.1.1 above); second, as seven BER dummy variables for the main letter grades only, “A” through “G”.[6] In all models we control for size (number of bedrooms and bathrooms), building type (apartment, bungalow, detached house, duplex house, end-of-terrace house, semi-detached house, terraced house and townhouse), price growth

[4] The PPR is freely downloadable from www.propertypriceregister.ie/website/npsra/pprweb.nsf/PPR?OpenForm. A “fuzzy” merge was carried out in STATA (“reclink” command) after a large number of standardisation procedures for address formats in both datasets (removal of punctuation, spaces, counties and common address terms such as road, crescent street etc.). The merge was then based on exact matches in county and the first five characters, and a fuzzy match for the remaining string characters.

[5] This condition is required for properties sold multiple times during the period.

[6] For example, “A1”, “A2” and “A3” are aggregated to “A”.

(month) and location (389 micro-markets within the daft.ie area coding). The rental model also controls for property attributes such as garden, parking and appliances (not available in the sales dataset).

Table 3.1.4 presents results for asking prices (sales). In the first model, a large BER premium is evident that is statistically significant (using robust standard errors) – for the control group pre-trial, each categorical increase raises the asking price by an average of 4.6%. This effect is large relative to other attributes, and a three-level BER increase (“D1” to “C1”, for example) is equivalent to adding an additional bedroom to the property (13.8% versus 13.1%). However, we note that this efficiency premium could be biased by missing property attributes, correlated with EE, such as condition, the quality of fixture and fittings and age.

For the control group during the trial, the BER premium has declined slightly by 0.4 percentage points (PPs) (efficiency-trial interaction is significant). Importantly, however, there is no significant difference between control and treatment groups during the trial period: the efficiency-trial-treatment interaction is not significant which implies that the monetary information did not affect asking prices.

The second model is largely complementary. For the control group pre-trial, asking prices rise consistently with higher BER ratings. Holding all other property attributes fixed, an “A” property is valued almost 60% higher than a “G”. Again, treatment did not affect property prices as anticipated – information on monetary energy costs did not affect the energy efficiency premium in the treatment group.

In both models, there is a large difference between control and treatment premiums pre-trial, the latter being 2 PPs lower in the first model. We partly attribute this difference to Dublin’s presence in the treatment group where premiums are considerably lower (not shown). This may be due to market stress as a result of severe supply shortages in many Irish urban areas, a problem which is considerably more acute in the capital. This difference reduces to about one percentage point when Dublin is excluded from the treatment group.

Table 3.1.4: OLS Results for Property Sales Prices (Asking)

	Continuous BER			*Categorical BER*		
		Coefficient	**Std. Err.**		**Coefficient**	**Std. Err.**
Bedrooms	***	0.131	0.002	***	0.129	0.002
Bathrooms	***	0.086	0.002	***	0.089	0.002
BER	***	0.046	0.001			
BER * Trial	**	-0.004	0.002			
BER * Treat	***	-0.020	0.002			
Trial * Treat	***	-0.047	0.015			
BER * Trial * Treat		0.003	0.002			
BER[F]				***	0.175	0.025
BER[E]				***	0.252	0.020
BER[D]				***	0.335	0.018
BER[C]				***	0.404	0.017
BER[B]				***	0.543	0.019
BER[A]				***	0.570	0.025
BER[F]*Trial					-0.015	0.032
BER[E]*Trial					-0.002	0.026
BER[D]*Trial					-0.026	0.023
BER[C]*Trial					-0.024	0.022
BER[B]*Trial				**	-0.062	0.025
BER[A]*Trial					0.009	0.030
BER[F]*Trial*Treat					0.016	0.037
BER[E]*Trial*Treat					-0.002	0.031
BER[D]*Trial*Treat					0.029	0.028
BER[C]*Trial*Treat					0.015	0.027
BER[B]*Trial*Treat				*	0.050	0.030
BER[A]*Trial*Treat					-0.012	0.036
BER[F]*Treat					-0.027	0.028
BER[E]*Treat				***	-0.083	0.023
BER[D]*Treat				***	-0.140	0.021
BER[C]*Treat				***	-0.154	0.020
BER[B]*Treat				***	-0.204	0.023
BER[A]*Treat				***	-0.203	0.029
Trial*Treat				*	-0.049	0.026
Property Type Dummy Variables		*Yes*			*Yes*	
Month Dummy Variables		*Yes*			*Yes*	
Area Dummy Variables		*Yes*			*Yes*	
N			65,926			65,926
Adjusted R-squared			0.787			0.79

Notes: ***, ** and * indicate significance at 1%, 5% and 10% level. Robust standard errors

The closing price results are displayed in Table 3.1.5. As mentioned in the data section, the sample drops considerably due to merging failures between the datasets. Similar to the asking price model, the pre-trial premium is significantly lower for the treatment group (about 50% lower). Again, the control group premium declines during the trial (0.8 PPs), which may reflect rising market stresses (supply shortages) during this time. However, the PPR data shows evidence that monetary labelling increases the demand for EE – the trial period premium decline observed in the control group is completely offset in the treatment group (rises by 0.9 PPs). In other words, allowing for the overall level effect between pre-trial and trial periods, the EE premium was almost one percentage point higher for properties with monetary information displayed. The second model (categorical BER) – while not showing any significant effects – is complementary, and shows higher premiums for 'A' and 'B' and 'C' properties that received treatment. As a robustness check, we employ this reduced sample to explore the effect on asking prices. As with the full sample, there is no effect treatment effect.

Table 3.1.5: OLS Results for Property Sales Prices (Closing)

	Continuous BER			*Categorical BER*		
		Coefficient	**Std. Err.**		**Coefficient**	**Std. Err.**
Bedrooms	***	0.136	0.004	***	0.133	0.004
Bathrooms	***	0.070	0.003	***	0.071	0.003
BER	***	0.042	0.002			
BER * Trial	**	-0.008	0.003			
BER * Treat	***	-0.022	0.002			
Trial * Treat	***	-0.081	0.028			
BER * Trial * Treat	**	0.009	0.004			
BER[F]				***	0.174	0.035
BER[E]				***	0.226	0.029
BER[D]				***	0.299	0.026
BER[C]				***	0.373	0.026
BER[B]				***	0.494	0.028
BER[A]				***	0.554	0.038
BER[F]*Trial					0.032	0.058
BER[E]*Trial					0.037	0.052
BER[D]*Trial					0.027	0.045
BER[C]*Trial					-0.004	0.044
BER[B]*Trial					-0.069	0.051
BER[A]*Trial					-0.082	0.081
BER[F]*Trial*Treat					-0.059	0.067
BER[E]*Trial*Treat					-0.051	0.060
BER[D]*Trial*Treat					-0.011	0.054
BER[C]*Trial*Treat					0.008	0.052
BER[B]*Trial*Treat					0.076	0.059

BER[A]*Trial*Treat			0.058	0.093
BER[F]*Treat		**	-0.077	0.039
BER[E]*Treat		***	-0.114	0.032
BER[D]*Treat		***	-0.163	0.030
BER[C]*Treat		***	-0.186	0.029
BER[B]*Treat		***	-0.231	0.032
BER[A]*Treat		***	-0.321	0.044
Trial*Treat			-0.027	0.050
Property Type Dummy Variables	*Yes*		*Yes*	
Month Dummy Variables	*Yes*		*Yes*	
County Dummy Variables	*Yes*		*Yes*	
N	24,770			24,770
Adjusted R-squared	0.802			0.803

Notes: ***, ** and * indicate significance at 1%, 5% and 10% level. Robust standard errors.

For the rental analysis (Table 3.1.6), the pre-trial BER premium (continuous BER) in the control group is statistically significant but considerably smaller at 0.8% (for each unit increase). During the trial, this premium disappears entirely (declines by 0.8 percentage points), which again may be the result of significant rental pressure in Ireland. However, the trial period premium for the treatment group is 0.7 percentage points higher, again implying that monetary labelling increased the demand for EE in the rental market. In the categorical BER model, we observe few significant relationships, although it appears that the continuous effect observed may be driven by premium increases at the higher end of the efficiency spectrum ("C" through "A").

Table 3.1.6: OLS Results for Property Rents (Advertised)

	Continuous BER			Categorical BER		
		Coefficient	**Std. Err.**		**Coefficient**	**Std. Err.**
Bedrooms	***	0.139	0.005	***	0.138	0.005
Bathrooms	***	0.064	0.004	***	0.063	0.004
BER	***	0.008	0.002			
BER * Trial	**	-0.008	0.003			
BER * Treat		-0.004	0.003			
Trial * Treat	***	-0.071	0.028			
BER * Trial * Treat	**	0.007	0.004			
BER[F]					0.080	0.056
BER[E]				***	0.113	0.044
BER[D]				***	0.112	0.041
BER[C]				***	0.138	0.040
BER[B]				***	0.146	0.042
BER[A]				***	0.170	0.054
BER[F]*Trial					0.028	0.080
BER[E]*Trial					-0.019	0.062
BER[D]*Trial					-0.027	0.059
BER[C]*Trial					-0.030	0.057
BER[B]*Trial					-0.061	0.060
BER[A]*Trial					-0.092	0.076
BER[F]*Trial*Treat					-0.024	0.090
BER[E]*Trial*Treat					0.038	0.072
BER[D]*Trial*Treat					0.008	0.068
BER[C]*Trial*Treat					0.015	0.066
BER[B]*Trial*Treat					0.040	0.069
BER[A]*Trial*Treat					0.107	0.085
BER[F]*Treat					-0.051	0.063
BER[E]*Treat				*	-0.083	0.050
BER[D]*Treat					-0.043	0.047
BER[C]*Treat					-0.063	0.046
BER[B]*Treat					-0.073	0.048
BER[A]*Treat					-0.087	0.061
Trial*Treat					-0.040	0.065
Property Type Dummy Variables		*Yes*			*Yes*	
Property Attributes Dummy Variables		*Yes*			*Yes*	
Month Dummy Variables		*Yes*			*Yes*	
County Dummy Variables		*Yes*			*Yes*	
N			32,043			32,043

Adjusted R-squared	0.657	0.658

Notes: ***, ** and * indicate significance at 1%, 5% and 10% level. Robust standard errors

Implications for research and policy

This trial has provided prospective buyers and renters with annual energy cost forecasts using information on the property's energy rating (the BER), size and the price of energy. This label was randomly assigned across all counties in Ireland. For the three models explored (asking prices, sales prices and rents), a significant treatment effect is observed for sales prices and rents. There are three key results: first, a large EE premium already existed in control counties pre-trial; second, this premium declined during the trial period in control counties (which we suggest is related to severe and increasing supply shortages); third, the efficiency premium in treatment counties during the trial is significantly higher. The magnitude of this treatment effect is large – in the sales price model (continuous BER), the change in BER premium in treatment counties is almost one percentage point higher than control counties. Thus, there is evidence that monetary labelling increased the demand for energy efficiency.

3.2 Household appliances field trial in Spain

Prior findings from Spain, reported in Deliverable 2.1, suggested that consumers often misunderstand the energy consumption information displayed in the EE labels (see Figure 3.2.1). More specifically, consumers would like to be able to compare energy consumption with a reference level to be able to assess whether the energy consumption displayed in the label is high or not. Based on these insights, we developed a monetary energy label to be used in a field trial in Spain for household appliances (washing-machines, fridges and dishwashers) (see Figure 3.2.2). The field trial was designed to analyse the effectiveness of a monetary label providing lifetime energy savings information for appliances at the point of sale and was carried out in close collaboration with several Chambers of Commerce.

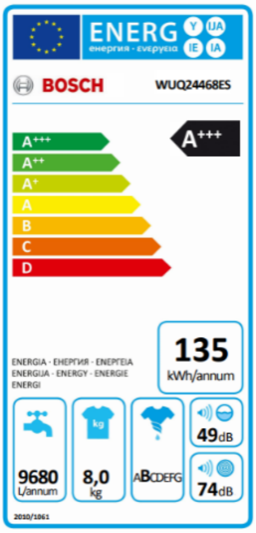


Figure 3.2.1: EU EE label for a washing machine in Spain

Treatment and experimental design

Based on inputs from focus groups undertaken in WP2 and the experts (e.g. representatives of the small retailers) that were reported in Deliverable 2.1, we decided to test three different interventions in the field trial: (i) a lifetime energy savings label displayed in monetary units; (ii) a training programme for the sales staff; and (iii) a combination of the previous two.

The design of the monetary (savings) label was based on input from the focus groups, as well as several interviews and meetings with experts. Specifically, focus group participants were asked to suggest how to improve the design and information displayed on the labels. They proposed the provision of energy consumption data in monetary units (as well as, or instead of, the physical unit of kWh/year). Participants claimed that having information on the operating costs would help them to decide whether they were willing to pay for more energy-efficient appliances or not.

According to the feedback received by experts (e.g. specialized staff from the Federación Mercantil de Gipuzkoa, FMG, a provincial small retailers' federation), information on energy *savings* may be more effective than information on energy *costs* to promote the purchases of EE appliances. Moreover, small retailers preferred energy-savings information to motivate sales with positive information and to avoid a possible misunderstanding with the other concepts of cost such as the price of the appliance. Consequently, a lifetime energy savings label in monetary units was designed to be used as a separate label from the mandatory one, with a clear aim to complement the existing information on EE.

The second proposal was the training program on EE for sales staff. This need was identified during the focus groups where participants talked about their understanding of energy labels. In particular, most participants were aware of the existence of EE labels, but none of them fully understood or fully trusted them. They stated that they usually tended to rely on the information and advice provided by sales staff. Therefore, training of sales staff was proposed as one of the treatments. The training consisted of providing information on EE and related concepts, such as, what does the EE mean, and under which assumptions is the energy consumption computed in the official energy label.

The final experimental design consisted of three sequential treatments in the so-called treatment stores and business-as-usual in the control stores. The treatments were: (i) adding lifetime energy savings labels to the existing energy labels, (ii) training the sales staff (while removing the additional labels), and (iii) combining the additional labels with the training, as outlined in the Table 3.2.1 below.

Table 3.2.1 Key information on the treatments

Treatment group (N=14)	Treatment description	Treatment Period
Treatment 1	Energy savings label	5th February – 4th April 2018
Treatment 2	Training of sales staff	5th April – 3rd June 2018
Treatment 3	Energy savings label + training of sales staff	4th June – 31th July 2018

The first treatment consisted of providing a lifetime energy savings label depicted in Figure 3.2.2 in addition to the mandatory energy label. Under this treatment, consumers could read the energy savings information in monetary units for any appliance displayed at the stores. The savings for each appliance were calculated with respect to the similar appliance with the highest annual energy consumption (See Appendix for more details on the design of the label and the calculation of energy savings). Note that under this first treatment the sales staff did not provide any additional information on energy savings to consumers.

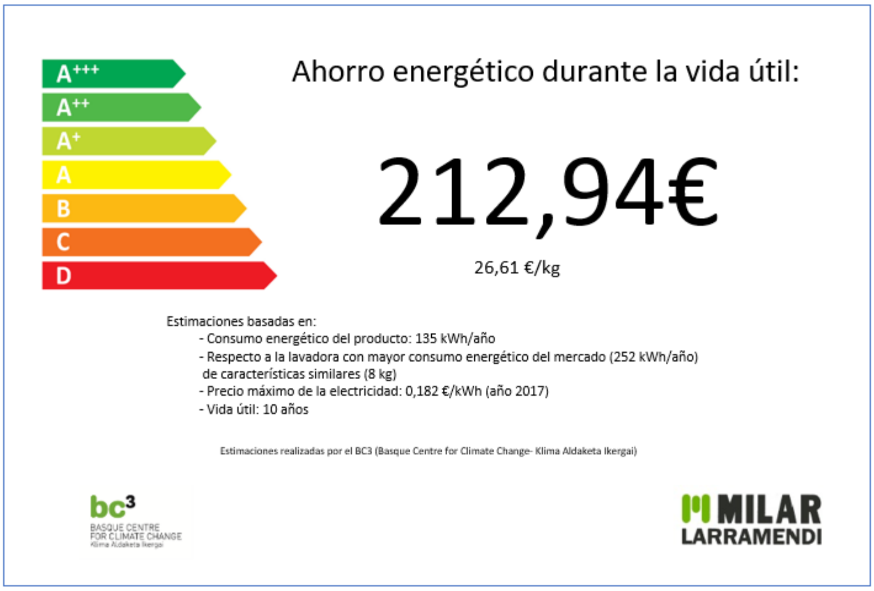


Figure 3.2.2: Lifetime energy savings label used in the field trial (Example for a washing machine with an energy consumption of 135 kWh/year)

In the second treatment, the sales staff provided potential consumers with information related to energy savings for each appliance under study (i.e. washing-machines, refrigerators and dishwashers). The aim of this treatment was to analyse the role the sales staff may have in guiding the purchasing decision. During the specific training sessions several aspects of the EE of appliances were highlighted and explained to be conveyed to consumers. Aspects such as how the EE level is calculated, which assumption[7] guides the calculation of the energy consumption of a product, how the energy savings in the monetary label are calculated, etc. It is important to note that during this treatment, the lifetime energy savings label was not displayed.

Finally, the third treatment was based on a combination of the two previous treatments: explanations by the sales staff and the lifetime energy savings label being displayed.

The comparison among the three treatments allows us to better understand which strategy is the best to effectively promote the purchasing of EE appliances. In addition, we designed short surveys to obtain key socio-demographic information about the consumers buying the appliances at all points of sale. These surveys were generally filled in by the sales staff with information such as gender, zip code and age of the consumer.

Implementation

The process of recruiting retailers was conducted through several Chambers of Commerce and Business Federations (e.g. FMG, CECOBI, etc.)[8]. These are non-profit associations created with the aim of protecting the interests of companies and small retailers as well as acting as lobby groups with the administration.

Once these organisations were contacted, a first meeting with FMG was held in July 2017 to explain the main objectives of the study and to collect some feedback. A second meeting with FMG was held in October 2017 where all the details of the experiment (such as different designs of the proposed lifetime monetary label, timeline for the field trial, etc.) were shared. FMG was in charge of conveying all this information across the small retailers in their network as well recruiting volunteer stores to participate in the field trial.

Similarly, CECOBI was contacted to act as intermediary between BC3 and retailers. A first meeting was held in October 2017 in which all the details of the field trial were explained. CECOBI provided access to 30 potential volunteering stores in several autonomous communities in Spain, namely Comunidad Autónoma Vasca, Comunidad Foral de Navarra, Cantabria and Aragón.

A researcher from BC3 visited each participating retailer during November 2017 for face-to-face meetings to explain the field trial design in detail, as well as to respond to any questions or issues that may arise. It should be noted that very useful feedback was received during these meetings related to the design of the monetary label. In the end, 26 small retailers consented to participate in the field trial.

We agreed with the participating retailers to assign stores to a treatment group and a control group, and to implement the three treatment elements in sequence at the treated stores. Note that the same treatment was implemented in all stores simultaneously in order to avoid the same customer being exposed to different treatments when visiting different stores. The assignment of the small retailers to each group was made based on the geographical location (provinces), size of the cities (small, medium and big) and sales volume for the appliances under study during the year 2017 (see Table A.1 in the Appendix). Consequently, 12 retailers were

[7] In order to measure the energy consumption of an appliance, some baseline assumptions are assumed for each appliance. For the three product categories we have assumed: Washing machine: 220 cycles per year and cotton programme (45º and 60º); Dishwasher: 280 cycles per year and standard programme (65º); Fridge: daily use.
[8] FMG: http://www.fmg.es/; CECOBI: http://www.cecobi.es

assigned to the control group and 14 to the treatment group according to the characteristics summarised in Table A.1.

By January 2018 we had contacted all the retailers to explain to them their role in the field trial, the timeline and the tasks to be conducted.

The first treatment started on February 5th 2018 and finished on April 4th 2018 (see Table 3.2.1). The second treatment lasted from April 5th until June 3rd 2018. BC3 researchers provided EE training to the sales staff of all the retailers (for the second treatment) between March and April 2018. The third treatment began on June 4th 2018 and finished on July 31st 2018. The time period for each treatment was controlled by regular phone contacts with each of the participants and random visits to the stores.

Results

Table 3.2.2 shows the number of appliances sold with different EE levels for each type of appliance during the period of the experiment. In the case of washing machines, almost all the products sold were A+++ class. For dishwashers almost all the products were classified as A++ and A+. Finally, for fridges almost half of the units sold were classified as A++. Further descriptive statistics are provided in Table A.2 in the Appendix.

Table 3.2.2: Share of sales and average prices by product category and EE level

Number of products sold	Washing machine	Dishwasher	Fridge	
A+++	990 (90.49 %)	61 (11.44%)	144 (14.11%)	Number of products sold
	€451.77	€709.72	€943.66	Average price
A++	79 (7.22 %)	234 (43.90%)	487 (47.74%)	Number of products sold
	€461.50	€471.59	€691.88	Average price
A+	25 (2.28 %)	236 (44.28%)	389 (38.14%)	Number of products sold
	€320.66	€425.82	€420.66	Average price
A	.	2 (0.37%)	.	Number of products sold
	.	€396.82	.	Average price
Total	1,094	533	1,020	.

The retailers provided the following information: number of products sold, date of the sale, price of the product sold, and data from the questionnaire (see Figure A.2 in the Appendix). The information collected enabled us to create a database including the attributes of each specific appliance model and the average income level in the area where the store is located. Specifically:

- For washing machines, we included information on the EE level, annual energy consumption, size, type of embedding (free standing or built-in) and water consumption.
- For dishwashers, we included information on the EE level, annual energy consumption, number of services, size of the dishwasher, type of embedding and water consumption.
- In the case of fridges, we included information on the EE level, annual energy consumption, height of the product, type of embedding, size of the fridge (in L) and size of the freezer (in L).
- Income per capita at the municipality level was taken from the statistical institutes of Aragón, Comunidad Foral de Navarra, Cantabria and Comunidad Autónoma Vasca[9]. We acknowledge that, in some cases, data at municipal level may not be enough, especially in the case of large cities. However, in our sample, the cities involved were relatively small so this caveat seems not to be so relevant.

To analyse the effect of the treatments we estimate a Probit model where our dependent variable (Y) is the EE level of the appliance in question and the explanatory variables are: the treatments (1, 2 and 3), the price of the product, and the specific attributes of the product (e.g. capacity, water consumption). The Probit model will allow us to estimate the marginal effect that each variable has on the probability of selling an EE appliance.

We chose to use a model that could be applied to the three types of product categories and which could explain the choice of EE product. Further details on the methodology are provided in the Appendix. In the case of washing machines, we use a dichotomic specification for the dependent variable: we grouped A+++ in one group and the rest of the efficiency levels (A++, A+ and A) in a second group. The selection of this variable was made based on the low number of A, A+ and A++ labelled washing machines. We used the same dichotomic specification for fridges. Finally, for dishwashers, we choose a dichotomic specification for the

[9] Income information is available for each municipality in the following sources: Instituto Aragonés de Estadística (IAE) for the region Comunidad Autónoma de Aragón, Instituto de Estadística de Navarra (NASTAT) for the Comunidad Foral Navarra, Instituto Cantabro de Estadistica (ICANE) for the region Comunidad Autónoma de Cantabria and Instituto Vasco de la Estadística (EUSTAT) for the region of the Comunidad Autónoma Vasca.

dependent variable; we grouped the EE level of the products sold under A+++ and A++ in one group, and the rest in a second group. Several tests were carried out with both dichotomic specifications in order to find the best model fit. The results of the selected models[10] are presented in Tables 3.2.3 through 3.2.5. We ran a similar model for the three product categories under study, including the specific attributes for each appliance.

Table 3.2.3 shows that for washing machines, energy savings information provided through the complementary energy label (Treatment 1), increases the probability of buying a high EE product (A+++) by 2.42% compared with the situation where no information on savings is given (control group). The other two treatments are not statistically significant. Other specific attributes such as capacity and water consumption are statistically significant.

Table 3.2.3: Marginal effects for washing machines in the household appliances field trial.

	Marginal effects	**P>z**
Treatments		
Control	----------------Reference-------------------	
Treatment 1 (=1 if the sale is under treatment 1)	0.02424* (0.01286)	0.060
Treatment 2 (=1 if the sale is under treatment 2)	-0.00256 (0.00947)	0.786
Treatment 3 (=1 if the sale is under treatment 3)	0.00588 (0.01075)	0.585
Washing machine attributes		
Price (€)	0.00005* (0.00003)	0.060
Capacity (kg)	0.05757*** (0.00879)	0.000
Type of embedding (=1 if free installation)	0.05444*** (0.01180)	0.000
Water consumption (L)	-0.00003*** (6.16e-06)	0.000
Number of observations 1,433		
LR chi2(7) 144.23		
Prob > chi2 0.0000		
Pseudo R2 0.2180		

Notes: ***, ** and * indicate significance at 1%, 5% and 10% level. Standard deviation in parentheses.

[10] We tested the effect of other variables for all the product categories: income per capita, gender and age. None of these variables were statistically significant for any of the products under study.

For the case of dishwashers, we tested two different probit models. For the first case, we ran the model including three dummy variables, one for each of the treatments (the variables take on value 1 during the treatment period for treated stores) as explanatory variables. As shown in Table 3.2.4, none of the treatments are statistically significant. The second probit model was run to test the effect of including a single treatment dummy variable[11] to check robustness. The single treatment dummy variable is not statistically significant neither. Results suggest that having information on energy savings through the label, through the sales staff or both together does not make a difference in terms of purchases of EE appliances (A+++ and A++).

Table 3.2.4: Marginal effects for dishwasher in the household appliances field trial.

	Marginal effects	**P>z**
Treatments		
Control	----------------Reference-------------------	
Treatment 1 (=1 if the sale is under treatment 1)	0.02408 (0.1201428)	0.841
Treatment 2 (=1 if the sale is under treatment 2)	0.03010 (0.10619)	0.777
Treatment 3 (=1 if the sale is under treatment 3)	-0.12633 (0.10702)	0.238
Dishwasher attributes		
Price (€)	0.00042 (0.00030)	0.162
Size (=1 if the size is 600mm)	1.17359*** (0.10885)	0.000
Type of embedding (=1 if free installation)	-0.33320*** (0.09000)	0.000
Water consumption (L)	-0.00191*** (0.00021)	0.000
Number of observations 430		
LR chi2(8) 411.39		
Prob > chi2 0.0000		
Pseudo R2 0.7021		

Notes: ***, ** and * indicate significance at 1%, 5% and 10% level. Standard deviation under parentheses.

[11] The dummy takes on a value of 1 if the sale was under any of the treatments, 0 if the sale was in the control group

For the case of fridges, we find that consumers who received any information on energy savings (i.e. all the three treatments) are more likely to invest in highly EE fridges (A+++) as compared with consumers who received no such information. Table 3.2.5 shows that the most effective information is the one received from the sales staff, which increases the probability of buying highly EE products by 6.02%. Other specific attributes are also statistically significant (price and volume). The price has a positive and significant effect which indicates that consumers are willing to pay more for highly EE fridges (A+++). For this appliance we also analyse the results of the probit model by including a single treatment dummy variable[12]. In this case, the treatment is also statistically significant and increases the probability of buying a high efficient fridge (A+++).

Table 3.2.5: Marginal effects for fridge in the household appliances field trial.

	Marginal effects	P>z
Treatments		
Control	----------------Reference-------------------	
Treatment 1 (=1 if the sale is under treatment 1)	0.053256** (0.02606)	0.041
Treatment 2 (=1 if the sale is under treatment 2)	0.06018** (0.02401)	0.012
Treatment 3 (=1 if the sale is under treatment 3)	0.05987** (0.02418)	0.013
Fridge attributes		
Price (€)	0.00019*** (0.00004)	0.000
Height (mm)	-7.17e-06 (0.00001)	0.536
Type of embedding (=1 if free installation)	0.04939 (0.05344)	0.355
Capacity- Volume of the fridge (L)	0.00225*** (0.00034)	0.000
Capacity- Volume of the freezer (L)	-0.00055 (0.00083)	0.507

Number of observations	854
LR chi2(8)	240.59
Prob > chi2	0.0000
Pseudo R2	0.3417

Notes: ***, ** and * indicate significance at 1%, 5% and 10% level. Standard deviation under parentheses.

We conducted additional regressions to analyse the robustness of our results. The full results are shown in Tables A.4 through A.6 in the Appendix. For the linear regressions, our dependent variable is the energy savings and as explanatory variables, we consider the EE of the product, the price of the appliance and the attributes of the product.

In the case of washing machines (See Table A.4), all treatments increase the overall energy savings of the products sold. Similar results are obtained when considering a unique dummy variable to represent all

[12] The dummy takes on a value of 1 if the sale was under any of the treatments, 0 if the sale was in the control group.

treatments. In the case of dishwashers (see Table A.6), providing energy savings information has a statistically significant effect in terms of improving the average EE. This analysis shows that the most effective treatment to increase the overall energy savings is Treatment 2 (energy savings information provided by sales staff). A similar regression was run with a unique dummy treatment variable and similar results were obtained. Finally, a similar strategy was developed for the fridges (see Table A.7). First a linear regression was run with three different treatment dummy variables. Each of these variables are statistically significant, meaning that all the three treatments encourage the increase of energy savings and thus promote the purchase of low energy consumption products (high EE products). Similar results were obtained when running the regression with a single treatment dummy variable (it takes value 1 if the product was sold under treatment, 0 otherwise).

Implications for research and policy

The analysis shows that providing consumers with monetary information on energy savings may significantly contribute to increase the number of efficient appliances sold. This information will be complementary to the already existing information on EE labels. Three treatments were tested. Each presented the information on energy savings in a different way: via an additional "monetary" label, via training sales staff who then provide the information and via the combination of the previous two.

Our findings suggest that monetary labels (in addition to the existing EE labels) may increase the probability of consumers buying more EE products compared to the current labelling situation for washing machines.

Surprisingly, no statistically significant effects were found in the case of the dishwashers. A tentative explanation may be that as usage of dishwashers very much determines the actual consumption of the appliance, consumers give little importance to rated energy savings when purchasing the dishwasher. Our research cannot shed light on why monetary information on savings may seem to work in the case of washing machines, but not in the case of dishwashers.

Finally, all the treatments increase the probability of buying an EE appliance (A+++) in the case of fridges. These results may be driven by the fact that consumers have more limited possibilities to control energy consumption during the use phase of fridges than they have for the two other product categories: fridges are usually connected 24/7, and it is unlikely that the thermostat setting is changed frequently. Actual energy usage is therefore largely given by the rated energy usage of the product.

In addition, we ran several robustness checks to see if there was any difference between running the probit model with different assumptions (the treatments in separate dummy variables vs all the treatments in a unique dummy variable; different dichotomy specification for the dependent variable, etc.).

Although further research is needed, this field trial provides very interesting insights to argue in favour of exploring options to include monetary energy information in EE labels.

In addition to this field trial, the research team had access to El Corte Inglés, a big retail store company with a large market share in Spain, with whom a similar trial is currently underway. This is additional to what was promised in the proposal. The results will strongly benefit the outcomes of the research undertaken in CONSEED. The analysis will significantly complement the understanding with respect to the effectiveness of monetary labels in small retailers versus much bigger ones.

3.3 New cars field trial in Norway

Since 1999, it has been mandatory to provide information on fuel consumption and CO_2 emissions for new cars in the EU. National implementation, however, varies considerably and information is not presented in a uniform way to consumers. Norway has adopted graphical labels, and the current template, provided by the Norwegian Public Roads Administration is shown in Figure 3.3.1 below.

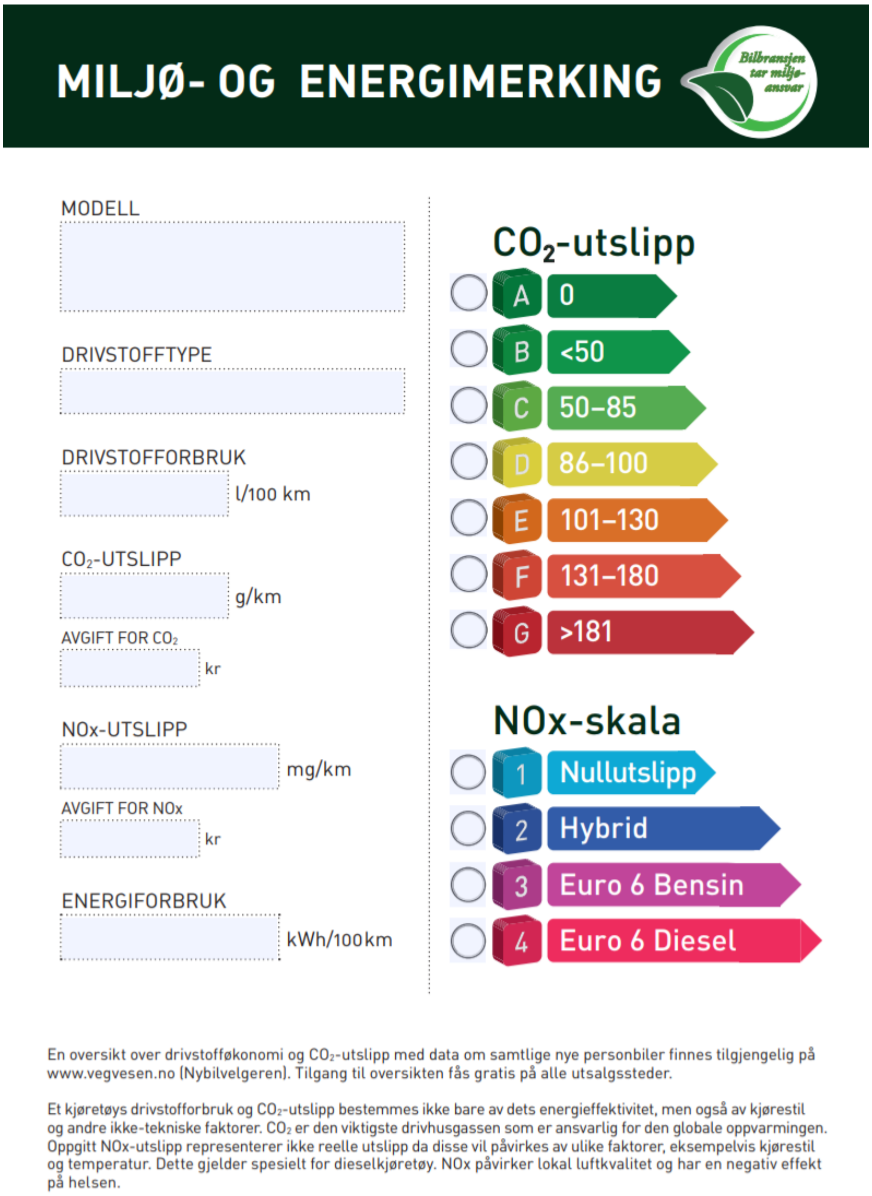


Figure 3.3.1 Current template for mandatory environmental and energy labelling of new cars in Norway

The purpose of the new cars field trial in Norway was to test whether providing information about energy costs could help convince consumers to purchase more EE cars (primarily by shifting from gasoline and diesel cars to electric or plug-in hybrid cars).

Treatment and experimental design

The field trial consists of three main elements:

- An operating cost label
- An online operating cost calculator
- Training of sales staff

In line with the hypothesis of CONSEED, a key element of the treatment is to introduce an additional label showing the energy cost of each car. As both consumers and car sales personnel in the focus groups (Deliverable 2.1) expressed that they would prefer to see information on the full operating costs, rather than just the energy costs, we agreed to make this modification to the original plan. It should be noted that in the case of electric cars versus conventional fuel cars, this tends to provide further incentives to buy an electric car as non-energy operating costs are typically lower (maintenance costs are lower, and expenditure on toll roads and ferries can be substantially lower due to rebates for electric cars). Figure 3.3.2 shows an example of the additional operating cost labels be introduced. The text before the number says, "*Operating costs per month estimated at*", and the six bullet points underneath the emissions rating scale explain the calculation:

- Distance driven per year 15,000 km i.e. 1,250 km per month.
- Gasoline NOK 15/l, diesel NOK 14/l, electricity NOK 1/kWh.
- The EU test procedure for estimating energy consumption (NEDC).
- Other costs based on an estimate from the Information Council for the Road Traffic.
- Includes energy, annual road user charge, maintenance, oil, tyre wear, service and repairs.
- Does not include depreciation, interest payments or insurance.
- Estimated by CICERO Center for International Climate Research.

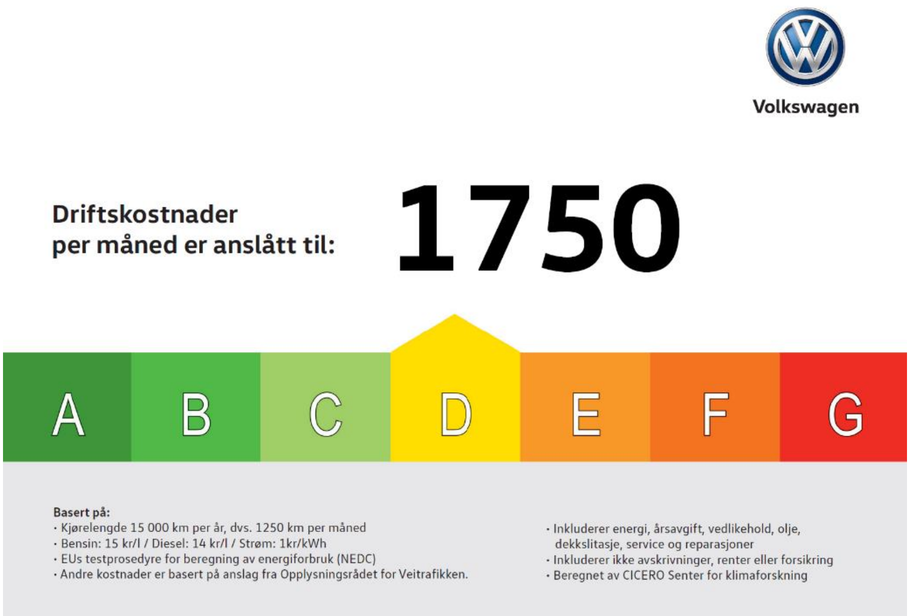


Figure 3.3.2 Example of an operating cost label used in the field trial

The second element of our treatment was driven by stakeholder feedback. One of the participants in the sales personnel focus group suggested that it would be even more convincing if the operating cost estimate could be tailored to each potential consumer as key variables such as driving distance, instances of paying road tolls or for ferry crossings, vary considerably. We suggested this in the consumer focus groups, and the idea was received very favourably. We therefore decided to include it in the field trial. CICERO obtained information on operating costs, and on specific characteristics of the individual models from Opplysningsrådet for veitrafikken ("Information Council for the Road Traffic"). We paid professional programmers to design a website where sales personnel can tailor the information entered (km driven per year, gasoline price, diesel price, electricity price, ferry trips per week, toll road payments per week), and then have the estimated operating costs displayed for different models. Based on feedback from the sales personnel, we also made it possible to remove the automatic calculation of each element – so that it can be replaced by the cost of service agreements. We also made it possible to include the monthly cost of leasing and insuring the car, which makes it a total cost of ownership calculation. The website is hosted on CICERO's home page as our implementing partner believed it would be more credible to have the information displayed by an independent and well-known institution, rather than by the industry itself, or on a purpose-built website. Figure 3.3.3 shows a screenshot of the online cost calculator. The calculator can be viewed and tested at: http://cicero.uio.no/no/carculator.

Oslo

Klikk her for Bergen

Klikk her for Stavanger

Generelt	
Kjørelengde per år i km	15000
Bensinpris per liter	15
Dieselpris per liter	14
Strømpris per kWh	1
Ferge	
Fergeturer per uke	0
Kostnad per fergetur bensin/diesel/hybrid	160
Kostnad per fergetur el-bil	67

Bompenger - Bom 1	
Antall passeringer per uke	5
Kostnad per passering - Bensin og Hybrid	37
Kostnad per passering - Diesel	44
Kostnad per passering - El-bil	0
Bompenger - Bom 2	
Antall passeringer per uke	5
Kostnad per passering - Bensin og Hybrid	49
Kostnad per passering - Diesel	53
Kostnad per passering - El-bil	0
Bompenger - Bom 3	
Antall passeringer per uke	0
Kostnad per passering - Bensin og Hybrid	18
Kostnad per passering - Diesel	18
Kostnad per passering - El-bil	0

Bil 1: e-Golf

Bil 2: Golf GTE - 1,4 TSI 204hk DSG

Bil 3: Golf - 1,0 TSI 110hk Businessline

Bil 4: Passat - 1,6 TDI 120hk Businessline

	Kostnad per måned				Kostnad per mil			
	Bil 1	Bil 2	Bil 3	Bil 4	Bil 1	Bil 2	Bil 3	Bil 4
× Drivstoff/elektristet	159,-	443,-	938,-	717,-	1,27	3,54	7,50	5,74
× Årsavgift	0,-	235,-	235,-	235,-	0,00	1,88	1,88	1,88
× Service og rep.	378,-	777,-	566,-	621,-	3,02	6,21	4,53	4,97
× Dekk	246,-	303,-	246,-	303,-	1,97	2,42	1,97	2,42
× Vedlikehold	409,-	433,-	409,-	433,-	3,27	3,46	3,27	3,46
× Olje	0,-	117,-	100,-	117,-	0,00	0,94	0,80	0,94
× Bompenger	0,-	1.862,-	1.862,-	2.100,-	0,00	14,90	14,90	16,80
× Fergeutgifter	0,-	0,-	0,-	0,-	0,00	0,00	0,00	0,00
× Forsikring	0	0	0	0	0,00	0,00	0,00	0,00
× Serviceavtale	0	0	0	0	0,00	0,00	0,00	0,00
× Leasing	0	0	0	0	0,00	0,00	0,00	0,00
Sum kostnader	**1.191,-**	**4.169,-**	**4.356,-**	**4.526,-**	**9,53**	**33,35**	**34,85**	**36,21**

Kostnadene inkluderer *ikke* avskrivning, renter, forsikring eller parkering.

Energikostnader er basert på oppgitt forbruk. Faktisk forbruk er oftest høyere, og varierer ut fra kjøremønster.

Service og reparasjon, Dekk, Vedlikehold, Olje: Basert på Opplysningsrådet for Veitrafikkens rapport «Eksempler på beregning av kostnader ved bihold januar 2017». Kostnadene er en funksjon av kjørelengde og bilens priskategori. Beregningene antar at kunden betaler for all service og alt vedlikehold. Ved egeninnsats, vil man kunne redusere kostnadene noe.

Vedlikehold omfatter for eksempel vask, rustbeskyttelse, rekvisita m.m.

Figure 3.3.3 Screenshot of the online cost calculator

The final element of the treatment is training of sales personnel. This is essential to ensure that sales personnel are able to use the cost calculator correctly.It also constitutes a separate element in itself: the training made the operating costs (and particularly the energy costs) of different cars more salient to the sales personnel and was intended to make them focus more on this aspect when interacting with consumers.

Implementation

We approached the Møller Mobility Group in November 2016. They agreed to be the implementing partner for the field trial. We furthermore decided that the Volkswagen brand was the most appropriate for the field trial for two key reasons: (i) highest selling car brand in Norway, and (ii) a model range with comparable electric, hybrid and gasoline or diesel models (e.g. the e-Golf, plug-in hybrid electric Golf, and gasoline and diesel Golf models).

Starting with the ten largest dealerships in major city regions in Norway (Oslo, Bergen and Stavanger), we randomly drew five treatment dealerships – with geographical stratification (two of four from Oslo in the treatment group; one of two in the treatment group from each of the "regions" greater Bergen, greater Stavanger, and the Oslo commuter belt). Table 3.3.1 shows the (stratified) allocation of dealerships to treatment and control groups:

Table 3.3.1 Allocation of dealerships to treatment and control groups

	Treatment	**Control**
Oslo	Møller Bil Oslo Vest Møller Bil Asker og Bærum	Møller Bil Ryen Erik Arnesen Bryn
Oslo commuter belt	Albjerk Bil Lier	Møller Bil Romerike
Greater Bergen	Møller Bil Drotningsvik	Møller Bil Nesttun
Greater Stavanger	Møller Bil Stavanger	Møller Bil Sandes og Jæren

Researchers from CICERO visited the five dealerships in the treatment group in October 2017 to introduce them to the CONSEED project, explain the purpose of the field trial, and to train them to use the online cost calculator. All relevant sales personnel at each dealership were invited to the meetings, and they were also asked to provide feedback on the cost calculator. Based on the feedback, we made several changes to the cost calculator, including an option to replace the automatically calculated service costs with the service package they offer, and to have different versions for Oslo, Bergen and Stavanger as the three cities have different toll roads rates.

The treatment period lasted from October 2017 until April 2018. Unfortunately, during the treatment period a major and unexpected external factor influenced implementation and results: During the final planning phase (spring 2017) delivery times for orders of new e-Golfs were around 3 months. By late autumn, this had increased to around 12 months due to high demand in Norway and limited supply from the Volkswagen factory in Germany. This has a very important and negative effects on the field trial as retailers' incentives to promote electric vehicles are lower when they are unable to deliver them within a reasonable period. Instead, incentives to promote (fossil-fuelled) vehicles already in store are higher Sales personnel were incentivized to promote fossil-fuelled vehicles, including through an internal competition to sell the most such cars. Because the cost estimates favour electric cars, sales personnel had a disincentive to use the calculator and labels. The labels were not displayed on cars as agreed. Only one retailer used the labels at all, and only on the electric cars. Traffic on the calculator website was near zero during the treatment period. This means our treatment is unlikely to have had an effect.

Results

We received data on sales from the Møller Mobility Group for the five treatment and five control dealerships for the treatment period (October 2017 – April 2018), and for the preceding year (January 2017 – April 2017), broken down by car model. Data is on the sale contracts signed during these periods, since delivery is lagged by several months.

Using the same data source as for creating the calculator and labels, we estimated the average energy costs for cars sold in the treatment stores and for cars sold in the control stores. These costs are expressed as NOK per 10km (the unit most commonly used in Norway). We assume diesel and gasoline cost 16 NOK per litre and that electricity costs 1 NOK per kWh. Table 3.3.2 shows this average for the treatment versus control stores, before and after the treatment started. The table shows a small increase in average energy costs for the treatment group and a small decrease for the control group. These differences might be driven by local changes in road tolls, a factor we will try to explore in further analyses.

We reject the hypothesis that the treatment resulted in lower average energy costs.

Table 3.3.2 Average energy costs (NOK per 10km) for cars sold

	Treatment group		**Control group**	
Pre-treatment period	NOK	4.35	NOK	4.30
Treatment period	NOK	4.51	NOK	4.24
Change	NOK	0.16	NOK	-0.06

Because electric cars have much lower energy costs, the average consumption of cars sold is heavily influenced by the share of electric vehicles in these sales, which is shown in Table 3.3.3. The same can be said for hybrids, albeit to a lesser extent. The share of hybrids sold is displayed in Table 3.3.4. Sales of electric vehicles increased somewhat, especially in the control stores, while the sale of hybrids fell. These two developments in opposite direction can therefore explain why average energy costs stayed roughly unchanged.

Table 3.3.3 Share of electric vehicles among all cars sold

	Treatment group	**Control group**
Pre-treatment period	41 %	41 %
Treatment period	42 %	47 %
Change	1 %	5 %

Table 3.3.4 Share of plug-in electric vehicles among all cars sold

	Treatment group	Control group
Pre-treatment period	25 %	26 %
Treatment period	18 %	17 %
Change	-7 %	-9 %

Implications for research and policy

Due to the serious impact of external factors, specifically the very significant increase in delivery times for new e-Golfs, the treatment was not put to test as desired. We are therefore unable to draw any conclusions regarding the effectiveness of providing operating cost estimates to customers, and consequently neither do we draw any policy implications. We did have a contingency plan of collecting individual level data from customers by contacting them through email, which could have produced valuable insights even if implementation of the treatment was imperfect. However, as our treatment period coincided with a period when the Møller Mobility Group was without a contract with a survey company to conduct customer satisfaction surveys (which is standard operating procedure), and because the General Data Protection Regulation prevented the Møller Mobility Group from sharing the email addresses with us (which would have allowed us to conduct our own survey), we were unable also to implement the contingency plan. Because the car dealerships' use of the labels and calculator was voluntary, the field trial illustrates how voluntary instruments do not work if they conflict with the retailers' incentives.

The online cost calculator is still operational, and labels can easily be updated to include new models as they arrive. We will therefore explore possibilities to relaunch the field trial when conditions are more favourable. Retailers and buyers currently report that, while waiting times for new electric vehicles have reduced, they are still typically 6-10 months, which means the time is not yet right to attempt a re-launch of the experiment.

CICERO is in contact with the Møller Mobility Group regarding a potential alternative use of the sales numbers: to determine how road toll rates (a key factor in overall operating costs, and with large geographical and temporal variation) impacts sales of electric vehicles (which are exempt from most road tolls).

The key lesson we can draw from this failed intervention therefore concerns how to implement field trials. Researchers should be aware that external factors can influence the field trial beyond what randomization and the inclusion of a control group allows to be controlled for, specifically by influencing the implementation itself. It may still be possible to obtain valuable insights from the field trial even when treatment implementation fails, especially if researchers start such explorations as soon as possible.

4. Conclusion

Energy labelling has triggered more EE products being placed on the market, resulting in energy and cost savings. However, while these labels are now used across Europe, relatively little is known about how consumers interact with these labels and how they affect the relative importance of energy consumption in the decision-making process. To investigate whether displaying monetary cost information on household appliances, properties and new cars would further encourage investment in EE we conducted three field trials in Spain, Ireland and Norway, respectively.

Implementation of the three field trials varied considerably due to the different nature of the implementing organizations, with the strongest similarities between the car and household appliances field trials. An external factor caused severe interference in the car field trial as supply problems lead to rapid growth in waiting times for new cars, reducing incentives to promote electric vehicles (which was the primary intention of the treatment).

The online property field trial explores how adding annual energy cost to a Building Energy Rating scorecard influences asking prices, sales prices and rental prices. Results show no significant effects on property asking prices from adding monetary information to a BER, but a significant increase in the efficiency sales premium of €2,608 for each letter increase in the BER for properties in the treatment group – when Dublin is excluded. For rental prices we find no statistically significant impacts of the treatment.

The household appliances field trial in Spain explores how sales of EE fridges, dishwashers and washing machines are influenced by three different interventions: providing an additional lifetime energy savings label; training of sales staff to emphasize energy efficiency; and the combination of the two. We find a positive and statistically significant impact on the probability that consumers purchase the most EE (A++ or better) for all treatments for the case of fridges, and for providing an additional savings label for the case of washing machines. Other combinations of treatments and product categories do not produce statistically significant results. The differences in results across product categories are broadly consistent with the degree of control consumers have over energy use during the usage phase: For fridges, options to influence energy use are very limited beyond changing the thermostat setting, whereas the energy use of dishwashers and washing machines depends heavily on frequency of use and the program selected (e.g. temperature). Interventions providing information on energy savings thus seems to be most effective when applied to products where consumer choices during the usage phase plays a limited role. It should be noted, however, that even for the cases where impacts are statistically significant, the increases in the probability of buying the most EE models are small compared to the impact of appliances specific attributes such as capacity.

The new cars field trial explores how providing an additional operating cost label, combined with training of sales staff and an online operating cost calculator that can be tailored to individual driving patterns, influences the average energy use of the cars sold. An external factor caused severe interference in this field trial as supply problems lead to rapid growth in waiting times for new cars, reducing incentives to promote electric vehicles (which was the primary intention of the treatment). Due to this there are no clear treatment results to report from the car field trial. The trial does, however, provide valuable lessons for the planning and implementation of field trials, and the required tools (labels and an online cost calculator) are in place for potential rapid relaunching of a new field trial when conditions are more favourable. We are also exploring options for secondary usages of the collected data.

The results from the two field trials with properties and household appliances generally support the hypothesis that displaying monetary energy information can lead consumers to purchase more EE products, albeit with noteworthy caveats, and with important differences across the two field trials.

5. References

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Tigchelaar, C., Backhaus, J., de Best−Waldhober, M., 2011. *Consumer response to energy labels in buildings, Recommendations to improve the Energy Performance Certificate and the Energy Performance of Buildings Directive based on research findings in 10 EU countries,* Deliverable 6 of the IDEAL EPBD project, European project on consumer response to energy labels in buildings.

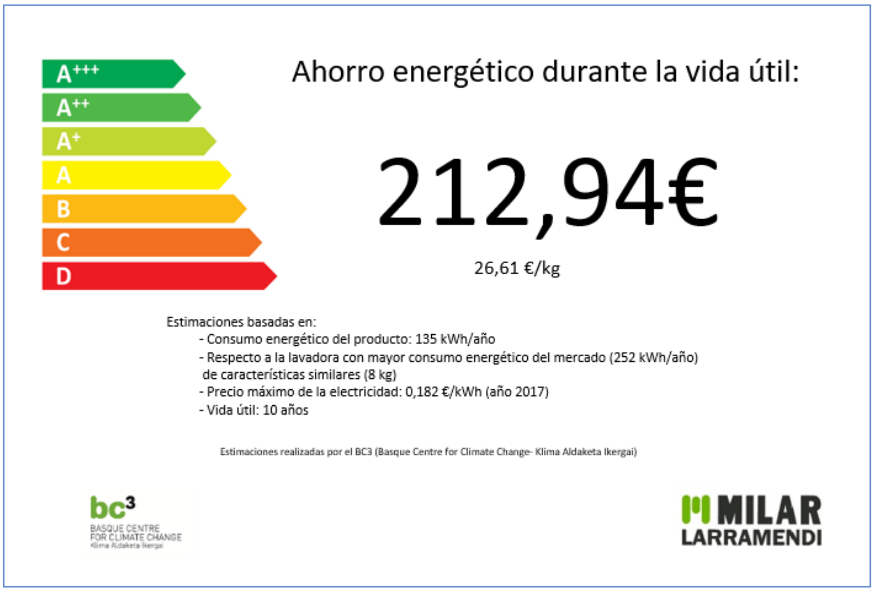
6. Appendices

The appendix contains additional information about the household appliances field trial conducted in Spain.

Table A.1 Details of the household appliances field trial by retailer.

Name of retailer	City	Province	Inhabitants	Size of city [13]	Washing machine	Fridge	Dishwasher	Total appliances sold	Predisposition towards the experiment
Ojanguren	Gernika	Bizkaia	16,869	M	139	109	43	291	Good
Bide Onera	Barakaldo	Bizkaia	100,313	G	136	73	29	238	Good
Serantes	Bilbao	Bizkaia	345,122	G	373	165	127	665	Acceptable
Solrac	Bilbao	Bizkaia	345,122	G	225	218	106	549	Good
Mañary	Durango	Bizkaia	29,031	M	132	70	63	265	Acceptable
Trobika	Mungia	Bizkaia	17,298	M	203	121	87	411	Good
Mancia 1	Sopela	Bizkaia	13,047	M	24	18	12	54	Good
Mancia 2	Getxo	Bizkaia	78,554	M	70	65	40	175	M
Ferretería Cantabra	Colindres	Cantabria	8,331	P	200	148	64	412	Good
Suquia	Ordizia	Gipuzkoa	9,998	P	209	152	70	431	Good
Beotibar	Tolosa	Gipuzkoa	19,386	M	224	79	97	400	Good
Zimer	Zumarraga	Gipuzkoa	9,918	P	188	121	63	372	Good
Milar larramendi	Azkoitia	Gipuzkoa	11,587	M	227	107	37	371	Good
Arrieta	Ermua	Gipuzkoa	15,951	M	164	137	69	370	Good
Benicoba	Eibar	Gipuzkoa	27,380	M	135	81	26	242	Good
Endañeta	Zumaia	Gipuzkoa	9,979	P	224	79	97	400	Good
Nuevo Gros	Donostia	Gipuzkoa	186,064	G	1,232	613	283	2,128	Acceptable
Bastida Sukaldeak	Bergara	Gipuzkoa	14,743	M	80	80	80	240	Good
Electricidad Resan	Donostia	Gipuzkoa	186,064	G	24	18	12	54	Acceptable
Milar Lagun	Zumarraga	Gipuzkoa	9,918	P	122	62	34	218	Acceptable
Casa Cheliz	Ainsa	Huesca	2,173	P	73	50	30	153	Good
Milar Electrovisión	Huesca	Huesca	52,282	M	349	317	167	833	Acceptable
Milar Arretxea	Elizondo	Navarra	3,563	P	133	59	31	223	Good
Milar Landarech	Sangüesa	Navarra	5,002	P	146	71	47	264	Acceptable
Milar Video Ega	Estella	Navarra	13,668	M	263	115	63	441	Acceptable
Yecora	Tarazona	Zaragoza	10,713	M	81	62	39	182	Acceptable

[13] P = less than 10,000; M = between 10,000 and 100,000; G = more than 100,000



Lifetime energy savings label used in the field trial (Example for a washing machine with an energy consumption of 135 kWh/year)

More information regarding the design of the label:

- How is computed the Energy savings during the lifetime of a product?
  The Energy savings are calculated thanks to this formula:
  - $Energy\ savings = (MEC - EC) * energy\ price * lifetime$
  - *MEC* = Maximum Energy consumption for that product category (data from January 2017)
  - *EC* = Energy consumption of the product
  - *energy price* = Maximum Energy Price registered in Spain in 2017 (https://www.esios.ree.es/es/pvpc)
  - *lifetime* = 10 years

- The design of the label was done by BC3 in collaboration with the experts from FMG and CECOBI.
  - The colour scale from the EU energy efficiency label was maintained in order to relate the EU energy efficiency label with complementary label proposed.
  - In the bottom part of the label the logos of BC3 and different retailers are visible.

Figure A.1 The lifetime energy savings label used in the household appliances field trial with additional information regarding the design of the label.

Comercio: ______________________________

Fecha: ______________________________

Tipo de electrodoméstico:

- ☐ Lavadora
- ☐ Frigorífico (combi)
- ☐ Lavavajillas

Modelo: ______________________________

1. Por favor, indique el código postal de su domicilio habitual: __ __ __ __ __ __
2. Género:
   - ☐ Hombre
   - ☐ Mujer
3. Por favor, indique el intervalo de edad en el que se encuentra:
   - ☐ 18-30 años
   - ☐ 31- 45 años
   - ☐ 45- 60 años
   - ☐ Más de 60 años

Commerce: ______________________________

Date: ______________________________

Type of appliance:

- ☐ Washing machine
- ☐ Fridge (combined or two-doors)
- ☐ Dishwasher

Model: ______________________________

1. ZIP code of your habitual residence: __ __ __ __ __
2. Gender:
   - ☐ Male
   - ☐ Female
3. Please, select your age range:
   - ☐ 18-30 years
   - ☐ 31- 45 years
   - ☐ 46- 60 years
   - ☐ More than 60 years

Figure A.2: Short questionnaire used for consumers in the household appliances field trial (right: English version, left: Spanish version)

Table A.2: Descriptive statistics for the analysis of the household appliances field trial

Variable	Obs.	Mean	Std. Dev.	Min	Max
Washing machine attributes					
Savings (€)	1,652	91.3867	84.3128	0	282.10
Energy efficiency (=1 if A+++ and A++)	1,652	.9200969	.2712253	0	1
Price (€)	1,446	449.1792	195.054	7.01	1508.87
Capacity (kg)	1,652	7.598668	.7085688	6	10
Type of embedding (=1 if free installation)	1,652	.8765133	.3290946	0	1
Water consumption (L)	1,629	9957.057	764.69	7400	12900
Dishwasher attributes					
Savings (€)	533	53.955	54.569	0	
Energy Efficiency (=1 if A+++ and A++)	533	0.114	0.319	0	1
Price (€)	434	481.893	188.194	15	1399
Size (=1 if the size is 600mm)	533	0.722	0.448	0	1
Number of services	533	12.231	1.958	9	16
Type of embedding (=1 if free installation)	529	0.643	0.480	0	1
Water consumption (L)	3,206	490.474	1109.625	0	4200
Fridge attributes					
Savings (€)	1,021	197.51	165.11	0	567.84
Energy efficiency (=1 if A+++ and A++)	1,021	0.141	0.348	0	1
Price (€)	872	625.049	294.403	17	2345
Height (mm)	1,020	1899.936	1411.255	550	20010
Type of fridge (=1 if is combined, =0 two doors)	993	0.842	0.365	0	1
Type of embedding (=1 if free installation)	1,020	0.951	0.216	0	1
Capacity - Volume of the fridge (L)	1,018	218.446	42.552	86	380
Capacity - Volume of the freezer (L)	1,004	79.241	18.706	10	119

Table A.3: Number of household appliance sold by product category and treatment

Number of appliances sold	Washing-machine	Dishwasher	Fridge	Total
Treatment 1	306	93	187	586
Treatment 2	410	105	229	744
Treatment 3	288	114	227	629
Control	648	221	378	1,247
Total	1,652	533	1,021	2,648

Table A.4: Linear regression for washing machines in the household appliances field trial.

Energy savings	**Coefficients**	**P>t**
Efficiency of the washing machine (=1 if the washing machine is A+++)	22.498*** (3.939)	0.000
Treatment 1 (=1 if the sale is under treatment 1)	151.978*** (2.617)	0.000
Treatment 2 (=1 if the sale is under treatment 2)	148.914*** (2.356)	0.000
Treatment 3 (=1 if the sale is under treatment 3)	149.006*** (2.657)	0.000
Price (€)	0.033*** (0.005)	0.000
Capacity (kg)	8.532*** (1.754)	0.000
Type of embedding (=1 if free installation)	16.329*** (3.115829)	0.000
Water consumption (L)	-0.023*** (0.001)	0.000
_cons	116.864*** (13.101)	0.000

Number of observations	1,433	
F (8, 1424)	908.26	
Prob > F	0.0000	0.8361
R-squared	0.8352	
Adj R-squared		

Notes: ***, ** and * indicate significance at 1%, 5% and 10% level. Standard deviation under parentheses.

Table A.5: Linear regression for dishwashers in the household appliances field trial.

Energy savings	Coefficients	P>t
Efficiency of the dishwasher (=1 if the dishwasher is A+++ or A++)	26.118*** (3.471)	0.000
Treatment 1 (=1 if the sale is under treatment 1)	92.326*** (2.989)	0.000
Treatment 2 (=1 if the sale is under treatment 2)	94.966*** (2.786)	0.000
Treatment 3 (=1 if the sale is under treatment 3)	88.700*** (2.780)	0.000
Price (€)	0.051*** (0.005)	0.000
Size (=1 if the size is 600mm)	-10.141*** (3.062)	0.001
Type of embedding (=1 if free installation)	-1.2310 (2.245)	0.584
Water consumption (L)	-0.011* (0.004)	0.05
_cons	2.268 (13.263)	0.864
Number of observations	430	
F (8, 421)	312.35	
Prob > F	0.0000	
R-squared	0.8558	
Adj R-squared	0.8531	

Notes: ***, ** and * indicate significance at 1%, 5% and 10% level. Standard deviation under parentheses.

Table A.6: Linear regression for fridges in the household appliances field trial.

Energy savings	**Coefficients**	**P>t**
Efficiency of the fridge (=1 if the fridge is A+++)	102.308*** (5.145)	0.000
Treatment 1 (=1 if the sale is under treatment 1)	301.505*** (4.513)	0.000
Treatment 2 (=1 if the sale is under treatment 2)	305.320*** (4.150)	0.000
Treatment 3 (=1 if the sale is under treatment 3)	305.786*** (4.144)	0.000
Price (€)	0.043*** (0.0069744)	0.000
Height (mm)	-0.005*** (0.001)	0.000
Type of embedding (=1 if free installation)	16.232** (7.576)	0.032
Capacity- Volume of the fridge (L)	-0.282*** (0.054)	0.000
Capacity- Volume of the freezer (L)	-0.947*** (0.107)	0.000
_cons	94.995*** (11.031)	0.000
Number of observations	853	
F (9, 843)	1223.49	
Prob > F	0.0000	
R-squared	0.9289	
Adj R-squared	0.9281	

Notes: ***, ** and * indicate significance at 1%, 5% and 10% level. Standard deviation under parentheses.

Methodology for probit models:

We use binary response models to analyse the data. The specification of these types of models is the following. Suppose $y^*$is a latent variable which follows $y^* = X\beta + e$, where X is the $1 \times K$ vector, β is a $K \times 1$ vector of parameters, e is independent of X and $e \sim$ Normal (0,1). However, instead of observing y^*, we observe only a binary variable indicating the sign of y^*:

$$y = \begin{cases} 1 & if\ y^* > 0 \\ 0 & if\ y^* \leq 0 \end{cases} \quad (1)$$

In binary response models, the interest lies in the response probability:

$P(y = 1 \mid X) = P(y^* > 0 \mid X) = P(e > -X\beta \mid X) = 1 - G(-X\beta) = G(X\beta) \equiv p(x)$ where G is the cumulative distribution function of a standard normal densify function (called a Probit model). G can also be the cumulative distribution of a logistic function (a Logit model). The vector X is a $1 \times K$ vector of explanatory variables so that $= \beta_1 + \beta_2 x_2 + \cdots + \beta_K x_K$. To know the marginal effect of a particular variable x_j on $p(x)$ is of particular interest in order to test the effect of this variable on the probability. The marginal effect is measured by $\frac{\partial p(X)}{\partial x_j} = g(X\beta)\beta_j$ where $g(z) = \frac{dG}{dx}(z)$. A peculiarity of this discrete response model is that the partial effect of a variable x_K depends on X through the function $g(X\beta)$. Knowing the sign of β_K would help to determine whether the effect is positive or negative, as $g(z) > 0$ for all z. However, to know the magnitude of the effect, i.e. the marginal effect, when x_K is a dummy variable (like having received subsidies), one has to estimate G($\beta_1 + \beta_2 x_2 + \cdots + \beta_{K-1} x_{K-1} + \beta_K$) - G($\beta_1 + \beta_2 x_2 + \cdots + \beta_{K-1} x_{K-1}$). When x_K is a continuous variable (like age), the effect on the probability $p(x)$ of x_K going from c_K to $c_K + 1$ is determined by G $[\beta_1 + \beta_2 x_2 + \cdots + \beta_{K-1} x_{K-1} + \beta_K (c_K + 1)]$ - G $[\beta_1 + \beta_2 x_2 + \cdots + \beta_{K-1} x_{K-1} + \beta_K (c_K)]$.

The applied Probit/Logit model can be expressed as: $P(y = 1 \mid X)$ where y the energy efficiency level (=1, if A+++ and A++) and X contains explanatory variables referring to: the specific type of *energy savings* information received (Treatment 1: Energy savings information through the complementary label; Treatment 2: Energy savings information through the sales staff, and Treatment 3: energy savings information through combination of the complementary label and sales staff) and the *attributes* of the appliances (e.g. size, type of embedding and water consumption):

$$P(y = 1 \mid X) = \beta_1 + \beta_2 Savings + \beta_3 Attributes + e \qquad (XX)$$

Tables 3.2.3 through 3.2.5 present the marginal effect of these explanatory variables on the probability that consumers purchase an appliance labelled with high energy efficiency (A+++ or A++).