

Technology adoption & policy acceptability: Results from CHEETAH choice experiments

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Outline

- *Brief overview of literature on*
 - *Policy acceptability*
 - *Energy efficient technology adoption in private households*
- *Results of CHEETAH survey and discrete choice experiments*
 - *Energy efficient technologies*
 - *Policy acceptability*

Previous research on EE policy acceptance

Policy-specific beliefs

- + Perceived effectiveness *(although direction of causality not known)*
- + Perceived positive outcome(s)
- + Scenario, procedural and distributional fairness
- + Perceived social norm to accept
- + Equitable and progressive policies
- + Pull measures

- Greater perceived cost *(monetary, effort, wellbeing)*
- Push measures *(although interacts with cost and social norms)*
- Perceived high cost *(e.g. difficult to change behaviour)*
- Infringement on freedom

General beliefs

- + Pro-environmental orientation *(when policy is related to env't)*
- + General trust in government.
- + Specific trust in government *(incumbent)*
- + Belief that policy approach (in general) is effective
- ± Trust in other citizens

Socio-economic factors

Less influential than general and specific beliefs

- + Younger
- + Left/green political orientation
- + Higher formal education

+ signifies positive relationship; - signifies negative relationship; ± signifies mixed findings.

Previous research on EE technology adoption

- *NB: other factors determine whether or not policies change behaviour*
- BRISKEE project reviewed technology adoption:
 - Financial costs and benefits
 - Attitudes, values and norms (env. attitudes, moral norms, social norms, identity)
 - Household characteristics (income, education, HH size, age)
 - Building characteristics (ownership, type, location)
 - Technology characteristics (quality/performance, brand, size, etc.)

Objectives of survey and discrete choice experiments (DCE)

- “Provide empirically robust insights **into relative importance of key decision factors for household adoption of energy efficient technologies and household response to energy efficiency policies**, allowing for **heterogeneity across households, countries and technologies.**”
- Employ demographically representative surveys including **stated preferences discrete choice experiments on technology adoption and policy acceptability.**
- Use statistical / micro-econometric methods to analyze data – **accounting for needs of energy-economic models** (Forecast, Invert, ABM).
- **Feed results into energy-economic models** (→ subsequent presentations).

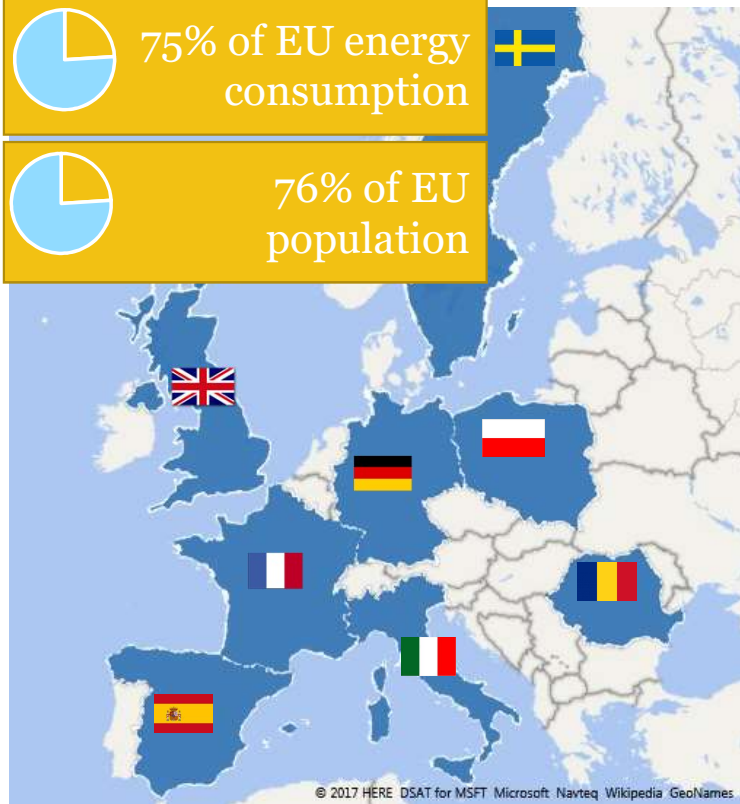
CHEETAH Survey



75% of EU energy consumption



76% of EU population

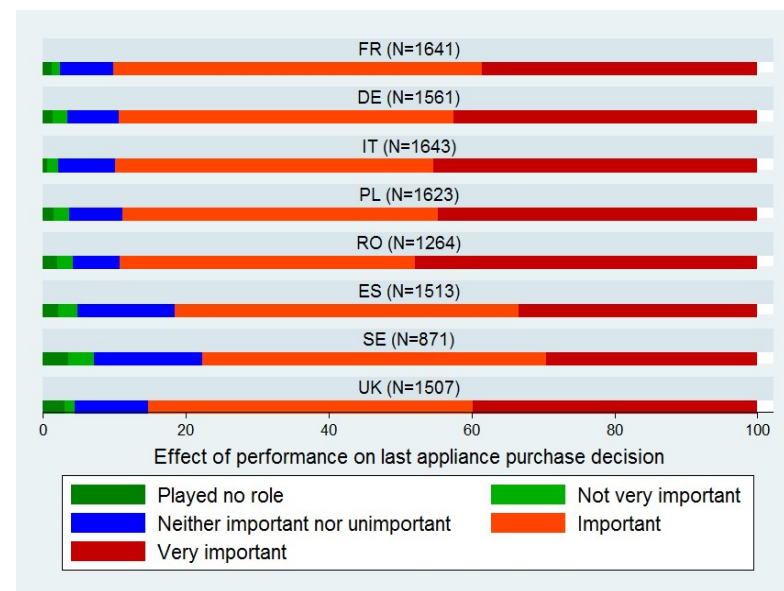
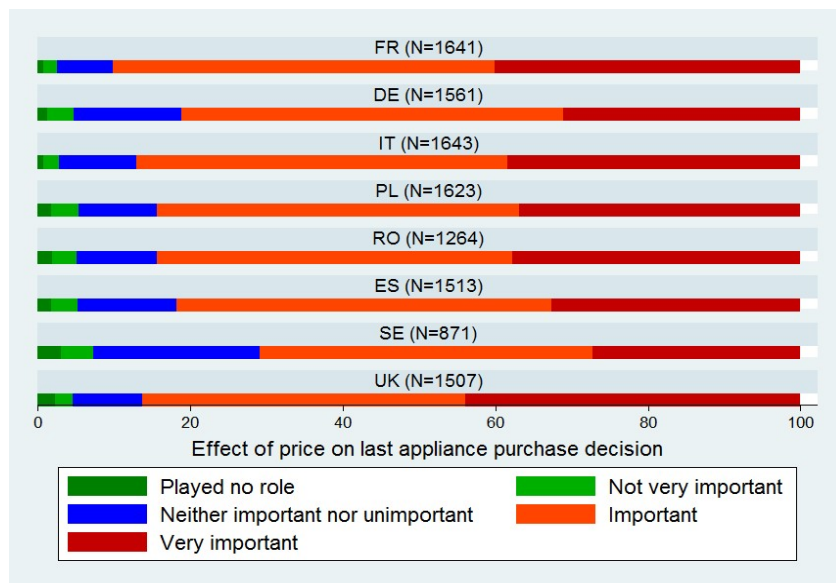


- Demographically representative, online survey in 8 EU countries
- Typically ~2000 participants per country
- Data collection 7/2018-8/2018
- Wide range of household, individual and dwelling/appliance characteristics, attitudes, energy literacy,....
- Stated Preferences Discrete Choice Experiments (DCEs)

Why discrete choice experiments?

Problems of typical Likert Scales – example from BRISKEE

“Concerning your decision for the last appliance purchased. How important were the following factors?”



BRISKEE D 2.2:
Results of Survey
<https://www.briskee-cheetah.eu/>

- *Typical finding: little variation across countries and factors*
- *Difficult to integrate results from ordinal scales into energy-economic models*

DCE example: Refrigerators

Imagine that **your refrigerator has broken down and you need to buy a new one.**

Scenario 1

Which refrigerator would you choose?

	Refrigerator A	Refrigerator B
Size	280 L	260 L
Energy class	A+++	A++
Warranty	2 years	6 years
Customer rating	3.5 stars	4.0 stars
Purchase Price	£700	£850
Subsidy	£25	£0

I choose: Refrigerator A Refrigerator B

DCEs include attributes reflecting benefits and costs to explicitly allow for trade-offs to be made.

I) Overview DCEs on technology adoption

Selected results for discrete choice experiments

- **a) Refrigerators** – labels & rebates, energy literacy (all 8 countries)
- **b) Thermostats** – rebates, recommendations by experts (all 8 countries)
- **c) Heating systems** – rebates and rebate provider (public vs. private financing) [PL, SE, UK]
- Heterogeneity in household response

(refrigerators: *household size, income group, environmental behavior*
thermostats & heating systems: *age, income group*)

Ia) Refrigerators

Introduction

Imagine that **your refrigerator has broken down and you need to buy a new one**. On the following pages, we will show you different refrigerator purchase options. We would like to know **which refrigerator you would choose, if these were your only options**.

Please assume that all refrigerator options fit properly in your kitchen and are currently available in colour and finish of your choice.

The refrigerators only differ on the following attributes:

Refrigerators

1. Size: The total internal space of each refrigerator is 220, 240, 260, 280, 300, or 320 litres. 20 litres corresponds to one small compartment. The picture below shows a 320-litre and a 220-litre refrigerator.



Refrigerators

2. Energy class: Refrigerators come with a label that looks like the following:



The colour "**green**" indicates a lower energy consumption while the colour "**red**" indicates a higher energy consumption compared to refrigerators with the same volume and features. You will choose among refrigerators with energy class **A+++**, **A++**, or **A+**.

Refrigerators

3. Warranty: The **warranty** for each refrigerator is 2, 4, or 6 years.
4. Customer rating: Ratings are provided by customers who have bought the same refrigerator. You may assume that the refrigerators you can choose from have **average ratings** of 3.5, 4.0, or 4.5 stars out of 5 stars.
5. Purchase price: Each **refrigerator costs £250, £350, £450, £550, £700, or £850.**
6. Subsidy: You may receive a **subsidy of £25, £50, or £100 when you purchase an A+++ refrigerator.** The purchase price does not include this subsidy.

Refrigerators: Mixed Logit results w/o interaction terms

Marginal willingness-to-pay

	France	Germany	Italy	Poland	Romania	Spain	Sweden	UK
WTP								
size	0.55	-	2.20	2.14	1.28	2.14	1.80	1.20
warranty	23.42	37.27	33.27	52.06	47.81	31.83	41.91	26.21
A2	72.41	75.10	124.96	87.10	156.98	92.59	89.93	47.87
A3_o	130.74	85.08	223.47	164.78	226.83	208.26	182.86	143.72
A3_sub	147.88	190.78	344.22	297.04	383.21	266.28	204.70	81.45
star4	60.51	61.39	93.75	118.20	102.74	86.48	97.90	77.00
star45	48.51	-	103.35	134.96	107.26	62.24	101.01	74.38

Refrigerators: Summary of main results

- **Willingness-to-pay for higher energy classes is positive** in all countries, though there is substantial heterogeneity within and across countries.
- **Subsidies increase WTP for A+++ refrigerators** in all countries except the UK, though there is again substantial heterogeneity within and across countries.
- Households size, income and environmental behaviours have an effect on the valuation of some attributes, but not on WTP for A+++ refrigerators.
- Respondents who are **more energy literate have a higher WTP for A++ or A+++ refrigerators** in 5 out of 8 countries.
- Results from **welfare analysis**: Phasing out refrigerators with energy label $< A+$
 - leads to **welfare losses, mostly for low energy literacy households** (rather than low income);
 - increasing energy literacy and rebates mitigate losses; rebates mostly benefit high-income households.

Refrigerators: Key policy implications

- The EU **energy label** appears to effectively signal additional benefits to consumers.
- **Rebates** for A+++-labelled refrigerators are an effective measure to boost the adoption of A+++ labelled refrigerators in all countries, except the UK.
 - In countries such as the UK, consumers may perceive rebates as a signal of low quality
 - rebate schemes could be complemented by customer ratings or by reports from organizations providing **credible product ratings** and reviews.
 - **But: providing a rebate for energy-efficient refrigerators may be regressive; rebates could be offered to low-income households only;**
- Labelling schemes are more effective for customers with a higher energy literacy.
 - **Raising the level of energy literacy** via education and information programs (e.g., brochures, or online or on-site courses) may be an effective means.
 - Ideally, such programs would be targeted at particular socio-economic groups.



TAH

Changing Energy Efficiency Technology Adoption in Households

Ib) Thermostats

Framing used to introduce the stated choice experiment

"Heating control devices are devices that **allow users to control the temperature of their home throughout the day**, for example by setting a different temperature at night. Moreover, some of those devices can be **connected to the Internet** and allow users to easily **adjust the temperature remotely**, for example by using a smartphone.

Example of a smart heating control device connected to the Internet using the home Wi-Fi network:



On the following pages, we will describe different heating control devices. We would like to know **which heating control device you would choose, if you were making a purchase and these were your only options.**"

Ib) Thermostats

Scenario 1

Which heating control device would you prefer?

	Option A	Option B
Heating bill	5% less	5% less
Remote temperature control	No	Yes
Display of changes in energy consumption	Yes	No
Recommendation	By friends or colleagues	By independent energy experts
Purchase price	£210	£270
Subsidy	£0	£60

I prefer:

How likely would you be to buy your preferred choice if it was available?

Very unlikely Somewhat unlikely Somewhat likely Very likely

Ib) Thermostats

Attribute	Levels
Heating bill	1% less, 5% less, 10% less
Remote temperature control	Yes, No
Display of changes in energy consumption	Yes, No
Recommendation	by friends or colleagues by independent energy experts by your energy provider
Purchase price	£150, £180, £210, £240, £270, £300.
Rebate	£0, £20, £40, £60

Thermostats: main results / policy implications

- Respondents are on average willing to pay between 26€ in the UK and 50€ in Germany for an additional 1% in annual heating cost saving.
- Low income households have a lower WTP for additional heating cost savings in France, Poland and Spain.
- Older respondents have a higher WTP for additional heating cost savings in France, but a lower WTP in Poland.
- More innovative respondents value smart features higher than less innovative ones.
- Concerns for information privacy and fear of losing autonomy lower value of remote control function.
- Promotion of smart thermostats (i.e. a fairly new technology!) should be coupled with **external advise/recommendations**, ideally by experts; recommendations by energy providers are typically less effective than by experts;

III) Heating system

Framing used to introduce the stated choice experiment

“Imagine your heating system has broken down and you need to buy a new one. On the following pages, different options for a new heating system will be offered to you. We would like to know which heating system you would choose, if these were your only options.

Please assume that all heating systems can be installed in your home and that their fuel type is the one you would like to have (for example oil, gas, coal, wood, other biomass, solar, air, water or geothermal heat).

III) Heating system

Scenario 1

Which heating system would you choose?

	Option A	Option B
Heating bill	25% less	75% less
Installation	3 days	half a day
Warranty	5 years	5 years
Purchase price	£3 000	£5 000
Subsidy	0%	15% (£750)
Subsidy provider	None	Energy provider

I choose: ☐ Option A ☐ Option B

III) Heating system

Attribute	Levels
Heating bill	25% less, 50% less, 75% less
Installation	half a day, three days, one week
Warranty	2 years, 5 years, 10 years
Purchase price	£3 000, £5 000, £8 000, £12 000, £15 000, £20 000
Subsidy	5%, 15%, 25% (of the purchase price)
Subsidy provider	Government, energy provider

Heating systems: Summary of main results

- Respondents are **on average willing to pay around 10€ to save one additional Euro in heating costs per year**, though there is substantial heterogeneity within and across countries. (reflecting high WTP to reduce emissions etc.?)
- **Rebates are effective** (but not in UK)
- **Respondents react more positively to subsidies if subsidies are offered by an energy provider rather than the government.**

IV) Policy acceptability

Text used for the choice experiment (UK version)

Current UK energy efficiency policies include a wide range of measures that are designed to reduce the energy consumption of households, businesses, and government agencies.

Suppose the government is considering a change to its current energy efficiency policy and thus proposes two alternatives, Policy A and Policy B. On the following pages, you will be asked to indicate whether you prefer Policy A, Policy B, or the current policy.

IV) Policy acceptability

Scenario 1

Which of these policies do you prefer?

	Policy A	Policy B	Current policy
Energy consumption by 2030	25% less	40% less	20% less
Dependence on energy imports	50% less	10% less	5% less
Main policy measure	Education and information programmes	Stricter minimum energy efficiency standards for buildings and appliances	Stricter minimum energy efficiency standards for buildings and appliances
Share of total costs paid by households	50%	40%	40%
Additional annual costs	£50	£200	£0

I prefer:

Policy A	Policy B	Current policy
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

IV) Policy acceptability

Attributes	Attribute levels
Reduction in energy consumption by 2030	20, 25, 30 or 40 percent
Dependence on energy imports	5, 10, 30 or 50 percent.
Share of total costs paid by households	30, 40, 50, or 60 percent.
Main policy instrument	<p>Education and information programmes on energy-saving measures.</p> <p>An additional tax on energy (e.g., for electricity, gas, oil, coal).</p> <p>A limit on energy consumption per person.</p> <p>Stricter minimum energy efficiency standards for buildings and appliances.</p>
Additional annual cost	25€, 50€, 100€, 150€, 200€, or 300€

Policy acceptability: Summary of main results

- Respondents generally **prefer more ambitious policies** with regard to reduction of both energy consumption and energy imports, though there is substantial heterogeneity within and across countries.
- **WTP for a reduction in import dependency is generally low (ca. 1.40 € to 4 € p.a. per percentage point reduction).**
- Contrary to expectations, respondents appear largely indifferent as to how costs are shared between households and other sectors.
- **More coercive policies and those incurring additional financial costs for householders were less preferred to standards, effect is mediated by trust in government (for taxes) and environmental identity (for consumption limits).**

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