Empower the consumer! The role of energy-related financial literacy

EIB-Institute, October 2018

Massimo Filippini

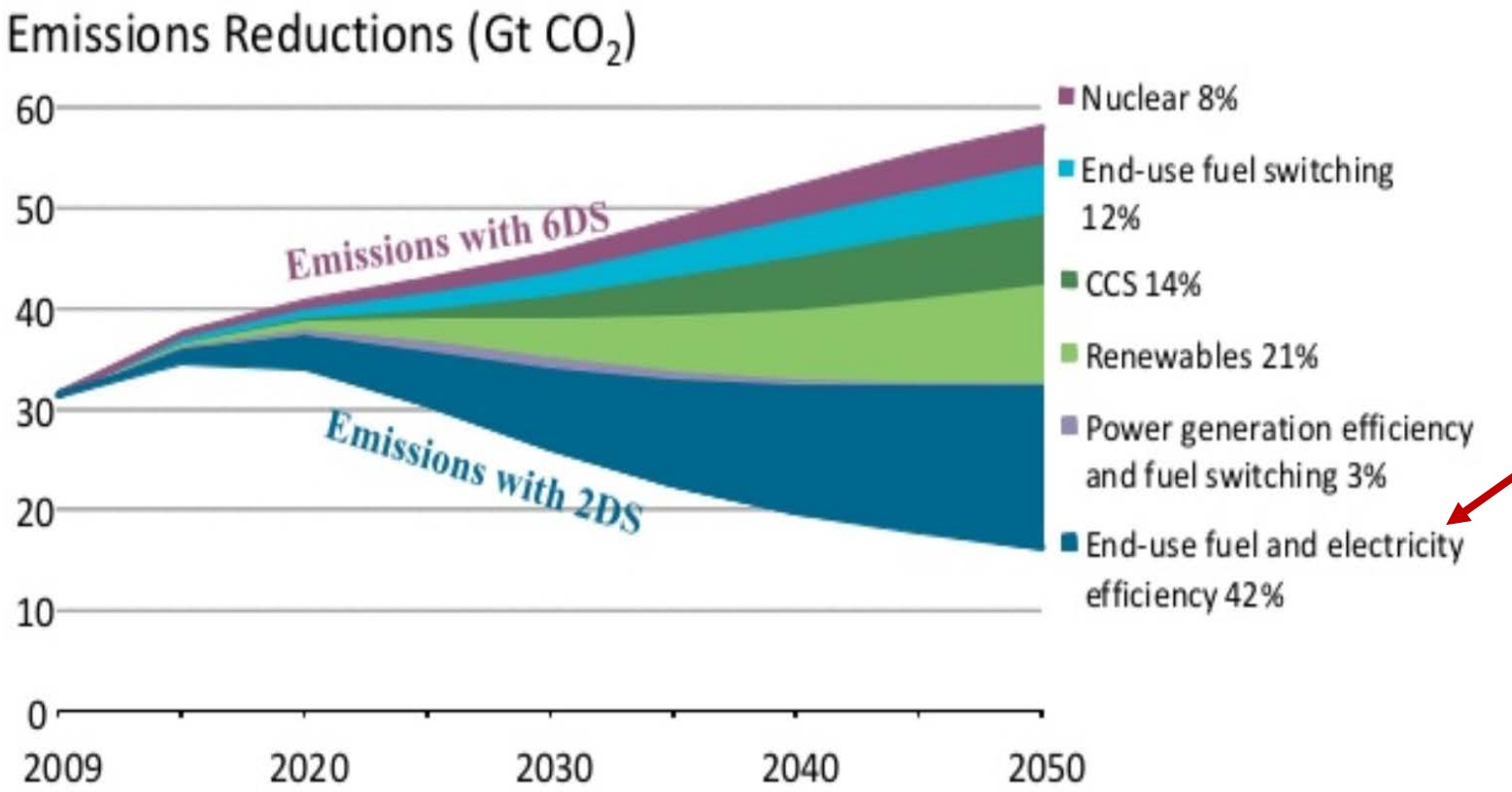
cepe
Centre for Energy Policy and Economics
Swiss Federal Institutes of Technology

Outline

- Energy efficiency gap and bounded rationality
- Level of energy related financial literacy in three European countries
- How can we help consumers in taking energy related investment decisions

Energy efficiency gap and bounded rationality

Energy efficiency and climate change



Source: International Energy Agency

- ***Increase of the level of energy efficiency*** *is crucial to cut CO2 emissions and to fight climate change and limit the average global temperature increase to 2°C*
- *Residential sector one of the areas with the greatest potential for energy savings*

«The cheapest and cleanest energy choice of all is not to waste it»

The Economist | World politics | Business & finance | Economics | Science & technology | Culture

Special report: Energy and technology

Energy efficiency

Invisible fuel

The biggest innovation in energy is to go without

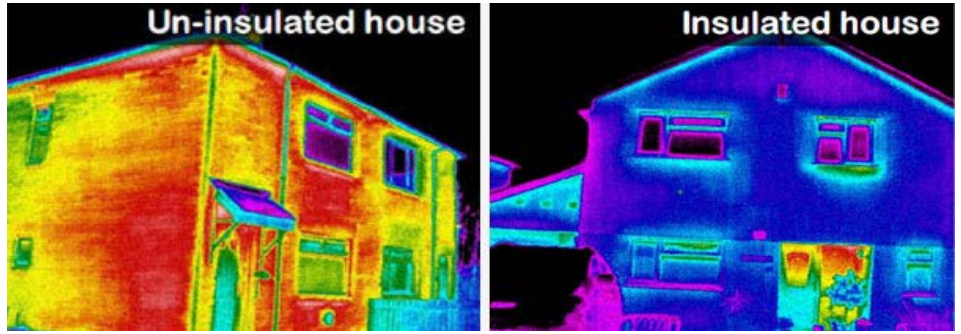
Jan 17th 2015 | From the print edition

Timekeeper | Like 1.4k | Tweet 420

THE CHEAPEST AND cleanest energy choice of all is not to waste it. Progress on this has been striking yet the potential is still vast. Improvements in energy efficiency since the 1970s in 11 IEA member countries that keep the right kind of statistics (America, Australia, Britain, Denmark, Finland, France, Germany, Italy, Japan, the Netherlands and Sweden) saved the equivalent of 1.4 billion tonnes of oil in 2011, worth $743 billion. This saving amounted to more than their total final consumption in that year from gas, coal or any other single fuel. And lots of money is being invested in doing even better: an estimated $310 billion-360 billion was put into energy efficiency measures worldwide in

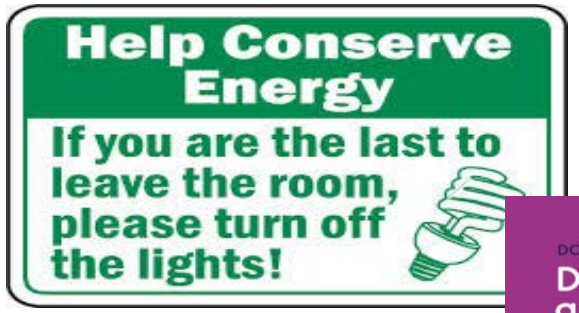
Inefficiency in the use of energy in the residential sector may be due to

low adoption of new energy-efficient technologies (energy efficiency gap)



Energy consumption *strongly influenced by* ***investment decisions*** *(type of cars, electrical appliances, houses,…)*

inefficient use of electrical appliances / heating system



Energy efficiency gap

Private view: Individual decision-makers do not choose the most energy-efficient technology, even if this technology is also the most cost-efficient choice (min lifetime costs)

Social view: some energy-efficiency technologies that would be socially efficient are not adopted

Market failures

Negative externalities
Lack of information (information not salient enough, only kWh,..)
Asymmetric information
…….

Behavioral failures

Bounded rationality

Cognitive Constraints, Status Quo Bias, Sunk Cost, Loss aversion, Endowment effect
…….

Behavioral Economics

Thaler & Mullainathan (2008)

«The standard economic model of human behavior includes three unrealistic traits- unbounded rationality, unbounded willpower, and unbounded selfishness»

In «Behavioral economics» in *The Concise Encyclopeida of Economics*, (2008) http://www.econlib.org/library/Enc/BehavioralEconomics.html

Standard economic model: individuals behave rationally, they have access to all information,….make decisions by rationally weighing all costs and benefits, they optimize…

Bounded Rationality

- *"Bounded rationality, an idea first introduced by Herbert Simon, refers to the obvious fact that human cognitive abilities are not infinite. We have limited computational skills and seriously flawed memories….."*

  Source: Jolls, Sunstein & Thaler (1998), p. 1477.

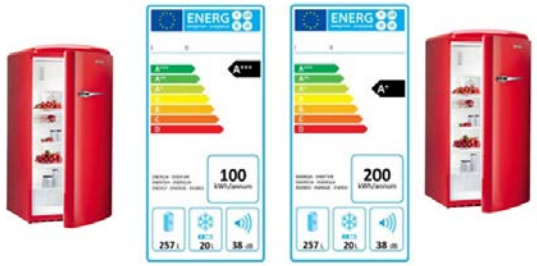
- Bounded rationality: there are limits to our thinking capacity, available information, and time (Simon, 1982)

Energy related investment decision

- Renovation of a house, change of the heating system, substitution of an electrical appliances, buying a new car,… are decisions that **show benefits and costs over a long period of time**

↳ From an economic point of view these decisions imply an **intertemporal optimization**

↳ In order to make these complex decisions, individuals need to collect **information**, make **assumption regarding the price, utilization over the life cycle**, perform an **investment analysis or calculate the lifetime cost**



Different decision-making strategies

Rational consumer

make decisions using information and cognitive skills to calculate the lifetime cost

Rational decision-making

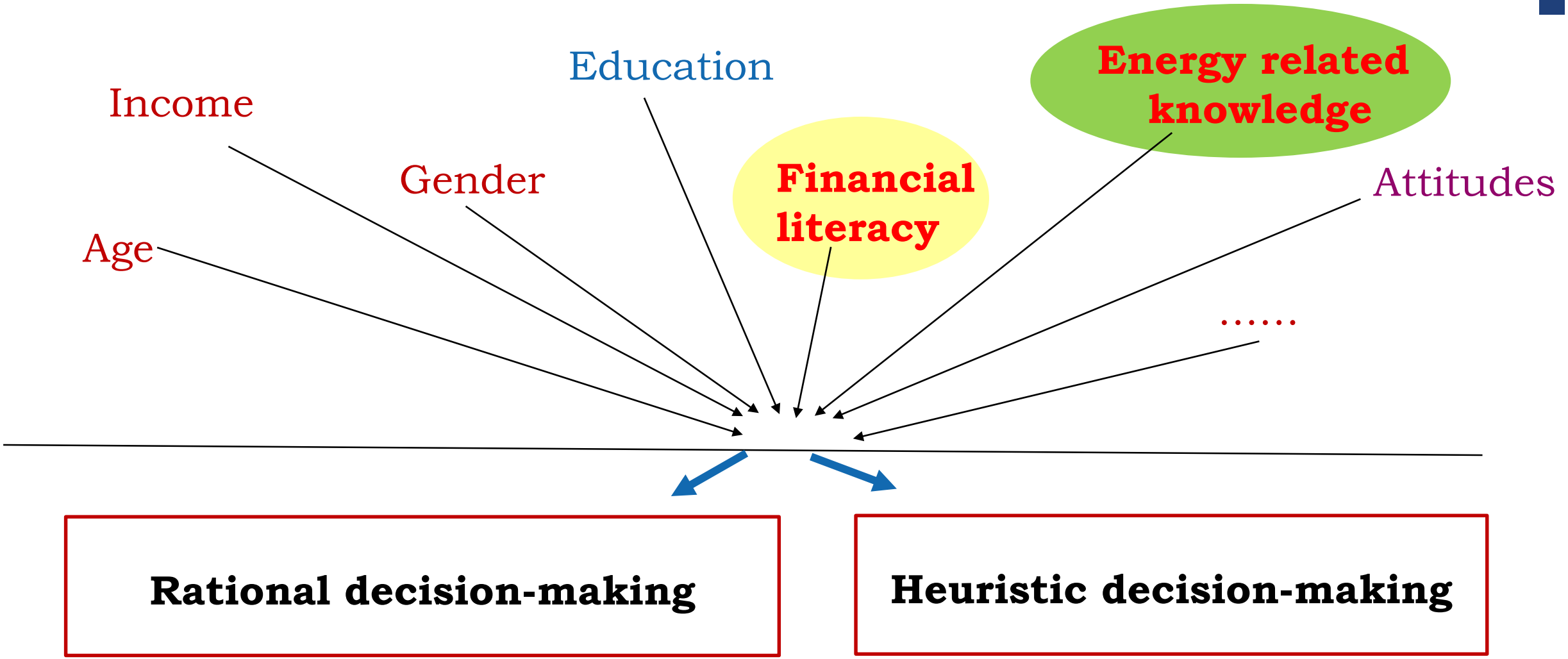
- Choose the appliance that minimizes lifetime usage cost based on upfront price energy price, intensity of use, lifetime

Bounded-rational consumer

make decisions using limited information and with cognitive constraints in processing information

Heuristic decision-making

- Choosing by comparing purchase prices
- Choosing by comparing the energy label
- Choosing by comparing energy consumption
- …
- choices that are simply „good enough“


Income
Education
Energy related knowledge
Gender
Financial literacy
Attitudes
Age
……
Rational decision-making
Heuristic decision-making

http://www.penny-project.eu/

Level of financial and energy related financial literacy in three European countries

Definitions literacy

- **UNICEF**: ability to use reading, writing and numeracy skills for effective functioning and development of the individual and the community

- In the last decades the word «literacy» has been used in a much broader way, methaphorical way….information literacy, media literacy, scientific literacy, financial literacy, energy literacy

Financial literacy and energy literacy

- **Financial literacy**:

↳ "Knowledge of basic financial concepts, such as the working of interest compounding, the difference between nominal and real values, and the basics of risk diversification" (Lusardi and Mitchell (2008))

- **Energy literacy**:

↳ Energy Literacy is an understanding of the nature and role of energy in the world and daily lives accompanied by the ability to apply this understanding to answer questions and solve problems.

(U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy)

Energy related financial literacy

- **Energy related financial literacy**

↳ the *combination of* ***energy-related knowledge*** *and* ***cognitive abilities*** *that are needed in order to take decisions with respect to the* ***investment for the production of energy services and their consumption***

(Blasch, Boogen, Daminato and Filippini (2018))

Measurement of energy related financial literacy

- **Energy related financial literacy measured with several questions**

- **Lifetime cost**
- Energy prices
- Usage cost of appliances
- Knowledge of energy saving of different technologies
- Interest rate
- Compound interest
- Stock option (risk diversification)

Some of the questions

Knowledge of electricity price: How much do you think 1 Kilowatt hour (kWh) of electricity currently costs in Switzerland (on average after taxes)? Please indicate your best guess without checking your bill or other resources.

- Amount in Rappen (no decimals)
- Don't know

Running cost of a washing cycle: How much do you think it costs in terms of electricity to run: A washing machine (load of 5 kg at 60°C)

- 0-19 Rappen
- 20-39 Rappen
- 40-59 Rappen
- 60-79 Rappen
- 80-100 Rappen
- More than 100 Rappen
- Don't know

Financial literacy 1: Suppose you had 100 CHF/euros in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow?

- More than €102
- Exactly €102
- Less than €102
- Don't know

Financial literacy 3: Please tell me whether this statement is true or false: "Buying a single company's stock usually provides a safer return than buying stocks of several companies."

- True
- False
- Don't know

Lifetime cost calculation: Suppose you own your home, your fridge breaks down and you need to replace it. As a replacement, you can choose between two alternatives that are identical in terms of design, capacity and quality of the cooling system. Fridge A sells for 400 CH and consumes electricity for the amount of 300 kWh per year. Fridge B has a retail price of 500 CHF and consumes electricity for the amount of 280 kWh per year.

Assume the average cost of energy is 0.20 CHF per kWh, the two models have both a lifespan of 15 years and that you would get a return of 0 percent from any alternative investment of your money. Which choice of purchase minimizes the total costs of the fridge over its lifespan?

- Fridge A
- Fridge B
- Fridge A and B are equivalent in terms of total costs
- Don't know

Results for a sample of 4600 European households

Penny project, EU

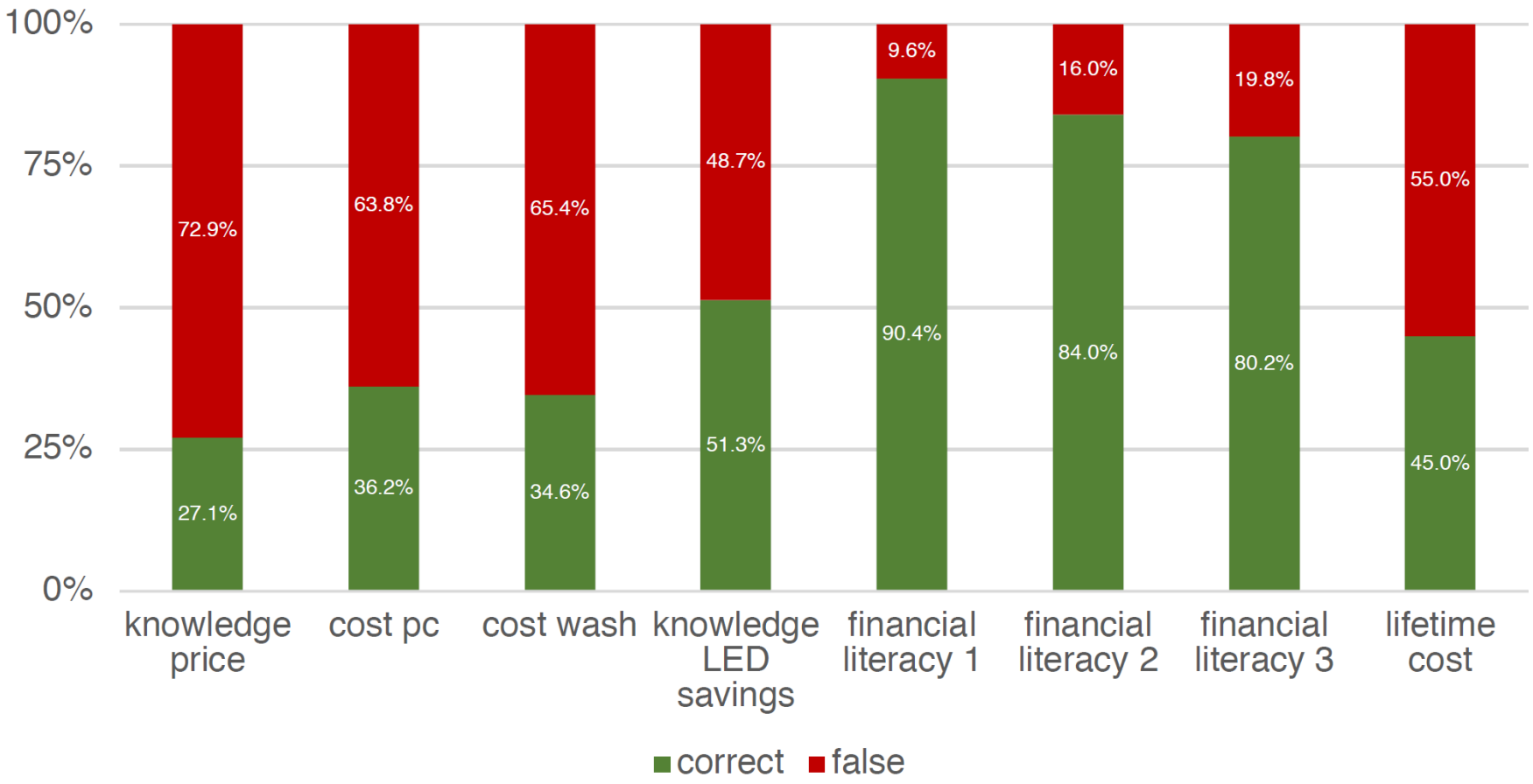


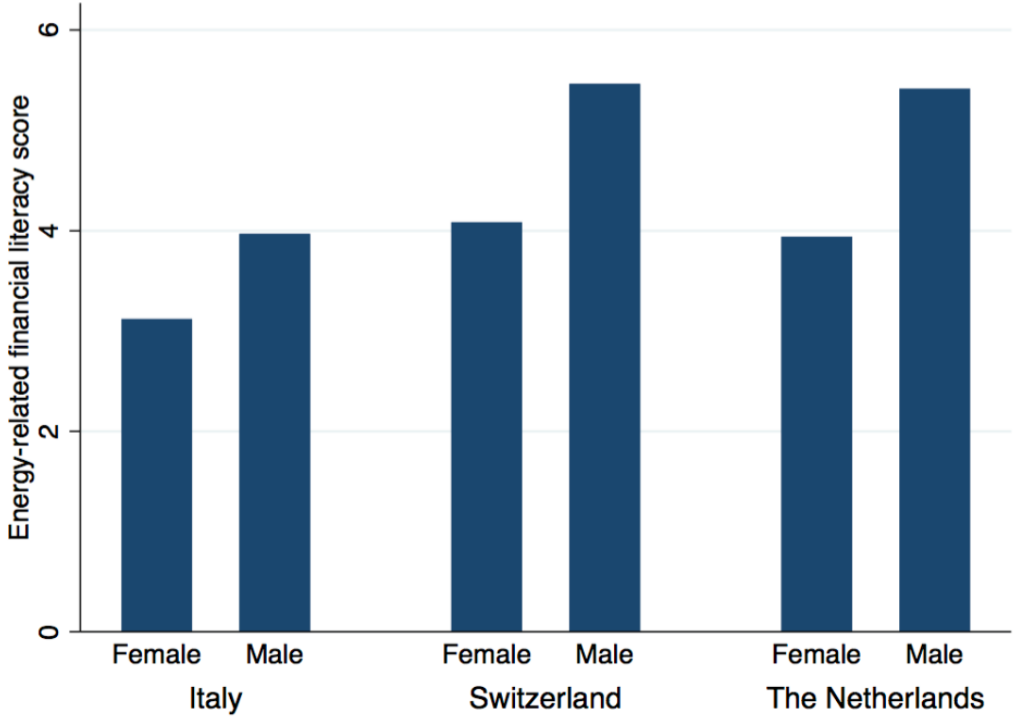
Figure 1: Results of survey questions on energy-related financial literacy.

Source: Blasch et. Al. (2018)

Table 4: Results of survey questions on energy-related financial literacy across countries.

		Italy (%)	Netherlands (%)	Switzerland (%)
Knowledge price	Correct	11.41	36.77	29.15
	False/Don't know	88.59	63.23	70.85
Cost of washing	Correct	29.03	33.91	44.09
	False/Don't know	70.97	66.09	55.91
Cost of PC	Correct	31.1	33.73	48.37
	False/Don't know	68.9	66.27	51.63
Knowledge LED savings	Correct	41.78	54.46	59.13
	False/Don't know	58.22	45.54	40.87
Compound interest rate	Correct	84.62	92.65	94.49
	False/Don't know	15.38	7.35	5.51
Understanding of inflation	Correct	76.99	87.84	86.97
	False/Don't know	23.01	12.16	13.03
Risk diversification	Correct	72.08	83.59	85.42
	False/Don't know	27.92	16.41	14.58
Lifetime cost calculation	Correct	30.17	54.96	47.78
	False/Don't know	69.83	45.04	52.22

Source: Blasch et. Al. (2018)



c) By gender

Figure 3: Energy-related financial literacy by country and household characteristics

Source: Blasch et. Al. (2018)

Analysis of the determinants of the level of energy related financial literacy

Econometric/Statistical methods ➔ *ordered probit regression model*

Level = f (gender, country of residence (IT) , education, income, age,…)

Has an important negative effect

Has an important positive effect

Has a partial positive effect, but not really important

How can we help consumers in taking energy related investment decisions?

Resource and Energy Economics xxx (2017) xxx–xxx

Contents lists available at ScienceDirect

Resource and Energy Economics

journal homepage: www.elsevier.com/locate/ree

Boundedly rational consumers, energy and investment literacy, and the display of information on household appliances☆

Julia Blasch[a,b,*], Massimo Filippini[b,c], Nilkanth Kumar[b]

[a] Institute for Environmental Studies (IVM), VU University Amsterdam, Netherlands
[b] Center of Economic Research (CER-ETH), ETH Zürich, Switzerland
[c] Università della Svizzera Italiana (USI), Switzerland

cepe
Centre for Energy Policy and Economics
Swiss Federal Institutes of Technology

CER-ETH – Center of Economic Research at ETH Zurich

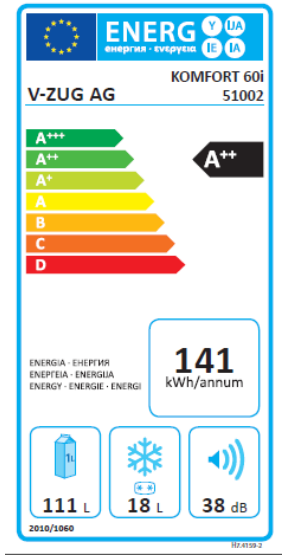
Narrowing the energy efficiency gap: The impact of educational programs, online support tools and energy-related investment literacy

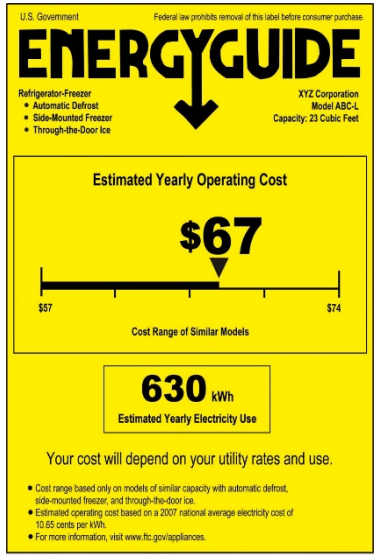
J. Blasch, M. Filippini, N. Kumar A. Martinez.Cruz

Working Paper 17/276
September 2017

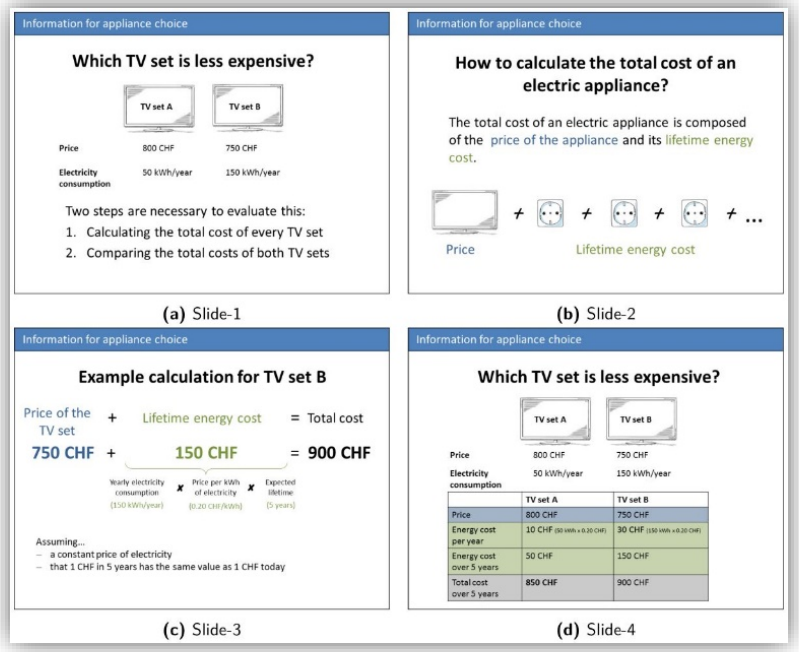
Possible instruments

Information on operating cost

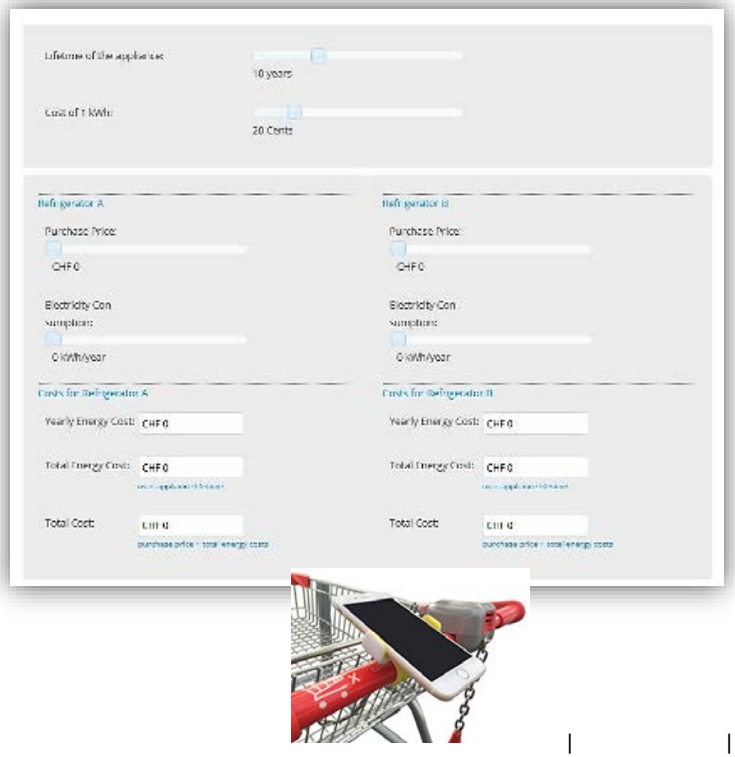




Educational program to increase the level of energy and financial literacy



Investment calculator



Based on a theoretical model we developed some hypothesis

↓

Organized 2 online surveys and collected data on Swiss households *(N ~5000)*

→ *Socioeconomic factors, Energy, financial literacy, energy consumption, appliances,…*

↓

Online randomized control experiment
Identify the appliance with lowest lifetime cost

→ ***Treated group*** *(educational program, calculator)* ***Control group***

↓

Econometric methods → the impact of energy and financial literacy and educational program/ calculator on the probability to identify the cost-minimizing appliance

↓

$$CHOICE = x_2^{'}\beta_1 + \alpha_{EN}\text{ENLIT} + \alpha_{MA}\text{INVLIT} + \alpha_{TSL}\text{TRSLIDE} + \alpha_{TCAL}\text{CALC} + \alpha_{INV}\ INVCALC + u_{it}$$

Experiment

Identification (not to choose) *of the most (cost-)efficient appliance*

Assume that you need to replace your fridge. You expect that you live in your current residence for another 10 years. In a shop you find the following two fridges which are identical in terms of size and cooling service.

	Fridge - A	Fridge - B
Purchase Price:	3300 CHF	2800 CHF
Electricity Consumption:	100 kWh/year	200 kWh/year

Assuming that one kilowatt hour (kWh) of electricity will cost about 20 Rappen on average during the next 10 years and that the value of 1 CHF in 10 years is the same as the value of 1 CHF today:

Which of the two fridges minimizes your expenditure for cooling food and beverages during the lifetime of 10 years?

- ○ The fridge for 3300 CHF
- ○ The fridge for 2800 CHF

- Random assignment of the households to one of the three groups
  - ***CONTROL*** – the control group
  - ***TRSLIDE*** – treatment 1 that sees a set of **education-slides**
  - ***TRCALC*** – treatment 2 that has access to a **simple web-based online calculator**

We tested the effectiveness of these three instruments (randomized control experiments)

Information on operating cost

Treated group (N=1420) with monetary information
Control group (N=1415) *only information on kwh*

Educational program

Treated group (N=785) with educational program
Control group (N=4342) *no program*

Investment calculator

Treated group (N=804) with investment calculator
Control group (N=4342) *no calculator*

Econometric/Statistical methods → Impact on the probability to identify the least cost electrical appliances

Has an important positive effect

Has a positive effect, but not really large

Has an important positive effect

Conclusions I

- From an energy policy point of view the results suggest that to improve, at least partially, the level of energy efficiency we could

↳ Oblige the producers of electrical appliances to provide **monetary information** on yearly energy consumption

↳ Promote **educational training** on energy and investment related topics

↳ Provide **decision support tools** such as online or mobile phone calculator tools or calculators at the point of sale

for **empowerment of the consumers**

Conclusion II

- More general:

↳ The effectiveness of the introduction of environmental taxes/subsidies can increase if people are informed and have a high level of energy related financial literacy

↳ Mixture of energy policy instruments: education, information, taxes and subsidies and standard

Questions/Discussion…

Thank you for your attention!

- Blasch J., Filippini M., Kumar N., Martinez-Cruz A. (2017). Investment literacy and Choice of Electric Appliances: The Impact of Educational Programs and Online Support Tools, CER-ETH Working Paper No. 276.
- Blasch, J. E., Filippini, M., Kumar, N. (2017). Boundedly rational consumers, energy and investment literacy, and the display of information on household appliances. *Resource and Energy economics*
- Blasch J., Boogen N., Daminato C., Filippini M. (2018). Empower the consumer! Energy-related financial literacy and its socioeconomic determinants CER-ETH Working Paper No. 289.