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 in order to reduce the energy efficiency gap**

⇨ Empirical results on the impact of four instruments (information, education, calculators, home-audit)

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Energy efficiency gap and bounded rationality

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Level of inefficiency in the use of energy in the residential sector

Explaining electricity demand and the role of energy and investment literacy on end-use efficiency of Swiss households

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Transient and persistent energy efficiency in the US residential sector: evidence from household-level data

Anna Alberini · Massimo Filippini

Level of inefficiency in the Swiss residential sector ~ 25%

**Level of inefficiency in the US residential sector ~ 25%**

Reducing the level of inefficiency is one of the cheapest and cleanest way to promote a sustainable energy system
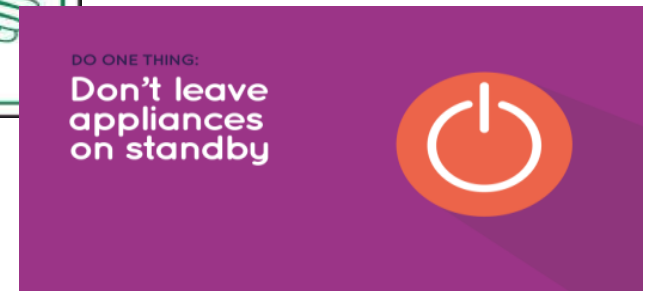
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Inefficiency in the use of energy may be due to

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

Un-insulated house   Insulated house
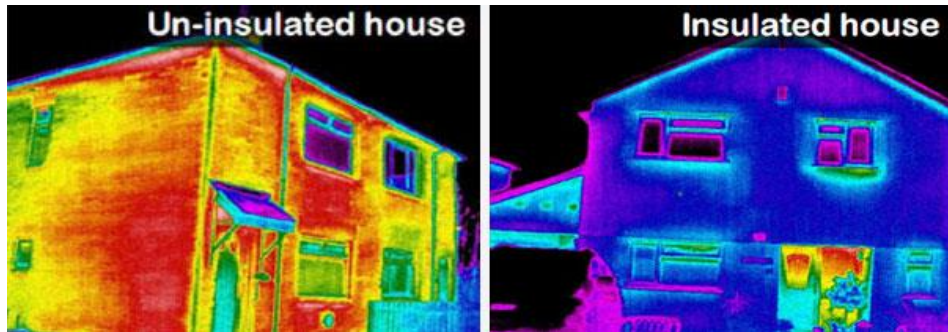
***Energy consumption** strongly influenced by **investment decisions** (type of cars, electrical appliances, houses,...)*

inefficient use of electrical appliances / heating system (inefficiency in the consumption)

Help Conserve Energy
If you are the last to leave the room, please turn off the lights!

DO ONE THING:
Don't leave appliances on standby

Energy efficiency gap

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

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
....

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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 type of consumers : rational and boundedly rational**

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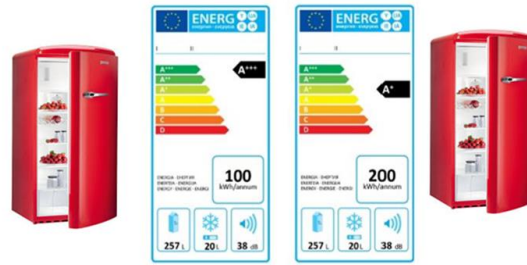
Different decision-making strategies

Rational consumer
(standard economic model)

make decisions using information and cognitive skills to calculate the lifetime cost
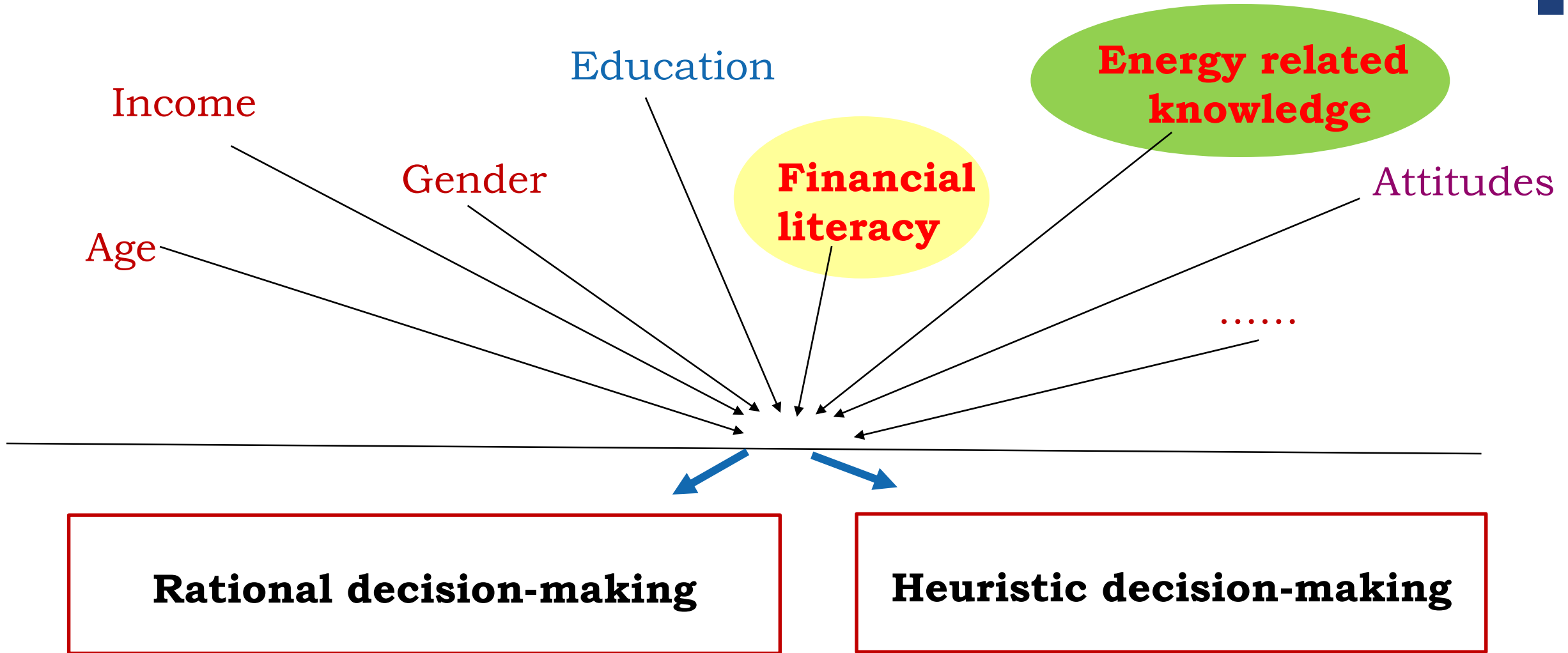
Rational decision-making

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

Boundedly rational consumer
(behavioral economics (Simon 1982))

make decisions using limited information and with cognitive constraints in processing; limited computational skills and seriously flawed memories…

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"

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Education

Income

Gender

Energy related knowledge

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

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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)

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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))

CER-ETH – Center of Economic Research at ETH Zurich

Empower the consumer! Energy-related financial literacy and its socioeconomic determinants

J. Blasch, N. Boogen, C. Daminato and M. Filippini

Working Paper 18/289
May 2018

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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)

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Results for a sample of 4600 European households
Penny project, EU
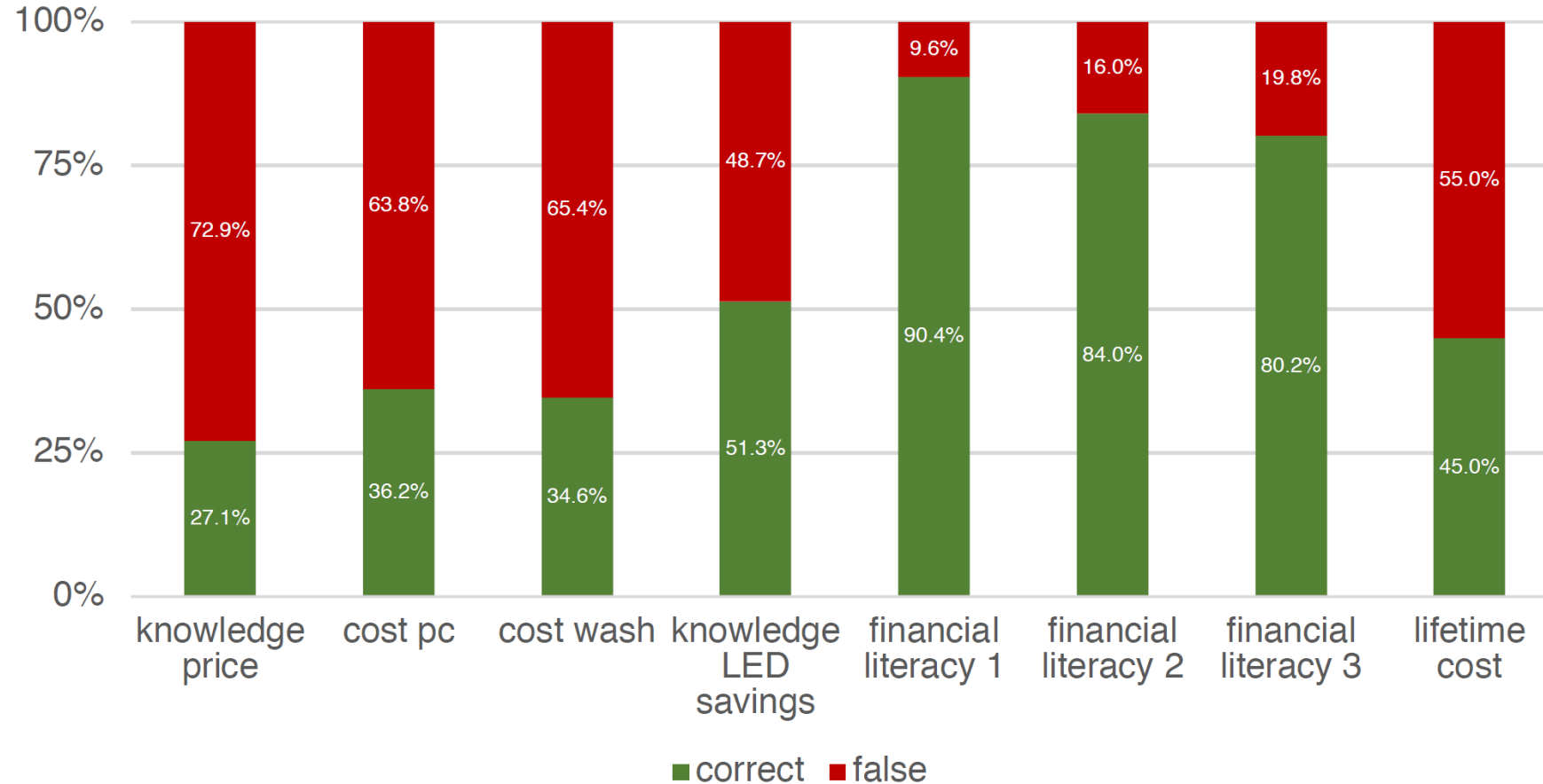
Figure 1: Results of survey questions on energy-related financial literacy.

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)
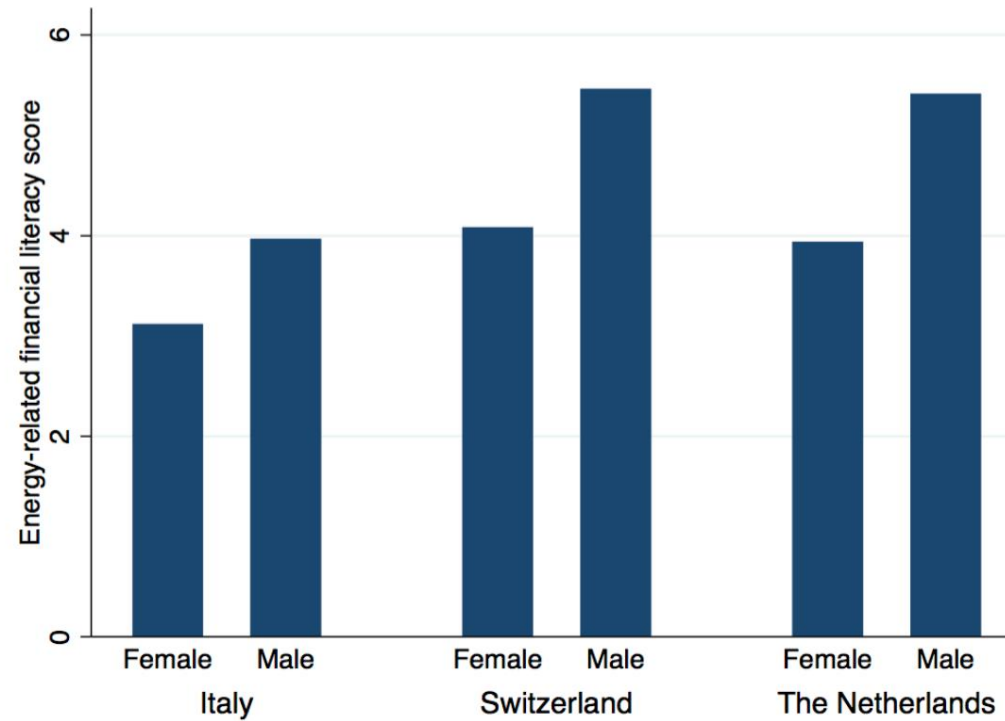
c) By gender

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

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

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

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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
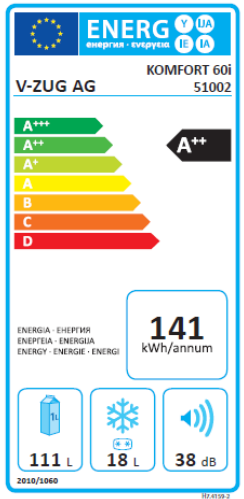
Working Paper 17/276
September 2017

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Project financed by the Swiss Federal Office of Energy
Energy – Economy – Society (EES) research programme

Possible instruments to increase the adoption of energy efficient appliances

1
Information on operating cost

2
Educational program to increase the level of energy and financial literacy

3
Investment calculator

4
Audit at home and provision of monetary information about the potential of savings from the adoption of efficient appliances

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Methodology to test the instruments: Randomized Control Experiments

Population of interest (customers of European utilities)

Instruments 1,2,3,4

Random assignment

Control group

Treated group

Comparison of the choices of the two groups

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Experiments to test instruments 1,2 and 3
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

↳ *TRINFO* – treatment 1 **information on operating cost**

↳ *TRSLIDE* – treatment 2 **education-slides**

↳ *TRCALC* – treatment 3 **simple web-based online calculator**

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

Information on operating cost

Educational program

Investment calculator

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

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

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
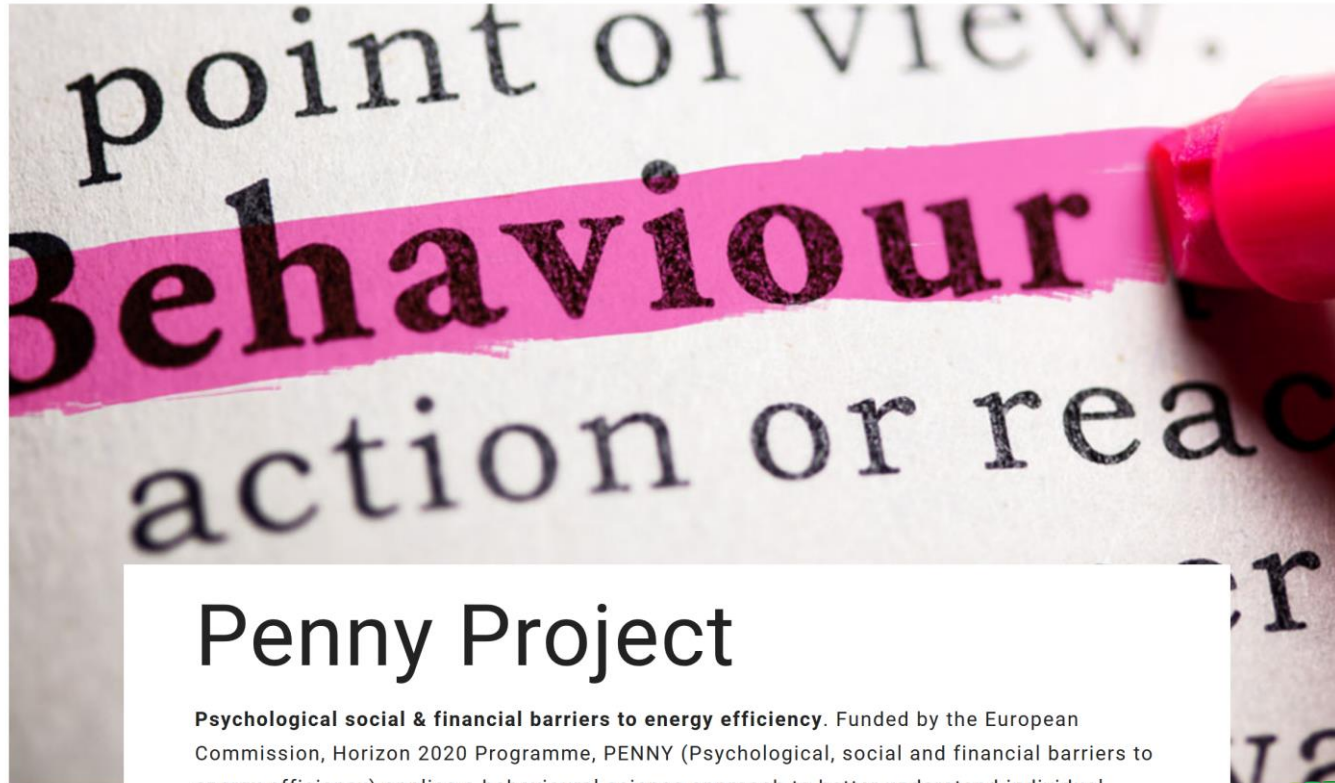
Has an important positive effect

Has a positive effect, but not really large

Has an important positive effect

Experiment 4

Analysis of the impact of home audit <u>(provision of monetary information)</u> on the adoption of energy efficiency appliances

point of view.
Behaviour
action or reac

Penny Project

Psychological social & financial barriers to energy efficiency. Funded by the European Commission, Horizon 2020 Programme, PENNY (Psychological, social and financial barriers to energy efficiency) applies a behavioural science approach to better understand individual behaviour in the domain of energy efficiency.

<u>Preliminary results</u>

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Experiment 4

	T=0 (2017)	T=1 (2018)
Treated *N=442*	1. **Baseline survey** 2. **In-home visit** (collection of information on type, consumption, level of efficiency of lightbulbs and most important appliances) 3. **Information treatment** (letter and access to a webpage)	**Follow-up survey on past purchases**
Control *N=219*		1. Baseline survey 2. In-home visit 3. Survey on past purchases

Experiment 4

Washing machine

Characteristics of your appliance: Producer: Miele, Width: 60 cm, Height: 85 cm, Year of purchase: unknown

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	Your appliance	Alternative appliance on the market (load capacity of 8 kg)	
		A++	A+++
Consumption per cycle	1.020 kWh	1.170 kWh	0.470 kWh
Cost of one cycle	0.204 CHF	0.234 CHF	0.094 CHF
Annual operating costs[ii]	45 CHF	51 CHF	21 CHF
Approximate price range of new appliances		725-2309 CHF	440-4099 CHF
Estimate of potential annual savings on operating costs (compared to current appliance)		No savings	24 CHF

[ii] The annual operating costs for the washing machine are estimated assuming 220 cycles.

- You can save an estimated CHF 24.- per year in electricity costs by replacing your washing machine with a new A+++ appliance.

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Preliminary results – impact on the level of efficiency of the newly purchased appliances

Generally positive impact on the efficiency of newly purchased durables

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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 on the energy label

↳ 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

⇨ In the near future, the set of digital and information technologies, home automation, new algorithms of artificial intelligence, "machine learning" will play an important role in helping consumers to make more sustainable development oriented choices.

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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*

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- Filippini, M., Kumar, N. and Srinivasan, S. (2019). Energy-related investment literacy and adoption of efficient household appliances in the Nepalese household sector. CER-ETH Economics Working Paper Series, 19/315.

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