Effective energy saving policy requires causal evidence

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Saving household energy requirement

› 15-20% Dutch CO_2 emissions due to residential energy use

› A substantial reduction is required to reach CO_2 emission goals

› Feedback can induce energy saving

  – Changes in behavior – closing doors and windows, turning off not used appliances, insulating dwelling, etc.

  – Feedback can be effective and efficient to stimulate better decisions by occupants

  – One of the Key reasons to mandate smart metering in the EU. EU commission: 80% of the households must have intelligent metering systems

# Dutch energy saving effects of smart meters (gas and electricity)

› 2012: Decision to install smart meters in all Dutch households

– Expected energy saving: 3,2% electricity and 3,7% gas (about 10 PJ)

– Expected financial saving: 770 mil. euros

› 2015-2019: Large scale roll-out

› End 2016 – PBL report:

– Proven savings: 0.9% nat.gas and 0% electricity

– Financial costs smart meter: about 300 mil. Euros (1 bilj. short)

– Advice: Measure effects of feedback systems with experiments (RCTs)

– Lots of media attention. Ministry economic affairs: No experiments

› Covenant with energy companies (10 PJ covenant)

– Estimation effects of diverse systems based on exsisting studies

▪ Expected energy reduction improved **extended energy bill**: -2.7%

▪ Monitoring impact: mandantory Randomised Controlled Trial (RCT)

# Why Randomised Controlled Trials (RCT)
to measure policy impacts?

› Why pursuing causal evidence to measure impacts policy interventions?

  – Avoid spoiling (€ and time) to roll out ineffective policy interventions

› Before – After measurements

  – Causality questionable,

› Randomised controlled trail – in the field

  – To establish causal effects

  – Effects can depend on the specific environment

  – Mind: no self-selection allowed after the randomisation
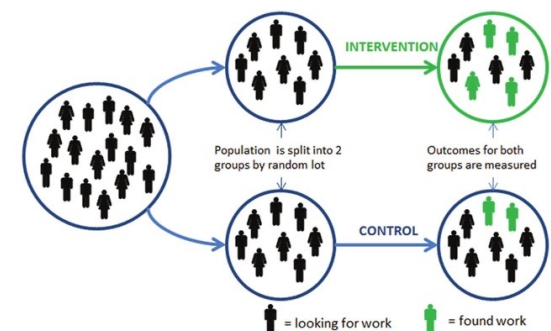
Measuring effects of feedback systems

› PBL decided to do its own research on feedback systems with RTC's on:

1. In-Home-Display
2. App with historic feedback
3. Email with information about monthly payments ←→ energy use
   – Cooperated with three energy companies

› Difficult to execute a good RCT in the field
   – Simple in theory …
     ▪ Just randomize control and treatment group
   – … but more complex in practice
     ▪ Strict RCT requirements (full randomisation, no self selection, etc)
     ▪ Smart meter readouts have to be available
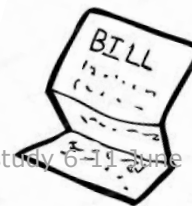
3 RCTs – Trial 1: In-Home-Display

› Simple display (Geo Trio–II)

› Estimate saving based on literature: -5% Electr. -6% nat. Gas

- Powerplayer: small sample, before-after measurement
- TOON: A self selected treatment group vs not self-selected control group

› Experiment

- Residents were invited to particpate - limited number of displays avaiable
- 900 participating households, randomly divided over 2 groups
- Treatment group: Free display and installation. Control group: not
- After measurement period (7-18 months): survey about knowledge, attitude, self-reported behaviour and placement display

› Results

- Savings: electricity 2,2% natural gas: 6.9%
- No improvement on knowledge, attitude, self reported behaviour
- Constant attention for the display (85% in living or kitchen)

3 RCTs – Trial 2: App – historic feedback

› App for phone or tablet, historic information nat. Gas and electricity

› Estimate saving based on literature: -2% Electr. -4% nat. Gas

  ▪ Anna: Historic feedback. Self selected treatment group vs control of users who stopped using the App

  ▪ Energiekrijgers: Realtime feedback. Before – after measurement

  ▪ Ectual: Realtime feedback. Self selection of treatment group after randomisation

› Experiment

  ▪ About 139.000 households randomly divided over 2 groups

  ▪ Treatment: Received 1 mails with encouragement to install the app. Control: No mail

› Results

  – No proof that the App has led to energy savings.

    ▪ Possible that too few people did install the app.

3 RCTs – Trial 3: E-mail

› Email with information about monthly installment ←→ energy use

› Estimate saving based on literature: N/A

› Experiment

  ▪ About 139.000 households randomly divided over 2 groups

  ▪ Treatment: Received 1 to 4 mails with information. Control: No mails

  • Information: wether the installement is too high or too low

  ▪ After measurement period : survey about knowledge, attitude,
    self-reported behaviour

› Results

  – No proof that the e-mails led to energy savings. Contrary, they were going to use more

    ▪ Maybe because most people got the message that the installement could be lowered.

  – No improvement on knowledge, attitude, A bit higher intention to take energy saving measures
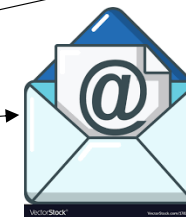
Effects of feedback systems

Energy savings due to Energy Consumption Managers based on RCTs.
estimation based on non-RCTs, valid for the Dutch context.

Energy consumption manager	Estimated savings (in %)		Number of ECMs in NLs by end 2019	Measured savings RCT Trials (in %)		Realised energy saving based on RCT trials (in PJ)
	gas	electr		gas	electr.	
1. In Home Display	-5	-6	0.4 million	-7	-2	1.25
2. App – historic feedback	-2	-4	1.2 million	no saving evidence		-
3a. E-mail with information balance use and payments	n.a.		n.a.	no saving evidence		-

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3a. E-mail with information balance use and payments	n.a.		n.a.	no saving evidence		-
3b. Web applications	-2	-2	0,8 million	no study		-
4a. Extended energy bill	n.a.		> 7 million	-0.9	0	2.65
4b. Improvement extended energy bill	-2.7	2.8	> 7 million	0.0	0.0	0

Conclusions

› Effective energy saving policy requires causal evidence

- Causal impact analysis is important

  ▪ Non causal research can lead to wrong assumptions and not effective policy

  ▪ Good RCTs in the field give strong evidence of (causal) effects

- Observational studies and field experiment evidence can be sensitive for country-specific envirionment

  ▪ Impacts measured abroad can differ from results found in the NLs.

› Realtime and continuous visible feedback of household energy use is effective

- Our study confirms what also earlier was found

- Simple In-Home-Display in the NLs: -7% for nat.gas and -2% for electricity

Discussion

› Measured energy savings by non-RCTs deviate from the results from RCTs.

  – Considering the RCT results more reliable: Underlines the value for evidence based policy of robust impact estimates by RCTs.

  – RCTs require more effort and time to implement correctly

› Limitations our 3 RCTs:

  – Trial 1: Display. More than average interesed residents did participate – possible affecting the external validity.

    ▪ Overestimation because of a higher motivation to save energy

    ▪ Understimation because of more energy saving actions are already taken

  – Trial 2: App. The treatment (sending an email to install the App) was perhaps too weak

    ▪ Perhaps too few installed the App, so we did not measure an effect.

    ▪ No conclusions can be drawn about effectiveness.

  – Trial 3: Email. No data available on who got which message (too high / too low)

    ▪ Possible because most of cusomers did pay too much no saving effect was measured, but the opposite.

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Principle of Randomised Controlled Trial