

Evaluating the impact of advice and appliances replacements on power demand and energy consumption: feedback from a field study on the Réunion Island

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Summary

1. The context of the Reunion Island and the USER project

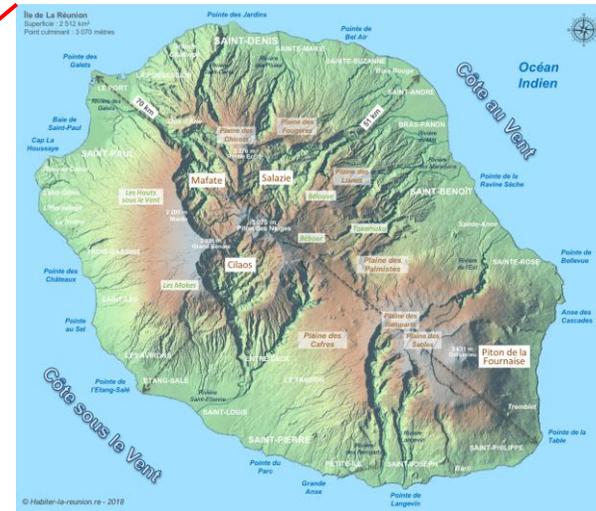
2. Methodology for the monitoring campaign and results

3. Conclusion and perspectives

1

The context of the Reunion Island and the USER project

The Reunion Island



- French overseas department
- 2512 sq.km
- 861 210 inhabitants
- Electricity generation in 2019 : 3 046.9 GWh (renewables 31.2 %) – source: OER Horizon Reunion

The Specificities of the overseas territories regarding electricity

- Electricity generation mainly relies on CO₂ rich solutions (69 % with fossil fuels)
- The tariff equalization mechanism keeps the price of the kWh on the island exactly the same as the one paid on France mainland

Answers:

- Switching to a larger share of renewables
- **Improving energy efficiency and reducing consumptions (in particular for the residential sector)**

The USER project

For most households on the Reunion Island, specific end-uses are their sole electricity consumptions (no heating, no hot water)

USER (specific end-uses of electricity on the Reunion Island) is a three-year project launched in 2019 and backed by the French Agency for Ecological Transition (ADEME)

Goals: Increase the knowledge about the specific end-uses on the Reunion Island: appliances ownership rates and characteristics, energy consumptions, impact of the energy efficiency advice, households behaviours regarding electricity and their choices

USER's answers:

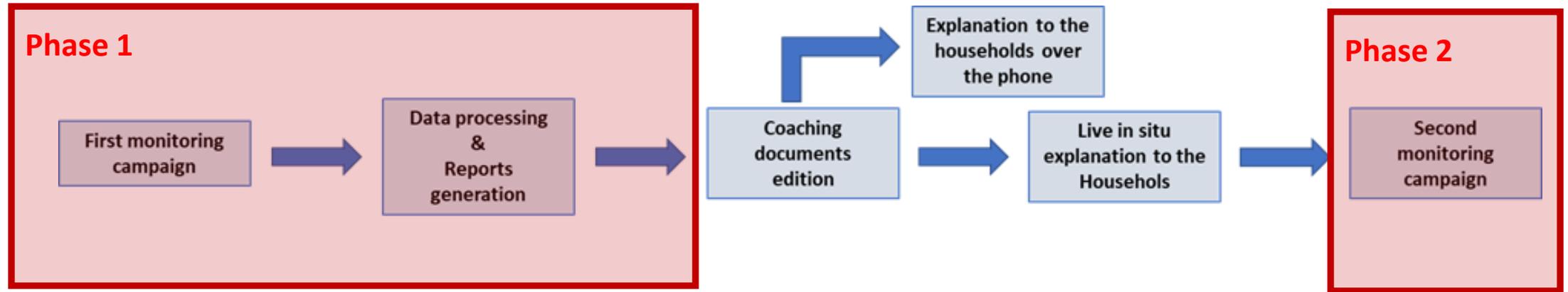
1. A quantitative survey to get an overlook on the appliances' stock on the island
2. A two-part qualitative monitoring campaign
3. A qualitative sociological study

We will focus on point 2

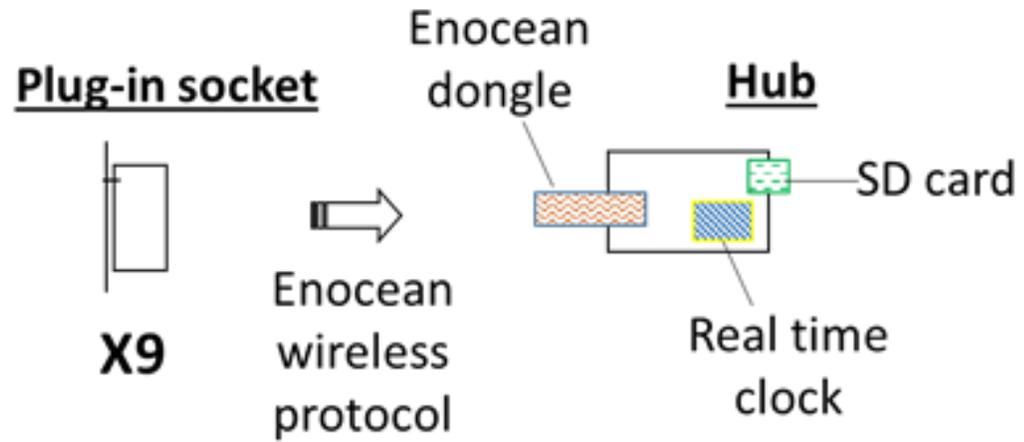
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Methodology for the monitoring campaign and results

A two-phase monitoring campaign to assess the impact of efficiency advice

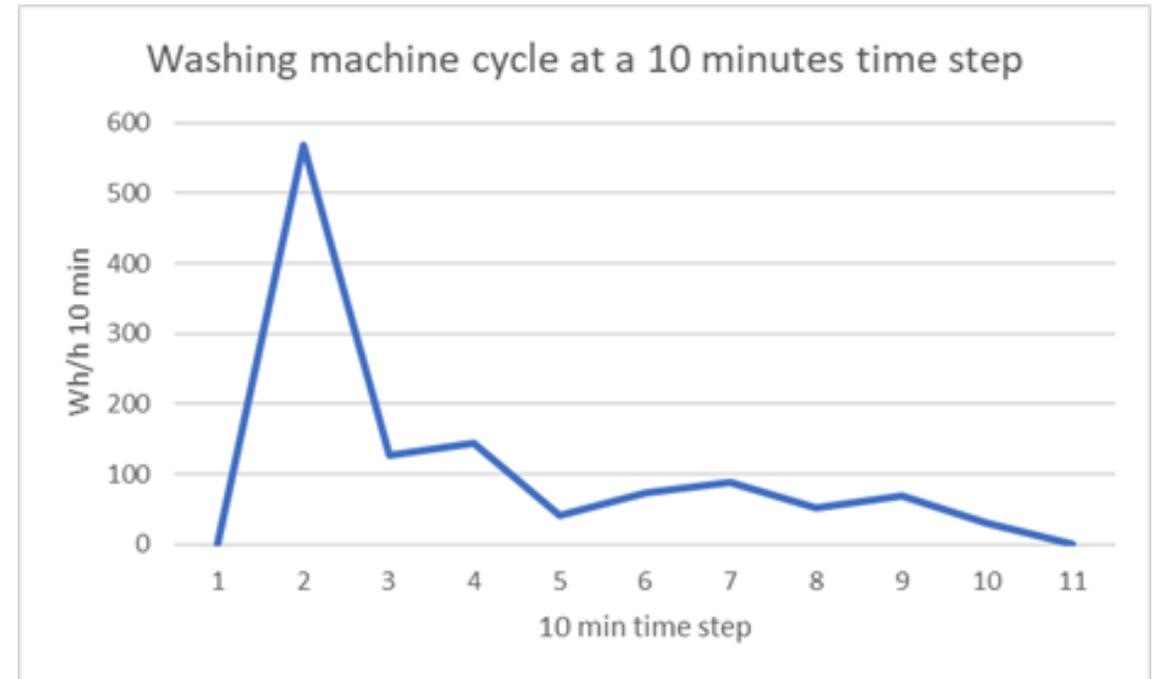
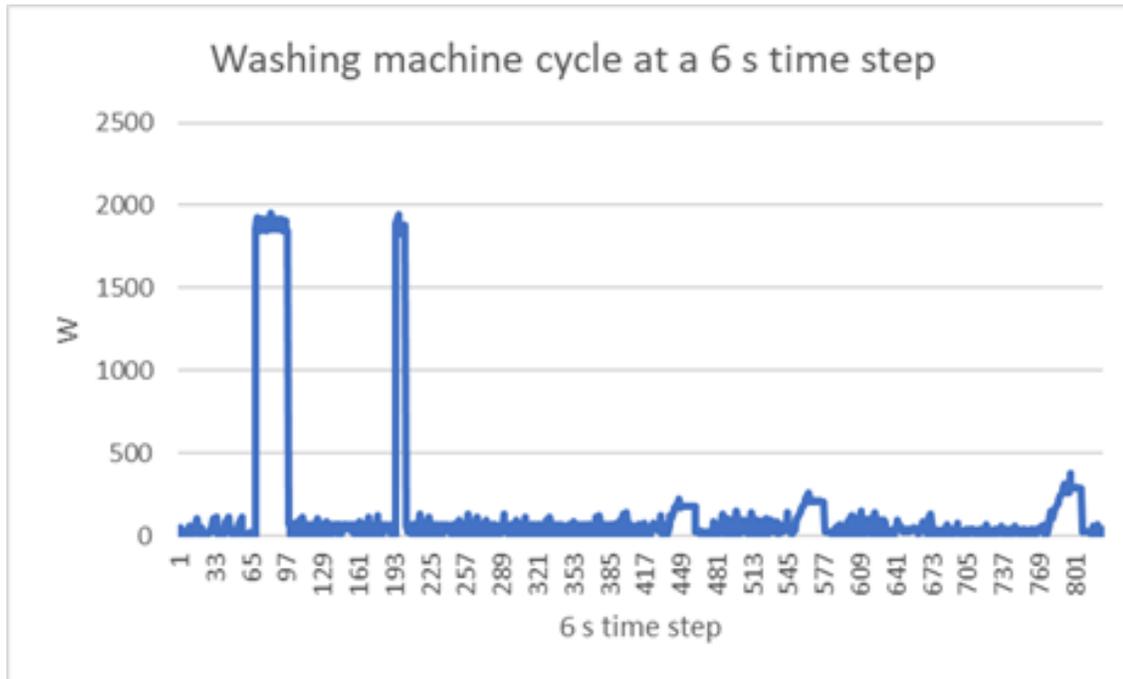


What is recorded?



- Instantaneous active power
- 6 seconds time step
- Up to 5 appliances
- Plug and play but in the USER context, installed on site by SPL-Horizon Reunion

The advantages of a « short » time step



- Real and accurate image of the appliances' functioning and power demand
- Allows to compute a large range of indicators

Building a balanced sample

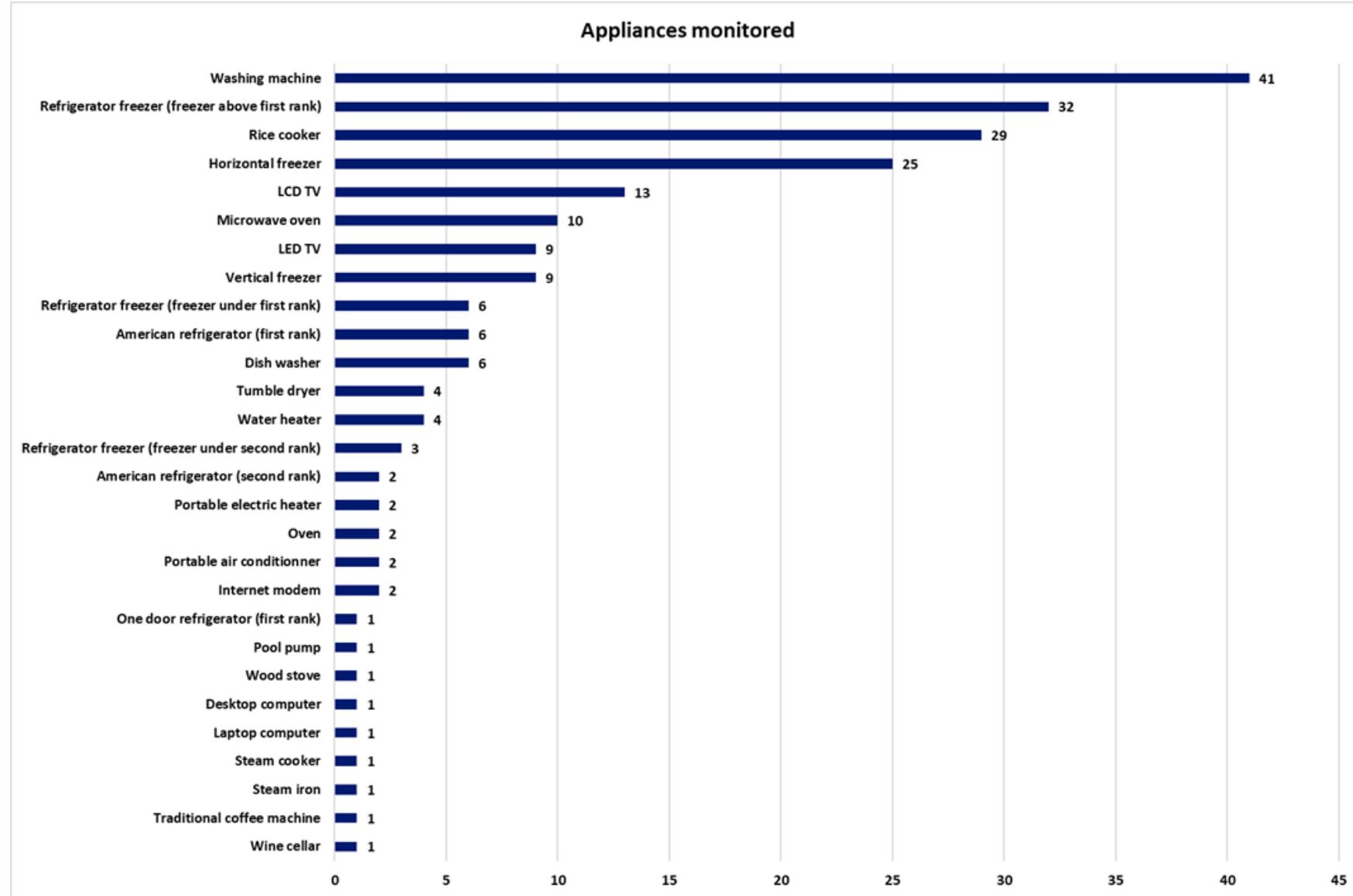
Two main guidelines:

- Capture enough diversity
- Follow as much as possible the same quotas than those used for the quantitative survey

Housing type	Household size (people over 15)	Financial status	Target	Number recruited	Percentage
House	≤ 2	Financial insecurity	11%	11	17%
House	≤ 2	No financial insecurity	26%	21	33%
House	> 2	Financial insecurity	9%	8	13%
House	> 2	No financial insecurity	21%	10	16%
Flat	≤ 2	Financial insecurity	6%	5	8%
Flat	≤ 2	No financial insecurity	12%	1	2%
Flat	> 2	Financial insecurity	5%	4	6%
Flat	> 2	No financial insecurity	10%	3	5%

Phase one: appliances recorded

- 28 different types of appliances recorded
- Focus on the cold appliances (refrigerators and freezers)
- Washing machines, TVs and rice cookers well represented
- Miscellaneous (acceptance sometimes hard)
- At least one month of data



Ex-post results

The five appliances considered are:

- The rice cookers
- The TVs
- The washing-machines
- The fridges
- The freezers (not presented because similar to the fridges)

Why those appliances?

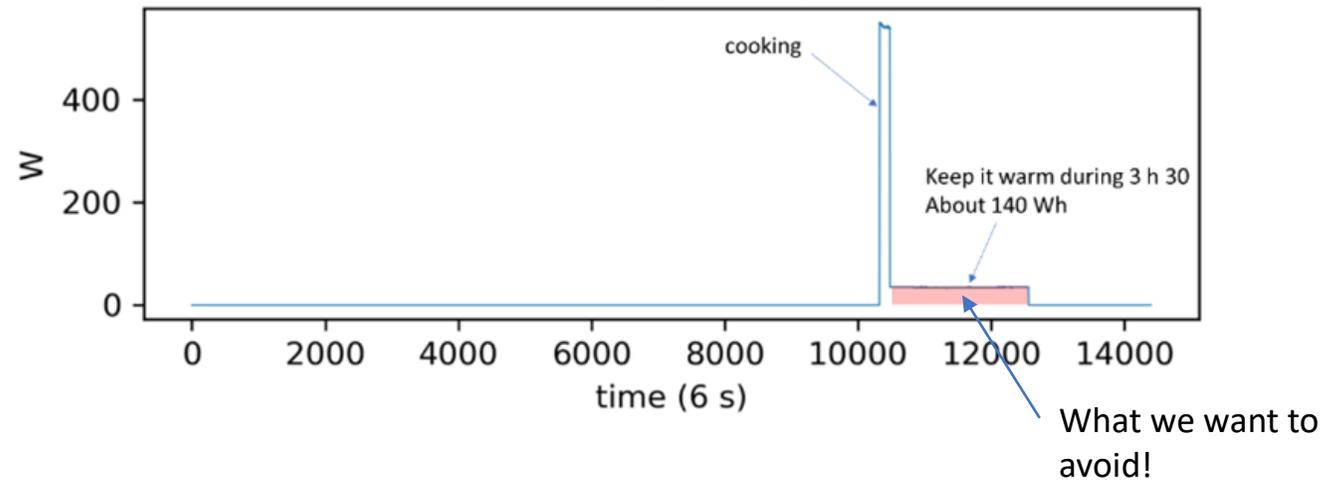
- **Widespread:** owned by a vast majority of households and therefore large sample
- **Cover different end-uses:** cooking, entertainment, hygiene, food preservation
- **Large share of the specific electricity consumptions** for the households

Results for the rice cookers

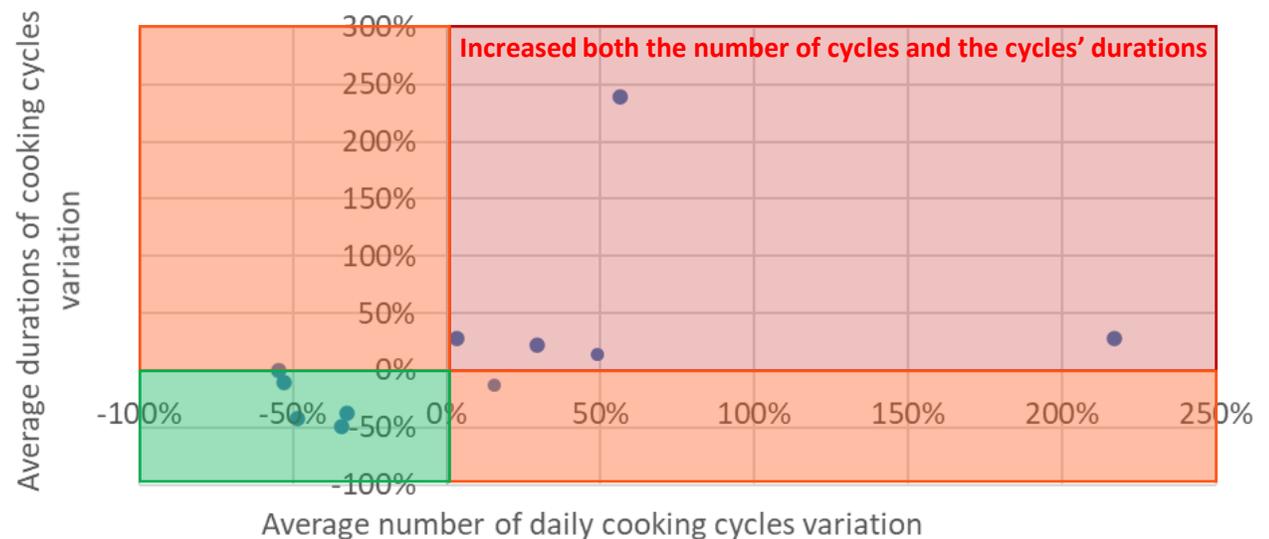
- 11 households
- Advice given:
 - ✓ Don't use the keep it warm

- About **one third** managed to both reduce their average daily number of cycles and the average cycles' durations

Rice cooker usage through one day



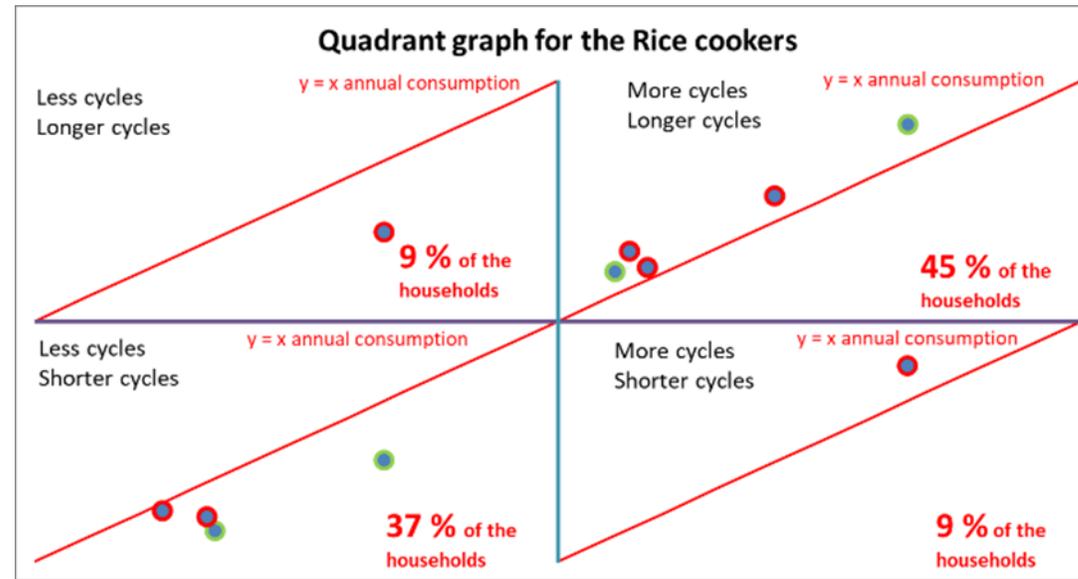
Rice cookers daily average number of cooking cycles variation vs daily average cooking cycles durations variation between phase 1 and phase 2



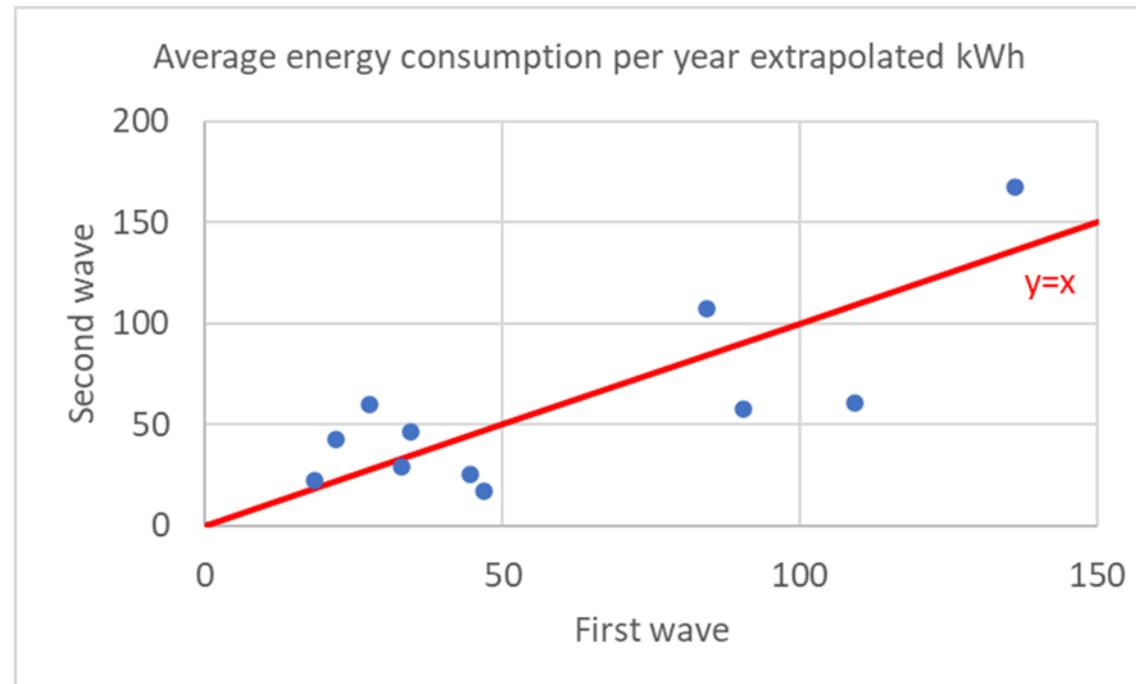
Results for the rice cookers

- 11 households

-  Household with an average consumption per cycle lower in phase 2 than in phase 1
-  Household with an average consumption per cycle higher in phase 2 than in phase 1

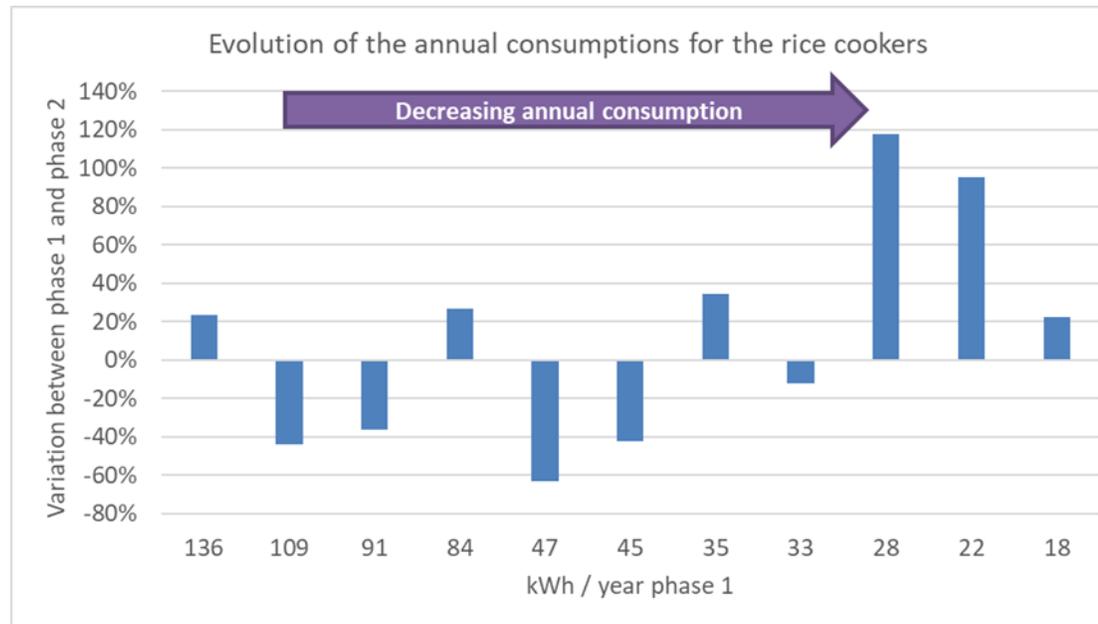


- Finally, 4 households out of 11 (36 %) managed to lower their consumption against 45 % which increased it

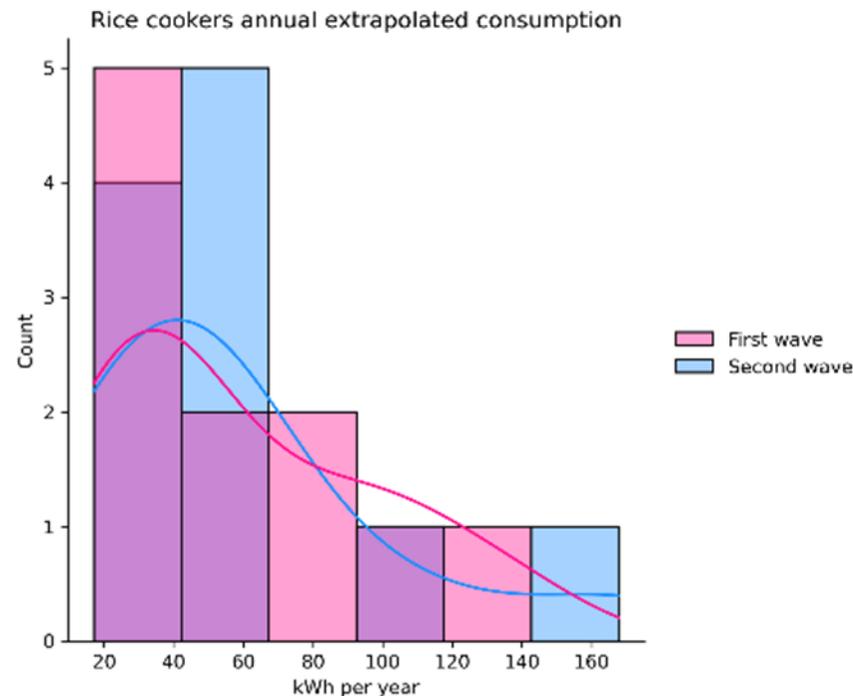


Results for the rice cookers

- 11 households
- Overall, the global (sum) consumption decreased by 2 %...

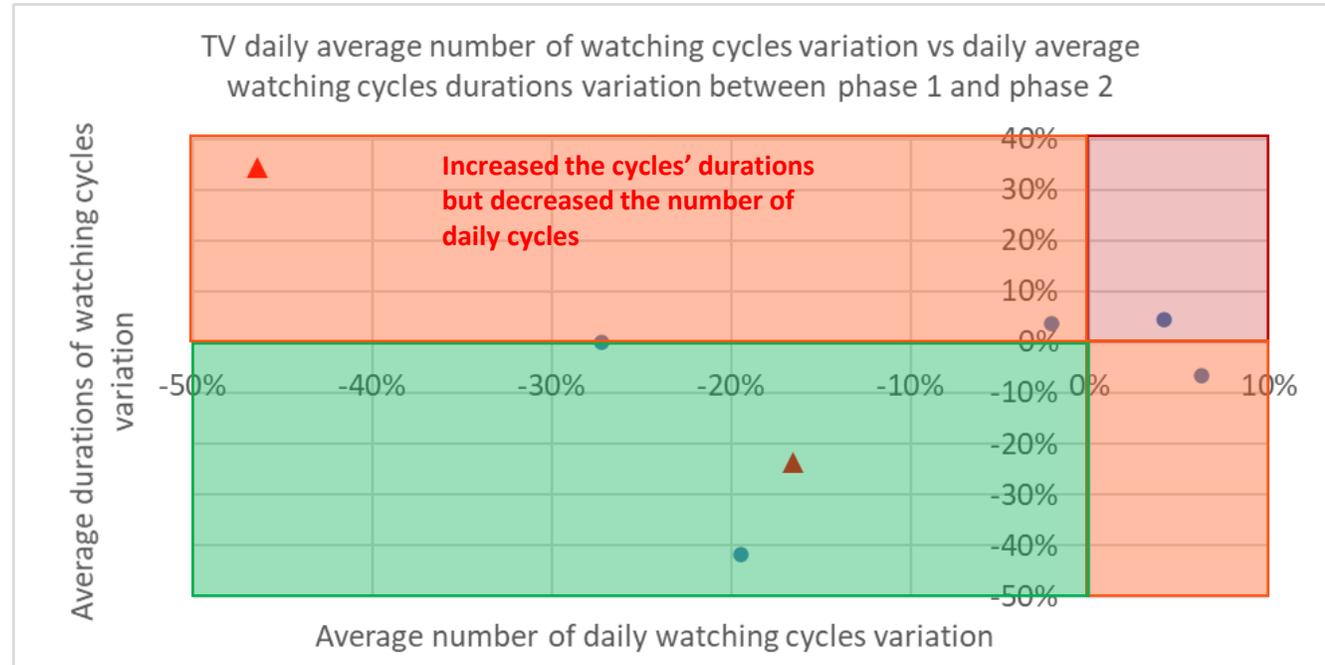


- **Lesson learned:** the advice for the rice cookers was very simple and easy to understand. Nevertheless it seems quite hard for a slight majority to follow it. This may imply that cooking is a quite difficult habit to change (?)



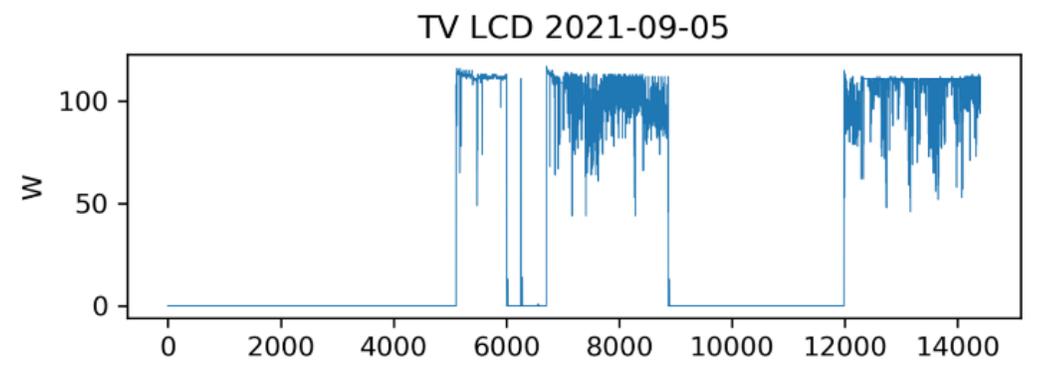
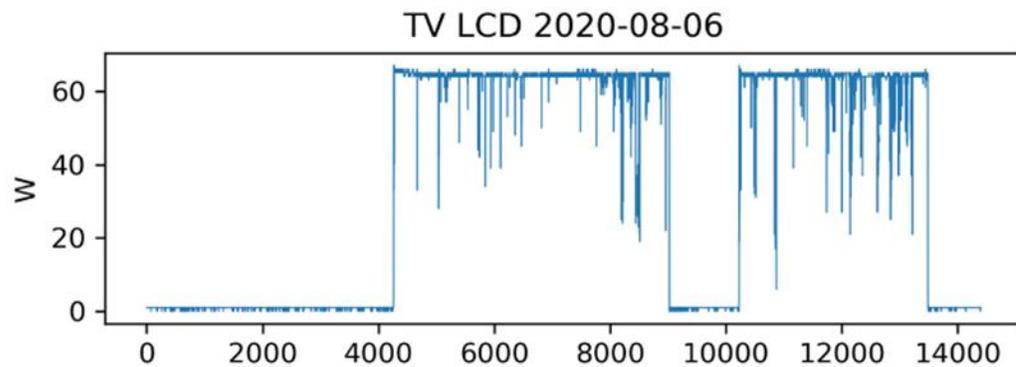
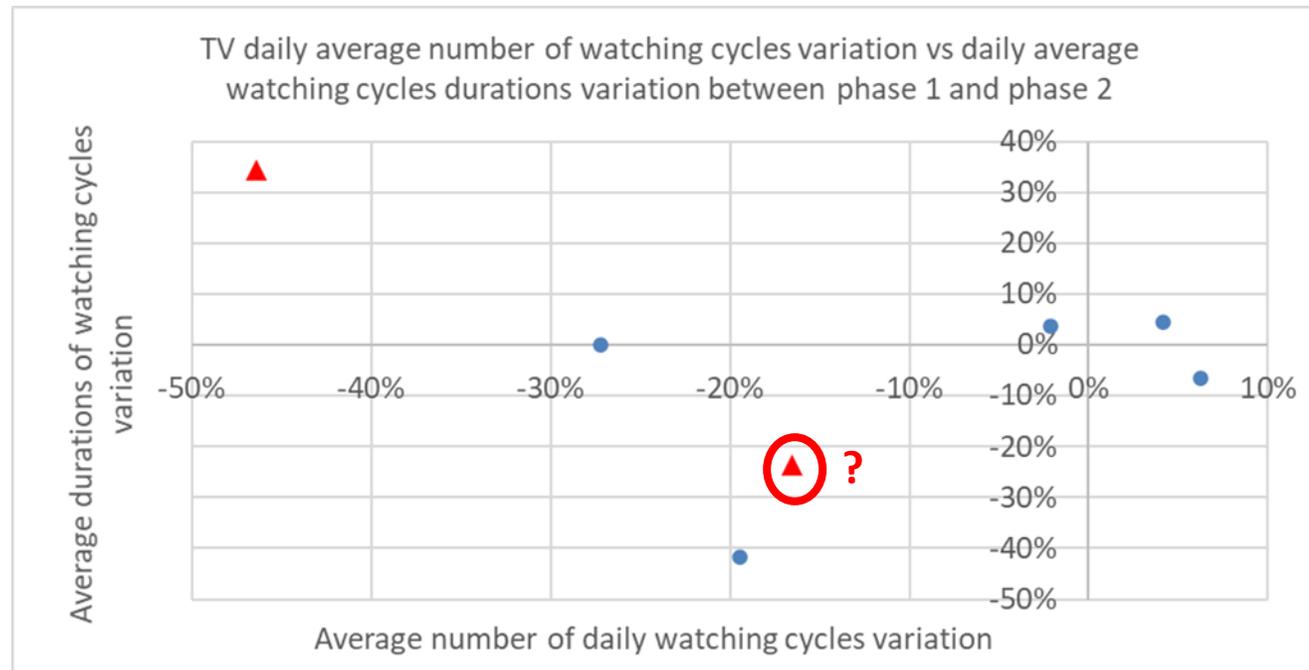
Results for the TV

- 7 households
- Advice given:
 - ✓ Watch TV less!
- The sample size is not significant, only three households managed to both reduce their number of cycles and their durations



▲ TV replaced by the household

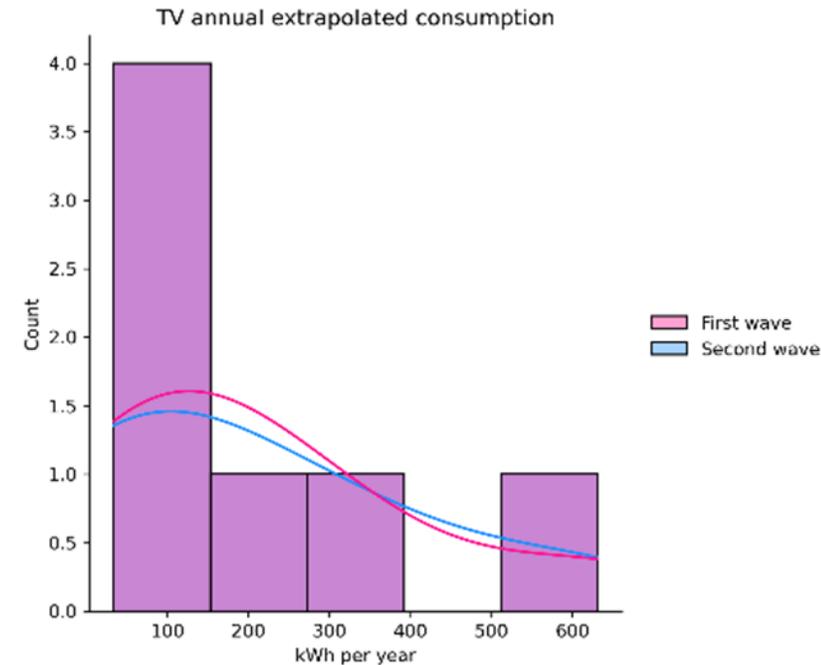
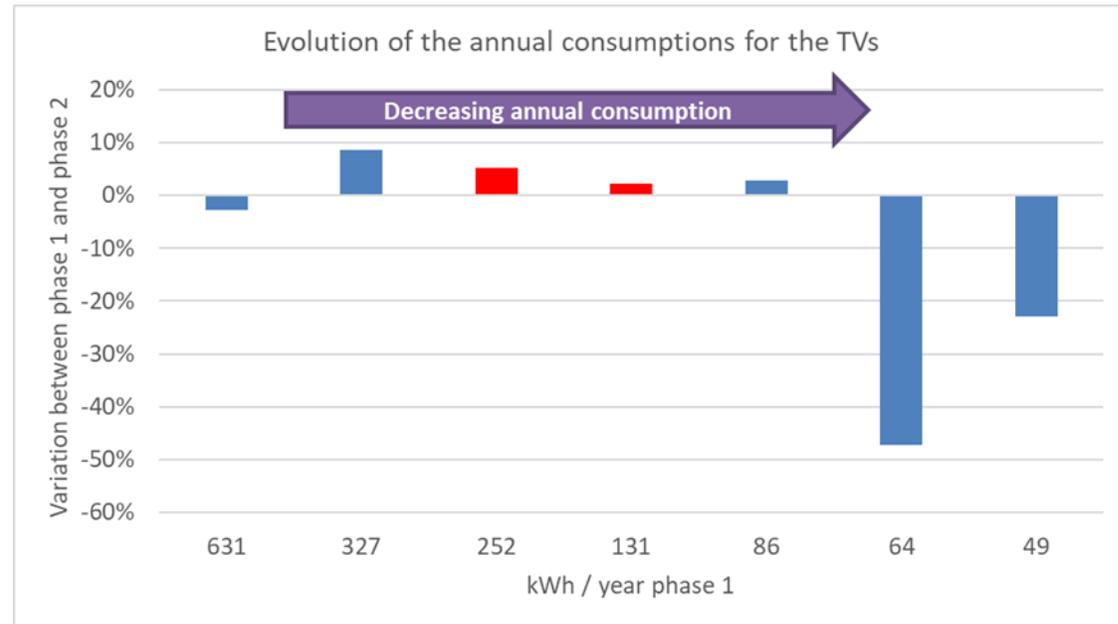
Results for the TV



Effort ruined!

Results for the TV

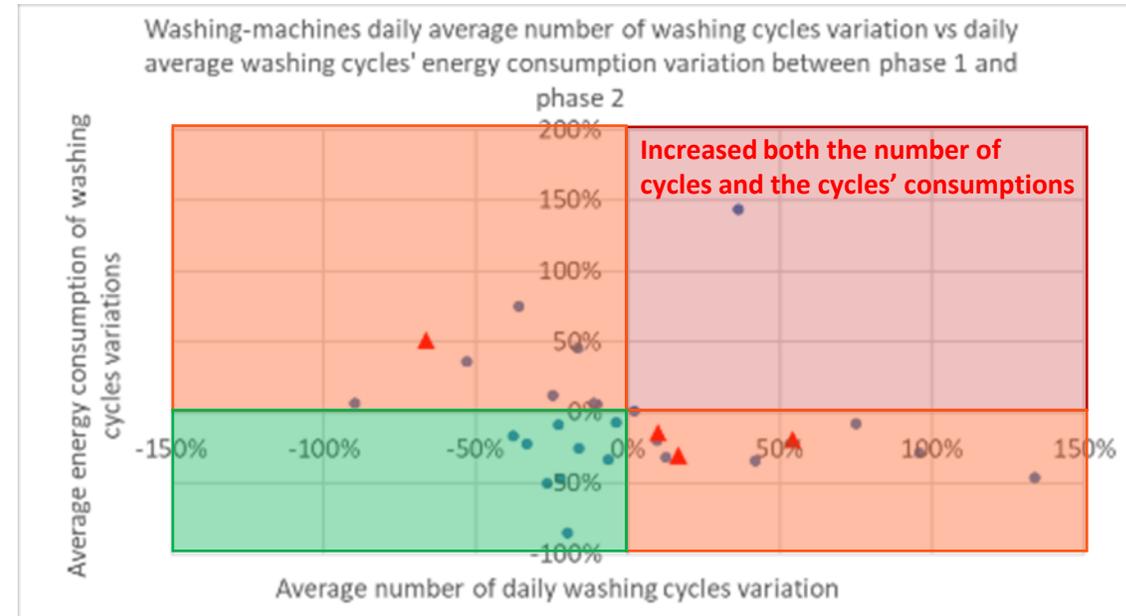
- 7 households
- Overall, the global (sum) consumption decreased by 1 %...
- **Lesson learned:** Like rice cookers, TVs' energy consumptions seem hard to lower!



Results for the washing-machines

- 28 households
- Advice given:
 - ✓ Reduce the number of cycles
 - ✓ Lower the washing temperature
- About **one third** managed to both reduce their average daily number of cycles and the average cycles' energy consumptions.

93 % of the households managed to reduce their cycles' consumptions and / or reduce their daily number of cycles

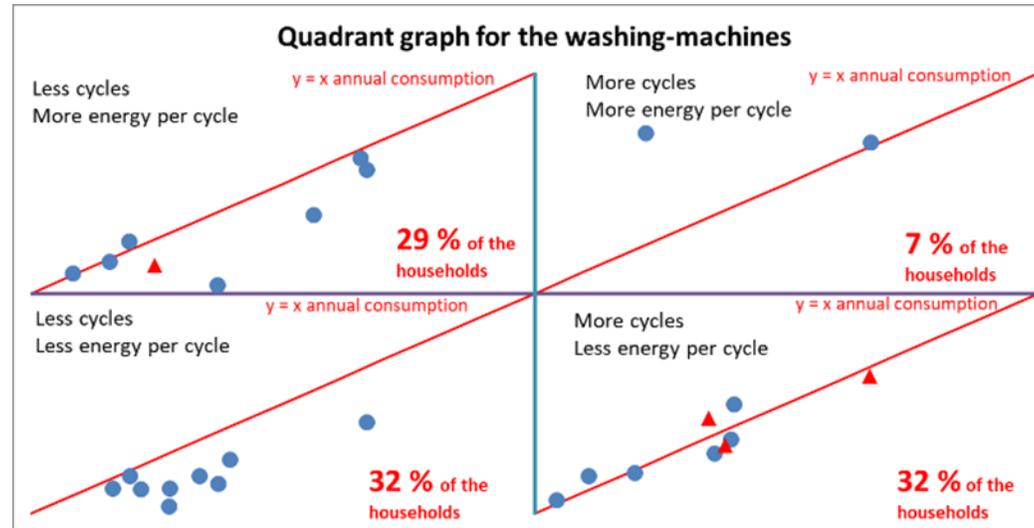


▲ Washing-machine replaced by the household

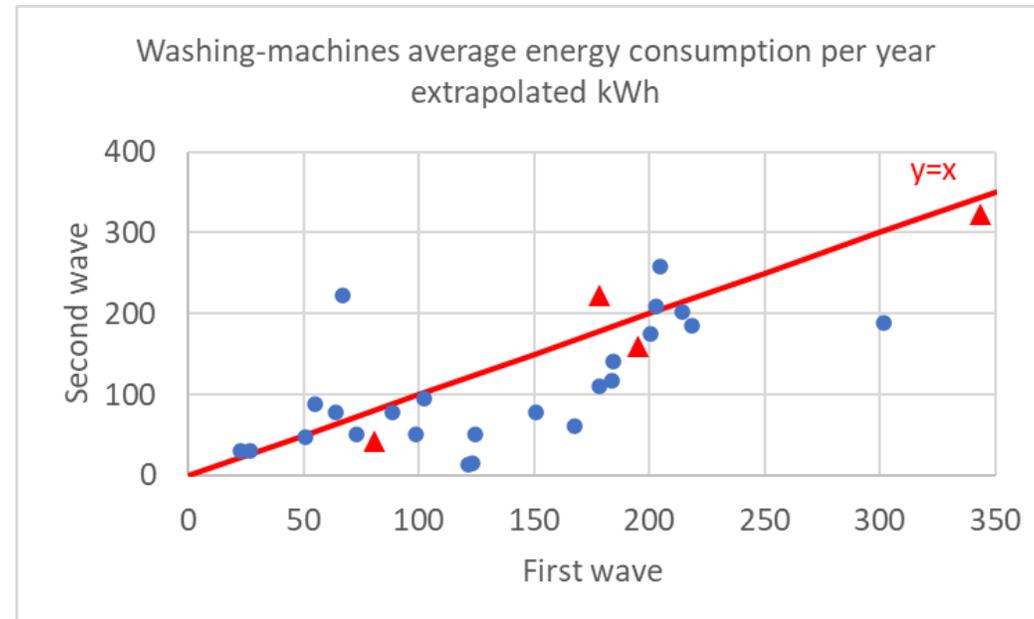
Results for the washing-machines

- 28 households

▲ Washing-machine replaced by the household

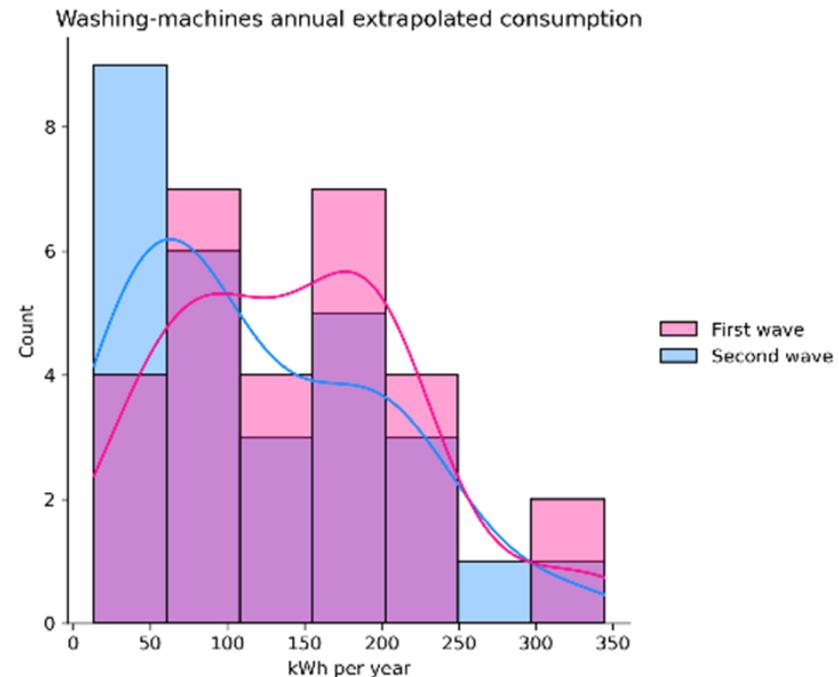
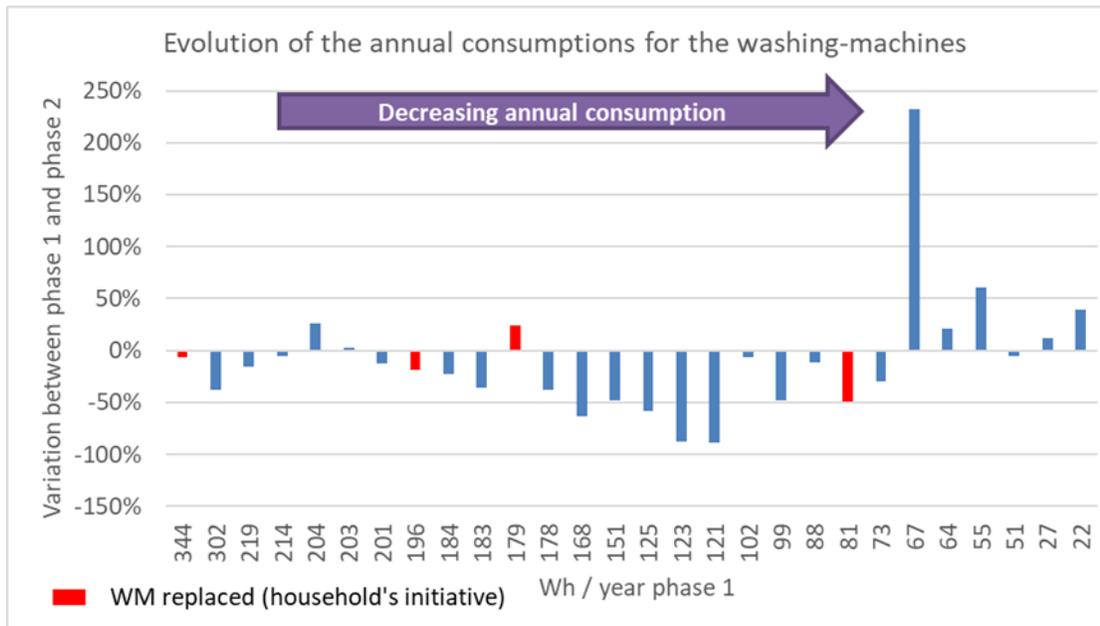


- Finally, 71 % of the households managed to reduce their energy consumptions of their washing-machines



Results for the washing-machines

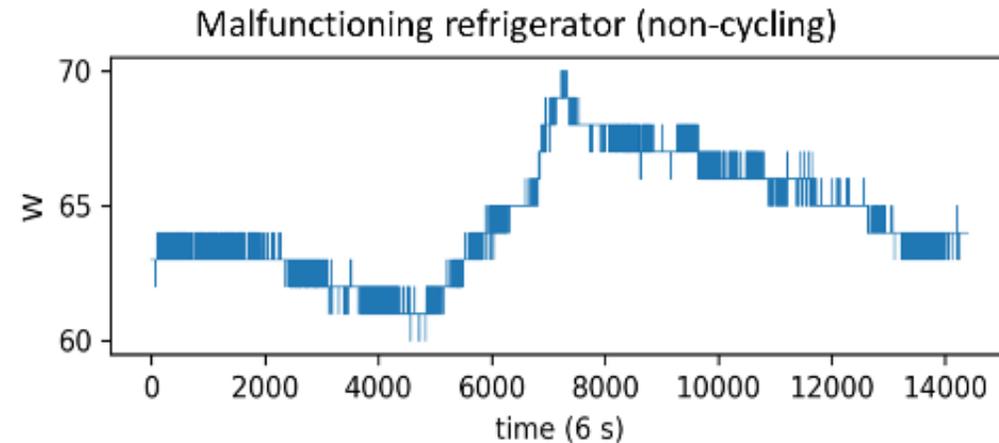
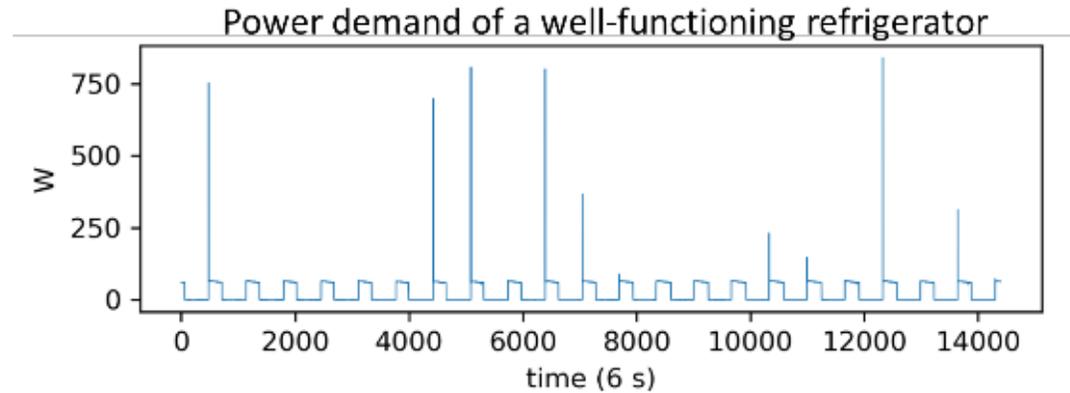
- 28 households
- Overall, the global (sum) consumption decreased by 17 %...
- **Lesson learned:** the advice for the washing-machines did work. People seem to have well understand simple actions on which they have total control with an identical result: wash less, lower the temperature



Results for the fridges

- 24 households
- Advice given:
 - ✓ Clean and defrost regularly
 - ✓ Avoid useless openings
 - ✓ Avoid storing too much food
an air flow is needed
 - ✓ Cool down food before
storing it
 - ✓ The temperature set point
should be of + 4 °C for the
refrigerators and of – 18 °C
for the freezers
 - ✓ The appliances should be in a
cool room or at least away
from the direct sunlight or
from a heat source.

10 % of the refrigerators were malfunctioning!

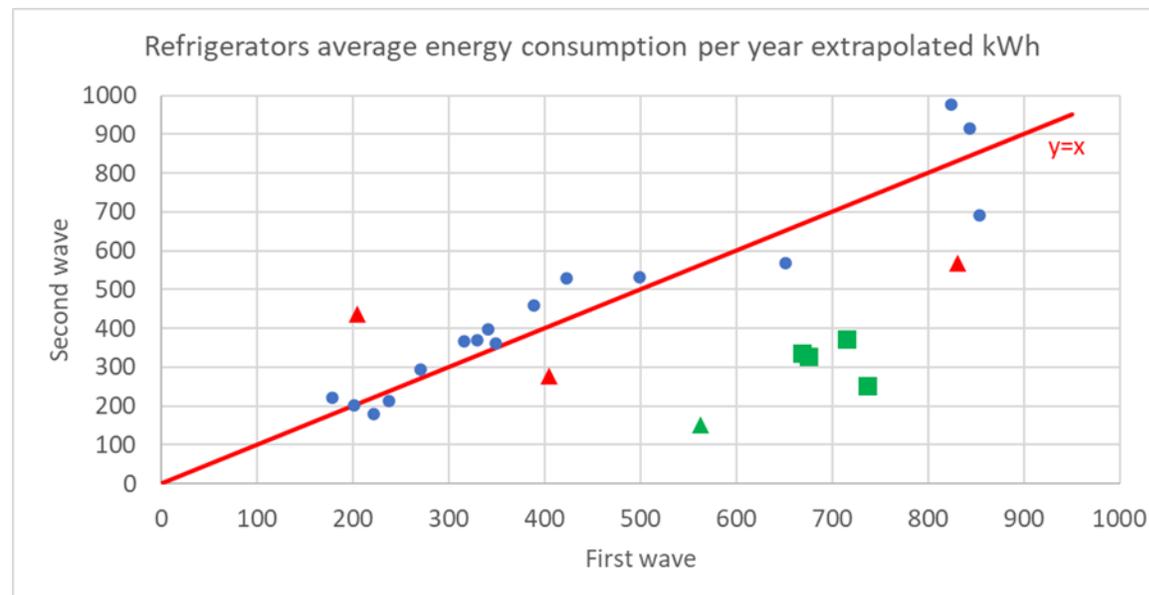
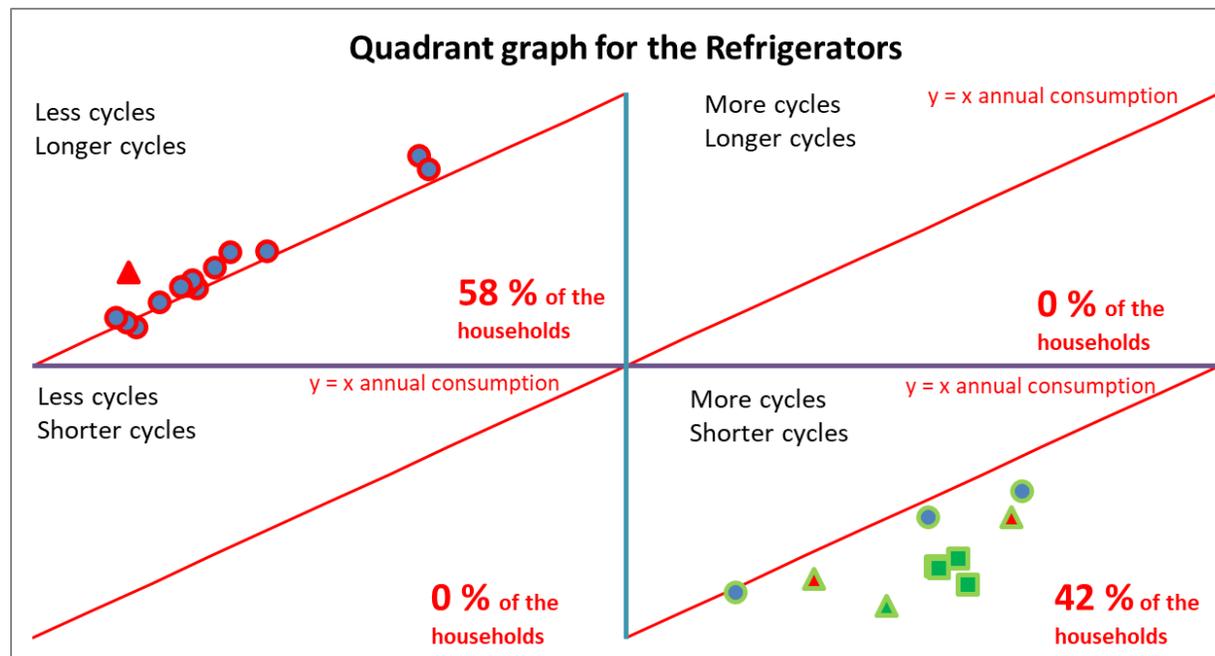


Results for the fridges

- 24 households

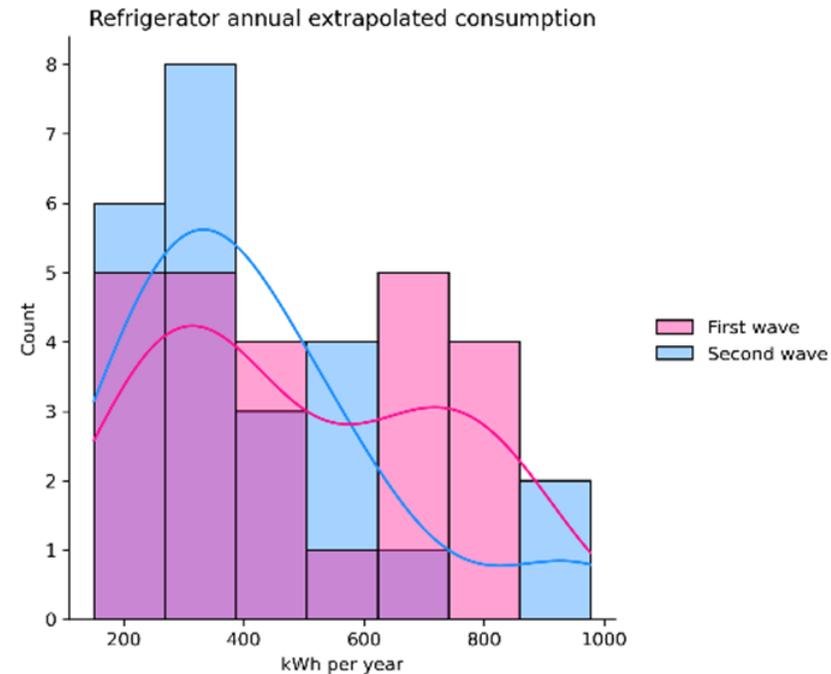
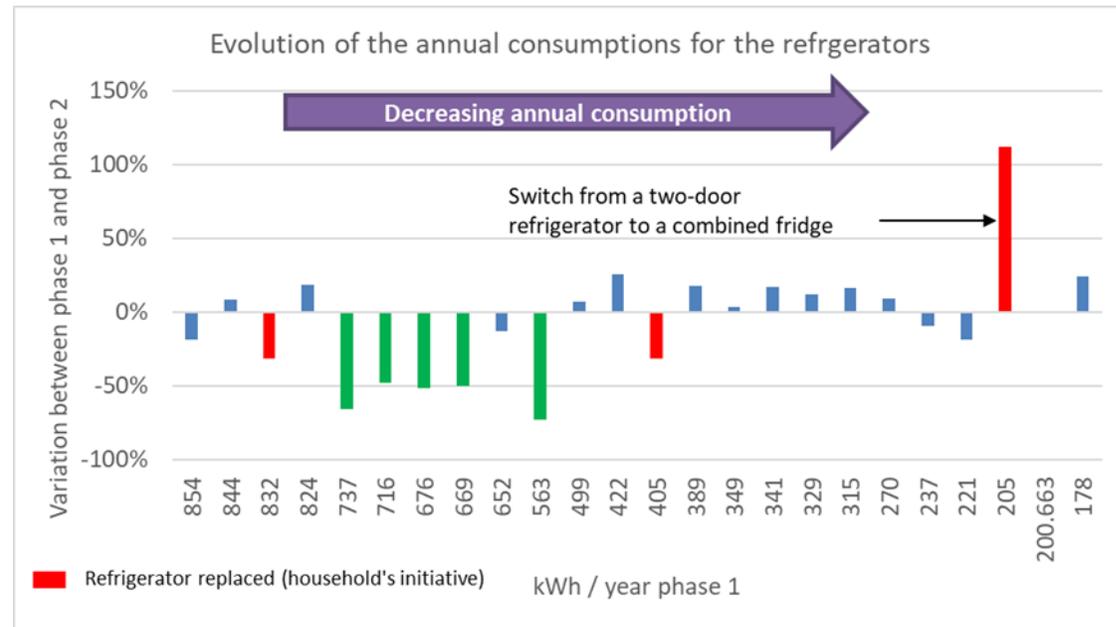
- Household with an average consumption per cycle lower in phase 2 than in phase 1
- Household with an average consumption per cycle higher in phase 2 than in phase 1
- ▲ Household with an average consumption per cycle lower in phase 2 than in phase 1 with an appliance replaced (household's initiative)
- Household with an average consumption per cycle lower in phase 2 than in phase 1 with an appliance replaced (USER's initiative)
- ▲ Household with an average consumption per cycle higher in phase 2 than in phase 1 with an appliance replaced (household's initiative)
- ▲ Household with an average consumption per cycle lower in phase 2 than in phase 1 with an appliance replaced (household's initiative with EDF coupon)

- The indoor temperature could not be controlled nevertheless, we can see that those who did not replace their appliance are somehow close to the first bissector



Results for the fridges

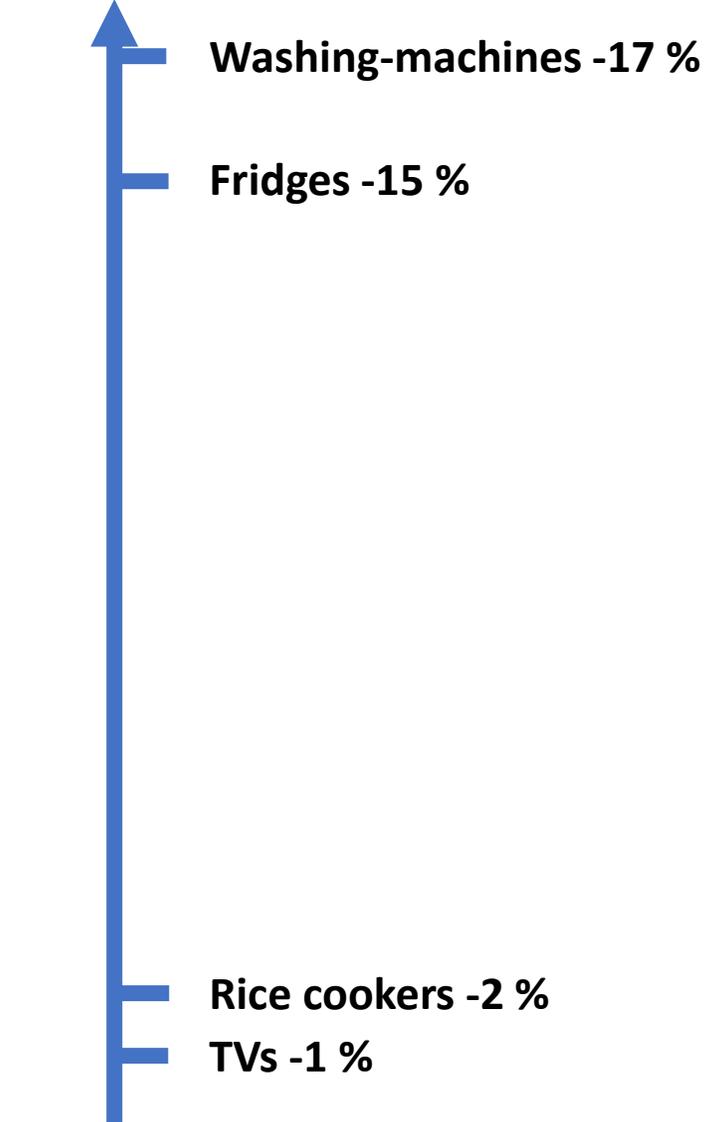
- 24 households
- Overall, the global (sum) consumption decreased by 15 %...
- **Lesson learned:** the appliances stock contains a significant number of malfunctioning appliances. When they are replaced, the gains are there. For the unreplaced ones, the effects of the advice are more uncertain



3

Conclusion and perspectives

Conclusion



- 2 groups:
 - ✓ Around -15%:
 - Washing-machines: advice
 - Fridges: replacement
 - ✓ Around -2 %:
 - Rice cookers: advice
 - TVs: advice
- Merit order according to what we noticed through the USER project:
 - ✓ **No replacement possible:** the appliances for which the household has “full control”, understands the direct impact of its actions (number of cycles, temperature) should be targeted first as for example the washing-machines
 - ✓ **A replacement is possible:** the malfunctioning cold appliances should be sought after. In doing so, the gains are significant in terms of direct electricity consumed
 - ✓ For **end-uses with strong habits** like cooking and entertainment, advice can be given but positive results seem harder to reach even if cooking leaves room for hope.

Perspectives

If further works should be continued, it would be interesting:

- To have a **feedback from the households** about why they could not follow some advice for some end-uses (cooking for example)
- To put in place, for the cold appliances, a **temperature control** instead of the sole “ same season ”
- To conduct the measures on a **larger sample** of households for more robust conclusions (but it's difficult and expensive!)

Curious about the first part of the USER project?

[“Load monitoring at a short time step to set up actions: a feedback from the USER project on the Reunion Island” ECEEE Summer Study 2022](#)

ADEME

- **Thérèse KREITZ** – White products expert – Ecodesign directive and energy labelling

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