DELIVERABLE 5.9:

SSH REPORT ON DEMAND RESPONSE AND CONSUMER BEHAVIOUR

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Change Control

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1 EXECUTIVE SUMMARY

With deliverable 5.9, the consortium is expected to report on the consumer behaviour and socio-economic status of Borkum's citizens. The deliverable is expected to provide insights of how citizens are currently consuming energy, how specific profiles of citizens are consuming energy, and how willing they are to adapt their energy consumption to the production of green energy on the island. This report will be updated regularly during the whole duration of the Islander project with new insights based on the data. Furthermore, in case of need, we will develop concrete actions that could be implemented to increase the willingness of citizens to adapt their energy consumption behaviour to the demands of the island, which will positively impact the success of the Islander project. For example, in this report we will present a study on which the KULeuven researchers arz currently working, used to develop a document (e.g. flyer) that will be implemented on the Island to stimulate citizens' willingness to adapt their energy consumption.

In this deliverable, we start by explaining which SSH data we plan to collect (such as the type of data and the methods of data collection) and wherefore we plan to use the data. Then, in the second part of the report, we focus on consumer engagement in general, how we can use existing literature in the Islander project, and present the development of the concrete action designed by the researchers of the KULeuven.

2 SSH REPORT

2.1 General

SSH (Social Sciences and Humanities) data are data containing information about the social and human aspects of the participants. To collect data concerning the SSH information of the involved sites and citizens, we developed multiple surveys based on existing validated questionnaires that will allow us to create a specific profile type for each respondent. For this project, we make a difference between private citizens and their household characteristics, and commercial citizens with their building characteristics. We decided to focus on private and commercial buildings separately because the type of building and its daily use requires a different energy consumption and also a different approach to adapt energy consumption to the production of green energy of the island. Therefore, for both types of citizens, a different method will be used to collect SSH data.

2.2 Private households

To collect SSH data of private households, we developed a questionnaire based on the validated questionnaire "Residential Energy Consumption Survey 2020" (RECS2020) [1]. We select the RECS2020 questionnaire as a base, because it was previously validated and used in data collection concerning erngy consumption and contained all questions we needed for the Islander project. We use most questions from the RECS that can be relevant and/or applicable to our current project and added a few specific questions (self-developed) that were necessary to get a complete view of the SSH data of the citizens of Borkum.

The questionnaire, called "Household Profile Survey", will collect data on the following SSH information:

- Household characteristic (such as age, number of persons living in the habitation, employment status, education of the respondent, yearly income)
- Habitation characteristic (e.g. number of floors, number of rooms)
- Number and type of appliances present in the habitation
- Heating and cooling settings
- Use of green energy
- Willingness to engage in the Islander project

The "Household Profile Survey" will be the first questionnaire participants will be asked to fill in. The main goal of this questionnaire is to create a specific household profile for each household based on their particular household characteristics. Based on the results of the descriptive and factor analyses, we will be able to create specific profiles of household, which will allow us to define the different socio-economics status present on Borkum, their energy consumption profile, and link their household profile with their (exact) energy use, allowing us to know how different types of private citizens consume energy.

The "Household Profile Survey" can be found in Appendix A.

2.3   Commercial buildings

For the SSH data collection of commercial buildings, we will use a in German translated version of the validated "**Survey of Commercial and Institutional Energy Use**" [2] questionnaire, which will be called the "Commercial Building Survey". As in previous section, the "Survey of Commercial and Institutional Energy Use" was selected because it was alreadu successfully validated and implemented in studie investigating energy consumption in different commercial buildings.

The "Commercial Building Survey" will be the first questionnaire presented to the commercial citizens participating in the Islander project, and will collect data on the following information:
- Type of commercial activity(ies) in the building
- Heating and cooling settings
- Number and types of parking
- Number of portable appliances (e.g., laptop) used in the building
- Specific questions related to the activity (e.g., restaurant, shopping mall, etc.)
- Number of equipment in the building

This questionnaire aims to collect tangible information about the number and types of commercial buildings on the island and their general energy use. The type of building and the activities practised in the building will be linked with their actual energy consumption data to define how much energy is consumed by a specific building.

The "Commercial Building Survey" can also be found in Appendix B.

3 (ENERGY) CONSUMPTION BEHAVIOR

3.1   General

Next to the general SSH data and energy consumption preferences and habits collected using the ""Household Profile Survey", we will collect data on citizens' real energy consumption behaviour using two methods. The first method will be used to collect real-time energy consumption data by using smart meters to be installed in a restricted number of households

on the island. The second method will be used to collect general energy consumption data of all involved citizens by using a diary survey.

3.2   Smart meters data

Smart metering technology is a key component of a smart grid system. It enables real-time measurement and communication of energy consumption data. The data collected are energy or power series (in kWh or kW) as a function of time. In contrast, traditional meters are not equipped with such communication abilities (the data is collected manually) [3].

In Borkum, accommodations and commercial buildings (except for larger consumers) are furnished with traditional meters. Electrical consumption data are collected once a year by NBG company.

Task 4.1 of WP4 aims at forecasting individual energy consumption. To do so, the model will learn from previously observed values. The granularity of the input data can significantly impact model accuracy. It must be equal or lower than the one of the output data. Given that, annual consumption data are not suitable for short-term (day-to-day) forecasting applications [4].

To address this issue, two options have been evaluated:

- On the one hand, we considered installing a smart meter connected to the inverter to be able to collect real-time consumption data at a low granularity (less than 1 hour)..
- On the other hand, we considered using smart meters alone. A comparative evaluation of the smart metering technologies was conducted. The smart meters were classified according to the communication network used (and its availability in Germany), the installation (by an electrician or not), its compatibility with all mechanical meters, data reliability, data accessibility, and data confidentiality and the budget. Four technologies were selected (cf figure): the Ecojoko assistant (https://www.ecojoko.com/), the Shelly 3EM (https://shelly.cloud/products/shelly-3em-smart-home-automation-energy-meter/), the Voltaware communicating meter (https://voltaware.com/), and the emonPi energy monitor (https://shop.openenergymonitor.com/emonpi/). The devices will be tested soon, and one will be selected in case the inverter solution is not available.
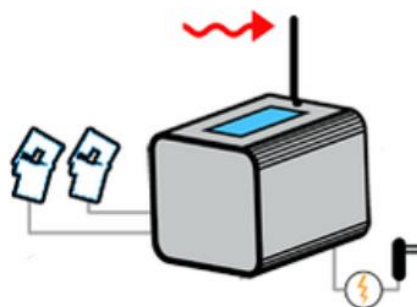

Figure: Picture of theEcojoko assistant (left side) and scheme of the emonPi energy monitor (right side).

3.3   Diary survey

3.3.1   Presentation

The diary survey was developed based on the validated survey "American Time Use

Questionnaire" [5]. This survey will be used complementarily to the smart meters data collection, in order to collect data on how citizens are using energy. The advantage of the diary survey, contrary to the smart meters, is that it allows to collect energy consumption data of a large group of citizens at once. As smart meters will be installed in a small number of households, we will use the diary survey to collect data in other households in our sample. The data collected with the diary survey will be compared to the data collected with the smart meters in order to assess the validity of the collected diary survey data.

3.3.2 Study design

A short time after completing the "Household Profile Survey", citizens involved in the project will be contacted for the start of the diary survey data collection. Citizens will be directly contacted by our partner "Borkum GMBH" to ask if they are interested in participating in the second part of the study. If they agree, the researchers of the KULeuven will contact them to plan the first contact.

During this first contact, the researchers will clearly explain the goal of the survey, how they will be asked to fill in the survey, and take notes of the number and type of appliances present in the house. After the first contact, citizens participating in the diary survey will receive a first diary survey online. In this diary survey, citizens will be asked to fill in once a day, for a duration of one week, which activities they did the last 24hours and which appliances were involved in the specific activities.

In order to get a view of how seasons are affecting energy consumption, citizens will be asked to repeat the diary survey each season. Thus, the diary survey will be filled in for four weeks in total, one week each season.

The diary survey can be found in Appendix C.

In any case, KUL will not use personal data such as email or full name to preserve identity, and all surveys will be pseudonimised. KUL will link each e-mail with a specific ID, and at the beginning of surveys, participants will be asked to fill in their ID. With this ID KUL will be able to link the data from different questionnaires for the same participant together.

Furthermore, all participants will be requested to sign a form to provide their explicit consent to process the data gathered in the questionaires.

3.3.3 Link with SSH data

The results of the smart meters and diary survey will provide us with concrete data representing the energy consumption of the involved households in the project. As stated above, this energy consumption data will be linked with the specific household profile computed based on the SSH data. This linkage will allow us to compute a predictive model (Individual energy demand forecast model), which will be used to predict how much energy will be consume by a specific type of household on the island. The final model and its data will be available in deliverable 4.1.

4 INCREASING ADAPTATION DEMAND RESPONSE (CONSUMER ENGAGEMENT)

4.1 Consumer engagement

Consumer engagement is an important factor in the success of the Islander project. The level of consumer engagement will define how strong Borkum's citizens will be willing to adapt

their current energy consumption accordingto the production of green energy of the island.

Different partners (KULeuven, EMEC, DAFNI, and REAK) will be involved in engaging citizens in the project. In this deliverable, we will discuss in detail what KULeuven can provide to the project.

4.2   Consumer engagement in Borkum

As stated in the introduction, we will keep track of Borkum's citizens' energy consumption behavior for a long-term duration (+- 1 year), which will allow us to gain insights on how citizens are adapting their energy consumption behavior during the project and to conclude if they were able to adapt fully to the production of the island or not.

The first time participants fill-in the dairy survey will be used as a baseline of their daily energy consumption. By comaring that baseline with the other answers to the dairy survey (which will be filled in on a period of 1 year), we will be able to investigate changes in their energy consumption behaviour. If the comparison indicates no or too small changes in energy consumption, we will implement interventions that will stimulate the participants to adapt their energy consumption better to the production of the island.

4.3   Increasing consumer engagement

If we note any problems with adapting energy consumption to the green energy production of the island, we will make use of existing literature to find a fast action to promote energy consumption adaptations, and if necessary, we will develop a concrete action to stimulate even further citizens' behavioral changes.

4.3.1   Literature Review

At this moment, we conducted a literature review that allowed us to select already proven engagement actions. The result of the literature review can be found in the table below. The table presents the following information:
- Authors: name of the authors of the scientific paper
- Year: year of publication
- Independent variable: factor and/of intervention used to stimulate engagement in pro-environmental behavior
- Dependent variable: the type of pro-environmental behavior measured
- Moderators: process behind the relation independent variable – dependent variable, if applicable
- Results: findings of the research paper
- Malleability of the factor: the ease with which we could implement the factor (e.g. intrinsic factors of individuals are very difficult to change)

Authors	Year	Independent variable	Dependent variable	Moderator(s)	Results	Malleability of the factor
Hatty, Smith, Goodwin, & Mavondo	2020	Connection with nature	Range of pro-environmental behaviors	/	Positive relation between connection with nature (CN) and environmental and altruistic values, time spent in nature and range of pro-environmental behaviors	Low
Meleady, Abrams, Van de Vyver, Hopthrow, Mahmood, Player, Lamont, & Leite	2017	Instructive message	Turning down car engine	Private self-focus	A surveillance condition (watching eyes) are not effective in stimulating individuals to turn down their car engine at a stop. However, evocating the private self-focus of individuals is effective in stimulating them to turn down their car engine.	High
Meyer	2015	Education	8 pro-environmental behaviors	/	Education increases a range of pro-environmental behavior (e.g. separate waste, reduce energy	High

					consumption…) because it causes individuals to be more concerned with social welfare	
Remmery & Van Gysel (Master Thesis)	2018-2019	Knowledge	Palm oil consumption	Consequence vs action knowledge	Consequence knowledge (and not action knowledge) increases willingness in PECB	High
Duarte & Wyverkens (Master Thesis)	2018-2019	Advertisement	Use of reusable cups	Humor	More use of reusable cups in library with humorous flyer than in library without. BUT: no difference in conditions if you take baseline into account	High
Kadic-Maglajlic, Arslanagic-Kalajdzic, Micevski, Dlacic, & Zabkar	2019	Pro-environmental & pro-social consumer engagement	Pro-environmental & pro-social behavior	Emotional intelligence	pro-environmental engagement and pro-social engagement are significant predictors of young adults' pro-environmental and pro-social consumption behavior. Emotional intelligence, which allows to be more aware of societal issues and problems and to be more aware of the positive consequences of their participation, boosts the effect of engagement on pro-environmental and pro-social consumption behavior, and it has a significant direct effect on pro-environmental behavior.	Low
Lee, Sung, Wu, Ho , & Chiou	2020	Episodic Future Thinking	Pro-environmental behaviors (air-conditioning use reduction, vegetarian food choice, cleaning beaches)	Climate Perception change	Episodic Future Thinking leads to more pro-environmental behaviors because it makes events more concrete and decreases psychological distance.	High
Tagkaloglou & Kasser	2018	Motivational Interviewing	pursuing collaborative activist pro-environmental goals	/	Motivational interviewing (= person-centered interview, used to elicit patient motivation to change a specific negative behavior. MI engages clients, elicits change talk and evokes patient motivation to make positive changes) works very good on individuals already engaged in pro-environmental behavior, if they are not already engaged in pro-environmental behavior then a directive (= interview in which we try to convince individuals) interview will be more effective	High
Jain, Gulbinas, Taylor, Culligan	2013	eco-feedback	energy consumption	/	social influence plays a role in energy consumption + Normative eco-feedback leads to more energy savings	High
James & Ambrose	2017	Behavioral change (education) & retrofit (targeting the building where individuals live in)	Energy consumption	/	Results of retrofit OR retrofit + behavioral change are the most effective. Behavioral change on his own has not more effect than control condition	High
Romanach, Hall, & Cook	2013	Social network, financial incentive, media, environmental motivation	Recruiting and retaining low-income individuals in behavioral program change	/	Recruitment of participants for energy behavior change programs through social networks of the participant was most effective to recruit and retain participants. Outside of social network then financial incentive was most effective but then lower retention Promotion of the program was important. Even more effective when promotion was done within the social network Use of media was ineffective Potential financial gain was main driver for participation	High
Wu, DiGiacomo, & Kingstone	2013	Sustainable building	Food disposal	/	People are more likely to engage in pro-environmental behavior in a building that is designed according to it compared to a "normal" building	High
Dietz, Stern, & Weber	2013	/	Energy consumption	/	Review on factors that could make an intervention for reducing energy consumption successful - Economic view is wrong. Not only financial aspect is important when designing an intervention (~energy efficiency gap) - Important to consider social & psychological factors - By examining plasticity, number of eligible households, and technical potential we can try to derive the success of an intervention	High

					- Most effective intervention has 5 factors o Financial incentives o Smartly communicated (social influences can be useful) o Information must be accurate and from credible sources o Simple processes are more likely to be adopted o Quality assurance is essential	
Burchell, Rettie, & Roberts	2016	feedback on in-home displays (IHDs)	Energy consumption	/	Findings support idea that providing feedback on energy consumption (and compared to neighbors) can positively affect energy consumption within household BUT: long-term involvement is difficult to achieve - Can be resolved (here: community feeling & weekly mail with advice, tips, reminders)	High
Jessoe & Rapson	2014	Information & feedback	Energy consumption	Learning facilitation	Information on price events combined with in-home displays reduced energy consumption by between 8 to 22%. Survey evidence suggest that information facilitates learning	High
Houde, Todd, Sudarshan, Flora & Armep	2013	Real-time feedback	Energy consumption	/	Access to the real-time feedback lead to an average reduction of 5.7% of household electricity consumption and significant reduction persist for up to 4 weeks. There were largest reductions observed initially at all times of the day. However, as time passes, morning and evening intervals show larger reductions	High
Asensio & Delmas	2016	Information messages	Energy consumption	/	Health based frame of information was found to induce persistent energy savings behavior by 8-10% over 100 days. However, more traditional cost saving frames was not that very effective	High
Delmas & Lessem	2014	Private versus public information	Energy consumption	/	Results show that, while private (for consumer only) information alone was not effective, public (open to everyone) information combined with private information motivated a 20% reduction in electricity consumption achieved through lower use of heating and cooling	High

4.3.2 Concrete proposition

Based on the studies of Meyer (2015) and Lee, Sung, Wu, Ho , and Chiou (2020) [see above], the researchers of the KULeuven are currently developing a physical document (e.g. flyer) that could be implemented on the island to stimulate citizens' engagement in the project. Concretely, the document will contain information about energy consumption and its consequences for the environment with a focus on the short-term consequences and its influence on the future daily life of individuals.

The efficacy of this document in increasing individuals' willingness to adapt their energy consumption and to invest in renewable energy sources will be investigated by means of an online study implemented on the platform Qualtrics.

If the efficacy of the developed document is proven to be high, the document will be translated and adapted to the island's citizens and used to stimulate the citizens of Borkum to engage in the Islander project and to adapt their current energy behaviour to be in line with the green energy production of the island.

5 GENERAL CONCLUSIONS

SSH data on demand response and consumer behaviour on the island will be broadly investigated by the researchers of the KULeuven and the involved partners.

In a first step, we will collect data allowing us to define a specific profile for each citizen involved in the data collection. Those profiles and their characteristics will be applied to the rest of Borkum's citizens. This will provide us with an overview of all the different kind of citizens living on the island. In a second stop, we will collect data on how citizens are consuming energy. Those data will be linked to their specific profile, allowing us to predict the energy consumption of each type of citizen on the island. The collection of energy consumption data will last for about 1 year, allowing us to follow-up changes and adaptions in energy consumption behaviour on the island.

Based on the results of the collection of energy consumption behaviour data, we will be able to asses if Borkum's citizens were enough engaged in the project to adapt their consumption behaviour to the green energy production of the island. If they were not able to adapt their energy consumption behaviour accordingly, we will make use of the document developed by the researchers of the KULeuven to stimulate their engagement and foster their willingness to adapt their energy consumption.

6 REFERENCES

[1] https://www.eia.gov/consumption/residential/

[2] https://www.statcan.gc.ca/eng/survey/business/5034

[3] Martins, João F., et al. "Smart meters and advanced metering infrastructure." *Pathways to a Smarter Power System*. Academic Press, 2019. 89-114.

[4] Bourdeau, Mathieu, et al. "Modeling and forecasting building energy consumption: A review of data-driven techniques." *Sustainable Cities and Society* 48 (2019): 101533.

[5] https://www.bls.gov/tus/

7 APPENDICES

7.1 APPENDIX A – HOUSEHOLD PROFILE SURVEY

Household Characteristics

What is your sex?
1 Female
2 Male
3 I prefer not to answer

What is your age?
_____ years old

Which best describes your current employment status?
1 Employed full-time
2 Employed part-time
3 Retired
4 Not employed

What is the highest degree or level of school you have completed?
1 Less than high school diploma

2 High school diploma
3 Bachelor's degree
4 Master's, or Doctoral degree

Including yourself, how many people live in this home? Do not include anyone who is just visiting,
those away in the military, or children who are away at college.
_____ household members

Are you currently living with a husband (wife) or partner?
1. Yes
2. No
3. Refuse

How many members of your household are in the following age categories?
0 to 17 years old _____ household members
18 to 64 years old _____ household members
65 years or older _____ household members

How many <u>weekdays</u> is someone at home most or all of the day?
0 None
1 1 day
2 2 days
3 3 days
4 4 days
5 5 days

Including all income sources, which category best describes the total combined income of all
household members for the last year, before taxes and deductions?
1 < 10.000€
2 10.000€ - 15.000€
3 15.000€ - 20.000€
4 20.000€ - 25.000€
5 25.000€ - 50.000€
6 > 50.000€

Who manages the household budget?
1 Me
2 My partner
3 Both
4 Someone Else

Who pays the bills?
1 Me
2 My partner
3 Both
4 Someone Else

Who makes decisions regarding purchase of electronic products (e.g. TV)?
1 Me
2 My partner
3 Both
4 Someone Else

Who makes decisions regarding purchase of financial products?
1 Me
2 My partner
3 Both
4 Someone Else

Who makes decisions regarding purchase of energy products (e.g. energy bills, heating sources…)?
1 Me
2 My partner
3 Both
4 Someone Else

Your home

Which best describes your home?
1 Mobile home
2 Single-family house detached from any other house
3 Single-family house attached to one or more other houses (for example: duplex, row house, or townhome)
4 Apartment in a building with 2 to 4 units
5 Apartment in a building with 5 or more units

Is any part of your basement finished? For this survey, a "finished" basement has finishing materials on the floor, ceiling, and
walls.
1 Yes
0 No

An attic is a space just below the roof of your home where a person can stand up. Does your home have an attic?

1 Yes
0 No

Is any part of your attic finished? For this survey, a "finished" attic has finishing materials on the floor, ceiling, and walls. [If attic is yes]
1 Yes
0 No

Not including basements or attics, how many stories does your home have?
1 One story
2 Two stories
3 Three stories
4 Four or more stories
5 Split-level

Does your home have an attached garage?
1 Yes
0 No

Is your home…
1 Owned by you or someone in your household?
2 Rented?
3 Occupied without payment of rent?

Do you pay for utilities as a part of your rent? [IF rented]
1 Yes
0 No

Although you do not know the exact year your home was built, it is helpful to have an estimate. About when was your home built?
1 Before 1950
2 1950 to 1959
3 1960 to 1969
4 1970 to 1979
5 1980 to 1989
6 1990 to 1999
7 2000 to 2009
8 2010 to 2015
9 2016 to 2020

For how long do you live in this house/apartment?
1 Less than 1 year
2 1 – 5 years
3 More than 5 years

Was your home vacant for one or more months between January 2021 and now?
1 Yes
0 No

What is the surface (in m2) of your home?
_____ square meter (m2)

How many of the following types of rooms are in your home? *If none, please enter "0."*
_____ Number of bedrooms
_____ Number of full bathrooms (A full bathroom includes a sink with running water, a toilet, and a bath or shower.)
_____ Number of half bathrooms (A half bathroom includes a sink with running water and either a toilet, a bath, or a shower.)
_____ Number of other rooms (Include kitchens, laundry rooms, living or family rooms, home offices, etc. Do not include hallways, closets, or rooms you already counted above.)

Most ceilings are about 2.50 meter high which is about 50 cm higher than a standard door. Are any of the ceilings in your home higher than 2.50 meter?
1 Yes
0 No

About how many windows does your home have?
1 1 or 2 windows
2 3 to 5 windows
3 6 to 9 windows
4 10 to 15 windows
5 16 to 19 windows
6 20 to 29 windows
7 30 or more windows

Not counting storm windows, which best describes the glass in most of the windows in your home?
1 Single-pane glass
2 Double-pane glass

3 Triple-pane glass

What is the orientation of your house/appartement?
1 North
2 South
3 East
4 West
5 North-East
6 North-West
7 South-East
8 South-West

Do any large trees or buildings shade your home from the afternoon sun?
1 Yes
0 No

Is your house built such that the sun can heat it ups?
1 Yes
0 No

Which of the following best describes the insulation level of your home?
1 Well insulated
2 Adequately insulated
3 Poorly insulated
4 Not insulated

How often do you or other members of your household find your home too drafty?
1 All the time
2 Most of the time
3 Some of the time
4 Never

Does your home have its own swimming pool?
1 Yes
0 No

In the last year, how many months was your swimming pool in use? [IF swimming pool is yes]
_____ months

Does your swimming pool have a variable-speed pump, which uses less energy by adjusting the motor speed? [IF swimming pool is yes]
1 Yes
0 No

What fuel is used to heat the water in your swimming pool? [IF swimming pool is yes]
0 None, my swimming pool is not heated
1 Electricity
2 Natural gas from underground pipes
3 Propane (bottled gas)
4 Fuel oil
5 Other

Does your home have its own hot tub, spa, or Jacuzzi, other than a bathtub?
1 Yes
0 No

In the last year, how many months was your hot tub, spa, or Jacuzzi in use? [IF jacuzzi is yes]
_____ months

What fuel is used to heat the water in your hot tub, spa, or Jacuzzi? [IF jacuzzi is yes]
1 Electricity
2 Natural gas from underground pipes
3 Propane (bottled gas)
4 Fuel oil
5 Other ([WEB: specify below / PAPER: please specify]) [FUELTUB_OTH]

What is your electricity/gas tariff?
1 on-peak
2 off-peak
3 I don't know

Appliances

Do you use "home automation", such that you can let appliances run without someone being at home?
1 Yes

0 No

Please, indicate which electric appliance you have in your home

Living room

Appliance	Number (0, 1, 2, etc)	How many times per week	At what time of the day? (morning, afternoon, evening, night)	Energy label or power of the appliances	Can the appliance be controlled (can you program it when you want?)
Small appliances (robot, toaster, rice cooker, coffee machine, mixer, etc)					/
Electric oven					/
Electric hob					/
Kitchen hood					/
Microwave					/
Freezer					/
Fridge					/
Dishwasher					Yes/No
Kettle					/

Appliance	Number (0, 1, 2, etc)	How many days per week	At what time of the day?	Energy label or power of the appliance
TV				
Tablet				
HIFI chain				

Cleaning devices

Appliance	Number (0, 1, 2, etc)	How many days per week	At what time of the day?	Energy label or power of the appliance	Can the appliance be controlled (can you program it when you want?)
Dryer					Yes/No
Iron					/
Vacuum cleaner					Yes/No
Washing machine					Yes/No

Desk

Appliance	Number (0, 1, 2, etc)	How many days per week	At what time of the day?	Energy label or power of the appliance
Laptop/Computer/Tablet				
Mobile phone				

Others

Appliance	Number (0, 1, 2, etc)	How many days per week	At what time of the day?	Energy label or power of the appliance	Can the appliance be controlled (can you program it when you want?)
Electric hot water tank					Yes/No
Towel dryer					/
Swimming pool					Yes/No
Electric vehicle					Yes/No
Heat pump					Yes/No
Jacuzzi					Yes/No
Electric bike					Yes/No
Hair dryer					/
Home cinema					/
Electric air conditioner					Yes/No
…					
…					

Space Heating

Is your home heated during the winter?

      1 Yes
      2 No, I do not have any heating equipment
      3 No, I have heating equipment but do not use it

Which of the following best explains why your home is not heated during the winter? [IF not heated]

      1 I live in a warm area where heating isn't needed
      2 I recently moved into this home and have not been here during the winter yet
      3 My heating equipment is broken or I can't afford to heat my home

4 I do not live in this home during the winter
5 Other

What is the main type of heating equipment used to provide heat for your home?
1 Central furnace
2 Steam or hot water system with radiators or pipes
3 Central heat pump
4 Ductless heat pump, also known as a "mini-split"
5 Built-in electric units installed in walls, ceilings, baseboards, or floors
6 Built-in room heater burning gas, oil, or kerosene
7 Wood or pellet stove
8 Portable electric heaters
9 Other

What is the fuel used by your home's main heating equipment?
1 Electricity
2 Natural gas from underground pipes
3 Propane (bottled gas)
4 Fuel oil
5 Wood or pellets
6 Other

About how old is your home's main heating equipment? Your best estimate is fine.
1 Less than 2 years old
2 2 to 4 years old
3 5 to 9 years old
4 10 to 14 years old
5 15 to 19 years old
6 20 or more years old

Does your home have a geothermal/ground source heat pump?
1 Yes
0 No

Many heat pumps have a backup or emergency heating method that can be used when it is very cold. What type of backup or emergency heating does your heat pump use? [IF heat pump]
1 Electric backup
2 Natural gas backup (dual-fuel system)
0 No backup

In addition to your main heating equipment, which of the following is used as a second source for heating your home? If more than one, select the type most frequently used.
0 No other equipment used
1 Portable electric heaters
2 Fireplace
3 Wood or pellet stove
4 Built-in electric units installed in walls, ceilings, baseboards, or floors
5 Ductless heat pump, also known as a "mini-split"
6 Other

Which of the following best describes how your household uses the secondary heating equipment during the heating season?
1 Use all or almost all of the time
2 Use at least once per week
3 Use a few times per month
4 Use only when it is very cold
5 Use only in rare situations, such as when a guest is visiting

How many portable electric heaters are used in your home?
_____ portable electric heaters

How many fireplaces are used in your home?
_____ fireplaces

How many ductless heat pump indoor units or "heads" are used to heat your home?
_____ indoor units

Are the following spaces in your home heated?
Basement
1 Yes
0 No
-3 Not applicable (my home does not have this space)
Attic
1 Yes
0 No
-3 Not applicable (my home does not have this space)

Attached garage
1 Yes
0 No
-3 Not applicable (my home does not have this space)

Humidifiers add moisture to the air and are often used in the winter. Is a humidifier used in your home?
1 Yes, a portable humidifier
2 Yes, a whole-home humidifier
0 No

How many portable humidifiers are used in your home? [IF humidifier]
_____ portable humidifiers

Which of the following best describes how your household uses the humidifier? [IF humidifier]
1 Use only occasionally, such as when someone in the household is sick
2 Use only during winter months
3 Use about half of the year
4 Use all or almost all of the year
5 Other

Air Conditioning

Is any air conditioning equipment used in your home?
1 Yes
0 No

What is the main type of air conditioning equipment used to cool your home? [IF air conditioning]
1 Central air conditioner
2 Central heat pump
3 Ductless heat pump, also known as a "mini-split"
4 Window or wall air conditioner
5 Portable air conditioner
6 Evaporative or swamp cooler

About how old is your home's main air conditioning equipment? Your best estimate is fine. [IF air conditioning]
1 Less than 2 years old
2 2 to 4 years old
3 5 to 9 years old
4 10 to 14 years old
5 15 to 19 years old
6 20 or more years old

Are the following spaces in your home air-conditioned? [IF air conditioning]
Basement
1 Yes
0 No
-3 Not applicable (my home does not have this space)
Attic
1 Yes
0 No
-3 Not applicable (my home does not have this space)
Attached garage
1 Yes
0 No
-3 Not applicable (my home does not have this space)

Thinking about the air conditioning, which of the following best describes how your household uses air conditioning? [IF air conditioning]
1 Use only occasionally, such as when it is very hot or when guests are over
2 Use only during summer months to stay cool
3 Use about half of the year
4 Use all or almost all of the year, such as for white noise or air circulation
5 Other ([WEB: specify below / PAPER: please specify]) [USECFAN_OTH]

Dehumidifiers remove moisture from the air and are often used in the summer. Is a dehumidifier used in your home?
1 Yes, a portable dehumidifier
2 Yes, a whole-home dehumidifier
0 No

How many portable dehumidifiers are used in your home? [IF dehumidifiers]
_____ portable dehumidifiers

Which of the following best describes how your household uses the dehumidifier? [IF dehumidifiers]
1 Use only occasionally, such as when someone in the household is suffering from allergies

2 Use only during summer months
3 Use about half of the year
4 Use all or almost all of the year
99 Other

Thermostats and temperatures

Does your household use a thermostat to control the temperature inside your home?
1 Yes, a manual or non-programmable thermostat
2 Yes, a programmable thermostat
3 Yes, a "smart" or Internet-connected thermostat
0 No

Which of the following best describes how your household controls the indoor temperature during the winter?
1 Set one temperature and leave it there most of the time
2 Manually adjust the temperature
3 Programmable or smart thermostat automatically adjusts the temperature
4 Turn equipment on or off as needed
5 Our household does not have control over the temperature
99 Other

The next questions are about the temperature inside your home during the winter. If you have a thermostat, think about where your household sets the temperature for your main heating equipment. If you do not have a thermostat, your best estimate about the temperature is fine.
During the winter, what is your home's typical indoor temperature…
When someone is home during the day? _____ degrees
When no one is inside your home during the day? _____ degrees
Inside your home at night? _____ degrees

Which of the following best describes how your household controls the indoor temperature during the summer?
1 Set one temperature and leave it there most of the time
2 Manually adjust the temperature
3 Programmable or smart thermostat automatically adjusts the temperature
4 Turn equipment on or off as needed
5 Our household does not have control over the temperature
99 Other

The next questions are about the temperature inside your home during the summer. If you have a thermostat, think about where your household sets the temperature for your main airconditioning equipment. If you do not have a thermostat, your best estimate about the temperature is fine.
During the summer, what is your home's typical indoor temperature…
When someone is home during the day? _____ degrees
When no one is inside your home during the day? _____ degrees
Inside your home at night? _____ degrees

Water Heating

What is the approximate size of your main water heater?
1 Small (115 liter or less)
2 Medium (116 to 185 liter)
3 Large (186 liter or more)
4 Tankless or on-demand

Is your main water heater insulated using a water heater blanket?
1 Yes
0 No

About how old is your main water heater? Your best estimate is fine.
1 Less than 2 years old
2 2 to 4 years old
3 5 to 9 years old
4 10 to 14 years old
5 15 to 19 years old
6 20 or more years old

What fuel does your main water heater use?
1 Electricity
2 Natural gas from underground pipes
3 Propane (bottled gas)
4 Fuel oil
5 Wood

6 Solar thermal
7 Other ([WEB: specify below / PAPER: please specify]) [FUELH2O_OTH]

Do you have more than one water heater?
1 Yes
0 No

Lightning
How many inside light bulbs do you have in the house?
_____

The next questions are about inside light bulbs. For fixtures with multiple bulbs, count each bulb separately.
Thinking about the light bulbs inside your home, how many are turned on…
Between 1 and 4 hours per day? _____ light bulbs
Between 4 and 8 hours per day? _____ light bulbs
More than 8 hours per day? _____ light bulbs

What portion of the light bulbs used inside your home are LED bulbs?
1 All
2 Most
3 About half
4 Some
0 None

Do you sometimes leave lights on in a room where no one is present?
1 Yes
0 No

Do you or someone else in your home sleeping with the lights on?
1 Yes
0 No

How many outside light bulbs do you have in the house?
_____

The next questions are about outside light bulbs.
Does your home have any outside light bulbs that are typically left on all night? Do not include light bulbs are controlled by motion detectors or solar lights that do not use electricity.
1 Yes
0 No

Green Energy
Not including back-up generators, does your home have any of these on-site systems that generate electricity? *Please select all that apply.*
No on-site generation system
Solar or photovoltaic system
Small wind turbine
Combined heat and power system
No

In what year was your solar or photovoltaic system installed? [IF solar system]
_____

What is the capacity of your solar or photovoltaic system in kW (kilowatts)?
_____ kW

Have you changed your consumption behavior since you have installed your solar panels?
1 Yes
0 No
99 I don't know

Explain:

Do you or any member of your household own or lease an electric vehicle? Please include both all electric and plug-in hybrid electric vehicles.
1 Yes
0 No

At which of the following places do you typically charge your electric vehicle? [IF electric vehicle]
Yes No

Your home		1 0
Your apartment building or complex	1 0	
Your workplace or school	1 0	
Shopping center or business you frequent	1 0	
Municipal parking lot or building, including libraries and post offices	1 0	
Car dealership		1 0
Highway rest stop	1 0	
Some other type of public charging station	1 0	

About how much of the charging for your electric vehicle is typically done at your home? [IF electric vehicle]

1 All at home (100%)
2 Almost all at home (80% - 99%)
3 Most at home (60% - 79%)
4 About half at home (40% - 59%)
5 Some at home (20% - 39%)
6 Very little or none at home (0% - 19%)

About how many total miles are driven in your electric vehicle per week? [IF electric vehicle]

_____

Potential Engagement

Do you and your household already implemented actions to reduce energy consumption?

1 Yes
2 No

If yes, explain

_____

Do you have the feeling that you and your household are using energy efficiently and in a pro-environmental way?

1 Yes
0 No
2 Sometimes

Are you and your household ready/willing to change your consumption in order to become more pro-environmental?

1 Yes
0 No
2 I don't know

COVID-19 Disruptions

Did you experience changes in your daily live due to covid-19? (e.g. more home working, less transportation….)

1 Yes
2 No

If yes, explain

_____

Do you have the feeling that you and your household are experiencing changes in energy consumption due to the covid-19 situation?

1 Yes
2 No

What type of changes in energy consumption?

1 More energy consumption
2 Less energy consumption

7.2 APPENDIX B – COMMERCIAL BUILDING SURVEY

Contact information

1) Company/Organization

_____ _____

Building information

2) City

_____

3) Is at least 50% of the floor area of this building dedicated to commercial, institutional, or organizational activities in the past year? [**If over 50% of the floor area of building is residential, select NO**]
   a. Yes
   b. No
4) Which of the following categories best described the ownership of the building?
   a. Corporation/Partnership
   b. Private individuals
   c. Private organization (for profit)
   d. Non-profit organization
   e. Private academic institution
   f. Government
   g. Other (please specify)
   h. Do not know
5) In which year was construction completed for the original building located at this address
_____
6) How many commercial units are in this building?
   _____
7) What is the total floor area of this building?
   _____
8) Which of the following activities or functions occurred in this building? [**select as many as possible**]
   a. Bank branch
   b. Retail store
   c. Recreation centre
   d. Performing arts
   e. Cinema
   f. Museum or gallery
   g. Warehouse
   h. Vehicle dealership
   i. Industrial
   j. Restaurant/café
   k. Hotel, motel….
   l. Vacant
   m. Other (please specify)
9) What was the m2 area used for the following activities or functions in this building?
   a. Bank branch
   b. Restaurant
   c. Retail store
   d. Recreation centre
   e. Performing arts
   f. Cinema
   g. Museum or gallery
   h. Warehouse
   i. Vehicle dealership
   j. Industrial
   k. Hotel, motel…
   l. Vacant
   m. Other (please specify)
10) Provide the average energy consumed by each of the activities or functions of the building per month
   a. Bank branch
   b. Restaurant
   c. Retail store
   d. Recreation center
   e. Performing arts
   f. Cinema
   g. Museum or gallery
   h. Refrigerated Warehouse
   i. Vehicle dealership
   j. Industrial
   k. Hotel, motel…
   l. Vacant
   m. Other (please specify)
11) What are the total weekly operating hours for the (majority of employees) of this building?
_____
12) During its main shift, approximately how many employees and volunteers work in this building?
_____
13) What is the average temperature of the building in winter?
_____
14) What is the average temperature of the building in summer?
_____
15) What percentage of the total floor area of this building was heated to at least 10 degrees Celsius in the past year?
_____
16) What percentage of the total floor area of this building was cooled (airconditioned)? [Indicate 0 if the building is not cooled]

_____

17) Which of the following types of on-site parking does this building have?
    a. Indoor parking
    b. Partially enclosed parking
    c. Outdoor parking
    d. No on-site parking

18) Is the indoor parking heated?
    a. Yes
    b. No

19) Was the indoor parking space shared with other buildings?
    a. Yes
    b. No

20) What is the total area of the parking space?
_____

21) Are there any portable structures (e.g. laptop) that consumed energy located on-site?
    a. Yes
    b. No

22) If YES, what was the total number of portable structures that consumed energy located on-site?
_____

23) How many floors are in this building are at ground level and above?
_____

24) How many floors are in this building are below ground level?
_____

25) How many elevators are in this building?
_____

26) How many escalators are in this building?
_____

27) Does this building have any computer server rooms with dedicated cooling and dedicated uninterruptable power?
    a. Yes
    b. No

28) If YES, how many rooms are dedicated for this and what is the total floor area?
_____

29) Provide the combined total power of all computer servers
_____

Refrigerated Warehouse

30) Does the building have a refrigerated warehouse space according to the temperature?
    a. Yes
    b. No

31) Is the temperature of the warehouse constant?
    a. Yes
    b. No

32) If YES, provide the total floor area of the refrigerated warehouse?
_____

    a. What is the amount of energy consumed per week
    _____

    b. Which of the following systems does the warehouse have?
        i. Under-pad heating
        ii. Free cooling system
        iii. None of the above

Restaurants

33) Which of the following best describe this restaurant? [**select as many as possible**]
    a. Café or Coffee shop
    b. Fast food restaurant
    c. Casual dining, pub, or bar
    d. Fine dining
    e. Other (please specify)

Food Preparation

34) Does this building have a kitchen for commercial food preparation?
    a. Yes
    b. No

35) If this building had more than one area used for commercial food preparation in the building, please provide the combined total floor area.
_____

Food Establishments

36) What is the maximum interior seating capacity dedicated to the restaurants, food courts, or cafeterias in this building?
_____

Hotel, Motel, Lodge, or Hostel

37) How many guest rooms or occupants rooms are there in your hotel/motel/lodge/hostel?
_____

38) What is the total number of room nights sold in a month, on average?
_____

Conferences and social events

39) Is there any designated space in this building used primarily for conferences or social events?
   a. Yes
   b. No
40) If YES, what is the total floor area for this?
   a. How many conferences or social events does the place hold per year/month on the average?

Domestic and commercial counts

41) How many of the following domestic and commercial appliances are in use in this building?
   a. Freezers
   b. Refrigerators
   c. Dishwashers
   d. Stove tops
   e. Ovens
   f. Ranges
   g. Kitchen Exhaust hoods
   h. Broiler
   i. Microwaves
   j. Washing machines
   k. Clothing dryers

Equipment counts

42) How many of the following types of devices, appliances, or equipment are in use in this building? [**total number and sizes** to be done in a table]
   a. Computers
   b. On-site servers
   c. Cash registers
   d. Televisions, electronic displays, or LCDs
   e. Printers
   f. Photocopiers
   g. Fax machines
   h. Multi-functional devices
   i. Walk-in freezers
   j. Walk-in refrigerators
   k. Open refrigerated cases
   l. Closed refrigerated cases
   m. Open freezer cases
   n. Closed freezer cases
   o. Vending machines
   p. Air conditioners
43) Which of the following energy sources were purchased for this building and the total amount (kWh) used for the past year? [**Select as many as possible**]
   a. Electricity
   b. Natural gas
   c. Furnace, heating or light fuel oil
   d. Diesel
   e. Kerosene
   f. Propane or bottled gas
   g. District steam from an off-site plant
   h. District hot water from an off-site plant
   i. District chilled water from an off-site plant
   j. Wood
   k. Other renewables, specify
   l. Other non-renewables, specify
44) What is the principal energy source used to heat the largest proportion of floor area in this building?
   a. Electricity

    b.   Natural gas
    c.   Furnace, heating or light fuel oil
    d.   Diesel
    e.   Kerosene
    f.   Propane or bottled gas
    g.   District steam
    h.   District hot water
    i.   Wood
    j.   Solar
    k.   Other Specify_____

45) Which of the following energy conversation or energy efficiency practices was adopted or undertaken in this building?
    a.   Energy monitoring (tracking energy use over time)
    b.   Energy benchmarking (comparing monthly bills)
    c.   Employee or occupant conservation awareness program
    d.   Corporate energy policy
    e.   Recommissioning project (a project to ensure all heating, cooling, ventilation, and lighting systems are performing at optimal levels)
    f.   Other Specify_____

46) Which of the following energy efficient features are present in this building?
    a.   Reduction of enclosed floor area
    b.   Energy efficient lightening (LED bulb)
    c.   Lighting energy management control system
    d.   Heat recovering system
    e.   Energy efficient cooling equipment
    f.   Free cooling system (circulating naturally cooled air as a source of space cooling)
    g.   Energy efficient windows
    h.   Exterior window shading
    i.   Insulation of basement, roof, or walls
    j.   Other Specify_____

47) In which of the following time periods was this building last recommissioned or retro-commissioned?
    a.   Between January 1st, 2015 to December 31st, 2020
    b.   Between January 1st, 2010 to December 31st, 2014
    c.   Between January 1st, 2005 to December 31st, 2009
    d.   December 31st, 2004 or earlier
    e.   This building has never been recommissioned or retro-commissioned
    f.   Do not know

48) During the last 5 years, which of the following systems in this building were subject to recommissioning or retro-commissioning? [**system tuning, operations, and maintenance training**]
    a.   HVAC systems
    b.   Monitoring and control systems
    c.   Lighting systems
    d.   Power systems
    e.   Plumbing or pumping systems
    f.   Other Specify_____

49) In which of the following time periods was this building install its last series of renovations? [e.g., repair, conversion, expansion, remodeling, or reconstruction]
    a.   Between January 1st, 2015 to December 31st, 2020
    b.   Between January 1st, 2010 to December 31st, 2014
    c.   Between January 1st, 2005 to December 31st, 2009
    d.   December 31st, 2004 or earlier
    e.   This building has never been renovated
    f.   Do not know

50) Which of the following reasons did the most recent series of renovations take place in this building? [**select all that apply**]
    a.   Faulty equipment
    b.   End of life of equipment
    c.   Improve energy efficiency
    d.   Improve asset value
    e.   Conversion of space to meet changes in operational needs
    f.   Voluntary application of codes and standards
    g.   New construction due to partial expansion
    h.   Other Specify_____

51) In which of the following time periods was this building install its last series of retrofits? [Retrofit is the process of upgrading a building's energy-consuming systemsor including energy efficiency measures in renovation and repair activities]
    a.   Between January 1st, 2015 to December 31st, 2020
    b.   Between January 1st, 2010 to December 31st, 2014
    c.   Between January 1st, 2005 to December 31st, 2009
    d.   December 31st, 2004 or earlier
    e.   This building has never been renovated
    f.   Do not know

52) Which of the following reasons did the most recent series of retrofits take place in this building? [**select all that apply**]
    a.   Faulty equipment
    b.   End of life of equipment
    c.   Improve energy efficiency
    d.   Improve asset value

  e. Conversion of space to meet changes in operational needs
  f. Voluntary application of codes and standards
  g. New construction due to partial expansion
  h. Other Specify_____

53) During the last 5 years, which of the following renovation or retrofits were implemented in this building? [select all that apply]
  a. Building insulation [include weather stripping]
  b. Windows and doors [include freezer strip doors]
  c. Exterior window shading
  d. Energy efficient lighting equipment {e.g., LED bulbs)
  e. Energy management control systems (EMCS) (e.g., controls for HVAC) [include lighting, motion detector, and automatic shut off]
  f. Space heating [include boilers, rooftop units, and furnaces]
  g. Waste heat recovery boiler
  h. Space cooling [include air conditioning systems and dehumidification systems]
  i. Ice making equipment
  j. Refrigeration plant
  k. Aesthetic or structural changes
  l. Other Specify_____

7.3 APPENDIX C – DIARY SURVEY

Introduction Now I'd like to find out how you spent your time yesterday, from 4:00 in the morning until 4:00AM this morning. I'll need to know where you were and who else was with you. If an activity is too personal, there's no need to mention it.
So let's begin. Yesterday, at 4:00 AM, what were you doing? /What did you do next? Until 4am the next day? *Tick off all activities that you did yesterday. 1. Sleeping 2. Grooming (self) 3. Watching TV 4. Working at main job 5. Working at other job 6. Preparing meals or snacks 7. Eating and drinking 8. Cleaning kitchen 9. Laundry 10. Grocery shopping 11. Attending religious service 12. Paying household bills 13. Other
How long did you spend [ACTIVITY]? 1. Enter start time 2. Enter end time
Which appliances did you use for this activity? [TICK OFF ALL THAT APPLIES] - Small appliances (robot, toaster, rice cooker, coffee machine, mixer, etc) - Electric oven - Electric hob - Kitchen hood - Microwave - Freezer - Fridge - Dishwasher - Kettle - TV - Tablet - HIFI chain - Dryer - Iron - Vacuum cleaner - Washing machine - Laptop/Computer - Mobile phone - Electric hot water tank - Towel dryer - Swimming pool - Electric vehicle - Heath pump - Jacuzzi - Electric bike - Hair dryer - Home cinema

- Electric air conditioner - Other: _____
Who was with you? / Who accompanied you? 0. Alone 1 Household members and nonhousehold children 2. All household members 3. Parents 4. Other non-HH family members <18 5. Other non-HH family members 18 and older (including parents-in-law) 6. Friends 7. Neighbors, acquaintances 8. Other non-HH children < 18 9. Other non-HH adults 18 and older (including parents-in-law) 10. Boss or manager* 11. People whom I supervise* 12. Co-workers* 13. Customers*
Where you at home? 1. Yes 2. No
You did not report any eating or drinking yesterday. Did you do any eating or drinking yesterday as your main activity? [IF Eating is not reported in Q1] 1. Yes 2. No
Did you cook yourself at home for at least one of your meal? [IF previous question = Yes] 1. Yes 2. No
For how long did you cook? [IF previous question = Yes]

DEVIATIONS

Delivery of the content is in time and to full satisfaction, without any deviations to actions planned.