User-Centred Energy Systems

Social License to Automate 2.0

Understanding the role of gender, age and income in demand side management participation potential

Lisa Diamond, AIT Austrian Institute of Technology
Giulia Garzon, Energy Institute at the Johannes Kepler University Linz

PROJECT OVERVIEW

History: Social License to Automate Task

The *Social Licence to Automate* concept refers to:

"…the extent to which an initiative has **the approval or acceptance of communities of stakeholders**, and captures a cluster of factors **beyond that of formal legal approval** which can shape its reception"

Adams, S., Kuch, D., Diamond, L., Fröhlich, P., Henriksen, I. M., Katzeff, C., Ryghaug, M., & Yilmaz, S. (2021). Social license to automate: A critical review of emerging approaches to electricity demand management. *Energy Research & Social Science*, *80*, 102210. https://doi.org/10.1016/j.erss.2021.102210

History: Social License to Automate Task

Runtime: Oct 2019 – Oct 2021

Participating Countries: Australia (Coordinator), Austria, Netherlands, Norway, Sweden, Switzerland

Analysis of 26 Cases: feasibility studies, trials, demos and mature automation projects, over 6000 participants

Methods

- **Common template** to collect case data regarding areas of focus
- **Original studies** for in-depth analysis of particular aspects
- **Country profiles** to understand contextual conditions

Areas of focus

- User interactions
- Energy practices
- Sociotechnical systems
- Institutional settings
- Business models & incentives

Final report

UsersTCP

Social License to Automate 2.0

Participating Countries: Austria (coordinator), Australia, Ireland, Netherlands, Norway, Sweden, Switzerland

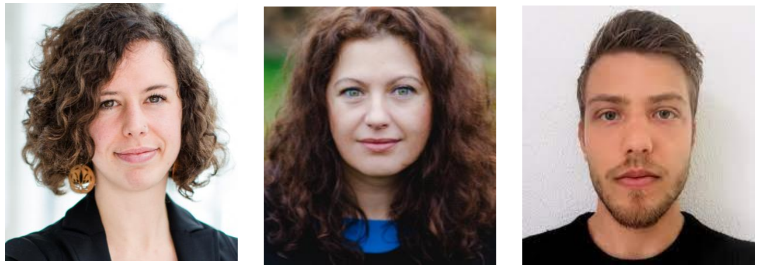
Runtime: Nov 2022 – Oct 2024

AIT AUSTRIAN INSTITUTE OF TECHNOLOGY
TOMORROW TODAY

FH University of Applied Sciences TECHNIKUM WIEN

CHALMERS
UNIVERSITY OF TECHNOLOGY

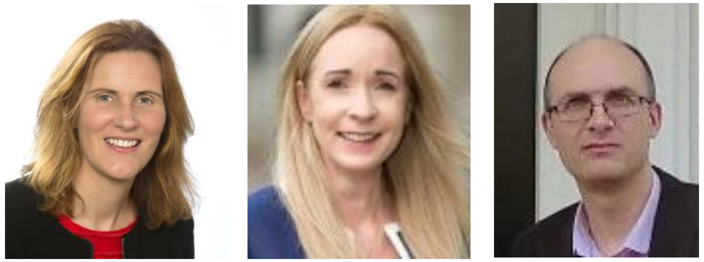
UNIVERSITÉ DE GENÈVE



ENERGIE INSTITUT
an der Johannes Kepler Universität Linz

WESTERN SYDNEY UNIVERSITY

NTNU



UCC
University College Cork, Ireland
Coláiste na hOllscoile Corcaigh

TU Delft

Motivation & Background

Results of SLA have shown that

- **DSM programs are typically still designed for generic users**, overlooking the impact user diversity has on their awareness, motivation, benefit perception, actionable knowledge and ability to participate
- Are typically addressing end-users as individuals, **struggling to achieve a sufficient reach** and are **missing opportunities** to harness the power of different types of **stakeholders** such as middlemen to help with achieving a social license
- **Fail to offer different types of involvement** to end-users depending on their ability and willingness to participate and expend effort, partly due to **missing insights and data** that would allow to differentiate between users with regards to their potential to respond to demand side needs

Objectives

1. **Understand the role of gender and diversity factors** in energy consumption flexibility and identify associated engagement approaches
2. **Identify the contribution potential of energy communities** (EC) and other community energy approaches towards establishing/ granting a *Social License* to automate
3. **Identify flexibility consumption profile markers via load profiles** and define **criteria for data quality and standardization** of flexibility profiles through a consolidated assessment

Image source: Freepik.com

Objectives

4. **adapt the social license concept towards** an integration of more diverse user groups and community approaches and the roles of different stakeholders
5. **develop stakeholder-specific recommendations** regarding flexibility-profiles, engagement approaches based on them and the use of community energy projects to reach more diverse user groups and increase acceptance and scalability

Image source: Freepik.com

Task Structure

Social License to Automate 2.0

Subtask 1: The role of gender and diversity factors in flexibility

Subtask 2: Contribution potential of energy communities

Subtask 3: Flexibility profiles and data quality

Subtask 4:

Synthesis

Concept adaptation

Stakeholder recommendations

Initial Results of Subtasks 1 and 2

Subtask 1: Gender & Diversity
Literature analysis

Social License to Automate 2.0

- Literature search identifiying articles published on demand side flexibility with diversity dimensions specifically addressed in the research
- 255 papers, 58 were included in the final review
- Diversity focus: gender, age, income
- Research questions:
    - Considered diversity dimensions (DD)
    - Role of DD in willingness/motivation to participate
    - Role of DD in ability to participate
    - Consequences of DSM in relation to DD

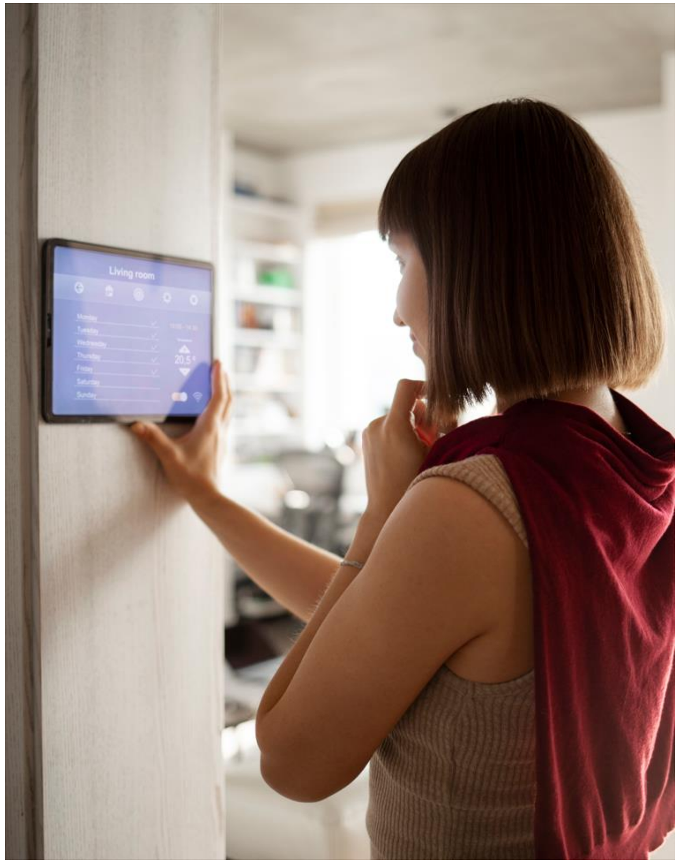


Image source: Freepik.com

Contributing countries: NO, SE, AT, IE, AU, CH

Subtask 1: Gender & Diversity
Initial Results

Social License to Automate 2.0

- Gender
  - DSM technology and communication is typically designed with male, technology-affine users in mind, not reaching women sufficiently
  - Gender roles challenge DSM implementation with the home as a feminine domain, technology as masculine domain
- Income
  - Energy saving practices are already part of the everyday life of the energy-poor but homes they live in are often energy-inefficient
  - Risk of excluding low-income households from the cheapest available energy when it is made dependent on being able to afford the necessary technology
- Age
  - Participation of the elderly is challenged by lacking digital literacy and apprehension towards new technology
  - Flexibility of younger consumers is limited by social constraints (lack of choices)

Subtask 1: Gender & Diversity
Initial Conclusions

- Gender, income and age impact motivations and ability to participate
- Scarcity of studies addressing the impact of diversity dimensions on DSM participation in an in-depth way
- DMS programs need to apply a user-perspective, considering implementation and effects within the everyday experiences of users
- Lower income group participation needs to be included as part of the program design; necessary technology needs to be provided as part of program participation, middle actors are crucial
- Participation of the elderly needs to be accompanied by digital literacy support, allowing the dynamic development of a relationship with the technology

Subtask 2: Energy Communities EC Initiatives Analysis

UsersTCP | Social License to Automate 2.0

- Energy Community (EC) initiatives were reviewed on a European and national level regarding their legislative background to understand key features, differences/similarities
- Core questions
  - How are social aspects (SA) addressed
  - Potential to gain a social license (SL)
  - Potential to gain a social license to automate (SLA)
- ECs were categorized according to type and identified potentials

Image source: Freepik.com

Contributing countries: CH, AT, NL

Subtask 2: Energy Communities Initial Results

UsersTCP | Social License to Automate 2.0

- Renewable/citizen energy communities
  - High potential for all SA, SL & SLA to EU directive demands (energy poverty, citizen engagement), incentivisation, wide reach, automation opportunities common
- Energy community projects
  - High for SA due to high sense of responsibility & community, medium for SL due to remoteness & limited reach but local awareness and acceptance
- Energy cooperatives
  - SA potential low due to high number of participants, geographical distribution, membership through purchasing; SL potential high through joint investments and wide reach; SLA potential low as direct incentive is missing
- Micro-scale energy communities
  - Very high potential to address SA due to small number of participants and high levels of trust & responsibility but medium for SA & SLA (need for proximity, geographical constraints, limited rooftop areas)

Subtask 2: Energy Communities
Initial Conclusions

Social License to Automate 2.0

UsersTCP

- Strengths and weaknesses vary between the different types of identified EC initiatives
- In order for successful scaling of EC initiatives and a contribution towards the building of a social license (to automate), social impacts need to be considered
- A clear understanding of how different EC features such as initiating actors, financing models and included technologies impact the potential of an EC to address social aspects and further the granting of a social license (to automate) can play a key role in the success of an EC initiative

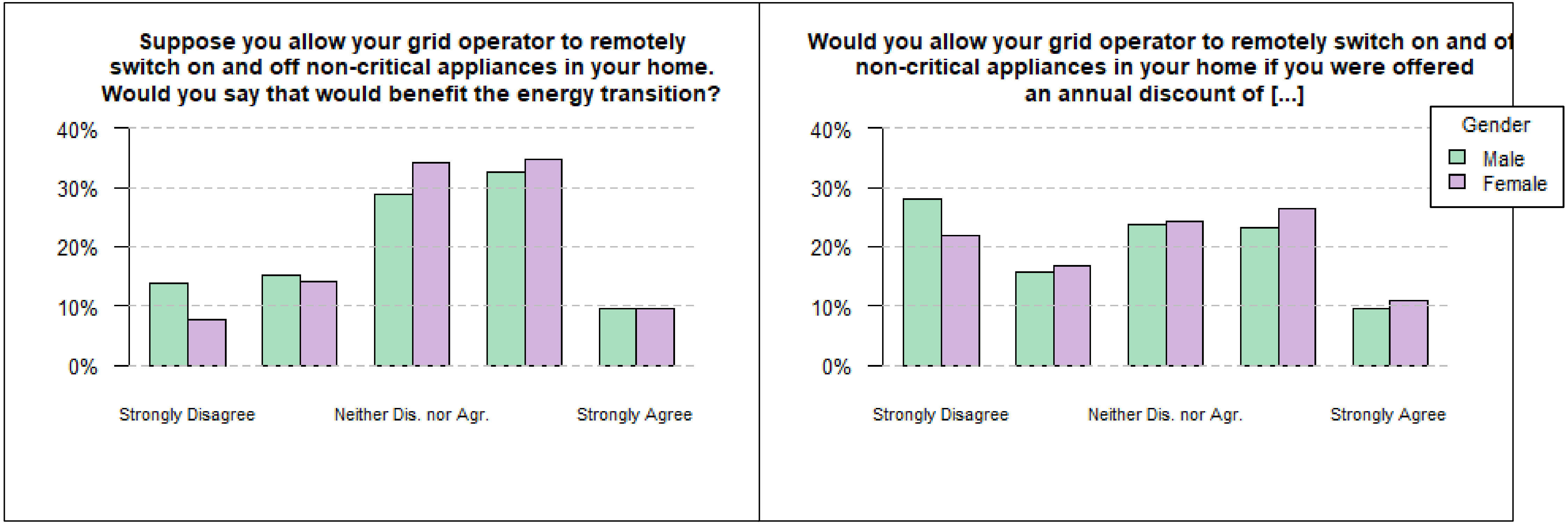
Subtask 3: Flexibility Profiles Use Case Analysis

Use case 1: ECHOES

Project details

- The primary ambition of this H2020 project is to:
    - identify the factors driving individual and collective choices and energy-related behaviour from micro-, meso- and macro perspective
    - estimate the magnitude of the factors' potential impact
    - derive policy-ready recommendations for policymakers
- Runtime: 2018-2021
- 14 Partners
- Multi-level, multi-disciplinary, and multi-technology focus
- Technological foci: implementation of smart technology to increase energy efficiency, network stability and consumer engagement
- Online survey of approx. 18,000 households in 31 countries (EU + UK, Norway, Turkey, Switzerland…)

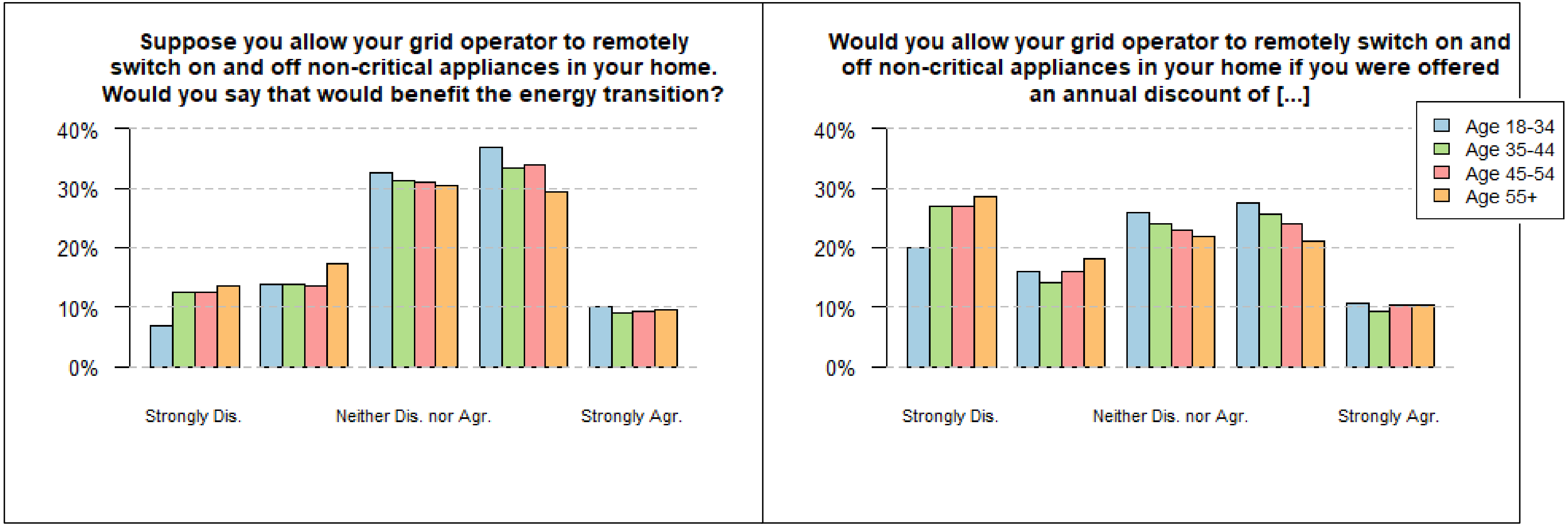
Gender



Source: ECHOES GA#727470 survey (2019), EU-27, UK, NO, TR, CH, n= 5968

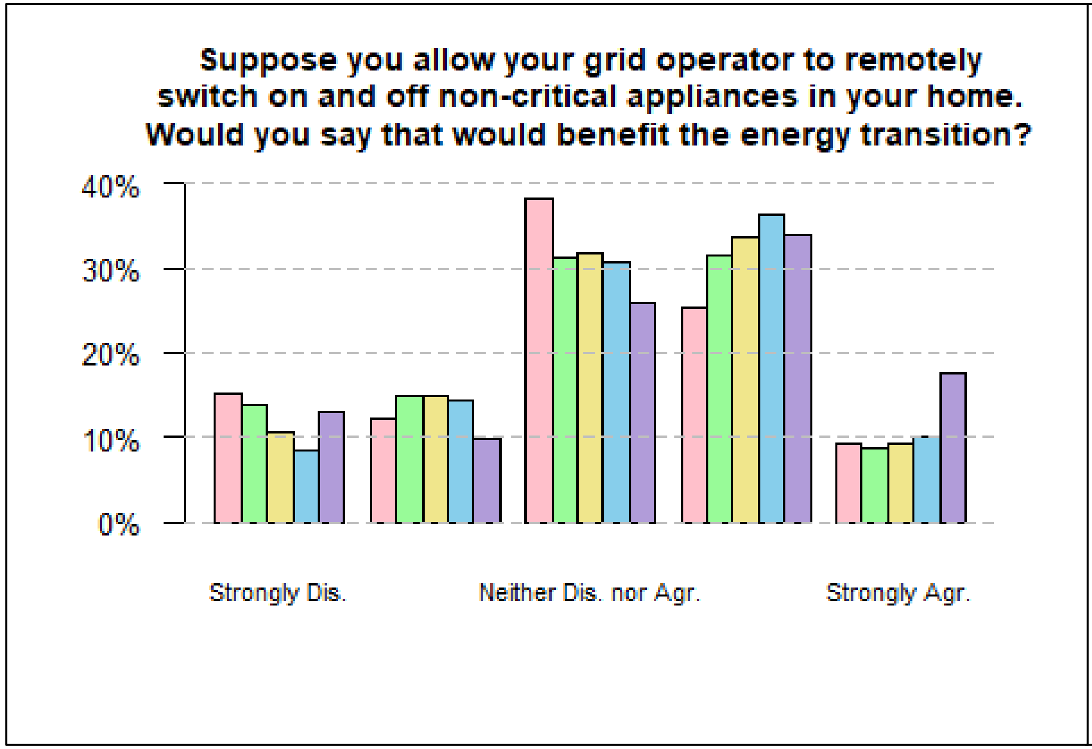
Social License to Automate 2.0

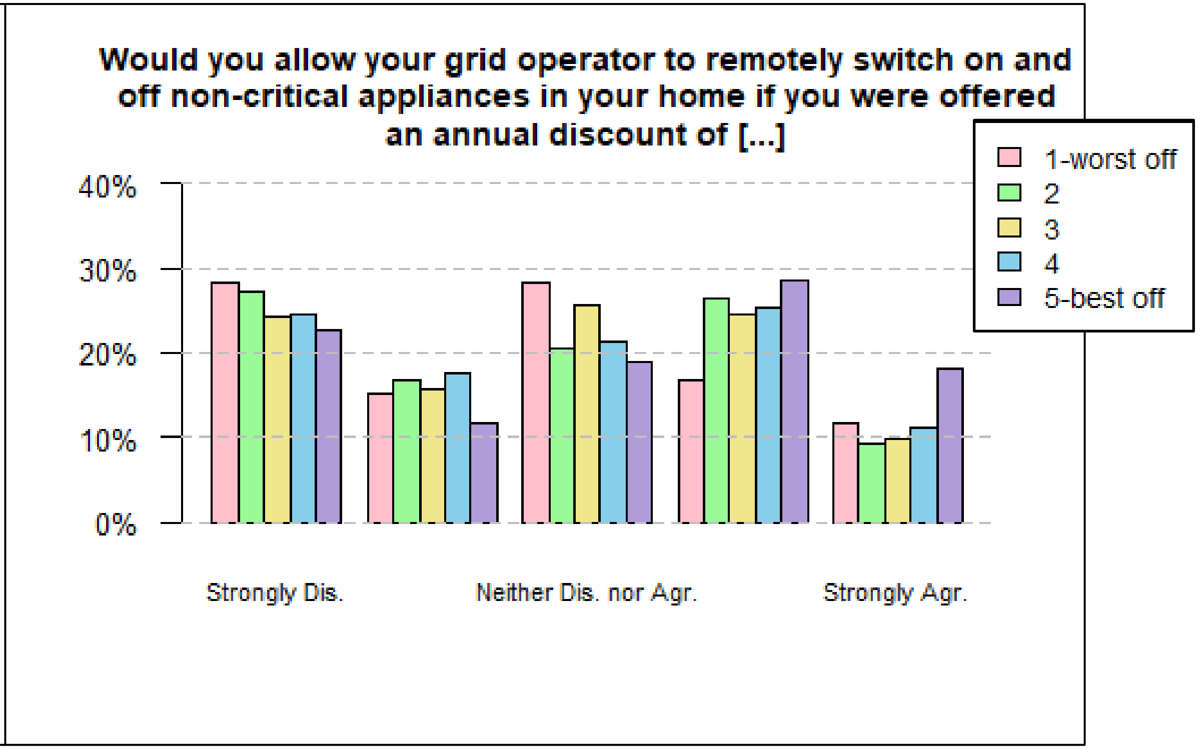
Age



Source: ECHOES GA#727470 survey (2019), EU-27, UK, NO, TR, CH, n= 5968

Social status

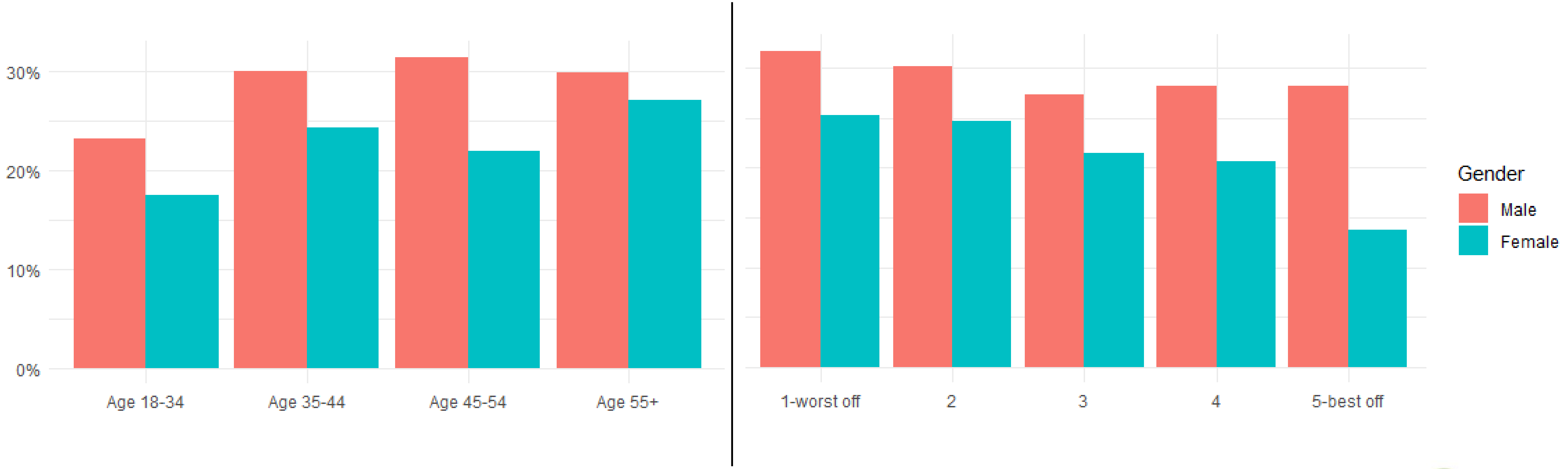




Source: ECHOES GA#727470 survey (2019), EU-27, UK, NO, TR, CH, n= 5968

Intersectionality

'Would you allow your grid operator to remotely switch on and off non-critical appliances in your home if you were offered an annual discount of [...]?', share of **strongly disagree** for **age groups** and **social status**



Source: ECHOES GA#727470 survey (2019), EU-27, UK, NO, TR, CH, n= 5968

Regression results for Q70

Ordinal Logistic Regression Model for Q70: 'Would you allow your grid operator to remotely switch on and off non-critical appliances in your home if you were offered an annual discount of [...]?':

St. significant:

- **Gender** and **age** (all classes)
- **University or college degree** (ed. 4)
- **Higher social status** (5-best off)

Not st. significant:

- Other education
- Employment
- Other social status
- Having children/children under 14

Other tests performed to see difference in response tendencies: Chi-test, Mann-Whitney, Kruskal-Wallis Test

Ordinal Logistic Regression Results

Variable	Coefficient	Std_Error	t_value	p_value
genderFemale	0.243	0.048	5.072	0.000
ageAge 35-44	-0.226	0.067	-3.368	0.001
ageAge 45-54	-0.197	0.075	-2.640	0.008
ageAge 55+	-0.368	0.091	-4.031	0.000
education2	-0.125	0.089	-1.408	0.159
education3	0.044	0.085	0.525	0.599
education4	0.188	0.079	2.368	0.018
education5	-0.048	0.184	-0.261	0.794
employment2	-0.120	0.097	-1.243	0.214
employment3	-0.169	0.095	-1.782	0.075
employment4	0.113	0.090	1.251	0.211
employment5	-0.158	0.127	-1.249	0.212
employment6	0.174	0.108	1.609	0.108
employment7	-0.053	0.101	-0.523	0.601
employment8	-0.293	0.146	-2.009	0.045
social_status2	0.044	0.152	0.289	0.773
social_status3	0.066	0.145	0.452	0.651
social_status4	0.052	0.153	0.339	0.735
social_status5	0.451	0.207	2.178	0.029
children2	-0.907	1.634	-0.555	0.579
children3	-0.845	1.634	-0.517	0.605
children4	-1.005	1.636	-0.615	0.539
children5	-0.923	1.646	-0.560	0.575
children6	-0.763	1.678	-0.455	0.649
children7	0.513	0.577	0.889	0.374
under_141	1.002	1.633	0.613	0.540
under_142	1.004	1.634	0.614	0.539
under_143	1.100	1.635	0.673	0.501
under_144	0.987	1.644	0.600	0.548
under_145	1.456	1.708	0.853	0.394
under_146	0.519	2.188	0.237	0.813
rural2	-0.077	0.051	-1.513	0.130
country_sample	0.009	0.003	3.363	0.001
1|2	-0.849	0.168	-5.051	0.000
2|3	-0.096	0.168	-0.572	0.568
3|4	0.900	0.168	5.359	0.000
4|5	2.478	0.172	14.430	0.000

UsersTCP Social License to Automate 2.0

echoes

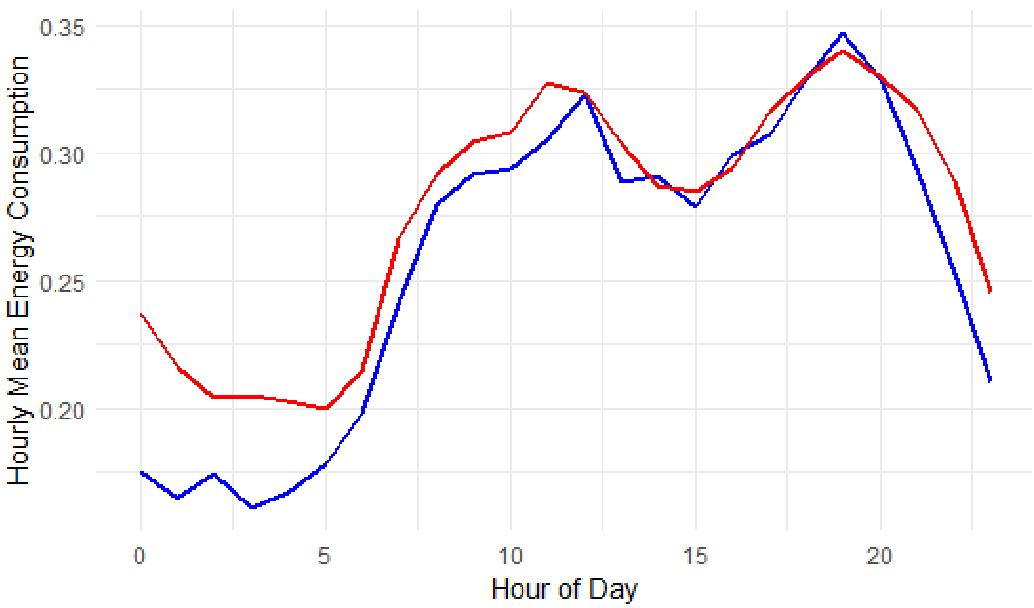
Use case 2: PEAKapp

Project details

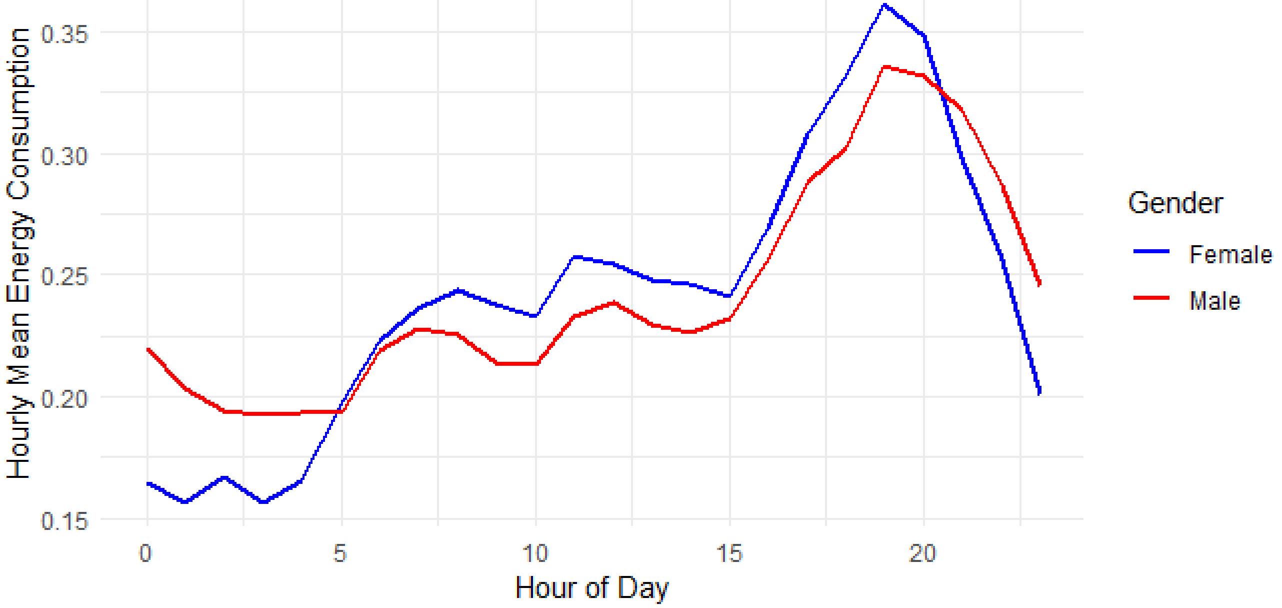
- Aim: quantify the effect of PEAKapp (Smart phone app for home energy administration) usage on household's electricity consumption (demand flexibility)
- 10 partners
- Field-tested in four European countries
- 3 treatment groups: control group, group exposed to varying electricity prices (short term price reductions) or to the PEAKapp
- Load profiles of ~1,500 households collected over a 17-month period (2017-2018) in Austria
- Surveys among the participating households provide socio-economic and living situation related information
- From 152 single households data we can derive gender information (1/3 females)

Peaks and weekly variation (kWh)

Weekend



Weekdays



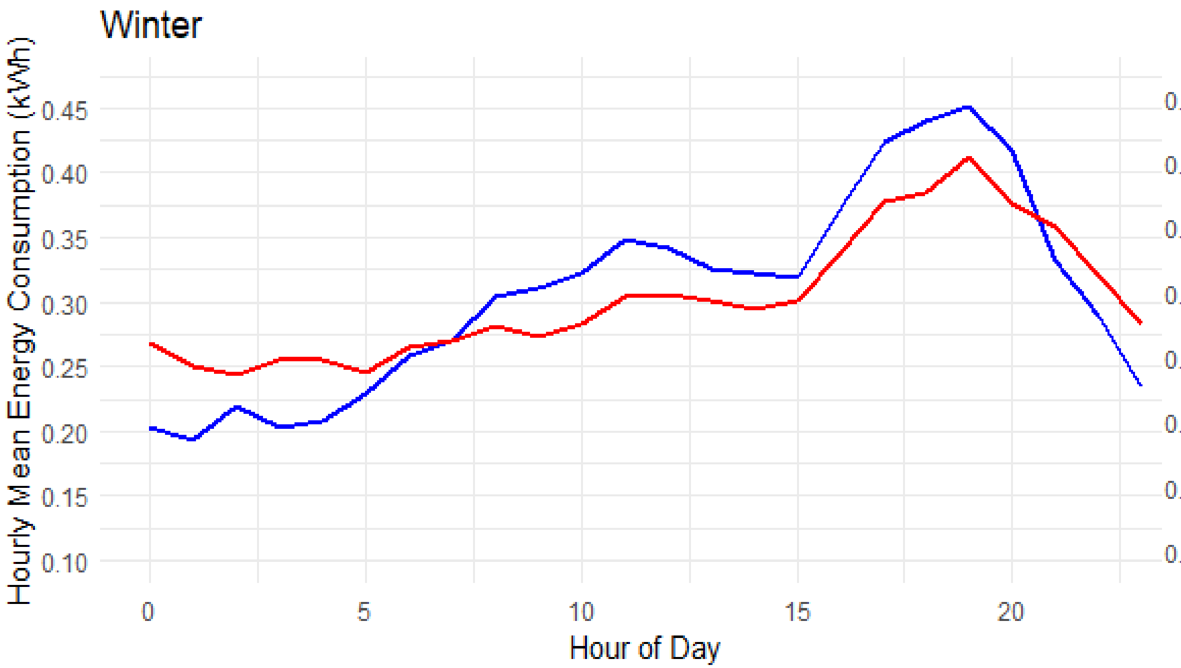
N=1,527,495

N=3,786,559

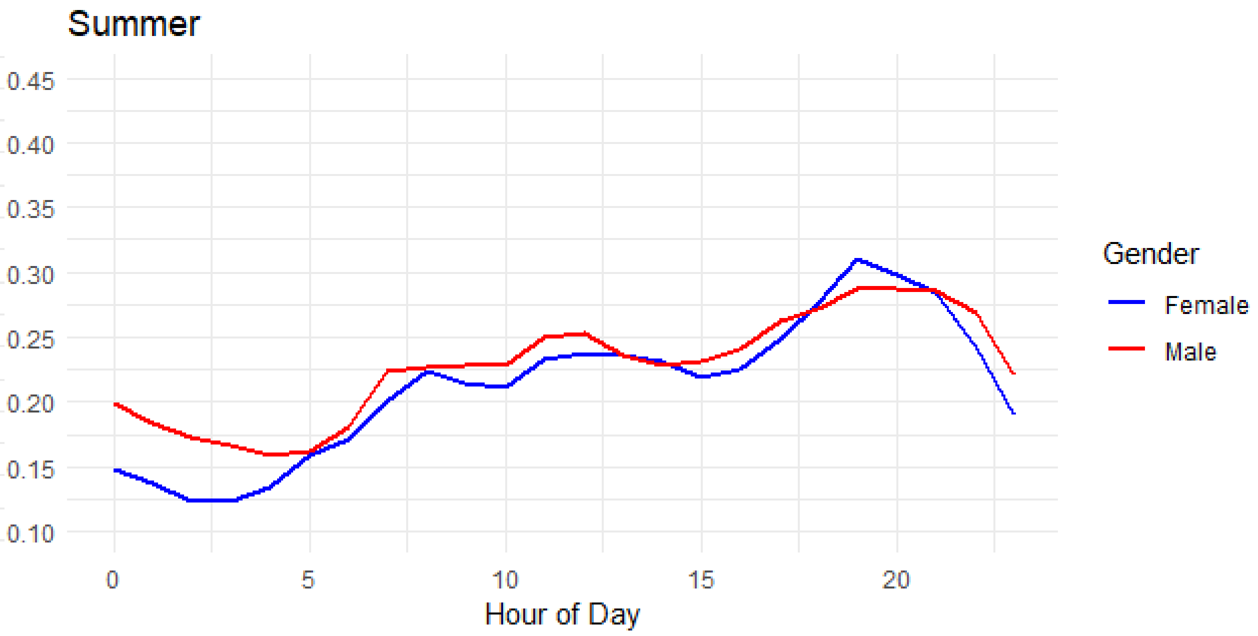
UsersTCP

Social License to Automate 2.0

Peaks and seasonal variation



N=327290



N=334320

PEAKapp

Peaks and seasonal variation

- Method: Linear regression
- Males consume more energy than females in winter on average
- Energy consumption is higher during the peak period (**hours 16-21:45**) compared to non-peak hours
- However, the interaction effect suggests that, during the peak period, **males reduce their energy consumption** by approximately 14% compared to females
- When comparing with results of regression for **summer,** the **difference** in consumption **peaks** between genders is **not as big** (-7.9% in energy consumption for males compared to females)

Linear regression for winter

Coefficients:

	Estimate	Std. Error	t value	
(Intercept)	-4.405	0.007	-676.923	***
genderMale	0.119	0.003	42.354	***
peak	0.527	0.004	125.559	***
housesinglehouse	0.109	0.004	24.456	***
housesplithouse	0.337	0.004	87.996	***
square_meter_categoryMedium	-0.211	0.003	-70.126	***
square_meter_categorySmall	0.063	0.003	18.229	***
square_meter_categoryVery Big	0.264	0.003	76.627	***
gas	0.258	0.006	40.817	***
district	0.213	0.006	35.704	***
heatPump	0.360	0.008	43.306	***
electric	0.799	0.008	105.076	***
biomass	0.177	0.007	25.583	***
oil	0.147	0.006	22.854	***
water_gas	-0.084	0.005	-16.766	***
water_district	-0.428	0.005	-81.411	***
water_heatpump	-0.283	0.007	-39.361	***
water_electric	-0.110	0.004	-27.351	***
water_biomass	0.027	0.006	4.340	***
water_oil	0.159	0.006	27.093	***
dryer	0.067	0.003	25.675	***
swimmingPool	0.435	0.005	92.685	***
aquarium	0.297	0.007	42.426	***
waterBed	0.517	0.005	101.058	***
sauna	0.134	0.004	35.452	***
airCondition	0.293	0.006	51.933	***
deepFreezers	0.194	0.002	92.619	***
computers	0.170	0.001	177.401	***
pev	-0.568	0.007	-85.785	***
ebike	0.355	0.006	57.069	***
controlgrp	0.037	0.003	14.613	***
appgrp	0.170	0.003	64.473	***
discount	-0.001	0.000	-1.995	*
discount_econ	0.021	0.019	1.107	
discount_solar	0.176	0.036	4.943	***
discount_wind	0.151	0.022	6.857	***
genderMale:peak	-0.145	0.005	-29.550	***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.1301 on 312013 degrees of freedom
(15072 Beobachtungen als fehlend gelöscht)
Multiple R-squared: 0.1003, Adjusted R-squared: 0.1002
F-statistic: 1023 on 34 and 312013 DF, p-value: < 0.00000000000000022

Treatment

Overall, discounts on electricity price don‘t have the desired effect on consumption (cause a decrease in consumption)
BUT interaction terms suggest that 10%, 20% and 50% discounts for males are associated with a higher increase in consumption compared to females when the same discount is applied

-> **Males** reacted to discounts more then **females**

Source: Peakapp data filtered for weekdays, n=3,786,559

Linear Regression Results

Variable	Coefficient	Std_Error	t_value	p_value
(Intercept)	-2.989	0.005	-641.083	0.000
genderMale	0.169	0.001	122.215	0.000
discount_10	-0.168	0.031	-5.379	0.000
discount_20	-0.173	0.030	-5.841	0.000
discount_30	-0.071	0.031	-2.315	0.021
discount_50	-0.076	0.031	-2.496	0.013
household	0.000	0.000	-218.975	0.000
monthFeb	0.024	0.003	8.403	0.000
monthMar	-0.033	0.003	-11.995	0.000
monthApr	-0.210	0.003	-73.797	0.000
monthMay	-0.193	0.003	-70.155	0.000
monthJun	-0.183	0.003	-65.092	0.000
monthJul	-0.173	0.003	-62.231	0.000
monthAug	-0.110	0.003	-39.952	0.000
monthSep	-0.194	0.003	-67.162	0.000
monthOct	-0.186	0.003	-64.459	0.000
monthNov	-0.102	0.003	-35.768	0.000
monthDec	0.022	0.003	7.711	0.000
day_of_week	-0.001	0.000	-1.709	0.087
day	0.000	0.000	3.792	0.000
hour_of_day	0.025	0.000	300.331	0.000
appgrp	0.145	0.001	112.903	0.000
hour_of_sample	0.010	0.001	7.796	0.000
day_of_sample	0.003	0.001	3.873	0.000
high_cons_devcomputers	-0.719	0.003	-232.318	0.000
high_cons_devdeep freezers	-0.330	0.003	-106.373	0.000
high_cons_devdryer	-0.459	0.004	-121.326	0.000
high_cons_devother	-0.616	0.003	-200.984	0.000
high_cons_devsauna	-0.532	0.005	-116.750	0.000
square_meter_categoryMedium	-0.301	0.002	-182.880	0.000
square_meter_categorySmall	0.110	0.002	58.603	0.000
square_meter_categoryVery Big	0.451	0.002	282.449	0.000
genderMale:discount_10	0.064	0.030	2.138	0.032
genderMale:discount_20	0.010	0.025	0.383	0.702
genderMale:discount_30	0.046	0.027	1.696	0.090
genderMale:discount_50	0.095	0.026	3.657	0.000

UsersTCP | Social License to Automate 2.0

PEAKapp

Subtask 3: Flexibility Profiles Conclusions

Social License to Automate 2.0

- The analysis of the ECHOES survey contributes to our Task as it helps us understand difference in **attitudes towards automation** in Europe, especially awareness of its importance for the energy transition and willingness to accept it
- Also, it helps us draw a concept of diversity that accounts not only for one aspect, such as gender, but also adds **intersectional insights** - for example gender, in relation to age and social status
- The analysis of the PEAKapp data delves deeper into the flexibility of Austrian single households and outlines **gender-related load profile differences** with regards to peaks, seasonal variation and treatment effects
- Further steps:
  - Comparison of PEAKapp single households consumption data with those of bigger households -> other diversity aspects
  - Analysis of datasets from Switzerland and the Netherlands
  - Synthesis of flexibility profiles

Publications

Social License to Automate 2.0

1. Ida Marie Henriksen, Helena Strömberg, Lisa Diamond, Jennifer Branlat, Lenart Motnikar, Giulia Garzon, Declan Kuch, Selin Yilmaz, Tomas Moe Skjølsvold (2023) The Role of Gender, Age and Income in Demand Side Management Participation: A Literature Review. BEHAVE 2023, Nov 28-29, Maastricht, NL
2. Bernadette Fina, Selin Yilmaz, Frederike Ettwein, Na Li, Andrea Werner (2023) Typologies of energy community initiatives and their social implications. IAEE 2023, July 24-27, Milan, IT
3. Giulia Garzon, Selin Yilmaz, Na Li, Andrea Kollmann and Benjamin Kirchler (2023) Unveiling Energy Consumption Flexibilities from a Gender and Diversity Perspective. BEHAVE 2023, Nov 28-29, Maastricht, NL
4. *Bernadette Power*, Dr. Gordon Sirr, Geraldine Ryan, Dr. John Eakins (2023) Community owned/co-owned wind farms: The extent and the determinants of citizens' willingness to participate under different types of arrangements. BEHAVE 2023, Nov 28-29, Maastricht, NL*
5. *Geraldine Ryan, Bernadette Power, John Eakins (2023) Sparks of Change: How do Age and Gender Impact the Actions Taken to Reduce Energy Use? BEHAVE 2023, Nov 28-29, Maastricht, NL*

Federal Ministry
Republic of Austria
Climate Action, Environment,
Energy, Mobility,
Innovation and Technology

FFG
Austrian
Research Promotion Agency

AIT AUSTRIAN INSTITUTE OF TECHNOLOGY
TOMORROW TODAY

ENERGIE INSTITUT
an der Johannes Kepler Universität Linz

UsersTCP
Social
License to
Automate 2.0

THANK YOU!

Lisa Diamond

AIT Austrian Institute of Technology

Center for Technology Experience

Lisa.Diamond@ait.ac.at

Giulia Garzon

Energy Institute at the Johannes Kepler University Linz

garzon@energieinstitut-linz.at

The “Social License to Automate 2.0” annex is carried out within the UsersTCP under the auspices of the IEA. The Austrian contribution is funded by the Austrian Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology.

UsersTCP

Contact: admin@userstcp.org

CampaignXchange Task

Overview

Task Duration:
1 June 2023 – 31 May 2024

Participating Countries:
Australia, Belgium, Canada, Finland, Ireland, Netherlands, Sweden, Switzerland, United Kingdom

Task Leaders:
International Energy Agency, Energy Efficiency Division

Webinars

User-Centred Energy Systems Academy

Tasks

UsersTCP | Social License to Automate

UsersTCP | Public Engagement for Energy Infrastructure

UsersTCP | Peer-to-Peer Energy Trading

UsersTCP | Hard-to-Reach Energy Users

UsersTCP | Behavioural Insights Platform

UsersTCP | Gender and Energy

User-Centred Energy Systems

userstcp.org