Policy Instrument Matrix

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AUTHORS

Benjamin Kirchler (EI-JKU), Giulia Garzon (EI-JKU), Melanie Knöbl (EI-JKU), Julia Haider (EI-JKU), Andrea Kollmann (EI-JKU)

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ENCHANT Report

Evaluation Report on Pilot Implementations
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Benjamin Kirchler (EI-JKU), Giulia Garzon (EI-JKU), Melanie Knöbl (EI-JKU), Julia Haider (EI-JKU), Andrea Kollmann (EI-JKU)

CONTRIBUTORS

Anca Sinea, Melania Lese (Babeș-Bolyai University)
Giuseppe Carrus, Federica Caffaro, Lorenza Tiberio, Chiara Massullo (Uni Roma3)
Mehmet Efe Biresselioglu, Muhittin Demir (Izmir University of Economics)
Michael Niederkofler (Energie Kompass)
Jasmin Steininger (Badenova)
Christian A. Klöckner, Berit Nilsen (NTNU)

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ABSTRACT

This report advances a policy instrument matrix, evaluating sustainability impacts of 15 pilot interventions across 6 countries. It establishes criteria for economic, environmental, social and political domains, offering insights from behavioral strategies and practical implementation. The resulting findings contribute to concrete recommendations for energy policymakers, enriching comprehension of real-world policy interventions across diverse settings.

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1 Introduction

The ENCHANT project aims to make a significant contribution to a deeper understanding of how energy, the environment and human behavior interact by translating complex ideas about behavior and energy use into practical policy recommendations, focusing on three key areas: Energy, Environment and People.

The project spans six countries (Norway, Italy, Romania, Türkiye, Austria and Germany) and uses different methodologies to explore the link between energy use and behavior. This report synthesizes the findings of the interventions carried out in these countries in the three domains of (1) energy saving behavior, (2) public transportation and (3) energy efficiency and renewable energy (EE and RES) investments. Furthermore, it derives policy recommendations based on the comprehensive quantitative and qualitative research and analysis in these three domains.

As already mentioned, the ENCHANT project involved a total of 15 interventions in six different countries. Austria implemented the Energy Compass intervention. In Germany, there were four interventions called Badenove / Hansgrohe, Badenova Waldsee quartier festival, Badenova Sustainability survey and Badenova Sustainability Test community. Italy had two interventions Energia Positiva and Fondazione / Ninfa Garden. In Norway, two interventions were deployed via the Naturvernforbundet energy portal and Viken energy portal. In Romania, one public transport intervention was rolled out in Cluj Napoca (Green Fridays) and two in the energy investment domain: Electrica online customers and Electrica offline customers. Türkiye had two interventions called Gediz customers and Izmirmetropolitan area. Finally, there was the transnational Multinational intervention Platform.
Due to the data situation and the possibilities that were available, it was decided to summarize some interventions for this report and cluster them under one country. Particularly in the environmental dimension, the interventions were considered purely by country. Furthermore, the interventions were grouped under the main areas of Energy Saving behavior, Public Transport, EE and RES Investment and ENCHANT Platform.

Energy Saving behavior
- Energie Kompass (AT)
- Energia Positiva (IT)
- Electrica Furnizare (online & offline) (RO)
- Gediz Electricity (TR)
- Hansgrohe Pontos (DE)

Public Transport
- Green Friday (RO)
- Public transportation (TR)

EE and RES Investment

- Ninfa Garden (IT)
- EE Online Counseling (Viken & Natuvernforbundet) (NO)

ENCHANT Platform

The core goal of this report is to develop a policy instrument matrix that allows the comparison of the broader effects of the different types of interventions, which were implemented in ENCHANT and to assess their effects from an economic, environmental, social and political perspective.

The development of the policy evaluation matrix is based on two critical phases of re- search. Phase 1: "Evaluation of experimental and quasi-experimental evidence" provides the baseline data for the matrix's input parameters. This phase evaluates both traditional and behavioral economic strategies for influencing energy consumption behavior, taking into account the challenges of translating controlled laboratory results into real-world con- texts. It also evaluates the effectiveness of various interventions such as information pro- vision, social and private norms and financial incentives, while taking into account the confounding effects of external factors such as the COVID-19 pandemic and energy crises.

Phase 2: "Evaluation of pilot implementations" contributes additional parameters by examining the operational aspects of the interventions, their immediate and long-term effectiveness, and their scalability. Planning, implementation and post-implementation lessons, including costs and challenges, provide a practical perspective on policy feasibility.

Together, these phases and the findings of the ENCHANT project provide a robust set of parameters for the policy evaluation matrix, ensuring that it reflects both the theoretical underpinnings of economic and behavioral strategies and the practical realities of implementing policy interventions in diverse and dynamic real-world settings. Alongside this matrix, the report includes three policy briefs that provide concrete recommendations for energy policy makers.

2 Development of the Policy Evaluation Matrix

The interventions described in the following are described in detail in deliverable 4.3 (Kirchler, Haider, Knöbl, Garzon, and Kollmann (2023). Please refer to this report of the ENCHANT project for further information, both for the intervention design and their psychometric/econometric evaluation.

The main aim of the policy matrix is to provide stakeholders with an accessible way to identify strengths but to also show potential weaknesses of interventions in order to guide

policy-making and future research. This section presents the method, how each of the three domains i) economic, ii) ecological, and iii) social & political is evaluated and defines evaluation criteria.

2.1 Economic Dimension

The economic dimension of the evaluation matrix focuses on the financial aspects of interventions, analyzing both costs and economic benefits. This analysis helps stakeholders to gain a detailed understanding of the economic impact of each intervention, enabling them to identify strengths, weaknesses and areas for future research and decision-making. The criteria used in the economic dimension of the evaluation matrix serve to provide a comprehensive analysis of the financial aspects of interventions. By using these criteria, stakeholders can gain a nuanced understanding of the economic strengths and weaknesses of each intervention. This helps to make informed decisions, plan future strategies and adapt to changing economic landscapes. Each criterion focuses on a specific aspect of economic impacts. All criteria employ a scale of 1-4, where the lowest score (1) is represented by a red color, 2 by a yellow color, 3 by a blue color, and the highest score (4) by a green color (Table 1).

2.1.1 Cost

The cost parameter measures the financial resources invested in the intervention, including expenses related to tools, materials, marketing, travel, and other relevant categories, taking into account the time invested in setting up the intervention. The score was calculated by multiplying the financial resources required (in euros) by the preparation time for each intervention in months. Values above 500,000 were assigned a score of 1, values between 100,000 and 499,999 were rated 2, and values between 20,000 and 99,999 were ranked 3. Finally, valuesbelow 20,000 were given the highest score (4). From Table 1-4 we can see that energy saving behavior interventions were generally less expensive compared to public transport and EE and RES investment interventions. Both public transport interventions had high expenses, but managed to reach a very high number of participants (Table 2). The high costs incurred by the Izmir Metropolitan Municipality can be explained by the use of billboards, screens and poster sites, which usually have quite high rental costs. EE online Counseling interventions, carried out by the Viken municipality and the NGO Naturvernforbundet, proved quite expensive but very successful in terms of effectiveness (see 2.1.2). The implementation of the intervention platform, on the other hand, incurred the highest financial expenditures in Norway, but it reached the highest number of participants, com- pared to the other countries where it was deployed. Where costs were very low, such as in Italy, Austria and Türkiye, the recruited samples were too small to allow for representative statistical analysis. Romania initially reached a very low number of participants, but some additional financial investmentin a following phase allowed the scientific team to reach

a sufficient sample to produce statistically relevant data. Incurred costs were still not as high as in Norway (Table 4).

2.1.2 Effectiveness score

The effectiveness score is an indicator aimed at evaluating and comparing the impact of interventions. The effectiveness score is defined as a set of criteria comprising statistical significance ($p < 0.05$), effect size ($\beta \geq 0.05$), and intervention duration. It is used to compare different models from the Saving Energy domain described in deliverable 4.3 by Kirchler etal. (2023), where we used similar approaches to estimate the effect of the interventions. A score of 4 indicates a very effective intervention with a statistically significant and large effect size established for an intervention duration of two months or more. A score of 1 signifies a lower level of impact which may be attributed to various reasons.

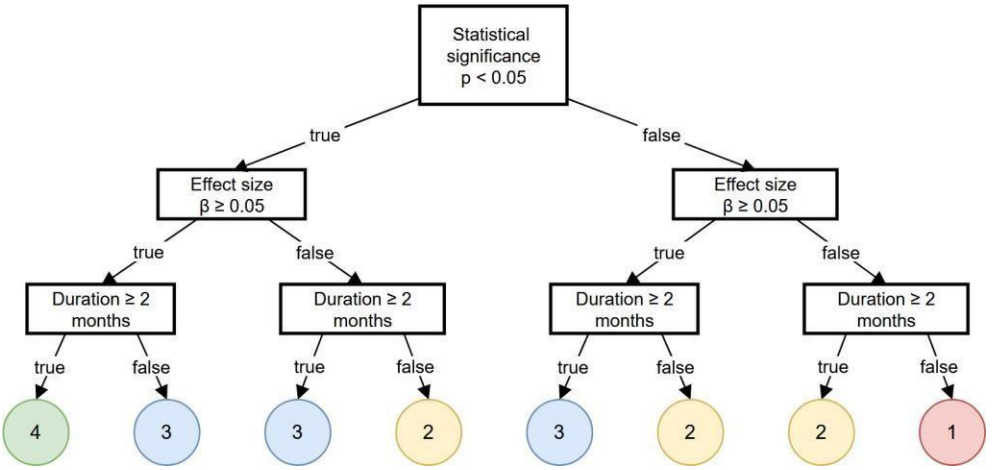


Figure 1: Decision tree to assign effectiveness scores.

We start by describing energy saving behavior interventions (Table 1). The structure of the data from the Austrian intervention conducted by Energie Kompass differs significantly from that of similar interventions in this domain, leading to the decision not to analyze it using regression models. Also, the intervention conducted by Hansgrohe in Germany does not target the analysis of electricity consumption and thus cannot be compared to other interventions in this domain. No scores were assigned to these interventions.

The intervention conducted by Energia Positiva, Italy, on the other hand, investigated the impacts of descriptive norm messages and injunctive norm messages on the customers' energy consumption behavior. The intervention using injunctive norm messages resulted in a statistically significant decrease in electricity consumption of about 17.3%. The intervention involving descriptive norm messages did not yield statistically significant results. The effect size observed for the descriptive norm messages indicated a minimal decrease in electricity consumption, approximately 0.2%. The intervention spanned a period of two

months. Therefore, the intervention utilizing injunctive norm messages is rated at level 4, and the intervention utilizing descriptive norm messages is rated at level 3.

The Romanian energy provider Electrica Furnizare tested four types of messaging and information on their online and offline customer base. Online customers received interventions during a two-month time period. Offline customers received the intervention in September 2022. The 0.3% increase in electricity consumption among online customers associated with "Individual benefit information" is not statistically significant. This results in a score of 2. The treatment using "Altruism and social norm information" decreased the electricity consumption by about 0.6%. However, this intervention is also not statistically significant and is rated at level 2. "Individual framing information" (decrease by 1.1%) and "Collective framing information" (decrease by 1.9%) both are statistically significant and are rated at level 3. Due to the design of the offline customer base intervention, we lack the ability to establish a causal link between the intervention and changes in electricity consumption. However, the effect of the linear regression model shows that the intervention is associated with a statistically significant decrease of about 15% in electricity consumption. This intervention is rated at level 3.

The Gediz intervention in Izmir, Türkiye, was implemented in northern regions of the municipality in a four-month period and in southern regions in a three-month period. Both groups received the same energy-saving tips but the time period differed slightly, leadingto a decrease in electricity consumption of 1.9% in northern regions and a decrease of 1.3% in southern regions. Both effects are statistically significant. This results in a score of 3 for both interventions.

Moving to Table 2, both public transport interventions proved quite effective. The difference-in-differences (DiD), which captures the interaction between Post Treatment and Treated and thus the treatment effect, was not statistically significant for any of the interventions. The Green Friday intervention resulted in an increase in transportation use of approximately 5% and the intervention in Türkiye led to an effect of 7.8% increase in daily passengers' transportation use. As the effect size was considerably large ($\beta \geq 0.05$) and both interventions lasted longer than 2 months, they were both assigned a score of 3.

As we can see from Table 3, the Ninfa EE and RES investment intervention did not prove to be effective. In fact, the figures are not statistically significant and the effect size was also small. This intervention is therefore assigned the lowest score. On the contrary, the EE Counseling interventions led to an increase in investment. Social norms had an effect on the willingness to renovate of +18.1%, attitudes 27.8%, personal norms 14.9% and self-efficacy 15.1%. These results are statistically significant. Given the magnitude of the effect size and the length of the interventions, they are given the highest effectiveness score.

The ENCHANT Platform, on the other hand, proved the most effective in Norway, Germany

and Romania. In fact, participants numbers in these countries were high enough to allow for statistical analysis and produced statistically significant results. Among the major effect sizes there are providing information (-14,31) and competition messages (-20,43) in Norway, commitment (-9,16) and competition messages (-12,59) in Germany, as well as providing feedback (-9,86) and public commitment messages (-12,23) in Romania, all resulting in significant reductions in weekly electricity consumption.

2.1.3 Participants reached

The quantity of individuals involved in an intervention is ranked on a scale of 1-4, reflecting the extent of participation. This evaluation helps determine the breadth and depth of involvement, providing insights into the reach and potential impact of the intervention based on the number of participants engaged. The score is assessed by assigning the minimum and maximum number of participants to the scores of 1 and 4, respectively, and computing the absolute difference between the other values. This process allows for the categorization of participants' values to assign them to a score based on their proximity. However, interventions that reached at least 5% of the total potentially reachable participants or that had high recruitment numbers despite limited recruitment potential were given an additional point. The rating is conducted within each of the three domains.

Among the energy saving behavior interventions (Table 1), the intervention conducted by Energia Positiva in Italy reached 442 customers. Experimental group 1 (n = 111) received newsletters containing injunctive norm messages. Experimental group 2 (n = 109) received newsletters containing descriptive norm messages. Customers in the control group (n = 222) did not receive any newsletters. This intervention is scored at level 2 based on the total number of participants reached, with an additional point added for reaching at least 5% of total reachable customers.

The Romanian energy provider Electrica Furnizare SA who sent interventions to their customer base reached 30,596 households with online accounts. The online customers were divided into four distinct experimental groups providing different information and framing messages, and one control group. Furthermore, 23,345 customers with offline accounts were reached by sending leaflets with information messages equal to one of the experimental groups in the online customer base. Overall, 53,941 customers participated in the two different settings. Both online and offline customer interventions are rated at level 3.

The newsletter campaign conducted by ENCHANT partner Energie Kompass in the Austrian federal state of Burgenland was sent to all 2,500 members of the energy communities operated by Energie Kompass. Energie Kompass then analyzed the aggregated electricity consumption data for all members, split into two experimental groups and one control group. Based on the absolute number of participants reached, and adding an additional point for reaching at least 5% of the total reachable members, this intervention is rated at level 3.

The collaborative intervention between the German energy provider Badenova involved ten participants who were equipped with the Pontos water management system. This is the smallest number of participants among the implemented interventions and is therefore rated at level 1.

Finally, the Gediz intervention in Türkiye reached about 1.5 million customers. Those within the experimental groups in the north region (n = 136, 785) and south region (n = 320, 598) received intervention messages on their electricity bills. Customers within the control group, in the metropolitan region, (n = 1, 104, 261) did not receive messages. The Gediz intervention reached the highest number of participants among the implemented interventions in the energy saving behavior domain and is therefore rated at level 4.

Among the public transport interventions (Table 2), the "Green Friday" campaign implemented by the Cluj-Napoca Municipality, Romania, counted a total of 11.2 million trips on public transport on Fridays, across all transport systems and lines, during the 18-week observation period. Therefore, this intervention receives a score of 4.

In Izmir, Türkiye, more than 466 million passengers were counted during the public transportation intervention where billboards and infographics were placed promoting public transport. This intervention reached the highest number of participants among all implemented interventions and is therefore rated at level 4.

In Norway, the municipality of Viken and the NGO Natuvernforbundet distributed a sur- vey through their websites, where they each also implemented an energy counseling plat- form. 437 participants completed the survey. 90% of the responses were recruited by the NGO. Based on the absolute number of participants reached, and adding an additional point for the high recruitment numbers despite limited recruitment potential, this intervention is given a score of 2 (Table 4).

The other EE and RES intervention at Ninfa Gardens in Italy asked visitors of the historic gardens to fill out a short survey, which was completed by 717 visitors. Among them, 360 of the participants were part of the intervention group. This intervention is thus rated at level 2.

The core ENCHANT intervention, the intervention platform, was implemented in Nor- way, Germany, Italy, Austria, Türkiye and Romania. Given the special case of the ENCHANT platform intervention, participation scores are not given by comparing numbers with the other interventions, but rather based on a cross-country comparison among those countries who implemented the platform. Norway had the highest participation rate, as Viken reached 916 participants and Naturvernforbundet 423, for a total of 1339. The use of the platform in Norway therefore receives a participation score of 4 (green). In Germany, a

diversified approach led to the recruitment of 677 participants. Platform implementation in Germany therefore receives a participants score of 2 (yellow). In contrast, recruitment in Romania yielded limited results with 118 participants, and after a recruitment company was hired to recruit additional participants, 523 new participants were added to the sample, resulting in a score of 2 (yellow). Türkiye reached the lowest number of participants, 9, and therefore receives the lowest score. Similarly, recruitment in Italy and Austria had modest results, with 27 and 63 participants, respectively, resulting in the lowest participation scores.

2.1.4 Covid Impact

This metric evaluates the impact of the COVID-19 pandemic on interventions using a 1-4 scale. It gauges whether the intervention was significantly affected throughout (1), con- ducted partially during the initial crisis (2), implemented after the immediate crisis (3), or remained unaffected (4) by the challenges and consequences posed by the pandemic. This evaluation helps understand the level of disruption or adaptation required in the intervention strategy due to COVID-19-related factors.

Starting off with energy saving behavior interventions (Table 1), the intervention conducted by Energia Positiva took place in September and October 2022 when most of the pandemic measures had already been removed. However, electricity consumption was observed since January 2022 and consequences of the pandemic might still be reflected in the consumption patterns. The intervention is rated at level 3 on the scale, signifying that it was implemented after the immediate crisis. This rating suggests that while the intervention occurred after the peak crisis period, some effects or adaptations due to the pandemic's aftermath might still have influenced its implementation or outcomes.

In Romania, the intervention by Electrica Furnizare was implemented between May and July 2022. Electricity consumption data was collected between January 2020 and December 2022. Therefore, the effect of the pandemic is fully captured within this time frame. This intervention is rated at level 1, indicating that it was significantly affected throughout the pandemic period. The intervention had to be postponed but the original intervention design remained unaffected. The electricity consumption data collected during this time is likely affected by the influence of pandemic-related measures, such as country-wide or local lockdowns, on consumer behavior and patterns.

The Austrian intervention by Energie Kompass took place in Spring 2023 when almost all COVID-19 measures had already been lifted. This intervention is rated at level 3, signifying that it was implemented after the immediate crisis. Despite taking place after the peak crisis period and the lifting of most restrictions, some effects related to changed consumption patterns due to the aftermath of the pandemic might have influenced its outcomes.

The Badenova / Hansgrohe intervention took place from 09.06.2021 to 25.05.2022 and was therefore directly affected by COVID-19 measures such as home office regulations and contact restrictions. Rated at level 2, this indicates that the intervention was conducted partially during the initial crisis period, being directly affected by such measures.

The Gediz intervention was implemented between November 2021 to February 2022 and the data collection started in December 2019. While the intervention was not directly affected by COVID-19 measures, the pandemic started during the observation and the electricity patterns are therefore impacted by the consequences of the pandemic. Rated at level 2, this signifies that the intervention occurred partially during the initial crisis period. De- spite not being directly influenced by COVID-19 measures, the intervention's timing coincided with the pandemic's emergence, suggesting that its outcomes might have been influenced by the broader consequences and changes in electricity consumption patterns due to the pandemic's effects.

Continuing with public transport interventions (Table 2), the Green Friday campaign in Cluj-Napoca, Romania, was significantly hit by the pandemic. The campaign has been implemented since June 2021 and the time frame we analyzed spans from March 2021 to December 2022. COVID been associated with a decline in ridership. Additionally, local lock-downs were implemented in 2021 that also affected public transport. Rated at level 1, this indicates that the intervention was significantly affected throughout the pandemic period. The Green Friday campaign coincided with the time when COVID-19-related factors, including the decline in ridership and the impact of local lock-downs, were influencing public transport. Therefore, these pandemic-induced circumstances might have had a substantial impact on the effectiveness and outcomes of the Green Friday campaign.

The public transport intervention in Izmir, Türkiye, took place from 01.12.2021 to 01.03.2022 and was therefore affected by the COVID-19 pandemic, which resulted in multiple closures or partial closures of public transport and a significant decrease in the number of passengers during lock-downs. Nevertheless, the use of experiment and control groups and the utilization of the data to account for pre-pandemic, pandemic and post-pandemic eras helped to identify and factor out the effects of the pandemic on the results. Given the ability of the research team to overcome potential confounding effects of COVID-19 on the results, this intervention is given an additional point, scoring a total of 2.

As shown in Table 3 (Economic dimension of EE and RES investments), the interventions of the municipality of Viken and the NGO Naturvernforbundet in Norway faced challenges due to the impact of the pandemic. The consequences were a delayed and scaled- down rollout of the energy counseling campaign in Viken, which spanned approximately a year from January 19, 2022, to January 11, 2023. The Naturvernforbundet energy portal

intervention, conducted from December 2, 2021, to December 12, 2022, were not facing direct challenges but the time period suggests that behavior of participants was still impacted by consequences of the Covid pandemic. Rated at level 3, this indicates that both interventions were implemented after the immediate crisis period. While the energy counseling campaign faced direct challenges and modifications due to Covid-related impacts, the behavioral patterns of participants in the energy portal intervention were likely influenced by the aftermath of the pandemic, even though it did not face direct challenges. This rating reflects the enduring influence of Covid-related consequences on the interventions' implementation and participant behavior.

The intervention in the Ninfa Gardens took place from 01.07.2021 to 31.08.2021 for the first wave and the second one lasted from 01.06.2022 to 31.07.2022. Modifications were made to the original intervention design due to COVID-19 restrictions that affected the planned behavioral measures. Rated at level 3, this indicates that the intervention was implemented after the immediate crisis period.

Lastly, the ENCHANT platform (Table 4) was largely deployed after the end of COVID-19 as a global health emergency was declared by the WHO, and is therefore assigned a score of 4.

2.1.5 Energy crisis impact

The final economic dimension analyzed in this context is the energy crisis impact (Table 1). This metric assesses the impact of the global energy crisis starting in 2021. The energy crisis was driven by COVID-19 pandemic and the Russian invasion of Ukraine leading to record highs of natural gas, electricity, and oil prices. The impact is evaluated on a scale of 1-4 depending on whether the intervention was fully (1), more than half of the time(2), less than half of the time (3), or not at all (4) affected. This metric is only related to interventions in the Saving Energy domain. All interventions conducted in 2021 onwards are considered as fully impacted. However, we lack specific information about increasing energy bills for individual households.

The intervention and the preceding observation period of customers' electricity consumption of Energia Positiva, starting in January 2022, were fully impacted by the energy crisis and are therefore rated at level 1.

The data collection by Electrica Furnizare in Romania started in January 2020 and was therefore more than half of the time impacted by the energy crisis. This intervention is assigned a score of 2.

In the scope of the Austrian intervention, electricity consumption data from January to

May 2023 was analyzed. Therefore, this intervention is also considered as significantly impacted by the consequences of the global energy crisis and is assigned an energy crisis impact score of 1. The same applies to the Badenova / Hansgrohe intervention in Germany. The intervention is also rated 1. Although this intervention does not directly address electricity consumption, the replicability of the sustainability survey conducted by Badenova may have been affected by the energy crisis, as the issue of sustainability gained a little more prominence at that time.

The data collection for the Gediz intervention started in December 2019. Therefore, the intervention is considered more than half of the time affected by the energy crisis. This results in a score of 2.

Public transport (Table 2) and EE/RES measures were also given a score of 1, as they were all implemented after 2021 and could therefore have been affected by the effects of the energy crisis and the resulting inflation. The same thing applies for the ENCHANT platform (Table 4).

Table 1: Economic dimension of energy saving behavior interventions

		Energy saving behavior				
		Cost	Effectiveness	Participants	Covid Impact	Energy Crisis Impact
Energie Kompass (AT)		🟢	-	🟡	🔵	🔴
Energia Positiva (IT)	Injunctive norm	🟢	🟢	🟡	🔵	🔴
	Descriptive norm	🟢	🔵	🟡	🔵	🔴
Electrica Furnizare (RO) online	Individual benefit	🔵	🟡	🔵	🔴	🟡
	Altruism and social norm	🔵	🟡	🔵	🔴	🟡
	Individual framing	🔵	🔵	🔵	🔴	🟡
	Collective framing	🔵	🔵	🔵	🔴	🟡
Electrica Furnizare (RO) offline	Individual benefit	🟡	🔵	🔵	🔴	🟡
Gediz Electricity (TR)	South region	🟢	🔵	🟢	🟡	🟡
	North region	🟢	🔵	🟢	🟡	🟡
Hansgrohe Pontos (DE)		🔵	-	🔴	🟡	🔴

Table 2: Economic dimension of public transport interventions

	Public tansport				
	Cost	Effectiveness	Participants	Covid impact	Energy Crisis Impact
Green Friday (RO)	🔴	🔵	🟢	🔴	🔴
Public transportation (TR)	🟡	🔵	🟢	🔴	🔴

Table 3: Economic dimension of EE and RES investment

	EE and RES investment				
	Cost	Effectiveness	Participants	Covid impact	Energy Crisis Impact
Ninfa Garden (IT)	🟡	🔴	🟡	🔴	🔴
EE Online Counseling (NO)	🔴	🟢	🟡	🟡	🔴

Table 4: Economic dimension of the ENCHANT Platform

	ENCHANT Platform				
	Cost	Effectiveness	Participants	Covid impact	Energy Crisis Impact
Norway	🟡	🟢	🟢	🟢	🔴
Germany	🟢	🟢	🟡	🟢	🔴
Italy	🟢	-	🔴	🟢	🔴
Austria	🟢	-	🔴	🟢	🔴
Romania	🟢	🟢	🟡	🟢	🔴
Turkiye	-	-	🔴	🟢	🔴

2.2 Environmental Dimension

The environmental dimension of the evaluation matrix assesses the environmental impact and sustainability of interventions. It offers stakeholders insights into how interventions affect ecological challenges, focusing on their ecological footprint, sustainability practices, and compliance with environmental goals. This analysis takes into account specific national contexts, such as the proportion of sustainable energy in total consumption, and estimates each intervention's effect on greenhouse gas (GHG) emissions. All criteria employ a scale of 1-4, where the lowest score (1) is represented by a red color, 2 by a yellow color, 3 by a blue color, and the highest score (4) by a green color (Table 5).

2.2.1 Greenhouse gas emissions

Greenhouse gases are atmospheric gases that contribute to the greenhouse effect by absorbing infrared radiation, trapping and holding heat in the Earth's atmosphere. This phenomenon warms the planet's surface and is crucial for supporting life as we know it. However, human activities, particularly the burning of fossil fuels and deforestation, have significantly increased the concentrations of these gases, enhancing the greenhouse effect and leading to global warming and climate change (Ritchie, et al., 2020).
Looking at a country's greenhouse gas emissions can tell us a lot about the success and effectiveness of an intervention. GHG emissions provide a starting point for understanding the current state of a country's environmental impact. This makes it possible to better assess the need for interventions to reduce these emissions. Knowledge of GHG emissions allows governments and organizations to set clear targets for emissions reduction. This helps with prioritization, especially for high consumption sectors. Different sectors con- tribute differently to overall emissions and therefore require different approaches. Emissions vary greatly between sectors such as energy, transport, agriculture and industry. By taking a sectoral view, the main sources of emissions can be identified. Through sectoral analysis, interventions can be targeted to maximize the impact on emissions reduction in a particular sector.

The interventions developed in the ENCHANT project are categorized in three sectors: energy saving, public transport and investments in EE and RES. For this reason, it seems particularly appropriate to look at consumption in the transport and energy sectors, especially electricity and heating. Depending on the current consumption, it is possible to allocate where an intervention should be prioritized or where a considerable efforts have already been made towards sustainable development and savings. In other words, an intervention is considered more appropriate where the savings potential is still very high. In these cases,

interventions can have a greater impact. In the following, we look at the transportation, electricity, and heating sectors. The energy sector includes emissions caused by the use of energy. The electricity/heating subsector includes, in particular, producers of electricity and heat, unallocated own consumption and other own utilization in the energy sector. The transport subsector includes emissions from road transport, rail transport, domestic air transport and possible domestic shipping.

The data describes a breakdown of CO2 emissions in a country per capita by sector. This breakdown is measured in tones per person per year. The aim of this presentation is to improve the understanding of the individual contribution to CO2 emissions in different sectors. In other words, it helps to quantify and analyze individual emissions in relation to different sectors within the country.

Table 5 compares the countries' existing emissions data and analyses the potential effectiveness of an intervention in this sector depending on consumption. Green means very high CO2 emissions in this sector, with an increased probability that an intervention will have a greater impact here. Blue means still high emissions and yellow means medium CO2 emissions. In this case, red is to be regarded as the lowest emissions of the comparative values and is therefore also considered to have a lower probability that an intervention will still have a major impact and a major influence on GHG emissions.

The per capita emissions from electricity and heating in Austria are 1.92 tons (Ritchie, Rosado, & Roser, 2020). This represents the average contribution of each Austrian citizen to greenhouse gas emissions in the electricity and heating sector. The intervention Energie Kompass, which took place in Austria is therefore given a score of 3 (blue), see Table 5. Italy reports per capita electricity and heating emissions of 1.64 tons (Ritchie, Rosado, & Roser, 2020). Italians contribute a moderate amount of emissions from electricity and heating activities on an individual basis which led to the result, that the intervention Energia Positiva was rated with a score of 2 (yellow). Romania records per capita emissions of 1.13 tons (Ritchie, Rosado, & Roser, 2020) in the electricity and heating sector, indicating a comparatively lower individual impact on greenhouse gas emissions. Therefore, the intervention Electrica Furnizare has been given a score of 1 (red). Per capita electricity and heating emissions in Türkiye amount to 1.71 tons (Ritchie, Rosado, & Roser, 2020), reflecting a moderate level of individual contribution to emissions in this sector which led to an estimation of 2 (yellow) for the intervention of Gediz Electricity. Germany has per capita emissions of 2.72 tons in the electricity and heating sector (Ritchie, Rosado, & Roser, 2020). This suggests a relatively higher individual impact on greenhouse gas emissions from electricity and heating activities. the intervention Hansgrohe Pontos is therefore given a score of4 (green).

Romania reports per capita transport emissions of 0.95 tons (Ritchie, 2020), showcasing a lower individual impact on greenhouse gas emissions from transportation activities. Therefore, the intervention Green Friday has been given a score of 1 (red). The per capita

transport emissions in Türkiye are 0.96 tons, indicating a relatively modest individual contribution to greenhouse gas emissions in the transport sector. Because of that the intervention Public Transporting in Türkiye is given a score of 1 (red)(Ritchie, 2020).

Due to the fact that there is no specific data for the consumption of GHG emissions in the area of investments in EE and RES, it was decided not to apply the GHG emissions factor for the two interventions in the area of investments in EE and RES (see Table 5).

2.2.2 Share of renewables

The ”share of renewable energy” refers to the proportion or percentage of total energy consumption that is derived from renewable sources within a specific geographic area, sector, or system. It quantifies the contribution of renewable energy sources, such as solar, wind, hydroelectric, geothermal, and biomass, to the overall energy mix. The share of renewable energy is a key metric used to evaluate the sustainability and environmental impact of energy consumption. This metric is crucial for assessing progress toward renewable energy targets, understanding the degree of dependence on fossil fuels, and guiding policy decisions aimed at promoting sustainable and cleaner energy practices. A higher share of renewable energy signifies a greater reliance on environmentally friendly and sustainable energy sources, contributing to efforts to mitigate climate change and re- duce dependence on finite and non-renewable resources. The share of renewable energyin the overall energy demand across several countries provides valuable insights into their respective energy landscapes.

Italy demonstrates a significant commitment to renewable energy, with renewables contributing to 33.54% of the total energy demand (IEA, 2022). This indicates a substantial portion of their energy consumption is sourced from renewable sources such as solar, wind, hydro, and biomass and therefore the interventions Energia Positiva and Ninfa Gardenare rated with 4 (green) because it is a very low value and increases the probability that an intervention will be successful. .

Romania exhibits an even higher reliance on renewables, with an impressive share of 51.17% (IEA, 2022). This suggests a substantial integration of renewable energy sources into Romania’s energy infrastructure, contributing to a more sustainable and environmentally friendly energy profile and allows a rating of the interventions Electrica Furnizareand Green Friday as 3 (blue).

Austria leads the way in embracing renewable energy, boasting an impressive share of 81.02% (IEA, 2022). This high percentage underscores Austria’s commitment to transitioning toward cleaner and more sustainable energy sources, aligning with broader global efforts to combat climate change. Therefore, the intervention in Austria, Energie Kompass, is given the score 2 (yellow).

Germany, a key player in renewable energy initiatives, maintains a substantial share of renewables at 52.74% (IEA, 2022). This emphasizes Germany's success in integrating renewable sources into its energy mix, a crucial aspect of its Energiewende strategy aimed at transitioning to a more sustainable energy system. As well as Romania the German intervention Hansgrohe Pontos is scored as 3 (blue).

Türkiye demonstrates a noteworthy commitment to renewables, with a share of 35.06%

(IEA, 2022). This reflects Türkiye's efforts to diversify its energy sources and reduce dependency on traditional fossil fuels, contributing to a more resilient and environmentally conscious energy sector. Due to the low value the interventions in Türkiye, Gediz Electricity and Public Transport, are given the score 4 (green).

Norway stands out significantly, showcasing an exceptionally high share of renewables at 114.56% (IEA, 2022). This remarkable figure is indicative of Norway's extensive use of renewable energy, particularly hydropower, which plays a pivotal role in meeting the country's energy needs. Due to the export of renewables, it is even possible that Norway will have a percentage of over 100. Therefore, the intervention in Norway, the EE Online Counseling, is given the score 1 (red) because the country is already showing so much effort and in this respect an intervention probably cannot achieve as much as in other countries.

Table 5 below compares the share of renewable energy in the demand of the individual countries. In countries where this share is not yet very high, an intervention can be fully effective. There is still potential here to make people and politicians aware and to achieve a major impact. Countries with a relatively high proportion of renewable energies were therefore categorized as red. Countries that also have a high share of renewable energies are categorized as yellow and those that still have a lower share of renewable energies as blue. Green is for those countries where an intervention can still have a full effect, as these are the countries with the lowest share of renewable energies.

2.2.3 Energy Transition Index

The Energy Transition Index (ETI) serves as a comprehensive benchmark, evaluating countries on two critical dimensions: the performance of their existing energy systems and their readiness for transitioning to a future characterized by energy security, sustainability, affordability, and reliability. The ETI employs a scoring system that ranges from 0to 100, offering a nuanced and quantitative assessment of each country's standing in the ongoing global energy transition. The performance aspect of the ETI delves into the effectiveness, efficiency, and sustainability of a nation's current energy infrastructure. It considers factors such as the mix of energy sources, emission levels, energy efficiency, and the overall resilience of the energy system. Countries demonstrating advancements in renewable energy integration, emission reductions, and overall system robustness receive higher performance scores. On the other hand, the readiness dimension evaluates a country's preparedness for

the impending energy transition. This includes assessing regulatory frameworks, policy initiatives, investment attractiveness, innovation capacity, and infrastructural development geared towards supporting sustainable energy practices. Nations scoring higher in readiness are deemed better equipped to navigate the challenges and seize the opportunities presented by the evolving energy landscape. The scoring scale from 0 to 100 provides a clear and standardized representation of a country's position in the global context. A higher score indicates a more favorable alignment with the goals of a secure, sustainable, affordable, and reliable energy future (Forum, 2023).

The ETI is important when considering the environmental dimension, as there is still a lot of potential to increase this value in some countries. An intervention can therefore still have a very large impact in countries with a lower value. The countries were therefore ranked according to their values and categorized in the table below on the basis of this ranking. A red color indicates a very high ETI with already strong efforts towards energy transition. Blue means a still very high value and yellow a rather low one. In this case, green means a very low comparative value with the potential to make further improvements. Intervention would tend to have a major impact here. Austria (69,3) (World Eco- nomic Forum, 2023) exhibits a commendable ETI score, indicating a relatively high level of both performance and readiness in its energy transition. This suggests a well-established and efficient energy system, coupled with proactive measures in place for a sustainable and resilient future and the intervention in Austria is given the score 3 (blue). Italy's (60,6) ETI score (World Economic Forum, 2023) reflects a moderate level of progress in its energy transition. While there are positive aspects, such as advancements in renewable energy, there may be areas where improvements can be made to enhance overall system performance and readiness for future challenges. Because of that the interventions Energia Positiva and Ninfa Garden are scored as 2 (yellow). Romania's (56,8) ETI score (World Economic Forum, 2023) suggests a position with room for growth in terms of both current energy system performance and preparedness for the transition. There may be opportunities for the country to enhance sustainability practices and strengthen its energy infrastructure. Probably by the interventions Electrica Furnizare or Green Friday which are rated as 4 (green) The ETI score in Türkiye (54,3) (World Economic Forum, 2023) indicates a lower level of progress in the energy transition, suggesting potential challenges in achieving a secure, sustainable, and reliable energy future. The country may benefit from increased efforts in policy development, innovation, and infrastructure investments. As well as Roa- mania the interventions in Türkiye, Gediz Electricity and Public transportation, are given the score 4 (green). Germany's (67,5) ETI score (World Economic Forum, 2023) is relatively high, signaling strong performance in its existing energy system and a high level of readi- ness for the transition. Germany is likely to implement effective measures in renewable energy integration and overall energy efficiency. Therefore, the intervention in Germany, Hansgrohe Pontos, is given the score 3 (blue). Norway (73,7) (World Economic Forum, 2023) stands out with a notably high ETI score, showcasing exemplary performance and readiness in its energy transition. This suggests a well-developed and sustainable energy system, possibly driven by effective policies and a strong emphasis on renewable energy sources and because of that the EE Online Counseling intervention is rated as 1 (red).

Table 5: Environmental dimension

		GHG	Share of renewable	ETI
Energy Saving behavior	Energie Kompass (AT)	●	●	●
	Energia Positiva (IT)	●	●	●
	Electrica Furnizare (RO)	●	●	●
	Gediz Electricity (TR)	●	●	●
	Hansgrohe Pontos (DE)	●	●	●
Public Transport	Green Friday (RO)	●	●	●
	Public transportation (TR)	●	●	●
EE and RES Inv.	Ninfa Garden (IT)	-	●	●
	EE Online Counseling (NO)	-	●	●

2.2.4 Environmental Dimension of the ENCHANT Platform

As mentioned above, most of the interventions carried out in ENCHANT were affected by at least one of the two major crises - COVID-19 or the energy crisis. Therefore, the online platform was developed to allow users to be randomly assigned to intervention groups and to collect their electricity meter readings as well as socio-economic and psychological information. The ENCHANT platform records different households and provides them with interventions. These can all be categorized as energy saving, energy consumption and energy saving tips.

As a result, Norway (2.67 tons per capita) and Germany (2.72 tons per capita) have the highest GHG emissions and are therefore rated as green, as there is still a lot of potential for savings in this sector in particular and interventions can have an impact here (Table 6). Witha value of 1.92 tones, Austria is in the blue area of the assessment, while Italy (1.64 tons) and Türkiye (1.71 tons) are in the yellow area. At 1.13 tons, Romania has the lowest comparativevalue and is therefore rated red in this matrix, as it has significantly lower emissions than the others (Ritchie, 2020) and (Ritchie, Rosado, & Roser, 2020).

The share of renewables is also rated by country. Here too, countries with an already very high share of renewable energies are rated red (1) (Norway with 114.56 %), yellow (2) if they still have a very high share of renewables (Austria with 81.02 %), blue (3) if the share is already only just under half or less (Germany with 52.74 % and Romania with 51.17 %) and green (4) if they have the lowest comparative value (Italy with 33.54 % and Türkiye with 35.06 %) (IEA, 2022).

The Energy Transition Index score is also based on an overall country score and is broken down in the same way as the other two. Countries with a very high value (Norway with

73.7 %) fall under the red (1) rating, as the potential efficiency of an intervention of the platform is not as high as in countries with a lower value. Italy with a value of 60.6 % was classified as yellow (2), Germany (67.5 %) and Austria (69.3 %) as blue (3). Both Romania (56.8 %) and Türkiye (54.3 %) have the lowest score and are therefore rated green (4) (World Economic Forum, 2023).

Table 6: Environmental dimension of the ENCHANT Platform

	ENCHANT Platform		
	GHG	Share of renewables	ETI
Norway	●	●	●
Germany	●	●	●
Italy	●	●	●
Austria	●	●	●

Romania	●	●	●
Türkiye	●	●	●

2.3 Social & Political Dimension

Finally, the third dimension considers factors that are associated with broader effects of well-being. The social dimension of the policy matrix is dedicated to evaluating the impact of interventions on societal well-being, equity, and inclusivity. This dimension provides stakeholders with insights into how interventions influence communities, social structures, and political dynamics. The criteria within this dimension are designed to capture the diverse and nuanced aspects of social and political implications. The social & political domain adopts a scale of 1 to 4, with the lowest score represented by a red color, 3 by a yellow color, 3 by a blue color, and the highest score (4) by a green color.

2.3.1 Awareness

Awareness, scored on a scale of 1 to 4, refers to number of stakeholder types engaged during the specific intervention or initiative among private (1), public (2), university and research (3), as well as civil society actors (4). All interventions started with a score of 1by default, as at least one actor was involved. The score was assessed by counting the additional external stakeholder type involved in the intervention, based on the partners' assessments and reporting.

Among the first group of interventions, Energie Kompass and Hansgrohe Pontos had no external stakeholders involved, and thus receive the lowest score. On the other hand, for Gediz Electricity the local electricity company was involved together with the university, andthus scores 2. Energia positiva was conducted by one scientific and one public actor, and thus scores 2. Similarly, both Electrica Furnizare interventions in Romania involved scientific and commercial actors, and thus score 2.

Both public transport interventions involved the local municipality, so they both received a score of 2. EE and RES interventions were among those which involved the highest number of external stakeholders. The interventions conducted in Norway by the municipalityof Viken and the NGO Naturvernforbundet involved the highest number of actors in total (4 public, 2 scientific, 1 commercial and 3 NGOs), and is thus assigned the highest score. Lastly, awareness scores look different across the countries that deployed the intervention platform. Germany scientific partners had no external actor involved, while the Norwegian scientific partners engaged with all types of external stakeholders: 3 public, 2 scientific, 1 commercial and 1 NGO. The platform implementation in Austria also involved a quite high number of actors: 10 municipalities, 8 enterprises and 1 research institute, and is thus assigned the second-best score. Italy involved all kinds of actors, and is thus assigned the highest score. The awareness scores for Türkiye and Romania were not reported.

2.3.2 Acceptance

Acceptance, scored on a scale of 1 to 4, measures the willingness and cooperation of the individuals or groups targeted by the intervention. It reflects the overall approval and support received from the target population. A score of 1 typically indicates low acceptance, while a score of 4 suggests high acceptance. The score is self-reported by the partners or stakeholders involved in the intervention, based on their observations and assessments of how well the intervention was received by the target audience.

Acceptance was generally higher in energy saving behavior interventions, as well as EEand RES investment, compared to the other intervention groups (Table 7). The lowest acceptance scores were assigned to the Green Friday campaign and to the ENCHANT plat- form deployment in Italy. The Green Friday message was widely circulated in Cluj-Napoca but did not generate significant behavioral change, and is therefore given the lowest score. For the other public transport intervention in Izmir, Türkiye, the relatively low score is explained by the impacts of the COVID-19 pandemic on citizens' willingness or ability to take public transport. Nevertheless, this intervention proved to be quite effective. Finally, the ENCHANT platform had the lowest acceptance in Italy, as the recruitment proved to be extremely difficult. In Norway the people participating responded well, but the recruitment rates indicate that the acceptance is not that high overall. Germany, too, encountered some issues with motivating recruits to participate over a long period of time, and thus scores 2. The acceptance scores for Türkiye, and Romania were not reported.

2.3.3 Replicability

Replicability, scored on a scale of 1 to 4, assesses the ease with which the intervention can be reproduced or implemented in similar contexts, settings, or by other organizations. A

score of 1 typically indicates low replicability, while a score of 4 suggests high replicability. The score is self-reported by the partners or stakeholders involved in the intervention, based on their assessments of the intervention's adaptability and potential for wider ap- plication. From Table 7 we can see that most interventions were rated with medium-high replicability. Among the energy saving behavior interventions, Energia Positiva stands out with the highest score. Between the two public transport interventions, the Turkish one is considered more replicable. Among the EE and RES investment interventions, Ninfa Gar- den is considered the most replicable. Finally, the ENCHANT platform was perceived as moderately or highly replicable in all countries. The replicability scores of the platform for Türkiye, and Romania were not reported.

Table 7: Social and political dimension

		Awareness	Acceptance	Replicability
Energy Saving Behavior	Energie Kompass (AT)	🔴	🟢	🔵
	Energia Positiva (IT)	🟡	🔵	🟢
	Electrica Furnizare (RO)	🟡	🟢	🔵
	Gediz Electricity (TR)	🟡	🔵	🟡
	Hansgrohe Pontos (DE)	🔴	🟢	🟡
Public Transport	Green Friday (RO)	🟡	🔴	🟡
	Public transportation (TR)	🟡	🟡	🔵
EE and RES Investment	Ninfa Garden (IT)	🔵	🔵	🟢
	EE Online Counseling (NO)	🟢	🟢	🟡
ENCHANT Platform	Norway	🟢	🟡	🔵
	Germany	🔴	🟡	🔵
	Italy	🟢	🔴	🔵
	Austria	🔵	🔵	🟢
	Türkiye	-	-	-
	Romania	-	-	-

3 Policy Recommendations

The Policy Recommendation section is designed to provide a structured and comprehensive overview of policy recommendations across three key domains: Energy Savings, Public Transport, and Investment in Renewable Energy Sources (RES) and Energy Efficiency (EE). Additionally, recommendations in light of the ENCHANT interventions platform are provided. The development of this matrix is informed by a multi-dimensional approach, considering economic, ecological, as well as social & political aspects.

3.1 Energy Saving Behavior

At the forefront of policy considerations should be the balance between the complexity and cost-effectiveness of interventions. Complex initiatives, such as the social norms approach exemplified by Italy's Energia Positiva, offer profound impacts, but often at higher costs and implementation challenges. On the other hand, simpler information interventions, such as Gediz's, offer a more straightforward and replicable model with broad appeal and lower costs. Policymakers need to consider this trade-off and should also consider the country- specific situation before deciding which intervention to replicate. Only by taking the broadersituation into account can the most effective intervention be chosen.

An effective energy policy must be tailored to the unique environmental and economic conditions of each country. For example, countries with a lower share of renewable energy in their energy mix will benefit more from targeted energy conservation measures. Furthermore, an often overlooked aspect of energy policy is the social dimension, in particular the fight against energy poverty. It is imperative that policy-makers develop strategies that enable economically disadvantaged households to participate in and benefit from energy-saving measures. Energy saving campaigns or the provision of information may not be sufficient to address this dimension. Therefore, we suggest that additional campaigns should be designed to help such households reduce their economic burden while at the same time reducing their economic footprint by investing in energy efficiency (EE) measures. Onlyby ensuring that the benefits of sustainable practices are equitably dis- tributed can general acceptance be increased.

In general policy makers should first focus on increasing the general awareness. The higher the general awareness regarding the importance of saving energy for the environment the more likely it is that a simpler campaign (Nudge) will have an impact. Future campaigns should aim to elevate public awareness about energy-saving practices across various domains, including water, heat, and electricity. In parallel, investing in consumer behavior research is critical. Understanding the nuances of consumer preferences and behaviors can inform the design of tailored energy efficiency messages and programs, thereby enhancing their impact. However, it is crucial to acknowledge the challenges and resources required for the long-term assessment of these interventions. Focusing on existing communities that share a higher interest in energy topics, such as energy communities might also help to

leverage spillovers.

Supporting energy communities presents a unique opportunity to create spillover effectsin energy savings. These communities can extend benefits beyond immediate participants, fostering a culture of sustainability and encouraging broader participation in EE and RES investments. Moreover, energy-saving campaigns must be contextually tailored. Focusing on the community level can leverage additional motivators such as community attachment and pride, thereby enhancing the effectiveness of these campaigns.

Building a cooperative and transparent environment within the energy sector is critical. Enhanced engagement and trust-building among all stakeholders, including energy companies, can lead to more innovative and sustainable practices. Furthermore, ensuring that citizens have access to up-to-date information about their electricity consumption behavior is essential. The implementation of smart metering technologies, wherever possible, can significantly aid in this endeavor, empowering consumers to make informed decisions about their energy use.

The path towards energy efficiency and sustainability is multi-faceted, requiring a harmonious blend of economic, social, and environmental considerations. Policymakers must navigate the complexities of intervention strategies, consider the unique contexts of their jurisdictions, and ensure inclusivity in energy-saving initiatives. By implementing these recommendations, we can move closer to a future where sustainable energy practices are not just an aspiration but a reality.

3.2 Public Transport

In the context of urban development and environmental sustainability, promoting the use of public transport can be achieved through the use of financial incentives and simpler behavioral nudges. Policymakers should focus on increasing the use of public transport, not only to reduce its environmental footprint, but also to improve the overall quality of urban life.

Monetary incentives such as reduced fares, free use or subsidies for regular users appeal directly to citizens' economic considerations. At the same time, behavioral nudges, such as well-placed reminders and education campaigns, can encourage the use of public trans- port. This dual approach can appeal to a wide range of public preferences and motivations.

In particular, implementing measures such as offering free public transport, even if only on certain days, can have a significant impact. This strategy not only increases the use of public transport, but also enhances the city's image as environmentally conscious and socially responsible. It also provides tangible financial relief to socially disadvantaged groups, integrating them into the sustainability movement and improving social equity. In addition,

the concept of free transport days can have positive spill-over effects. For example, people who use public transport on these free days may be more likely to use it on other days, reinforcing sustainable habits over time. However, this positive behavior change could reduce the measurable effect size of such interventions, suggesting the need for more ex- tensive research and data collection to accurately assess their impact.

As with the previous behavioral dimension, it is important to consider the broader social, environmental and economic context of the nation. The collective environmental footprint is influenced by the fuel used in public transport. Switching from fossil fuel private trans- port to renewable energy has a greater positive impact than switching to fossil fuel buses.

Future policies should also collect additional data to capture positive spillover effects on public health and environmental quality. By collecting data on particulate matter, emissions, and other environmental factors, policymakers can gain insight into the health and environmental benefits of their initiatives and enable a comprehensive evaluation of such interventions. Taking these benefits into account can reduce the investment costs of implementing such interventions. In addition, the data-driven approach allows for continuous improvement of public transportation policies and campaigns.

While information campaigns are easier to implement both financially and organization- ally, they often face challenges in measuring their direct impact. Future campaigns should be designed to effectively use different media channels to reach different audiences, emphasizing the convenience, cost-effectiveness and environmental benefits of public trans- port. The focus should be on creating a compelling narrative that resonates with the public's values and daily experiences. To increase the reach and effectiveness of these campaigns, a variety of media channels should be used. This includes traditional media such as television and radio, as well as digital platforms that appeal to younger demographics. The content of these campaigns should be tailored to highlight the practical benefits of public transport, such as time and cost savings, as well as the wider environmental bene- fits.

Finally, it is essential to foster a collaborative and transparent environment within the urban planning and transportation sectors. This requires culturally sensitive engagement strategies that build trust among different stakeholders, including transport providers, urban planners, and the public. Understanding and adapting to cultural diversity within urban communities is key to promoting innovation and sustainable practices in public transport.

3.3 Investment in RES and EE

Investments in energy efficiency (EE) and renewable energy sources (RES) are critical to the sustainable development of our society. However, these investments often involve

significant financial commitments and are challenging due to high upfront costs, uncertain returns and technical complexity. A common obstacle is the lack of easy access to financial instruments, which may discourage citizens from taking action.
Thus, a key strategy for encouraging investment in EE and RES is to provide detailed and accessible information to the public. This can be achieved by developing tools that pro- vide insight into potential savings, returns on investment and payback periods. Such tools play a crucial role in clarifying the financial aspects of EE and RES projects. They can pro- vide estimates of energy savings, breakdowns of initial and running costs, information on subsidies or tax breaks, and calculations of payback periods under different scenarios. In addition, highlighting the environmental benefits, such as reduced carbon emissions, can highlight the environmental value of these investments alongside their economic benefits.

In addition to providing information, it is important to connect citizens directly with local service providers through information campaigns and platforms. This not only facilitates access to relevant information, but also creates economic value by bridging the gap be- tween service providers and end-users. By facilitating these connections, policymakers can fostera more dynamic and responsive market for EE and RES solutions.

Focusing on community-based projects is another important aspect of promoting sustain- able energy practices. Policymakers and stakeholders should aim to implement sustain- able initiatives within existing communities, leveraging their audiences and donation potential to drive the energy transition. This community-centered approach ensures that sustainable projects are not just seen as infrastructural developments, but are integrated into the community's identity and collective efforts towards sustainability.

Finally, improving collaboration between different stakeholders is paramount. Combining cultural adaptability with effective information dissemination and leveraging partner networks can improve communication and create additional economic value. Such collaborative efforts enable the sharing of resources, expertise and knowledge, leading to moreinnovative and effective sustainable energy solutions. By addressing the financial, informational and community aspects of sustainable energy investment, these initiatives can make a significant contribution to the transition to a more sustainable and environmentally friendly future.

3.4 ENCHANT Platform

The platform results clearly show that electricity consumption (as an example of energy consumption) is strongly dependent on the structure and culture of electricity use. Countries with high levels of per capita electricity consumption have a greater potential for behavioral change-based reductions than countries that already have lower levels of electricity use.

Structural interventions can have a strong and lasting impact; for example, reducing the need for energy to heat or cool the home and efficient water heating are likely to be the most effective ways to reduce energy consumption. Therefore, programs that improve these structural aspects should be prioritized.

Electricity prices also show a clear impact on people's consumption behavior. Thus, price signals seem to be able to manage people's consumption, but the prospect of energy poverty, especially for households that do not have the means to invest in energy efficient technology, needs to be acknowledged.

Providing specific energy saving tips also seems to be an effective strategy. Not only informing about the need to save, but also how to do it without major investments can bea way forward, probably with even smarter websites that identify the highest saving potentials based on a dialog with the users (and maybe data about the household and the dwelling from central databases - see also the pilot with the energy advice websites in Norway).

The other interventions show a more mixed picture: social norm interventions work in some cultures, but backfire in others. Feedback works for cultures with lower levels of energy literacy, but not when people already know a lot. Commitments and competitions work well in some cultures, but only for people who accept them; people who reject them tend to use more energy, suggesting that perhaps only people who already know they have or can achieve lower levels of consumption commit to saving or enter competitions. This means that such interventions need to be carefully tailored to the target groups.

4 Policy Briefs

ENCHANT
Energy Efficiency through behaviour Change Transition Strategies

POLICY BRIEF: INNOVATIVE ENERGY-SAVING STRATEGIES ACROSS EUROPE

Introduction

In a world grappling with climate change and rising energy demands, the ENCHANT project proposes innovative solutions. This initiative, spanning several European countries, showcases diverse approaches to reducing energy consumption. From newsletter campaigns to smart installations, ENCHANT's journey offers valuable insights for future energy-saving strategies.

Overview of Electricity Saving Interventions

ENCHANT's multi-country approach encompasses:

- **Austria:** Leveraged newsletter campaigns offering energy-saving tips.
- **Romania:** Utilized both online and offline messages emphasizing individual benefits, altruism, and social norms.
- **Türkiye:** Implemented messages on electricity bills, targeting different regional groups.
- **Germany:** Introduced the Pontos water management system, providing real-time consumption data to households.

Each intervention, distinct in its method and scope, offers a unique perspective on engaging communities in energy-saving practices.

Intervention Effects: A Snapshot

The effectiveness of these interventions varied, highlighting the importance of context in energy-saving initiatives:

- **Austria**: Notable reduction in electricity consumption among those exposed to the energy-saving newsletters.
- **Romania**: A modest yet significant decrease in electricity usage, thanks to the focus on collective action.
- **Türkiye**: Regional differences were evident, with a more pronounced decrease in electricity consumption in the northern regions compared to the south.
- **Germany:** Despite high acceptance of the technology, there was no significant impact on electricity or water consumption.

Key Takeaways and Implications

Varied Effectiveness

The mixed results across countries underline the importance of tailoring energy-saving strategies to specific cultural and regional contexts. For instance, the success in Austria and Romania suggests that well-crafted messaging, whether focused on practical tips or collective benefits, can influence behavior.

Technology vs. Behavior Change

Germany's experience with the Pontos system highlights an interesting point: technological solutions alone may not suffice. Behavioral change, driven by awareness and education, plays a crucial role in achieving tangible energy savings.

Regional Variations

Turkey's results point to the need for regional customization in messaging and strategy. What works in one area may not have the same impact in another, emphasizing the need for localized approaches.

Moving Forward: Recommendations

- **Customize Interventions:** Tailor strategies to fit cultural and regional nuances.
- **Focus on Education and Awareness:** Combine technological solutions with efforts to change behavior through education and awareness campaigns.
- **Monitor and Adapt:** Continuously monitor the effectiveness of interventions and be ready to adapt strategies based on feedback and results.

Conclusion

he ENCHANT project serves as a vital case study in the pursuit of reducing energy consumption. Its varied results across Europe offer key insights for policymakers, stakeholders, and communities aiming to make a difference in their energy use. Through customization, education, and adaptability, we can hope to craft more effective energy-saving strategies for a sustainable future.

POLICY BRIEF: IMPLEMENTING LARGE-SCALE BEHAVIORAL INTERVENTIONS FOR SUSTAINABILITY

Introduction

As the urgency of achieving significant reductions in greenhouse gas emissions increases, so does the importance of promoting sustainable behaviors and practices. While behavioral science has demonstrated the pathways to behavior change through small-scale pilot studies, the urgency of our climate goals demands that these interventions be applied on a larger scale. The ENCHANT project has been designed to address a key challenge: translating theoretical concepts into widely applicable, practical solutions. The focus is on the efficient and inclusive implementation of these strategies, ensuring that they are well received and effective in different territories and cultural landscapes. ENCHANT's interventions include a range of strategies targeting three key behaviors: energy conservation, increased use of public transport, and investment in energy efficiency (EE) and renewable energy sources (RES). By integrating insights from behavioral science with practical applications, these interventions aim to promote sustainable habits among individuals and communities. They are tailored to different cultural contexts and scales, from large urban areas to smaller communities, ensuring broad and impactful reach.

- **Saving Energy**

Previous research on energy conservation has yielded mixed results, with some studies demonstrating the effectiveness of energy-saving tips, while others found no significant impact. A key factor in these varied outcomes is the general lack of awareness about electricity use patterns among consumers. Our intervention aims to address this by combining information provision with monetary incentives or saving tips, thereby enhancing the understanding of energy consumption patterns and encouraging more sustainable electricity usage.

- **Public Transport**

In the domain of public transport, earlier research primarily focused on modifying transportation choices. Notably, experiments providing free transit passes have shown a temporary increase in public transport ridership, indicating potential for habit formation and altered perceptions of bus travel. Our study extends this research by conducting large-scale experiments in varied cultural settings, aiming to provide a more comprehensive understanding of the impacts of such interventions.

- **Investment in EE and RES**

The third focus area is encouraging investment in EE and RES, crucial for achieving the EU's 2030 emission reduction goals and moving towards climate neutrality. Interventions in this domain explore factors influencing individuals' investment decisions in both public and private sectors, through surveys and field experiments.

Locations of the ENCHANT interventions:

- **Challenges and Opportunities in Field Experiments**

Field experiments, while offering insights into the real-world applicability of interventions, face several challenges including ethical, consent, and practical issues. These experiments provide vital data on the acceptability, feasibility, scalability, and reproducibility of interventions, as well as the robustness of their effects in natural environments. Understanding the complexity and resource requirements of these interventions is crucial. Simpler, less resource-intensive interventions may be more adaptable and easier to deploy across various contexts, offering a general framework for behavior change that can be tailored to local needs.

- **Conclusion**

The path from small-scale pilot studies to large-scale implementation of behavioral interventions is fraught with complexities but is essential for achieving significant and sustainable changes in behavior. This journey requires a deep understanding of cultural, social, and economic dynamics to develop interventions that are effective, scalable, and accepted across diverse settings. The insights gained from these interventions will be instrumental in shaping future policies and practices aimed at promoting sustainability on a global scale.

Find out more: **https://enchant-project.eu/**

POLICY BRIEF: The ENCHANT Platform - Evaluating Energy-Saving Behavioral Interventions Across Europe

Introduction

The ENCHANT platform is a ground-breaking online system designed to assess the effectiveness of different behavioral interventions in reducing household electricity consumption. Implemented in six European countries, the platform exemplifies how digital tools can advance large-scale environmental research. At its heart are six unique interventions, each designed to influence energy-saving behavior, and the platform's sophisticated design allows these interventions to be combined to measure their collective impact.

Core Interventions

ENCHANT's interventions are diverse and include information provision, message framing, social norms, consumer feedback, competitive elements and engagement strategies. These interventions are delivered through the platform and reach households from different socio-economic and cultural backgrounds.

Implementation and Recruitment

Despite challenges in programming, testing and varying recruitment success across countries, the ENCHANT platform managed to recruit a significant number of households in Norway, Germany and Romania. Recruitment methods ranged from social media campaigns to working with local organisations and were adapted based on regional responses.

Evaluation Methodology

The evaluation of the platform focused on weekly household electricity consumption, normalised for the number of occupants. This data, combined with secondary metrics such as peak electricity consumption and adherence to energy-saving behaviours, provided a comprehensive understanding of the impact of the intervention.

Results Analysis

The data analysis revealed interesting patterns:

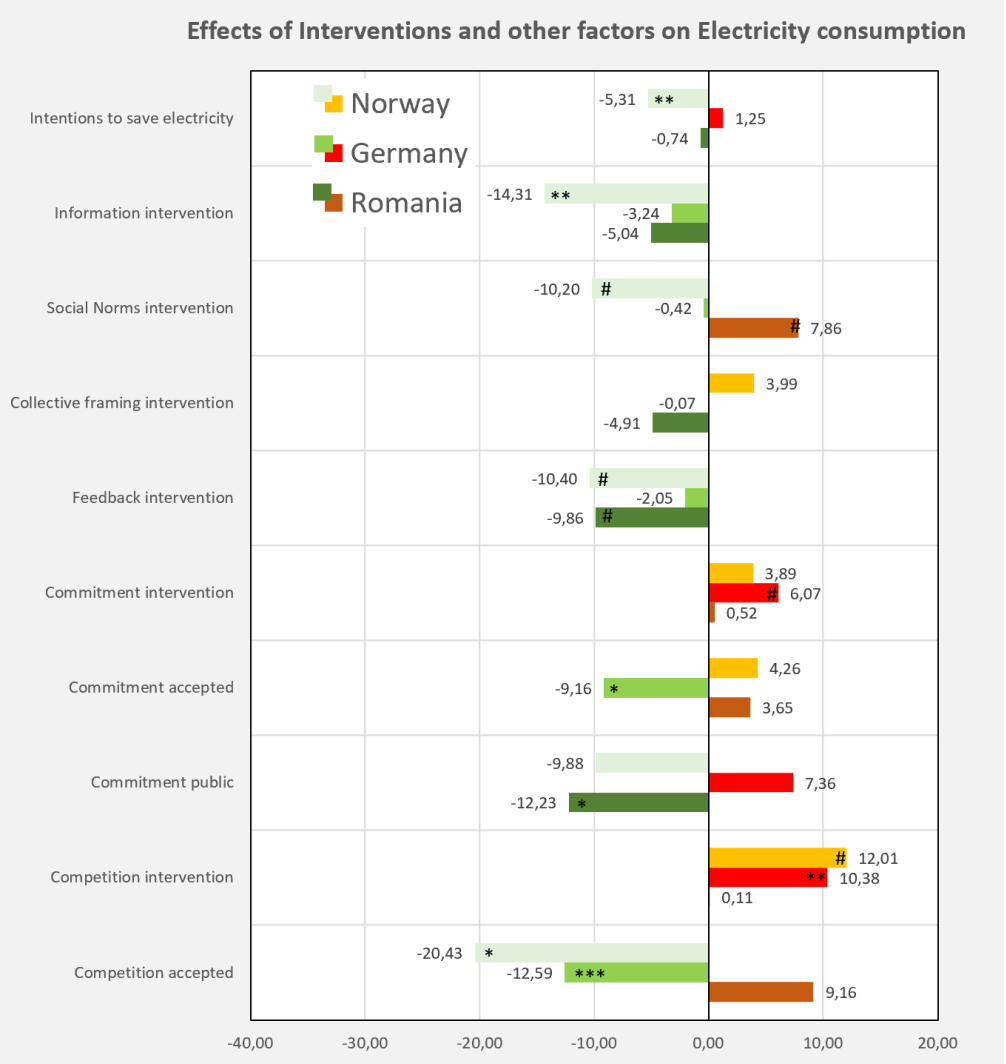
- Average electricity consumption decreased over time in Germany and Norway but remained stable in Romania.
- Interventions led to more significant reductions in consumption compared to control groups.
- Variations in intervention effectiveness were noted across countries, highlighting the influence of cultural and geographical factors.

Intervention Impacts

A detailed mixed-model analysis, accounting for various structural and psychological factors, provided insights into the specific impacts of each intervention. Key findings include:

- Structural factors like heating degree days and electricity prices significantly influenced consumption.
- Information provision consistently led to reduced consumption across countries.
- The study found that the impact of various factors and interventions on electricity use varies from country to country. For example, in Norway, where electricity use is generally higher, interventions like providing information, promoting social norms, and offering feedback are more effective. In Germany, publicly committing to save electricity has a strong impact. In contrast, some of these interventions don't work as well in Romania.

Visualization of the structural and intervention impacts on weekly electricity consumption for each country: In this figure, red bars represent factors that are associated with an increase in electricity consumption, while green bars indicate factors that are associated with a decrease in consumption. The effect size is represented as a percentage within the bars.



Conclusion

The ENCHANT platform's comprehensive approach, integrating behavioral interventions with psychological analysis, has set a new benchmark in energy-saving research. Its findings offer valuable lessons for policymakers, community leaders, and organizations in designing targeted, effective energy conservation strategies. As the results continue to influence post-implementation activities, the ENCHANT platform stands as a testament to the power of innovative digital tools in environmental research and intervention.

Find out more: https://enchant-project.eu/

5 Conclusion

The ENCHANT project aims to improve our understanding of the interactions between energy, the environment and human behavior. The project focuses on these by translating complex concepts into practical policy recommendations. The project spans six countries - Norway, Italy, Romania, Türkiye, Austria and Germany - and uses different methods to investigate the relationship between energy use and behavior.

This deliverable summarizes the results of 15 measures in the participating countries in three areas energy-saving behavior, public transport and investments in energy-saving behavior, public transport, investments in energy efficiency and renewable energy, and the ENCHANT platform. The main objective of this report is to create a matrix of policy instruments to compare the broader impacts of different interventions in terms of eco- nomic, environmental, social and political perspectives. The matrix was developed in two research phases - the evaluation of experimental evidence and the evaluation of pilot implementations. These phases provide parameters that take into account both theoretical foundations and practical realities and ensure a comprehensive assessment.

The economic dimension of the evaluation matrix focuses on the financial aspects of interventions, providing a detailed analysis of both costs and economic benefits. Stakeholders can use this analysis to understand the economic impact of each intervention, identifying strengths, weaknesses, and areas for future research and decision-making. The environmental dimension assesses the environmental impact and sustainability of interventions, providing insights into how they address ecological challenges. It considers factors such as ecological footprint, sustainability practices, and compliance with environmental goals, accounting for specific national contexts and estimating interventions' effects on greenhouse gas emissions. The third dimension focuses on the broader effects of well-being, evaluating the impact of interventions on societal well-being, equity and inclusivity. Stakeholders gain insights into how interventions influence communities, social structures, and political dynamics.

In the area of energy savings, various recommendations are made. For energy savings interventions in Romania, it is stressed that the lack of cooperation between decision-makers, energy companies and consumer organizations leads to uncoordinated policies and a lack of trust in the market. The recommendation is to set up multi-stakeholder committees comprising government institutions, private companies and consumer representatives to promote a coordinated approach. Furthermore, the culture of mistrust between companies should be overcome in order to facilitate data sharing.

The energy savings intervention in Austria emphasized the effectiveness of energy communities as a means of communication and awareness-raising. It is recommended to facilitate access to existing and new energy communities by promoting easily accessible information and advice services. Lowering barriers to entry and support from regional service

providers, such as energy agencies, should be prioritized.

The energy savings intervention in Germany highlighted the fact that simply monitoring energy consumption does not necessarily lead to savings. The policy recommendations include a more comprehensive and targeted awareness campaign for energy savings in the areas of water, heat and electricity. In particular, it shows that monitoring alone is not enough and that a conscious change in energy behavior is needed.

For Türkiye (Gediz), it is recommended that utilities increase their efforts to promote energy efficiency. This includes collaboration with academic institutions, development of strategies to reduce electricity consumption, and innovative approaches to consumer communication. Data analysis should be used to better understand consumer behavior and provide tailored recommendations for energy-efficient behavior.

In the area of public transport, Izmir, Türkiye is encouraged to invest in improving public transport infrastructure and promoting sustainable transport options. An inclusive approach that combines different modes of transportation is emphasized, as is the use of data analysis and technology to improve transportation decision-making. Community involvement and targeted awareness campaigns will highlight the benefits of public transport.

For the second public transport project in Romania (Green Friday), it is recommended to develop a robust evaluation framework to support the transferability of the model. The need for a qualitative perspective to understand citizen satisfaction and administrative challenges is underscored. The implementation of interviews and feedback mechanisms is suggested to enable a comprehensive evaluation of the initiative.

In the area of investments in renewable energy (RE) and energy efficiency (EE), several policy recommendations are made based on the intervention in the gardens of Ninfa in Italy. These include the integration of sustainable practices in historical and botanical gar- dens inorder to use them as educational centers for sustainable development. It is pointed out that educational initiatives can promote awareness of renewable energy, especially if they aim to integrate such information into the tourist experience.

In the case of Norway, specifically for small-scale energy efficiency measures, general recommendations are given for cooperation between academics and user partners. The need foreffective dialogue and informed collaboration is emphasized in order to achieve targeted and measurable impacts. It is emphasized that a one-stop-shop platform to promote energy efficiency measures can be effective, but only if it is accompanied by a positive societal discourse. It is emphasized that a balanced campaign to promote energy efficiency and specific platforms tailored to different target groups should be coordinated.

The outcomes from the platform highlight a strong correlation between electricity consumption and the cultural and structural aspects of electricity use. Countries with higher

per capita electricity consumption exhibit greater potential for behavior-based reductions compared to those with lower consumption levels. Structural interventions, particularly addressing home heating, cooling, and efficient water heating, prove most effective in achieving lasting reductions. Notably, electricity prices play a pivotal role in influencing consumption behavior. While price signals can effectively manage consumption, concerns about energy poverty among households lacking resources for energy-efficient technology must be acknowledged. Providing specific energy-saving tips emerges as a successful strategy. Informing users about the need to save, coupled with practical guidance on implementation, proves effective, especially through innovative websites tailored to user dialogues and data from central databases.

In summary, the policy recommendations cover a wide range of strategies, from strengthening cooperation and trust between stakeholders to promoting targeted education and awareness campaigns. A culturally appropriate approach and recognition of the diversity of market conditions are essential.

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