Creating Renewable Energy and Energy Efficiency Awareness

A Case Study on a Public Energy Awareness Campaign

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***Abstract*— This paper presents the outcomes of the collaborative project "Renewable Energy and Energy Efficiency for Sustainable Development in Sibiu County," conducted jointly by Sibiu County, Romania, Lucian Blaga University of Sibiu (LBUS), Romania, and the University of South-Eastern Norway (USN). The paper presents an awareness campaign targeting citizens and schools to foster understanding and adoption of renewable energy and energy efficiency practices. Emphasizing the importance of smart energy solutions, the paper introduces the Technology Acceptance Model (TAM) as a framework for understanding user acceptance of new technologies. The awareness campaign utilized offline and online channels, with an estimated reach of 150.000 citizens, while engaging educational institutions to cultivate sustainability awareness from an early age. The paper also discusses the development of an environmental protection course for university students. A SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis highlights the campaign's strengths, weaknesses, opportunities, and threats. The paper also discusses challenges met when running energy awareness campaigns. The paper underscores the significance of behavior change in achieving sustainable energy goals.**

Keywords: renewable energy; energy efficiency; awareness; campaigns; social media.

I. INTRODUCTION

The collaborative project "Renewable Energy and Energy Efficiency for Sustainable Development in Sibiu County," a joint effort between Sibiu County, Romania, Lucian Blaga University of Sibiu (LBUS), Romania, and the University of South-Eastern Norway (USN), aimed to increase public awareness of renewable energy and energy efficiency [1].

A previous paper [2] focused on a training program targeting Small and Medium-sized Enterprises (SMEs) and public institutions. The paper discussed the strengths and weaknesses of the current Sibiu County strategy identified during training sessions with technical specialists.

This paper reports on a broader awareness campaign targeting the citizens and schools. In recent years, citizens have become extensively aware of the environment, demonstrating their openness to changing their behavior, particularly related to renewable energy and energy efficiency. Public awareness and government incentives have accelerated the interest in sustainable energy solutions.

The focus of this paper is not government incentives but how a regional government can help inform and educate citizens to help them understand the potential of renewable energy and energy efficiency.

Smart energy is not only about installing solar panels or better building insulation. It is about using smart devices to automate or guide users to reduce their energy consumption. It is possible to reduce the load on the electricity grid in specific periods of the day and shift energy consumption to other periods of the day. This is called “peak shaving” and “load shifting” [3].

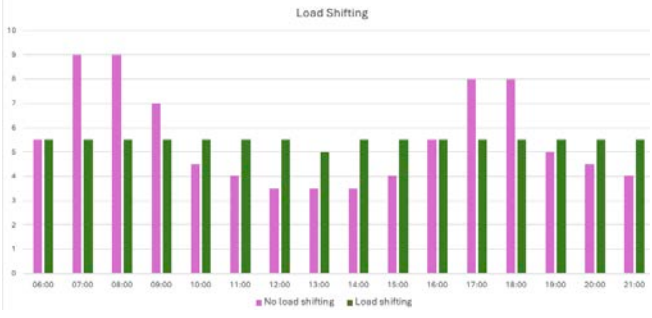

Figure 1. Load shifting in practice.

One example is charging an electric vehicle when the grid demand is low. When the market is low, the price is

more beneficial. Electric water heaters can be turned on during the day when solar panels provide energy. Since the water heater works as a thermos, it will keep the water warm for later consumption. Fig. 1 shows how load shifting can reduce peaks by moving consumption from peak to non-peak periods. This can be done for a single household, a local grid, or a larger scale.

Smart digital solutions to control household energy consumption are available in the market. However, more than the availability of technology itself is required.

The Technology Acceptance Model (TAM) is a widely used framework for understanding user acceptance and adoption of new technologies [4]. Fig. 2 illustrates TAM. The central premise of TAM is that an individual's behavioral intention to use technology is primarily determined by perceived usefulness and ease of use.

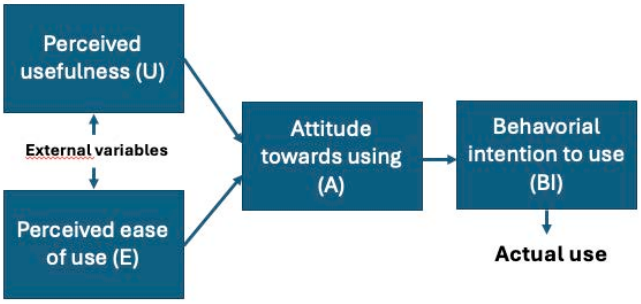

Figure 2. Technology Adoption Model.

Perceived usefulness is the degree to which a person believes using a particular technology helps them achieve their goals. In this case, the goal is to reduce their electricity bills in the long term.

On the other hand, perceived ease of use refers to the degree to which a person believes that using the technology will be free from effort. In other words, will the technology be easy to use to avoid causing frustrations?

These two factors influence an individual's attitude toward technology, shaping their behavioral intention to use it. Ultimately, this behavioral intention is a crucial predictor of technology usage.

Over the years, TAM has been refined and extended to incorporate additional factors that may impact technology adoption, such as subjective norms, perceived risk, and trust. Despite its simplicity, TAM has demonstrated robust predictive power across various technologies and user populations. It is a valuable tool for researchers and practitioners seeking to understand and predict technology acceptance and designing interventions to promote the successful adoption of new technologies. However, potential users need to be aware of the potential of new technology before considering using it. Our project fills this gap by creating awareness among citizens and students about the potential of smart energy solutions.

The following section discusses the awareness campaign. Section III presents a SWOT analysis of the campaign. Section IV introduces an environmental protection course developed as a spin-off from the project. Section V discusses the results. Finally, Section VI provides some conclusions.

II. AWARENESS CAMPAIGN

Kim and Choi [5] define *environmental awareness* as consumers' understanding of environmental issues, including various practices and the connection between certain activities and their environmental impact. However, the main issue is increasing consumers' awareness of their effect on the environment and changing their behavior. If social change affects individual behaviors, marketing is crucial in driving a particular behavior.

Andreasen [6] promotes social marketing as central to influencing and changing behavior. Kotler and Armstrong [7] state that social marketing involves applying marketing concepts and tools "to encourage behaviors that will create individual and societal well-being."

A. Energy awareness campaigns

Hassan et al. [8] reported on an energy awareness campaign at Loughborough University, United Kingdom, where they reduced energy consumption by up to 10% in only 52 days. Their research shows that awareness campaigns can have immediate results related to energy consumption.

Wai et al. [9] proposed a conceptual framework for the energy awareness development process. The framework consists of nine phases, starting with energy awareness stimulus. Our campaign is stimulating citizens (and students) to make better choices.

Khambalkar et al. [10] conducted a survey to assess public attitudes toward renewable energy. The survey showed positive attitudes and a willingness to invest in household renewable energy and energy efficiency. This was a motivation for our campaign.

Szakály et al. [11] examined the relationship between self-reported and actual knowledge of renewable energy sources. The study was done in Hungary, and the results showed that actual knowledge was more favorable than self-reported knowledge. The authors pointed out socio-demographic differences and that young citizens generally had a higher level of awareness. Our campaign saw the same pattern among the participants in training events.

B. Our campaign

An awareness campaign was launched to engage stakeholders and disseminate information on sustainable energy practices. The awareness campaign utilized several communication channels to reach the public, including social media, radio, interviews, videos, flyers, and other promotional materials. Additionally, partners organized kick-off and closing events. Results indicate increased awareness and understanding of sustainable energy practices, greater engagement in initiatives, adoption of sustainable practices at individual, institutional, and community levels, and positive changes in attitudes toward energy consumption and conservation.

During the campaign, 35 training events were held in different locations, and 1146 citizens attended in person. The

campaign was mentioned in newspapers and newscasts (TV and radio) 520 times, 287 on a national level and 233 on a local level. The media analytics company mediaTRUST analyzed the campaign. The company evaluated the influence of public relations and marketing communications across diverse media channels by analyzing advertising value and audience engagement, revealing that the campaign effectively reached 1.97 million citizens [12]. Even if there is a big difference between attending a training event and hearing about renewable energy potential on the radio, it still helps increase citizens' awareness. Fig. 3 shows one of the mock-ups used during the training event. The solar panel platform was 3D-printed and automatically adjusts the direction and tilt to optimize energy production. Fig. 4 shows a prototype of a house powered by solar panels, which was used to show the amount of energy produced by the solar panels.

Figure 3. Mock-up of solar panel platform.

Four schools and educational institutions were involved in the campaign to create engagement with the educational community and to foster awareness and understanding of sustainable energy practices among children and educators. More than 300 primary and secondary school children from four different educational institutions participated in the information workshop "Discover the World of Renewable Energy." These institutions include "Samuel von Brukenthal" National High School, Sibiu Secondary School No. 2, "Mihai Viteazu" Secondary School Șelimbăr, and "Ioan Lupaș" High School of Technology Sălișteа.

Multiple schools and educational institutions participating emphasized the campaign's success in reaching diverse students and educators. This indicates a deliberate effort to actively engage with the educational community and promote knowledge and awareness of renewable energy principles and environmental sustainability from an early age.

During the children's workshop, professors and students from the Engineering Faculty of "Lucian Blaga" University of Sibiu delivered informative sessions covering various themes related to renewable energy and environmental sustainability. These sessions included topics such as solar energy utilization, wind energy conversion, environmentally friendly lifestyles, the importance of nature conservation, energy consumption reduction strategies, stories of renewable energy heroes (for Middle School - Who are the scientists and inventors behind renewable energy?), renewable energy games, storytelling, and experiments and envisioning a future powered by renewable sources.

Figure 4. Prototype of a solar-powered house.

To measure engagement, the following methods were used:

- Attendance records: Keeping track of the number of participants who attended training events, workshops, and Green Week presentations organized as part of the campaign.
- Online analytics: Monitoring website traffic, social media engagement, and the number of unique visitors or followers who viewed campaign-related content online.
- Surveys and registration forms.
- Media coverage and visibility of the campaign.
- Number of schools and educational institutions involved in the campaign.
- Feedback and satisfaction levels from participants and stakeholders.
- Number of resources distributed or shared during the campaign (e.g., informational materials, toolkits, presentations).

III. SWOT ANALYSIS

A SWOT analysis is a planning tool that identifies **S**trengths, **W**eaknesses, **O**pportunities, and **T**hreats. Hunger and Wheelen criticized SWOT analysis for several shortcomings [13]:

- *It generates lengthy lists.*
- *It uses no weights to reflect priorities.*
- *It uses ambiguous words and phrases.*
- *The same factor can be placed in two categories (e.g., a strength may also be a weakness).*
- *There is no obligation to verify opinions with data or analysis.*
- *It only requires a single level of analysis.*
- *There is no logical link to strategy implementation.*

However, the model is simple, easy to comprehend, and well-suited to presenting some critical factors for the campaign's purpose. These are shown in Fig. 5 and further elaborated below.

Figure 5. SWOT analysis.

A. Strengths

- Structured Communication Plan: The campaign benefited from a well-defined communication strategy that utilized offline and online channels, including social media, television news, radio, interviews, videos, and promotional materials.
- Broad Reach: According to mediaTRUST, a media analytics company, the campaign reached 298.000 through social media, 201.000 through portals, and 1.47 million through press and radio TV (RTV). The campaign's overall reach amounted to 1.97 million, indicating a wide dissemination of information and engagement within the community [12]. This increased visibility not only enhances awareness of sustainable energy practices but also positions Sibiu County as a leader in environmental sustainability on a larger scale.
- School Engagement: The involvement of four schools and educational institutions facilitated direct interaction with students and educators, fostering awareness and understanding of sustainable energy practices from an early age.
- Expert Involvement: Professors and students from the Engineering Faculty of "Lucian Blaga" University of Sibiu provided informative sessions on renewable energy and environmental sustainability, adding credibility and expertise to the campaign.

B. Weaknesses

- Limited Metrics: While attendance records, online analytics, and feedback surveys were utilized, there may be gaps in measuring the campaign's impact comprehensively, particularly in assessing long-term behavior change and adopting sustainable practices.
- Resource Constraints: The campaign faced challenges related to budgetary constraints and limited resources to sustain long-term engagement and follow-up activities beyond the initial outreach efforts.

C. Opportunities

- Collaboration: The campaign presents opportunities for collaboration with additional stakeholders, such as local businesses, community organizations, or government agencies, to further amplify its impact and reach.
- Educational Partnerships: Strengthening partnerships with educational institutions can lead to developing tailored curriculum materials and ongoing educational initiatives to embed sustainable energy principles into school curricula.

D. Threats

- Sustainability Challenges: Maintaining momentum and sustaining engagement beyond the initial campaign period may pose challenges, particularly without dedicated resources or ongoing support.
- Competition for Attention: The campaign may face competition from other initiatives or priorities competing for stakeholders' attention, potentially diluting its impact or reach.

Overall, the SWOT analysis highlights the extensive awareness campaign's strengths and opportunities while identifying potential weaknesses and threats that may need to be addressed to maximize its effectiveness in promoting sustainable energy practices in Sibiu County.

IV. ENVIRONMENTAL PROTECTION COURSE

In collaboration with Lucian Blaga University, an Environmental Protection course was developed for third-year students specializing in Transport and Traffic Engineering. The course curriculum, spanning 14 weeks with 28 hours of instruction and 14 hours of laboratory work, focused on fundamental topics related to energy resources, electricity production, energy consumption, and methods for assessing energy efficiency. This course aimed to equip

students with the knowledge and skills necessary to address environmental challenges within their field of study. The course is already in its second edition (ongoing). Because of its interest, it was divided into several application modules, which were then presented to students from several specializations, depending on the area of interest and specialization.

The students will know how to collect and analyze data from a quantitative and qualitative point of view, from various alternative sources, and from the literature in the field to formulate arguments, decisions, and concrete approaches in energy efficiency applications. This will lead to training and stimulating the awareness and sensitivity of future engineers to environmental issues.

LBUS proposed a strategy to attract young students to green energy and its practical applications by organizing the interactive contest "Mock-up for energy efficiency systems." During the laboratory hours, the students participating in the Environmental Protection course will make five Mock-ups with a freely chosen theme: Innovative solutions to reduce energy consumption.

The expected results from this course are:

- Increased participation and engagement: Track the number of students enrolled in the course compared to previous years to assess increased interest.
- Completion rates: Monitor the percentage of students who complete the course to gauge its effectiveness.
- Performance improvement: Assess changes in student performance through pre- and post-course evaluations or exams.
- Mock-up creation: Evaluate the quality and creativity of the mock-ups produced by students during laboratory sessions.
- Feedback analysis: Analyze feedback from students regarding the course content, structure, and overall learning experience to identify areas for improvement.
- Adoption of energy-efficient practices: Measure how students apply knowledge gained from the course in real-world contexts, such as implementing energy-saving measures or promoting sustainability initiatives within their communities.

V. DISCUSSIONS

This section discusses some challenges in conducting this kind of energy awareness campaign.

One significant challenge is related to *awareness and engagement*. Despite the comprehensive strategy outlined in the paper, reaching and engaging all stakeholders, including community members and businesses, may require some clarification. Overcoming barriers to awareness and participation requires ongoing efforts to tailor communication strategies and outreach activities to diverse audiences. It is essential to employ a variety of communication channels and messaging techniques to ensure that information reaches and resonates with all segments of the population.

Another challenge is *resource constraints*. Implementing the multifaceted interventions described in the paper may require significant resources, including funding, expertise, and logistical support. Securing adequate resources and coordinating efforts across various stakeholders may present logistical challenges. To ensure the success and sustainability of these initiatives, it will be essential to mobilize support from government agencies, non-profit organizations, and private sector partners.

Finally, encouraging *behavior change* towards sustainable energy practices can be complex. Addressing entrenched habits, attitudes, and cultural norms may require targeted interventions, ongoing education, and community engagement. It is essential to recognize that behavior change takes time and may require a combination of incentives, regulations, and social norms to promote sustainable practices effectively.

Fig. 5 illustrates these challenges. The multifaceted approach outlined in this paper represents a valuable framework for promoting sustainable energy practices. By addressing these challenges head-on and leveraging the strategy's strengths, stakeholders can work together to overcome barriers and achieve meaningful progress toward a more sustainable future. Ongoing evaluation and adaptation of strategy will ensure that interventions remain relevant and effective in the face of evolving needs and circumstances.

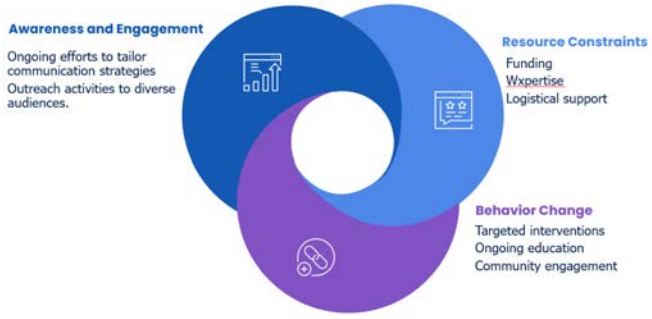

Figure 6. Challenges of the project implementation.

VI. CONCLUSIONS

A digital society is where digital transformations contribute to solving more significant societal problems. Reducing energy consumption and introducing renewable energy sources are essential to society and individual households. Smart energy solutions are available, but to be adopted, they must create value for the user and be easy to use. However, adoption requires awareness of smart energy solutions, from installing renewable energy to utilizing peak shaving and load shifting. However, a prerequisite to the adoption of technology is awareness of the possibilities of the technology. Therefore, this kind of awareness campaign presented here is essential.

This project is unique because Sibiu County took leadership in raising awareness about renewable energy and energy efficiency and partnered with academia to create an awareness campaign.

The project underscores the importance of behavior change in achieving sustainable energy goals. Encouraging

individuals and businesses to adopt energy-saving practices requires addressing entrenched habits, attitudes, and cultural norms. Future efforts should focus on providing incentives, education, and support to facilitate behavior change and promote a culture of sustainability.

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The prototype of the solar-powered house in Fig. 4 was created by Nichita-Traian Chicioroagă, a student at Lucian Blaga University of Sibiu, as a student project.

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