

# Engaging SMEs and Public Institutions in Renewable Energy and Energy Efficiency

A Case Study from Sibiu County, Romania

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**Abstract**—The paper presents a collaborative project on renewable energy and energy efficiency in Sibiu County, Romania. Through interactive stakeholder workshops, several strengths and weaknesses were identified. Through an extensive training program for small and medium-sized enterprises and public institutions, the project has led to measurable impacts, including increased public awareness, adoption of sustainable technologies, and significant energy and monetary savings, demonstrating the effectiveness of collaborative initiatives in driving the renewable energy agenda and contributing to global efforts against climate change. The project also produced a guide to help Small and Medium-sized Enterprises (SMEs) and public institutions adopt renewable energy and energy efficiency measures.

**Keywords**—renewable energy; energy efficiency; training; strategy.

## I. INTRODUCTION

This paper presents an overview of 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). Initiated in April 2023 and slated for completion in March 2024, the project aims to foster sustainable development in Sibiu County through targeted training programs and awareness campaigns focused on renewable energy and energy efficiency.

The project's core objective is to develop training materials and courses to assist Small and Medium-sized Enterprises (SMEs) and public institutions in adopting renewable energy solutions and reducing energy consumption. This initiative seeks to train representatives from these entities and raise renewable energy awareness among the citizens of Sibiu County. While this paper concentrates on the interactions with SMEs and

public institutions, a subsequent article will detail the public awareness campaign. More information about the project is available on the website [1].

In the face of projections indicating a sharp increase in electricity consumption within the residential and commercial sectors, the urgency to transition towards more sustainable energy practices becomes paramount. With non-OECD countries expected to see electricity consumption rise significantly by 2050 [2] and the European Union (EU) setting ambitious greenhouse gas reduction targets for 2030 [3], the project aligns with broader efforts to address climate change and promote energy efficiency.

The methodology for creating the project's training materials and courses involved reviewing existing strategies and qualitative research, including semi-structured interviews with local officials, focus group discussions with various stakeholders and stakeholder consultations. These approaches provided comprehensive insights into the region's challenges and opportunities for implementing renewable energy and energy efficiency measures. The outcomes of these efforts are encapsulated in a guide on renewable energy, serving as a key deliverable of the project and a resource for promoting sustainable energy practices in Sibiu County and beyond.

While many renewable energy training programs exist, the authors have searched for and found no similar programs where a county has set out to train SMBs and public institutions on renewable energy.

Section 2 describes the methodology, Section 3 discusses implementation, Section 4 provides results, Section 5 discusses the results, and Section 6 provides a conclusion and plans for future work.

## II. METHODOLOGY

To create training materials and courses, the project group used a combination of reviewing current strategies and plans [4][5] combined with qualitative information gathering through the following methods:

### A. Semi-Structured Interviews

Semi-structured interviews were conducted with local officials representing each Administrative Territorial Unit (ATU) within Sibiu County, where lecturers from LBUS prepared training for citizens and workshops for specialists.

These interviews provided a unique opportunity to engage with influential decision-makers and acquire detailed insights into the specific circumstances, challenges, and prospects of implementing renewable energy and energy efficiency measures in the region.

### B. Focus Group Discussions

Focus group discussions were organized with representatives from diverse stakeholder groups, including local government agencies, academic institutions, energy utilities, non-governmental organizations (NGOs), and community groups.

These sessions facilitated candid dialogue, idea sharing, and collaborative ideation on sustainable energy initiatives, comprehensively examining varied viewpoints and priorities.

### C. Stakeholder Consultations

Stakeholder consultations were conducted to engage a broader spectrum of stakeholders and solicit feedback on strategic planning, policy formulation, and project implementation.

These consultations comprised interactive sessions wherein stakeholders had the opportunity to articulate their perspectives, express concerns, and actively contribute to shaping the trajectory of sustainable energy projects in the ATU.

The key deliverable from the project, a guide on renewable energy and energy efficiency, was created based on the collected data.

## III. IMPLEMENTATION

Workshops were conducted in more than 30 ATUs across Sibiu County, selected based on their

designation as development poles. Development poles, characterized by concentrated economic activities and strategic importance for regional development, were identified as ideal locations for delivering training initiatives. When selecting the ATUs for citizens' training, several vital characteristics were considered:

### A. Population Density

ATUs with higher population densities were prioritized to ensure broader outreach and maximize the dissemination of knowledge on renewable energy and energy efficiency practices. Also, there is the possibility that some citizens from nearby villages will attend the training.

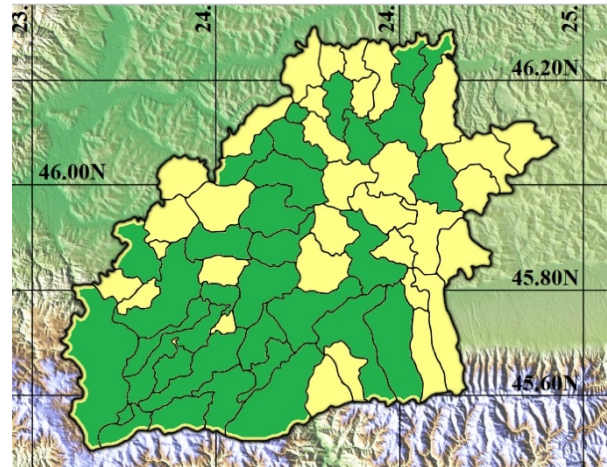


Figure 1. Sibiu County map with selected ATU's  
Source: Sibiu County Council

The selected ATUs comprise roughly 81% of Sibiu County's population, which is 388,325 residents. This demonstrates substantial coverage of the county's population.

Fig. 1 shows the 64 administrative-territorial units of Sibiu County: 2 municipalities, nine towns, and 53 communes. The ATUs selected for citizens' training are highlighted in green.

Sibiu County is situated in the center of Romania, covers an area of 5433 km<sup>2</sup> and shares borders with Mures County to the north, Arges and Valcea Counties to the south, Alba County to the west, and Brasov and Mures Counties to the east.

Sibiu County's terrain comprises three main relief areas: the mountainous area, the highland area, and the depression contact area. The

mountainous region, covering approximately 30% of the county, includes the Făgăraș Mountains, with peaks exceeding 2500 m. The highland area constitutes around 50% of the county, with heights ranging from 490 m to 749 m. The depression contact area, occupying about 20% of the county, runs continuously between the mountainous and highland regions.

The decision to prioritize workshops in development poles with higher population densities was strategic, as it allowed for the efficient allocation of resources and ensured a more significant impact on a larger population segment. Moreover, conducting workshops in these areas aligns with broader regional development objectives, leveraging existing economic activities and infrastructure to promote sustainable energy practices and drive positive change within the community.

### *B. Energy Consumption Patterns*

ATUs exhibiting significant energy consumption rates, particularly in the residential sector, were targeted to address specific energy-related challenges and opportunities relevant to the community.

Analyzing energy consumption patterns in Sibiu County involves examining various energy usage factors across different sectors, such as residential industrial and commercial energy consumption, transportation energy use, renewable energy integration, non-electrified households located more than 2 km from the distribution network, energy efficiency measures, and environmental impacts.

Sibiu County has a significant residential sector contributing to energy consumption, with a diverse range of housing types, including urban apartments, suburban houses, and rural dwellings. Household energy consumption is influenced by heating, cooling, lighting, and household appliances. Seasonal variations in energy demand are likely, with higher consumption during winter months for heating purposes. Adoption of energy-efficient technologies and renewable energy systems in residential buildings may vary across different areas of the county.

Sibiu County hosts various industries and commercial establishments, including

manufacturing plants, businesses, and retail outlets. Production processes, machinery operation, and facility heating/cooling needs drive industrial energy consumption. Lighting, heating/cooling systems, refrigeration, and equipment operation influence commercial energy usage. Energy-intensive industries, such as manufacturing, significantly impact overall energy consumption patterns in the county.

Transportation significantly contributes to energy consumption in Sibiu County, combining private vehicles, public transportation, and freight transport. Commuting patterns, travel distances, and vehicle types (including conventional and electric vehicles) affect transportation energy consumption. Investments in public transportation infrastructure, promotion of sustainable mobility options, and improvements in fuel efficiency have influenced energy usage in the transportation sector.

In recent years, Sibiu County has undergone significant developments in its public transportation infrastructure, marking a notable transition towards enhanced mobility and connectivity for its populace. Positioned centrally within Romania, this region has adopted progressive measures to address transportation demands while emphasizing sustainability and environmental conservation.

Central to this transformation has been the expansion and optimization of bus networks throughout the county. Prioritizing improved linkages between urban centers, suburban locales, and rural areas, introducing new bus routes has sought to augment service frequency and reliability. Concurrently, integrating modern, low-emission buses into the fleet attempted to minimize the ecological footprint while ensuring passenger comfort and operational efficiency.

Complementing the expansion initiatives, considerable endeavors have been directed toward modernizing Sibiu County's bus fleet. Replacing older, less environmentally friendly vehicles with contemporary counterparts adhering to stringent emission standards has markedly curtailed environmental pollution, enhancing air quality within the region. Such transitions underscore an ecological prerogative and a commitment to

elevating public transit systems' overall efficacy and sustainability.

In tandem with these efforts, Sibiu County has embraced a spectrum of sustainable mobility solutions aimed at diminishing reliance on private automobiles and promoting alternative modes of transportation. Initiatives encompassing bike-sharing programs, pedestrian-oriented infrastructure enhancements, and the establishment of electric vehicle charging infrastructure have been pivotal in fostering environmentally conscious travel behaviors among residents.

Sibiu County meets the conditions to exploit various renewable energy resources, including solar, biomass, and hydroelectric potential. Integrating renewable energy sources into the county's energy mix can reduce dependence on fossil fuels, mitigate greenhouse gas emissions, and promote energy independence in isolated localities. Adoption of renewable energy technologies in residential, commercial, and industrial sectors can vary based on factors such as resource availability, economic feasibility, and policy support.

Implementing energy efficiency measures is crucial in reducing overall energy consumption and improving sustainability in Sibiu County. Initiatives, such as energy audits, building insulation, efficient lighting systems, and appliance standards, can help optimize energy use. Public awareness campaigns and incentives for energy-efficient practices may encourage individuals, businesses, and organizations to adopt energy-saving measures.

In addition, the evaluation procedure was significantly influenced by the pre-existing infrastructure within the ATUs. ATUs with infrastructure that facilitated the adoption of renewable energy sources were prioritized. The objective of this decision was to optimize the utilization of existing resources and support the successful execution of sustainable energy initiatives, thus enhancing the effectiveness and efficiency of interventions.

Community participation was another crucial aspect of ATU selection. It was determined that ATUs that actively engaged the community in sustainability initiatives were the most suitable

ones for intervention. It was acknowledged that the active engagement of community members was critical for the effective adoption and execution of sustainable practices, thereby guaranteeing the initiatives' enduring viability and community ownership of initiatives.

Furthermore, the strategic significance of ATUs in the county of Sibiu was considered throughout the selection procedure. Priority was given to intervening in ATUs identified as vital economic centers or strategically positioned to stimulate broader regional development and economic expansion. Utilizing the economic potential of these ATUs, this strategic approach is intended to propel sustainability initiatives throughout the county.

In conclusion, policy support was indispensable in the ATU selection process. Local governments that exhibited a steadfast dedication to advancing renewable energy and energy efficiency were given precedence over ATUs lacking such frameworks. Policy environments of this nature were crucial in establishing a conducive atmosphere for effective training initiatives and guaranteeing the enduring viability of interventions. The workshops aimed to empower citizens with knowledge and skills related to renewable energy resources, energy efficiency measures, and available financial opportunities. Participants engaged with specialists from LBUS to gain insights into sustainable energy practices and explore potential pathways for implementation.

During two research trips to Norway, the project team gathered inspiration for innovative ideas to be implemented in Sibiu County. The trips included visits to Horten High School with BREEAM NOR Outstanding certification [6], a regional hospital with an extensive energy efficiency program, a local airport with an energy efficiency plan, a biogas production facility, and meetings with climate and energy advisors in Vestfold County Council.

#### IV. RESULTS

Technical specialists from six pivotal communities within Sibiu County participated in three-day training sessions focused on renewable energy, energy efficiency, and energy security.

Each session, conducted in collaboration with experts from the University of Southeast Norway (USN), addressed topics such as energy savings technology, alternative energy systems, and environmental protection. The training aimed to enhance the capacity of technical experts to implement sustainable energy practices within SMEs and public institutions.

#### A. Strengths

During the sessions with technical experts, the following strengths of the Sibiu County strategy were identified [17]:

1) *Medium and long-term vision for reducing greenhouse gas emissions*

Sibiu County demonstrates a forward-thinking approach with a clear vision for reducing greenhouse gas emissions, complemented by expert technical training that enhances the capacity of local stakeholders to implement renewable energy and energy efficiency initiatives aligned with county objectives.

2) *Stable international relations*

The county's stable international relations facilitate collaboration opportunities, knowledge exchange, and access to best practices from global partners in renewable energy and energy efficiency, further augmented by expert technical training that fosters international partnerships and expertise sharing.

3) *Programs in place for renewable energy*

Existing programs and initiatives focused on renewable energy, and expert technical training provides a robust foundation for sustainable energy transition, offering practical skills and knowledge to stakeholders involved in implementing renewable energy projects.

4) *Increased capacity for external funding*

Sibiu County's increased capacity to attract and manage externally funded projects is bolstered by expert technical training, which equips local stakeholders with the necessary expertise to navigate funding opportunities and effectively utilize resources for renewable energy and energy efficiency initiatives.

5) *Specialized human resources*

The county benefits from specialized human resources with expertise in renewable energy technologies and energy efficiency measures, augmented by expert technical training that

enhances skills development and knowledge transfer among local stakeholders, ensuring the successful implementation of renewable energy projects.

6) *Functional infrastructure and logistics*

Sibiu County's functional infrastructure and logistics, including modern material bases and established mechanisms for project implementation, are complemented by expert technical training, which provides practical insights and guidance on effectively utilizing infrastructure and resources for renewable energy initiatives.

7) *Strong partnerships with stakeholders*

Stable partnerships with stakeholders are reinforced by expert technical training, which promotes collaboration and coordination among government agencies, academic institutions, and private sector entities involved in renewable energy and energy efficiency projects, fostering a supportive ecosystem for sustainable development.

8) *Participatory decision-making processes*

Sibiu County's participatory decision-making processes are enhanced by expert technical training, which empowers stakeholders to actively contribute to renewable energy and energy efficiency policies and initiatives, ensuring that decisions are informed by local expertise and needs.

9) *Access to information sources*

Easy access to information sources at national, European, and international levels is complemented by expert technical training, which provides stakeholders with up-to-date knowledge and resources to support informed decision-making and knowledge sharing in the renewable energy and energy efficiency sectors.

10) *Political support*

Political support within the County Council is reinforced by expert technical training, which cultivates a conducive environment for advancing renewable energy and energy efficiency agendas, strengthening the implementation of strategic initiatives and projects through collaborative efforts between policymakers and trained technical experts.

#### B. Weaknesses

The sessions also identified several weaknesses:

1) *Insufficiently developed strategic framework for climate change*

A comprehensive strategic framework for combating climate change and adapting to its effects is necessary for effective coordinated efforts and initiatives to address climate-related challenges.

2) *Lack of integrated public policies*

The absence of integrated public policies at the county level on climate change exacerbates the challenge of implementing cohesive strategies and actions to mitigate greenhouse gas emissions and enhance resilience to climate impacts, as well as inhibiting the effectiveness of training programs in fostering widespread adoption of sustainable practices.

3) *Inadequate database management*

Facing challenges in maintaining integrated and updated databases of implemented projects related to climate change, limiting the ability to track progress and assess impact effectively and hindering the training program's ability to tailor interventions to specific needs and measure outcomes accurately.

4) *Uncertain legal status of assets*

The uncertain legal status of some assets owned by Sibiu County, such as buildings and land, poses obstacles to implementing energy efficiency measures and sustainable development initiatives on these properties while potentially limiting the effectiveness of training programs in addressing these challenges comprehensively.

5) *Lack of organized working groups*

The absence of organized working groups at the county level dedicated to addressing climate change and facilitating technical training restricts collaboration and coordination among stakeholders, impeding progress in climate action planning and implementation and limiting the effectiveness of training programs in fostering knowledge sharing and capacity building.

6) *Low cooperation with local authorities*

A low level of cooperation with local authorities within the county regarding climate change issues hinders coordinated efforts and synergy in addressing shared challenges, impeding the training program's ability to mobilize local resources and support.

7) *Lack of awareness and education initiatives*

Insufficient mechanisms for raising awareness and educating citizens, decision-makers, and business representatives about the impacts of climate change in Sibiu County contribute to a limited understanding of climate-related risks and opportunities while also potentially hindering the effectiveness of technical training initiatives in fostering behavior change and adopting sustainable practices.

8) *Limited disaster response capacity*

Sibiu County's capacity to respond to climate-related disasters is constrained by insufficient resources and preparedness measures, increasing vulnerability to extreme weather events and other climate-induced hazards while also potentially limiting the effectiveness of technical training programs in building resilience and emergency response capabilities.

9) *Poor rural infrastructure*

Some rural areas in Sibiu County suffer from inadequate infrastructure, including roads, utilities, and services, which not only impairs the quality of life for residents but also poses challenges for implementing renewable energy and energy efficiency projects, as well as hindering access to and participation in technical training initiatives.

10) *Skilled labor migration*

The outmigration of skilled labor from Sibiu County to other regions or countries reduces the availability of qualified personnel for implementing climate change mitigation and adaptation measures. It limits the pool of potential technical training program participants, undermining efforts to build local capacity and expertise in sustainable practices.

11) *Uncertain legal status of land*

Ambiguities in the legal status of land ownership and usage rights in Sibiu County create uncertainty and barriers to investment and development in renewable energy and energy efficiency projects, as well as complicating efforts to implement land-based climate change mitigation and adaptation strategies, further exacerbating vulnerabilities to climate impacts.

12) *Economic and political interests*

Conflicting economic and political interests may prioritize short-term gains over long-term sustainability, leading to unsustainable practices in forest conservation and management, which

undermines efforts to mitigate climate change and exacerbates the county's environmental degradation and biodiversity loss.

### C. Elaboration of a Guide

A comprehensive guide [7] was developed to enhance awareness of the benefits of renewable energy and energy efficiency in Sibiu County. It provides insights, practical information, case studies, and recommendations for adopting sustainable energy practices, targeting the public, technical specialists, policymakers, and businesses. By compiling expert and stakeholder inputs, the guide promotes sustainable development, energy conservation, and the use of renewable resources. It also offers guidance on policy frameworks, funding opportunities, and best practices for renewable energy projects and energy efficiency measures, serving as a tool for capacity building. The guide's effectiveness is demonstrated by its impact on increasing public awareness, comprehension, and motivation towards sustainable energy practices, with its reach measured by the distribution of physical copies and online views/downloads.

Surveys and interviews are conducted to assess changes in knowledge and attitudes before and after exposure to the guide. Statistical information includes:

- The percentage of respondents who demonstrate increased knowledge and understanding of renewable energy and energy efficiency concepts.
- The percentage of households or businesses that have adopted renewable energy technologies or implemented energy efficiency measures recommended in the guide.
- Quantifying the amount of energy saved because of implementing guide-recommended measures.
- Calculate the monetary savings achieved through reduced energy consumption or improved energy efficiency. This includes savings on utility bills or other related expenses.
- Assessing the environmental benefits of adopting renewable energy and energy efficiency measures, such as reductions in

greenhouse gas emissions, air pollution, and water usage.

- Qualitative feedback from guide users to understand their perceptions, experiences, and suggestions for improvement.
- Track the distribution and dissemination of the guide to quantify its reach and impact across different audiences.

The success of behavior change efforts will be evaluated based on observable shifts in consumer behavior. The statistical indicator used the number of households/businesses implementing energy-saving measures recommended in the guide and the amount of renewable energy capacity installed due to guide recommendations.

The guide's contribution to sustainable development will be measured in quantifiable reductions in greenhouse gas emissions and improvements in energy efficiency. This includes percentages of carbon emissions and energy consumption reductions achieved through guide-recommended actions.

## V. DISCUSSION

Supporting SMEs promotes economic and environmental sustainability. These interventions benefit individual businesses and contribute to the county's overall well-being by offering training sessions and guidance on implementing sustainable energy practices.

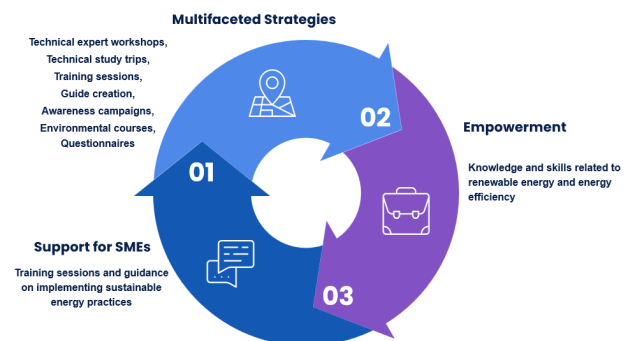


Figure 2. Successes of the project implementation

By supporting SMEs in adopting more sustainable practices, the strategy helps to reduce carbon emissions, mitigate environmental impact, and create a more resilient and prosperous local economy.

Fig. 2 illustrates the multifaceted approach. Overall, this approach, with support for SMEs and public institutions combined with a general awareness campaign, represents a promising strategy for promoting sustainable energy practices. By combining various tactics and focusing on empowerment and support for SMEs, the strategy has the potential to make a meaningful impact on both the environment and the local economy.

## VI. CONCLUSION AND FUTURE WORK

In conclusion, the collaboration project in Sibiu County has created a comprehensive guide to foster sustainable development by promoting renewable energy and energy efficiency. This guide is a testament to the concerted efforts of experts, stakeholders, and the community in driving the renewable energy agenda forward. It serves as an educational resource and a catalyst for action, equipping a wide range of audiences with the knowledge and tools necessary to embark on a path toward a more sustainable and energy-efficient future.

The guide's impact is measurable and significant, as evidenced by the public's increased awareness and understanding of renewable energy and energy efficiency concepts, adoption of sustainable energy technologies, and implementation of energy-saving measures. The quantitative and qualitative outcomes— from energy and monetary savings to environmental benefits—highlight the guide's role in effecting tangible changes and contributing to the broader objectives of reducing greenhouse gas emissions and enhancing energy efficiency in Sibiu County.

Furthermore, using a linear model to assess the guide's impact on public awareness has provided valuable insights into the guide's effectiveness in promoting renewable energy and energy efficiency. This model underscores the multifaceted benefits of the guide, from increasing knowledge and understanding to encouraging the adoption of sustainable practices and measuring the subsequent environmental and economic advantages.

As we progress, the guide's success in Sibiu County is a blueprint for future initiatives to

advance sustainable energy development. The project's achievements underscore the potential for collaborative efforts to significantly impact community awareness and behavior towards renewable energy and energy efficiency, laying a solid foundation for continued progress in achieving sustainability goals. This endeavor not only enhances the quality of life for the residents of Sibiu County but also contributes to the global effort to combat climate change, marking a pivotal step towards a greener, more resilient future.

## ACKNOWLEDGMENT

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