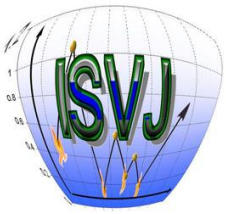

Energy Poverty Alleviation Plan of Jiu Valley Region

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JUSTEM

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ABBREVIATIONS

ANRE	National Agency for Energy Regulation
CSD	Center for the Study of Democracy
CSR	Corporate Social Responsibility
EC	European Commission
EIB	European Investment Bank
EU	European Union
EU-SILC	European Union statistics on income and living conditions
FNEE	National Energy Efficiency Fund
JTF	Just Transition Fund
JTM	Just Transition Mechanism
MFE/MIPE	Ministry of European Funds/Ministry of Investments and European Projects
NRRP	National Recovery and Resilience Plan
ORSE	Romanian Observatory of Energy Poverty
NECP	Integrated National Plan for Energy and Climate Change (PNIESC in Romanian)
POR	Regional Operational Program
PPP	Public-private partnerships
PR Vest	Regional Program West
RES	Renewable energy sources
TJTP	Territorial Just Transition Plan
SDG	Sustainable Development Goals
SG	Secretariat-General
SNRLT	National Long-Term Renovation Strategy
UNDP	United Nations Development Programme

1. INTRODUCTION

1.1. Relevance and Urgency

In Romania, energy poverty affects around 25% of the population, with vulnerable households dedicating 8.7% of their energy expenditure and 15.2% failing to keep their homes warm in winter, ranking among the most affected in the EU (Robayo-Abril et al., 2024). This problem is compounded by energy-inefficient housing and energy price increases, underlining the need for targeted policies such as subsidies for vulnerable households and thermal rehabilitation programs.

The Jiu Valley is a former coal mining region that has faced significant economic challenges following the decline in coal mining. It is an eloquent example of the economic and social challenges associated with the transition from fossil fuels, having 90% of the country's mining workforce concentrated in the region in the 1990s. (Murafa, 2022). The region's transition from coal has led to high unemployment rates, economic hardship, and energy poverty, as many residents struggle to afford adequate energy for heating, cooking, and other essential activities.

The Jiu Valley Energy Poverty Mitigation Plan is part of broader regional development and energy transition efforts that aim to ensure that the community can move towards a sustainable future while meeting the needs of vulnerable populations.

Given the broader commitment of the European Union to the European Green Deal (European Commission, SG, 11.12.2019) and the Just Transition Mechanism (MIPE, 2020), the need to alleviate energy poverty in regions such as the Jiu Valley is seen as urgent and central to ensuring a socially inclusive energy transition. At national level, Romania's Integrated National Energy and Climate Plan (NECP) (European Commission, 2023a), and Romania's Energy Strategy 2025-2035, with a view to 2050 (Ministry of Energy, 2024) align with these EU objectives. At the local level, the Jiu Valley faces different challenges in implementing these frameworks, requiring an immediate and targeted approach to address its specific concerns about energy poverty.

The urgency of addressing energy poverty in the Jiu Valley stems from its distinct challenges: high unemployment, economic dependence on coal, harsh climatic conditions, and an aging population and infrastructure. Aligning local policy frameworks with EU and national strategies, such as the European Green Deal and Romania’s NECP, provides a roadmap for a fair and inclusive energy transition. However, the plan needs to be adapted to address the unique challenges of the region, while prioritizing investments in renewable energy, energy efficiency, and economic diversification to ensure long-term sustainability and alleviate energy poverty in the region.

1.2. Target Group

The Jiu Valley Energy Poverty Reduction Plan is the result of a detailed analysis of the current situation of energy poverty in the region, correlated with the policies outlined in the main national and European legislative instruments. It is complemented by qualitative insights gathered through the active participation of stakeholders from local communities, as well as relevant findings from the JUSTEM Impact Matrix Report (Peretto et.al., 2024) covering the Just Transition Territorial Plan (TJTP) for the Jiu Valley.

With consideration for the unique requirements of the Jiu Valley's communities, the plan is intended to act as a strategic instrument to assist local authorities in tackling energy poverty in all of its manifestations. Whether a household is already experiencing or at risk of experiencing energy poverty, it identifies important support opportunities for those in vulnerable situations. The Plan seeks to reduce energy poverty and assist local governments in carrying out successful interventions by identifying policies that are specific to the area.

1.3. Objectives

The Energy Poverty Alleviation Plan for the Jiu Valley region is designed with a clear set of objectives that align with its overall objective to improve energy affordability, promote energy efficiency, and facilitate a just transition from coal. These objectives consider the unique needs and priorities of coal-dependent communities, ensuring that the region can move toward a sustainable and inclusive future without leaving behind its most vulnerable populations. By providing targeted support to local authorities, vulnerable households, and former coal workers, the plan will play a crucial role in the economic revitalization of the region and the energy transition.

1.4. Replicability

The actions outlined in this Plan are intended to make it easier to implement and/or modify them in other parts of Romania where energy poverty poses a strategic risk. In this regard, conducting a thorough basic needs analysis and evaluating the local context of each location—including the environment, socioeconomic circumstances, and demographic makeup—is a crucial first step to guarantee appropriate and successful interventions catered to the unique requirements of each location.

Adherence to a clearly defined methodology, thorough documentation of the data collection process, participation of pertinent stakeholder structures, utilization of publicly available data sources, and economic evaluation of suggested solutions all contribute to the overall transferability of the process and measures outlined in the plan. The latter includes detailed budget estimates for each type of measure, thus guaranteeing the practical viability of implementation and supporting replication in other regions, such as that of the quarries in Oltenia.

2. STATUS QUO OF ENERGY POVERTY IN JIU VALLEY REGION

2.1. Needs Assessment – Jiu Valley

The coal industry has been for more than a century the main pillar of the economy in the Jiu Valley. The region is home to the largest coal deposits in Romania, in the Jiu Valley Basin, and the local economy has been closely linked to coal mining and energy production. However, since the 1990s, the decline of the mining sector has had a profound socioeconomic impact, leading to high unemployment, labor emigration, and an increase in social vulnerabilities.

Currently, the GDP of Hunedoara County, which includes the Jiu Valley, is among the lowest in the Western region of Romania, and the unemployment rate is about 3.5%, below the national average due to the large share of pensioners and those not listed as registered unemployed. The energy transition, which includes the closure of all remaining mines by 2032, will increase the socioeconomic vulnerabilities of the region unless supported by appropriate economic diversification measures.

Households in the Jiu Valley have incomes significantly below the national average, which contributes to a high rate of energy poverty. In the region, households spend up to 8.7% of their income on energy, compared to an average of 6% elsewhere in Romania (Koasidis et al., JUSTEM, D2.1, 2023). This phenomenon is exacerbated by high unemployment and the lack of economic alternatives after the decline of the mining industry. The state of the housing stock represents a major challenge as 85% of the dwellings were built between 1950 and 1989, most of them poorly insulated; 90% of homes are privately owned, which places the responsibility for renovations on citizens, who are often 'poor homeowners' and almost 75% of buildings fall into energy classes E, F, and G, indicating significant heat loss.

Most households use solid fuels, such as wood and coal, for heating. (Nazare, ed., 2024). Approximately 45% of the dwellings were connected to centralized heating systems, until 2019 when the heating supply from the Paroseni Thermal Power Plant was closed in the Jiu Valley. Thus, some of the dwellings switched to individual gas power plants and others to wood stoves, waste, even second-hand objects. This has led to a higher level of pollution than during the existence of the 10 mines in operation in the valley. Long-term exposure to polluted air can have serious effects on human health (hunedoaraplus.ro, 2024).

Many households in the region do not have access to modern heating systems or renewable energy. Only 12% of households have access to renewable energy, such as solar panels or heat pumps, despite initiatives such as the Green House Photovoltaic program, which approved 55,000 photovoltaic systems nationwide but with limited impact in the region (Koasidis et al., JUSTEM, D2.1, 2023).Recent projects such as the

"Photovoltaic Green House" seek to improve access to renewable energy sources, but their implementation is still limited at the local level.

In the Jiu Valley region, access to energy services is low, and citizens fall within the factors mentioned by the European Parliament regarding the definition of energy poverty, namely: Insufficient disposable income; high energy expenditure and low energy efficiency of housing.

2.2. Energy Poverty Status

According to the Romanian Observatory on Energy Poverty (ORSE), in Romania, low incomes, living in inefficient housing, and implicitly, high energy consumption are factors that create a high risk that many families will face energy poverty. According to some estimates made in 2019 by the CSD, for more than 45% of Romanians, the energy bill is too high a burden in the family budget, producing a state of energy vulnerability for 1 in 2 Romanians (Romanian Observatory of Energy Poverty).

Approximately 30% of households in the Jiu Valley face energy poverty. Households in the region spend between 8% and 12% of their income on energy and 17.8% report frequent delays in paying their energy bills. In winter, 15.2% of households do not heat their homes properly. (Robayo-Abril et al, 2024), (Koasidis et al, JUSTEM, D2.1, 2023)

According to the report “Identifying vulnerability to ETS 2 in the Central and Eastern European region based on the example of Romania and Poland. Recommendations for Social Climate Plans" The Center for the Study of Democracy (CSD) together with nongovernmental organizations from Poland (WiseEurope) and Germany (Adelphi, Berlin), on the effects of ETS 2 on countries in the region, Romania, will be one of the largest beneficiaries of the Social Climate Fund, which will create a significant opportunity to reduce the rate of energy poverty at national level. Thus, Romania will receive 9.25% (EUR 6 billion) of the EUR 65 billion financing package from the Social Climate Fund, available between 2026 and 2032. The financing instrument is intended to mitigate the potential negative effects on households resulting from the introduction of the ETS 2 carbon taxation mechanism. This new mechanism to tax fossil fuels used for domestic heating and road transport will be applied in the EU from 2027. The funds will have to be used for investments to support vulnerable groups, citizens in energy or transport poverty. (Center for the Study of Democracy CSD, 2023)

Regarding the annual energy renovation rate, Romania plans to achieve this progressively increasing rate of the total building stock (linked to energy poverty targets) of 2% per year by 2026, 3% per year by 2030, 3.5% per year in 2031-2040, and 4% per year in 2041-2050, as well as the use of RES in subsidized residential buildings. (Koasidis et al., JUSTEM, D2.1, 2023).

To address energy poverty, the following solutions are proposed:

- Thermal renovation of homes, which can reduce energy consumption by up to 70% and reduce energy expenditure by up to 50%. A comprehensive energy renovation program supported by European funds is essential for vulnerable households (Robayo-Abril et al., 2024).
- Investments in renewable sources, such as photovoltaic panels and heat pumps, can reduce dependence on fossil fuels.
- Social interventions: direct subsidies to vulnerable households and tailored financial support to vulnerable groups, such as the elderly, women-led households, and those with unemployed members, to ensure their access to affordable energy (Murafa, 2022), (Nazare, Ed., 2024).).
- Education and awareness: Energy efficiency campaigns can help reduce noneconomic energy consumption.

2.3. Just Transition Challenges

Employment in Romania is a highly regarded, though not dominant, concern, with investment and participatory decision-making being the most discussed in the national literature. In particular, even the creation of job opportunities to counteract up to 6,000 and 15,000 job losses in the respective West and South-West regions (Voicu-Dorobanțu et al., 2021) was framed as an investment growth problem (Nicola and Schmitz, 2022), with a lack of resources allocated to entrepreneurs and start-ups (Voicu-Dorobanțu et al., 2021). For 2022, unemployment in Hunedoara was 3.97%, almost twice the national average of 2.0%.

An important social aspect is related to the type of housing or the type of property of the dwellings; in this respect, Romania is among the countries with a large share of privately owned dwellings (about 91.2%), but in Hunedoara only 52.3% of the dwellings are owned by owners, much less than the national average, while 34.8% of the dwellings are rented, expected more than the national average. (Koasidis et al, JUSTEM, D2.1, 2023)

Mining in the Jiu Valley has numerous and various negative effects on society and the environment, including material damage, the impact of pollution on human health, occupational diseases, land degradation, and soil pollution/contamination, with almost 20% of the nationally registered contaminated sites located in Hunedoara County. (Koasidis et al, JUSTEM, D2.1, 2023)

3. POLICY AND ENABLING FRAMEWORK TO ADDRESS ENERGY POVERTY

3.1. Policy Context

The Jiu Valley Energy Poverty Alleviation Plan is framed in a comprehensive national and regional policy context, reflecting Romania's commitments to address energy

poverty, promote sustainable development, and ensure social inclusion. National and EU policies, together with regional strategies, provide a support framework that integrates the reduction of energy poverty with broader economic, social and environmental objectives, ensuring the transition of the Jiu Valley towards a sustainable future.

The national policy framework shall comprise:

1). Romania's integrated national energy and climate plan (NECP) 2021–2030, which has the following key objectives (European Commission, 2023a):

- Transition from coal, expansion of renewable energy and increased energy efficiency;
- Prioritize the reduction of energy poverty in vulnerable coal-dependent regions such as the Jiu Valley.

The measures concerned relate to:

- Large-scale energy efficiency programs for low-income households (insulation of buildings, modernization of heating).

- Support for the integration of renewable energy (e.g., rooftop solar systems, community energy projects).

- Just transition: financial and technical support for economic diversification, reskilling of the workforce and mitigation of social impacts in coal-dependent areas.

2) The Romanian Energy Strategy 2020-2030, with a perspective to 2050 (Ministry of Energy, 2024) includes among its fundamental objectives "Protection of vulnerable consumers and reduction of energy poverty". It underlines the importance of ensuring access to energy for all consumers and financial affordability, proposing measures to protect the vulnerable and underlining the need to prevent energy poverty.

3) The National Recovery and Resilience Plan (NRRP) has as priorities: programs for decarbonization, modernization of infrastructure, and social inclusion. The impact is substantial funding for housing modernization, efficiency of public buildings, and job creation in green sectors to support energy-poor households.

4) The national long-term renovation strategy to support the renovation of the national stock of residential and non-residential buildings, both public and private, and its gradual transformation into a high-energy and low-carbon real estate stock by 2050, approved by Government Decision No. 1034/2020 (SNRLT). It aims to gradually transform the national stock of residential and non-residential buildings into a high-energy-efficient, low-carbon building stock by 2050, through deep renovations, the integration of renewable energy sources and the mobilization of public and private investment. A key objective of the strategy is to combat energy poverty by prioritizing the renovation of housing occupied by vulnerable households, reducing energy costs and ensuring

equitable access to efficient energy services. The strategy also provides for financial support, education and monitoring measures to reduce social inequalities and improve the quality of life of the population affected by energy poverty. By Government Decision no. 10/2023 SNRLT was amended and supplemented with an ACTION PLAN for the implementation of the strategy in stage 1 - 2022-2030.

The regional policy framework includes the following:

- Jiu Valley Sustainable Development Strategy (2021–2030) (MFE, 2021) with the objectives of economic diversification (renewable energy, tourism, agriculture) and reduction of energy poverty. The actions concerned are: - Modernizing housing and improving access to energy for low-income households; - Promoting community-led renewable energy projects (solar, wind, hydro).
- The EU Just Transition Mechanism (JTM) and the Just Transition Fund (JTF) (MIPE, 2020), which provide financial support for economic diversification, social inclusion, and investment in renewable energy. Focus areas: Energy efficiency improvements (building insulation, efficient heating systems) and social programs for reskilling the workforce and creating green jobs.

The key elements of the plan to reduce energy poverty in the Jiu Valley require a holistic and integrated approach:

1. Mainstreaming energy efficiency and social inclusion: combine the modernization of housing with direct social support (subsidies, energy assistance); focus on vulnerable groups (low-income families, elderly, unemployed).

2. Align with the Sustainable Development Goals (SDGs) and contribute to SDG 7 (Clean and Affordable Energy), SDG 8 (Decent Work), and SDG 13 (Action for Climate) and support the European Green Deal by promoting decarbonization and green job creation.

3. Just transition and economic revitalization: by reskilling mining workers for jobs in renewable energy and energy efficiency and supporting local economic diversification and improving households' access to affordable energy.

3.2. Necessary Interventions

Based on the assessment and analysis of the needs of the energy poverty situation in the Jiu Valley, several key interventions are needed to create a comprehensive and integrated energy poverty reduction plan. These interventions cover different policy areas, including energy efficiency, the use of renewable energy, and community empowerment. The following are prioritized interventions with a focus on potential impact, feasibility, cost-effectiveness, and alignment with broader policy objectives.

Energy Efficiency

a. Supporting energy efficiency in housing and buildings, which aims to: decarbonize and improve the energy efficiency of residential buildings, increasing energy performance, and improving living conditions.

Actions taken:

- Energy renovation of multifamily residential buildings through incentive mechanisms: low-interest grant and loan programs have been introduced to support the renovation of residential buildings (both owned and rented properties), focusing on insulation, window replacement, and the uptake of sustainable heating and cooling systems for blocks of flats (multifamily residential buildings).
- Sustainable renovation solutions have been promoted: the use of sustainable materials and designs that increase thermal comfort and reduce energy consumption, targeting at least 50,000 homes over the next 10 years.

The Impact of the Potential: Large-scale modernization will reduce energy consumption by 30-40% per household, lowering energy bills, and reducing energy poverty rates.

Cost effectiveness: On average, while initial costs are high, long-term energy cost savings and emission reductions make it cost effective in the long term.

b. Replacement of inefficient equipment and systems aims to replace outdated and inefficient heating systems and appliances with modern energy-efficient technologies.

Actions that can be carried out:

- Replacement of inefficient heating systems: providing subsidies or incentives to single-family houses to replace coal and wood-fired stoves with efficient alternatives such as heat pumps, solar thermal systems, and biomass boilers.
- Energy-efficient appliances: promote the adoption of energy-efficient lighting, refrigerators, and other household appliances through discount programs.

The potential impact is estimated to result in 15-25% reductions in household energy consumption and improved indoor air quality.

Cost efficiency: high, by replacing inefficient heating appliances and systems, it can have an immediate impact on energy saving, with relatively low implementation costs.

c. Smart energy infrastructure, with the objective of empowering energy-poor households to better manage their energy costs through the adoption of smart energy technologies.

Possible actions:

- Smart energy management systems for vulnerable households: installation of smart meters and energy management systems in homes to enable consumers to track and optimize energy use, in particular for vulnerable households receiving energy subsidies.

- Energy efficiency education and awareness program: combine smart infrastructure deployment with educational campaigns to teach households how to reduce energy consumption.

Potential impact: smart energy solutions could reduce energy consumption by up to 10-15%, empowering households to manage consumption and reduce energy bills.

Cost efficiency: high. The installation of the smart meter has moderate upfront costs but can significantly reduce energy bills over time.

Renewable energy

Community solar energy projects: promoting inclusive energy transition by supporting investments to be made by renewable energy communities, including and involving vulnerable consumers in energy poverty, with the aim of reducing the burden of energy bills, promoting increased self-consumption, and energy sharing.

Supportive Policies and Regulations

- Incentives and subsidies for energy efficiency and renewable energy solutions.

The interventions presented represent a comprehensive approach to address energy poverty in the Jiu Valley region. Priority is given to energy efficiency, renewable energy deployment, and community empowerment, as these areas offer the greatest potential for immediate and long-term impact. Supportive policies and regulations will ensure that these interventions are implemented effectively and aligned with broader regional and national objectives for sustainable development and social inclusion.

3.3. Integration with Just Transition Principles

The Just Territorial Transition Plan (TJTP) for Hunedoara County and Jiu Valley region, respectively, is designed to address the economic, social and environmental challenges posed by the transition from coal. The TJTP recognizes energy poverty as a significant problem that affects coal-dependent communities in the region and highlights interventions to alleviate it. In line with the principles of a just transition, the proposed Energy Poverty Reduction Plan for the Jiu Valley incorporates key elements of social equality, labor rights, environmental justice, and community participation. (European Commission, 2021).

4. MEASURES AND INVESTMENT NEED TO ALLEVIATE ENERGY POVERTY

4.1. Energy Poverty Alleviation Measures

To alleviate energy poverty in the Jiu Valley region, based on information gathered from workshops with citizens, expert estimates, and existing sources, the following

interventions of interest resulted: energy efficiency, renewable energy, community empowerment, and social inclusion.

The following tables (Table 1- Table 5) present specific and targeted measures. Each measure is designed to address the key challenges identified in the region and to align with the broader objectives of economic revitalization, energy efficiency, and social fairness.

Table 1 Energy renovation of multifamily residential buildings

Measure 1. Energy renovation of multifamily residential buildings	
Responsible entity and leading person	Ministry of Energy, Ministry of Development, Local Public Administration, Energy Efficiency Agency, Local Authorities
Target group for the measure	Owner associations in residential buildings located in municipalities in the Jiu Valley region, low-income households, elderly residents, tenants in energy-inefficient dwellings
Measure design	Renovation of 25,000 homes in the Jiu Valley region in 10 years. Included upgrades: insulation, window replacement, modernization of heating systems. The measure involves a complete upgrade of the building envelope. It is designed to facilitate the sustainable energy renovation of multifamily residential buildings, improving both their energy performance and living conditions. Prioritizes the participation of energy-vulnerable households, as well as residential buildings with the lowest energy performance assessments. Anticipated impacts include a reduction in residential energy consumption and associated costs, a reduction in greenhouse gas emissions, and, ultimately, a reduction in energy poverty for homeowners in renovated buildings.

Scheduling	Phase 1 (2025-2027): Upgrading 12,000 homes. Phase 2 (2028-2030): Upgrading the other 13,000 homes.
Budget	€ 250 million (financing from the EU Just Transition Fund, National Recovery and Resilience Plan, National Energy Efficiency Programs, PR Vest).
Drivers	The aim is to reduce energy consumption and improve living conditions in residential buildings, while fostering resilience among the most disadvantaged populations. Furthermore, the successful implementation of the measure is based on the energy renovation model already established and tested in the National Renovation Program 2016-2019 and the ongoing implementation of Phase I of the RRP.
Barriers	A system to evaluate energy-poor households based on the latest definition of energy poverty adopted in 2021 has not yet been established, which may pose a challenge to identify households with the greatest needs. High upfront costs; lack of awareness or co-financing by homeowners; logistical difficulties in rural areas

Justification: This measure addresses the energy inefficiency of the housing stock, which is a key driver of energy poverty in the Jiu Valley. Upgrading homes will lead to significant energy savings (estimated at 30-40% per household), improved thermal comfort, and reduced energy bills. Given the harsh winters in the region, these improvements will also improve health outcomes for vulnerable populations.

Table 1 Replacement of inefficient heating systems for single-family houses

Measure 2. Replacement of inefficient heating systems for single-family houses	
Responsible entity and manager	Ministry of Energy, Local Authorities
Target group for the measure	Single-family houses using coal and wood for heating

Measure design	Replace 10,000 inefficient heating systems (coal and wood stoves) with modern, energy-efficient alternatives such as heat pumps, solar thermal systems, or biomass boilers. Target for financial support: vulnerable and low-income households
Scheduling	2025-2029: gradual replacement with a target of 2,500 systems per year
Budget	€100 million (subsidies from the National Energy Efficiency Fund, support from the EU Just Transition Fund, C16 Component REPowerEU from NRRP with investments such as voucher schemes for improving energy efficiency in individual households, Climate Social Funds).
Drivers	Reducing air pollution and energy costs, improved health outcomes, strong alignment with EU decarbonization objectives
Barriers	Lack of awareness of the benefits of energy efficient systems, initial costs of new systems, difficulties in reaching isolated communities High upfront costs; lack of awareness or co-financing by homeowners; logistical difficulties in rural areas

Justification: This measure directly addresses the use of inefficient and polluting heating systems, which contribute to both high energy costs and air pollution. Replacing these systems will improve indoor air quality, reduce energy bills, and reduce greenhouse gas emissions. The measure is also particularly relevant in rural areas, where coal and wood are commonly used for heating.

Table 2 Community solar energy projects

Measure 3. Community solar energy projects	
Responsible entity and manager	Local authorities, energy communities, and renewable energy developers

Target group for the measure	Low-income communities and former miners
Measure design	Developing 6 community-owned solar energy projects throughout the region, allowing residents to generate their own electricity and share surplus energy. The focus will be on both public buildings (schools, hospitals) and residential blocks.
Scheduling	2026-2029: Pilot projects in 6 communities
Budget	€150 million (from the EU Just Transition Fund and private sector investment).
Drivers	Reducing energy costs through renewable energy, promoting community ownership and empowerment, and contributing to regional decarbonization objectives.
Barriers	Initial investment costs, technical challenges in creating energy sharing mechanisms, potential resilience of energy utilities

Justification: This empowers communities to take control of energy production, reducing dependence on external energy suppliers and encouraging local ownership. The projects will provide low-cost renewable energy to vulnerable households, reducing energy poverty, and contributing to the transition from coal. The cooperative model promotes community participation, which is essential for a just transition.

Table 3 Smart energy management systems for vulnerable households

Measure 4. Smart energy management systems for vulnerable households	
Responsible entity and manager	Ministry of Energy, Local Authorities, and Energy Utilities
Target group for the measure	Households at risk of energy poverty, particularly in multifamily residential buildings
Measure design	Install smart meters and energy management systems in 20,000 homes

	to help residents monitor and reduce their energy consumption. Provide training and support to vulnerable households to maximize energy savings.
Scheduling	2024-2027: Gradual deployment of smart systems, with a focus on vulnerable households that receive energy subsidies
Budget	€50 million (from national smart grid initiatives and EU funds for energy efficiency).
Drivers	Reducing energy consumption of households, empowering vulnerable consumers to manage energy costs, in line with the objectives of the digital energy transition
Barriers	Lack of digital knowledge among some target groups, potential resistance from utilities, upfront costs for infrastructure deployment

Justification: This measure supports vulnerable households to better manage their energy costs through smart technologies, providing real-time data on energy use, and encouraging behavioral changes that lead to savings. This aligns with the wider digitalization of the energy sector and ensures that vulnerable consumers are not left behind.

Table 5 Energy Efficiency Education and Awareness Program

Measure 5. Energy efficiency education and awareness program	
Responsible entity and manager	NGOs, local authorities, and community leaders
Target group for the measure	All residents, with a focus on low-income households, students, and elderly residents
Measure Design	Carry out an extensive education campaign on energy efficiency targeting vulnerable households. Use workshops, information brochures, and digital platforms to raise awareness about

	energy saving behaviors, available subsidies, and renewable energy options.
Scheduling	2024-2025: Development and dissemination of materials 2025-2030: Ongoing campaigns and workshops
Budget	€10 million (funded from national energy efficiency programs, EU social inclusion funds and Operational Program Education and Employment)
Drivers	Increase awareness and participation in energy savings measures, improve community participation, aligned with the overall objective of reducing energy poverty
Barriers	Difficulty reaching isolated or less engaged populations, potential language barriers, limited digital access for some groups

Justification: Education and awareness are key to ensuring the success of other energy efficiency and renewable energy measures. By raising awareness and providing resources, this program will allow households to take advantage of available subsidies and technologies, ultimately leading to a reduction in energy consumption and bills.

In conclusion, the proposed measures are interlinked and aim to address the different dimensions of energy poverty in the Jiu Valley, from improving the energy efficiency of housing to empowerment communities through renewable energy projects. These interventions are designed to be both cost-effective and impactful, focusing on vulnerable populations and contributing to the broader objectives of social inclusion, economic revitalization, and environmental sustainability. Each measure aligns with the Just Territorial Transition Plan (TJTP) and the region's long-term development objectives, ensuring a fair and just transition for all.

4.2. Funding

Implementing the Energy Poverty Reduction Plan for the Jiu Valley region requires a coordinated approach to financing, drawing on various sources of financing, including government grants, private investment, philanthropic support, and international development assistance. By combining these funding streams, the plan can achieve its ambitious goals of improving energy efficiency, reducing energy poverty, and

supporting the region's transition towards a sustainable and inclusive energy future. The main sources of funding are listed below.

1.Government grants

a. The EU Just Transition Fund (JTF) is a dedicated financial instrument to support regions heavily affected by the energy transition, such as Jiu Valley. It aims to help six counties in Romania transition to a low-carbon economy while ensuring social inclusion and economic revitalization. The aim of the funding is to support large-scale energy efficiency modernization programs, renewable energy projects, and the creation of green jobs in the region. As a Jiu Valley allocation, it is expected to receive a substantial part of Romania's allocation from the JTF, with an estimated value of EUR 750 million.

b. The National Recovery and Resilience Plan (NRRP) related fund aligns with the EU Recovery and Resilience Facility, which provides funding for the post-COVID-19 economic recovery, with a strong focus on green transition projects. The program co-finances energy efficiency measures, including the renovation of residential and public buildings and the deployment of smart energy infrastructure in the Jiu Valley. The estimated allocation of EUR 200 million will be made available for energy efficiency and renewable energy measures.

c. National Energy Efficiency Fund (NEEF) - The Romanian Government provides funding through the National Energy Efficiency Fund, which supports building modernization, heating system modernization and supports the implementation of projects under energy efficiency programs. NEEF is a financial structure that has the role of mobilizing financial resources for investments in reducing energy consumption and increasing efficiency in various sectors, including residential buildings, industry and public infrastructure. This fund will provide direct financial support to vulnerable households to make energy efficiency improvements, such as home insulation and heating system replacement. Allocation of approximately 100 million euros for the Jiu Valley over the next 10 years for energy efficiency initiatives.

2. Private investment

a. Public-private partnerships (PPPs) will play a crucial role in attracting investment for community renewable energy projects, such as solar energy communities and small-scale wind or hydropower projects. The aim is to involve the private sector in financing the development and maintenance of renewable energy infrastructure, providing returns on investment through energy sales and joint profits from community energy projects.

b. Green bonds are financial instruments that can be issued by local authorities or companies to raise special capital for environmentally sustainable projects, such as renewable energy installations or building upgrades. It will be used to finance renewable

energy initiatives and large-scale modernization programs, allowing long-term investments with a focus on sustainability.

3. Philanthropic support

a. Philanthropic Foundations

b. Corporate Social Responsibility (CSR) initiatives

4. International development assistance

a. European Investment Bank (EIB) provides low-interest loans and technical assistance for green transition projects in EU Member States, with a focus on energy efficiency, renewable energy and sustainable infrastructure. EIB loans will help finance large-scale infrastructure projects, including the development of renewable energy systems and smart energy infrastructure in the Jiu Valley.

b. The World Bank provides funding and technical support for poverty reduction, energy transition, and infrastructure development, especially in regions undergoing economic restructuring. World Bank loans and grants will be oriented towards addressing energy poverty and supporting low-income households in the transition to more efficient energy systems.

c. The United Nations Development Program (UNDP) supports sustainable development projects globally, with a focus on access to energy, climate action, and social inclusion. UNDP grants can be used to support local capacity building, community empowerment, and sustainable energy initiatives that align with the UN Sustainable Development Goals (SDGs).

5. EXPECTED BENEFITS FROM THE IMPLEMENTED MEASURES

The measures implemented as part of the Jiu Valley Energy Poverty Reduction Plan will bring substantial and long-lasting benefits to the area and its inhabitants. These include improved energy performance of homes, improved access to energy services, decreases in energy consumption, and enhanced energy literacy. In addition, the plan will contribute to economic revitalization through job creation, promote environmental sustainability and promote social inclusion, increase the quality of life, and sustain the health of inhabitants, ensuring that vulnerable populations are prioritized in the just transition of the region from coal.

6. EXPECTED CHALLENGES AND BARRIERS (THAT NEED TO BE REMOVED FOR MEASURE IMPLEMENTATION)

The implementation of the Energy Poverty Reduction Plan in the Jiu Valley will face several challenges and barriers, given the region's socioeconomic conditions, coal dependence, and infrastructural limitations. These challenges could hinder the successful implementation of energy efficiency, renewable energy, and community empowerment measures. Table 6 identified potential barriers, possible bottlenecks, and strategies to overcome these challenges, i.e., some aspects of risk management.

Table 4 Risk management

Barriers	Challenge	Risk	Measures impacted	Mitigation Strategies
1. Economic and financial barriers				
1.1. High upfront costs for households	Many households in the Jiu Valley, especially low-income and vulnerable families, may not be able to afford the upfront costs associated with modernizing energy efficiency, replacing heating systems, or renewable energy installations.	Despite long-term savings, upfront costs may discourage participation, especially in cases where co-financing from owners or tenants is required.	Measure 1. Energy renovation of multifamily residential buildings Measure 2. Replacement of inefficient heating systems	Grants and financial assistance: Ensure that government subsidies fully cover the costs for vulnerable households or provide interest-free loans and low-cost financing options to make adaptation affordable. - Phased implementation**: implement the modernization and replacement of the system in stages, prioritizing the most vulnerable households to demonstrate savings and build confidence in the program.
1.2. Limited access to private investment	Attracting private investors to participate in energy	Without sufficient investment in the private sector, large-	Measure 3. Community solar energy projects	Public-private partnerships (PPPs): create incentives for private investors by

	efficiency and renewable energy projects in the Jiu Valley can be challenging due to perceived economic risks, low financial returns, or concerns about long-term viability.	scale renewable energy projects or community initiatives may lack the financial resources needed for successful implementation.		offering tax advantages, long-term contracts, or profit-sharing models through PPPs. Public funding (e.g., the EU Just Transition Fund) can be used to reduce investment risk. Green bonds and guarantees: Issue green bonds or provide government-backed guarantees to make investments more attractive and reduce financial risk for private companies.
2. Technical and Infrastructure Barriers				
2.1. Outdated Infrastructure	The existing energy and housing infrastructure in the Jiu Valley is obsolete and lacks modern energy-efficient systems. Limited access to modern energy networks, especially in rural or remote areas, will pose challenges in the deployment of smart energy technologies and renewable	Without adequate infrastructure upgrades, the deployment of smart meters, energy management systems, or community energy projects will be delayed.	Measure 4. Smart energy management systems for vulnerable households	- Integrated infrastructure planning: Coordinate energy efficiency modernization with broader infrastructure improvements (e.g., network modernization, natural gas expansion) to ensure that all households, especially in rural areas, have access to modern energy services. - Prioritize high-impact areas: Focus on upgrading

	energy systems.			infrastructure in areas with the greatest potential for energy savings and renewable energy generation to maximize immediate benefits.
2.2. Gaps in Technical Expertise	The Jiu Valley region may face a lack of skilled workforce and technical expertise needed to install energy efficient systems, renewable energy technologies, or smart energy infrastructure.	Delays in implementation and higher costs if local contractors or workers need to be trained or if external specialists are needed	Measure 3. Community solar energy projects Measure 4. Smart energy management systems for vulnerable households Measure 5. Energy efficiency education and awareness program	Workforce training programs: partnerships with vocational schools, universities and local authorities to provide training programs to former miners and unemployed residents to acquire the necessary skills for the green energy sector. - Technical assistance: harness international and national technical expertise through partnerships with energy agencies, NGOs, and government bodies to provide guidance on complex projects.
3. Social and Behavioral Barriers				
3.1. Resistance to change	Residents may be resistant to the adoption of new technologies or systems, especially in traditional or rural communities	Low community involvement and participation in renewable energy projects or energy efficiency measures could undermine the	Measure 4. Smart energy management systems for vulnerable households Measure 5. Energy efficiency	- Community involvement and education: conduct extensive awareness campaigns, workshops, and information sessions to educate households about

	dependent on coal. Cultural attachment to coal as a source of energy and jobs can hinder the acceptance of renewable energy solutions.	objectives of the plan.	education and awareness program	the long-term benefits of energy efficiency and renewable energy, including cost savings and health improvements. Demonstration projects: Implement pilot projects in specific communities to showcase the efficiency of new energy technologies. Positive results of pilot projects can generate trust and encourage greater participation.
3.2. Digital Literacy and Access to Technology	Vulnerable populations, especially older people and those in rural areas, may have difficulties in adopting smart energy technologies (e.g. smart meters or energy management systems) due to poor digital knowledge or lack of access to technology.	Households may not fully benefit from energy savings if they are unable or unwilling to use the smart energy technologies provided.	Measure 2. Replacement of inefficient heating systems Measure 3. Community solar energy projects Measure 4. Smart energy management systems for vulnerable households Measure 5. Energy efficiency education and	-Digital literacy programs: provide targeted training and support programs to improve digital literacy, ensuring that vulnerable groups can understand and benefit from smart energy systems. -Simplified technology options: offer simplified or user-friendly versions of smart technologies for households that may have difficulty navigating more complex systems

			awareness program	
4. Regulatory and policy barriers				
4.1. Insufficient implementation of the policy	Poor enforcement of energy efficiency and renewable energy regulations may lead to delays or noncompliance with targets. Local authorities may not have the capacity to apply modernization standards or ensure compliance with renewable energy uptake policies.	Lack of compliance could reduce the overall effectiveness of measures to reduce energy poverty, leading to incomplete goals and projects.	Measure 1. Energy renovation of multifamily residential buildings Measure 2. Replacement of inefficient heating systems Measure 3. Community solar energy projects Measure 4. Smart energy management systems for vulnerable households Measure 5. Energy efficiency education and awareness program	- Reinforced regulatory framework: Set clear regulatory guidelines and set applicable standards for energy efficiency improvements, renewable energy uptake, and retrofitting projects. Include penalties for non-compliance and incentives for timely implementation. - Capacity building for local authorities: Provide training and resources to local authorities to strengthen their capacity to enforce regulations and ensure compliance with measures to reduce energy poverty.
4.2. Delays in Policy Implementation	Bureaucratic delays in approving policies, distributing funds, or processing permits can slow down the	Delays can erode trust among communities and investors, leading to project cancellations or	Measure 1. Energy renovation of multifamily residential buildings Measure 2. Replacement	- Simplified authorization processes: Simplify permitting processes for retrofit projects and renewable energy installations. Establish early

	implementation of energy efficiency projects and renewable energy initiatives	reduced participation.	of inefficient heating systems Measure 3. Community solar energy projects Measure 4. Smart energy management systems for vulnerable households Measure 5. Energy efficiency education and awareness program	approval mechanisms for initiatives to reduce energy poverty. - Policy coordination: Ensure that national and regional policies are well coordinated and that local authorities have the necessary autonomy to effectively implement energy poverty measures.
5. Barriers to engagement and participation				
5.1. Limited community participation	Some members of the community may not be involved in measures to reduce energy poverty due to lack of awareness or distrust of external interventions.	Without broad community participation, community-based renewable energy projects in particular may fail to scale up or achieve the expected impact.	Measure 4. Smart energy management systems for vulnerable households Measure 5. Energy efficiency education and awareness program	Inclusive participation models: Create inclusive participation models that actively involve communities in decision making. Ensure that vulnerable households are represented in community energy cooperatives and other participatory initiatives. - Trusted local leaders: Engage trusted community

				leaders in communication efforts to build trust and ensure households feel connected to the benefits of the proposed measures.

Source: Authors, 2025

The successful implementation of the Energy Poverty Reduction Plan in the Jiu Valley will require a proactive approach to address the barriers identified in this risk assessment. The key to overcoming these challenges lies in the following:

1. Provide financial assistance to reduce upfront costs for vulnerable households.

2. Strengthening technical capacity through workforce training programs and technical support for local authorities.

3. Engage communities through education, awareness raising, and use of pilot projects to showcase the benefits.

4. Strengthen regulatory frameworks and ensure timely implementation and enforcement of policies.

5. Promoting digital literacy and offering user-friendly technology options to ensure that all households can participate in the energy transition.

Addressing these challenges through targeted strategies, Valea Jiului can successfully implement the proposed measures, reducing energy poverty and facilitating a just and inclusive energy transition for its inhabitants.

7. ADVICE FOR THE PLAN REFINEMENT, IMPLEMENTATION, AND MONITORING

7.1. Monitoring indicators

The successful implementation of the Energy Poverty Reduction Plan requires a robust monitoring framework to track progress, assess effectiveness, and allow adjustments during the implementation process. Table 7 presents key performance indicators (KPIs) in different policy areas and strategic measures to alleviate energy poverty identified in Section 4.

Table 5 Measure-Specific Indicators

policy area	Measure	Indicator	Target

Energy efficiency	Renovation of energy of residential buildings	Number of renovated dwellings	25 000
Energy efficiency	Replacement of inefficient carbon-intensive heating appliances	Number of households with carbon-intensive appliances replaced	10,000
Energy efficiency	Deployment of building-integrated smart energy infrastructure in residential buildings	Number of dwellings equipped with smart meters	20 000
Renewable energy	Establishment of energy communities to produce renewable solar energy	Number of established energy communities	6 (one for each of the 6 target municipalities)
Energy efficiency	Energy efficiency education and awareness program	Number of workshops	6

7.2. Monitoring Mechanism

The success of implementing a plan to reduce energy poverty in the Jiu Valley depends on an effective monitoring and adjustment process. To ensure the relevance and impact of the proposed measures, the following elements are essential:

1. Definition of the reporting process and delivery mechanisms

A standardized reporting process will be established, including the necessary resources and clear responsibilities of the parties involved.

- Each intervention will be accompanied by a detailed roadmap with objectives, concrete actions, timeframes, and associated resources.

2. Clear responsibilities for monitoring and implementation

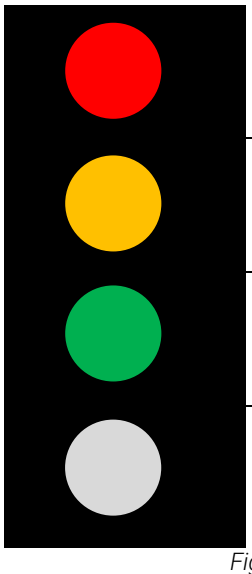
- The Intermediate Authority has overall responsibility for monitoring the plan.

- Hunedoara County Council, representing the regional level, is responsible for coordinating the plan;

The local municipalities of Petrosani, Vulcan, Petrila, Lupeni, Uricani, and Aninoasa will have daily implementation roles for the measures included in the plan.

3. Annual reporting and RAG system

Each municipality will prepare an annual progress report detailing the implementation of the measures and the achievement of the established KPIs. Progress will be assessed using the RAG (Red/Amber/Green) system.



Behind schedule (Significant improvement required to achieve the target)

In progress (Some progress made towards the achievement of the target)

Completed (The target has been met)

Not started

Figure 1 RAG System for Assessment of Progress against Plan Measures

The report will be submitted to the local councils, who will review and ratify the documents. The consolidated findings will then be submitted to the Hunedoara County Council for a review of the overall progress at the regional level and finally to the Intermediate Authority.

4. Involvement of stakeholders

To ensure the relevance of the measures, the continuous participation of all stakeholders is essential.

- Direct beneficiaries of the measures (e.g.: Rehabilitated homeowners, miners, or retrained staff) will provide feedback through surveys, meetings, and public consultations.

- Local institutions and organizations: NGOs, academia, and private sector representatives will help monitor and adjust the plan.

5. Assessment of progress and adjustment of the plan

Local committees on sustainable development, social policies, and the budget will review the reports annually and propose adjustments if necessary.

The consolidated report, prepared at regional level, will be used for further recommendations to municipalities and for adapting measures to changing economic and social circumstances.

6. Collecting feedback

In order to assess the impact of the measures implemented, the following feedback mechanisms will be used:

Formal surveys conducted with vulnerable households and other target groups.

- Public meetings and consultation sessions to identify challenges and suggestions for improvement.

- Informal discussions and direct interactions with stakeholders to gather views and suggestions.

Figure 2 Energy Poverty Alleviation Plan Implementation and Monitoring Process

A robust monitoring system, combined with continuous stakeholder participation and a well-structured feedback mechanism, will ensure that the plan to reduce energy poverty in the Jiu Valley is effectively implemented and remains relevant in the face of socio-economic challenges. This model can serve as an example for other vulnerable regions in Romania.

8. CONCLUSIONS

Energy poverty in the Jiu Valley represents a significant barrier to a fair energy transition. Through better coordinated policies, targeted local interventions and the optimal use of European funds, the region can become a successful model for reducing energy poverty in other vulnerable areas in Romania.

Current national and regional policies are criticized for the lack of specificity and practical details needed to implement the strategic objectives. For example, thermal rehabilitation of dwellings is supported by programs such as the 'Photovoltaic Green

House', but its impact in the Jiu Valley is limited due to bureaucracy and insufficient resources.

Tackling energy poverty in the Jiu Valley requires integrated interventions including extensive thermal rehabilitation, financial support for vulnerable households, economic diversification, and safeguards against energy market liberalization. These measures are essential to protect vulnerable communities and support the just energy transition.

The national and regional policy support frameworks create a solid basis for the Jiu Valley Energy Poverty Reduction Plan. These frameworks facilitate a holistic and integrated approach to addressing energy poverty, combining energy efficiency, the use of renewable energy, social inclusion, and just transition principles. By aligning with Romania's national strategies and the larger climate and energy objectives of the EU, the plan has the potential to effectively reduce energy poverty, contribute to sustainable development and ensure that the most vulnerable communities of the Jiu Valley are not left behind in the transition to a greener economy.

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CONTEXT

This Energy Poverty Alleviation Plan of Jiu Valley Region has been developed in the context of the project JUStice in Transition and EMpowerment against energy poverty (JUSTEM). In the spirit of the EU principle to “leave no one behind” in the transition, JUSTEM addresses the energy transition planning through a double-sided approach: (1) it helps regional authorities to develop ‘just’ energy transition plans that are sensitive to regional impacts such as job losses and energy poverty; and (2) it helps citizens build their capacity and find their place in a greener economy.

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