RePowering the regions

A comparative analysis of decarbonisation strategies in nine central and eastern European countries

CEE Bankwatch Network

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Introduction

'RePower the Regions: Ambitious and inclusive clean energy plans for repowering the just transition regions' is a project that aims to help pioneering just transition regions in central and eastern Europe accelerate the decarbonisation process. Funded by the EU's LIFE programme, the project is being implemented in nine countries: Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Poland, Romania, Slovakia, and Ukraine.

This analysis, which forms part of the project, includes just transition regions in countries currently shifting away from coal (Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovakia, Ukraine), oil shale (Estonia), and peat (Latvia). We have chosen these regions for their unique circumstances, taking into account the initiative they have already shown in driving the energy transformation in central and eastern Europe. These also happen to be regions in which CEE Bankwatch Network has built up extensive experience, creating a solid base for the planned activities.

The project involves contributions from the following Bankwatch member organisations: Friends of the Earth Bulgaria (Za Zemiata), the Centre for Transport and Energy (Centrum pro dopravu a energetiku) in the Czech Republic, the Estonian Green Movement (MTÜ Eesti Roheline Liikumine), the National Society of Conservationists – Friends of the Earth Hungary (Magyar Természetvédők Szövetsége), Green Liberty (Zaļā brīvība) in Latvia, the Polish Green Network (Związek Stowarzyszeń Polska Zielona Sieć), Bankwatch Romania Association (Asociaţia Bankwatch România), Friends of the Earth-CEPA (Priatelia Zeme-CEPA) in Slovakia, and Ecoaction in Ukraine.

Each non-governmental organisation has commissioned at least one study from national or local experts. These regional studies aim to enhance knowledge of decarbonisation pathways, develop a better understanding of energy transformation solutions, explore ways of unlocking EU funding mechanisms, and share best governance practices for inclusive, just and sustainable local and regional clean energy.

Research was conducted on the ground, engaging with relevant stakeholders to provide a detailed picture of the current situation in these areas. The methodology used is diverse and comprehensive, involving the collection of primary and secondary data, performing qualitative and quantitative analyses, mapping the locations of relevant stakeholders, identifying their needs, and evaluating their approaches to decarbonisation. All nine research papers are available on the RePower the Regions website.[1]

We also provide a comprehensive overview of ongoing efforts to plan decarbonisation and meet climate neutrality goals in these regions. We evaluate whether current strategies and plans reflect the ambitious targets set by EU legislation and initiatives, while considering the unique geographical, societal and political contexts of each country. The regional studies identify the key groups involved in the transition process, their specific needs, their current stage of decarbonisation planning, and assess their readiness to drive the process forward. The research topics were selected in collaboration with local stakeholders, including public administration officials, through consultations and discussions organised by Bankwatch member groups in each municipality.

[1] CEE Bankwatch Network, RePower the Regions: Ambitious and inclusive clean energy plans for repowering the just transition regions, *CEE Bankwatch Network*, accessed 10 December 2024.

District heating emerged as a primary decarbonisation issue in five countries: Bulgaria, Slovakia, Czech Republic, Ukraine, and Romania. Many communities in these countries still rely on centralised heating systems powered by fossil fuels, which is exacerbated by the excess heat wasted by energy plants in these countries' coal regions. While individual heating systems offer an alternative solution, they come with many drawbacks, prompting local municipalities to find ways of decarbonising their existing district heating systems or develop new systems in underserved areas. Historically, families in the region that have transitioned from centralised to individual heating systems have been left without adequate heating due to financial constraints. In some municipalities, especially smaller and more rural ones, district heating was never even developed. For this reason, some of our research specifically focuses on the challenges of household heating and improving energy efficiency, especially in Poland.

We also explore the development of energy communities in two countries: Estonia and Hungary. We investigate how potential investments in energy efficiency projects, particularly for the ageing housing stock, can be doubled. Additionally, we highlight the untapped potential for harnessing solar power from private and public buildings. Finally, in Latvia, we focus on proposed interventions prioritising sustainable public transport as well as alternative modes like cycling which would significantly improve transport in rural areas.

Bulgaria

Pernik, located in the west of the country, has a population of about 70,000 people, making it one of the largest towns in Bulgaria. Its proximity to Sofia also makes it a popular residential area for people working in the capital. Often referred to as the birthplace of Bulgarian mining, Pernik boasts a rich mining history, and it was here that the first electric light bulb in Bulgaria was illuminated.

While mining transformed the original small settlement into a major urban centre, the industry's decline in the 1990s, culminating in the closure of the last mine in 2009, left Pernik as a symbol of the region's unjust transition. The current local authorities are committed to a just transition and are open to sustainable projects that promote green energy. However, challenges persist, particularly from conservative forces like TPP Republika, a major polluter and privately owned district heating company that has shown little interest in decarbonisation.

This study focuses on Tsarkva, a 1,148-hectare neighbourhood in Pernik with an estimated population of 6,771 living mostly in single-family and two-family homes.

The neighbourhood of Tsarkva is located within the wider urban area of Pernik (photo credit: Petar Kamburov).

Current situation

The main environmental concern for Tsarkva is the pollution emanating from its district heating plant. Owned by Bulgarian energy oligarch Hristo Kovachki, the privately operated facility is notorious for its poor condition and frequent outages. TPP Republika, the company responsible for the plant, has shown no interest in decarbonisation and continues to absent itself from just transition discussions. Its lack of

investment and commitment raises concerns about the future of the plant, with fears of a potential closure without a viable alternative.

Yet there is room for hope as Tsarkva is not connected to the district heating system, giving the neighbourhood a unique opportunity to demonstrate the potential of renewable energy sources for community benefit.

Who is working to address these challenges?

The municipality of Pernik is at the forefront of efforts to address these challenges. They have partnered with Friends of the Earth Bulgaria to sign a memorandum of understanding, committing to promoting renewable energy alternatives in the region.

Friends of the Earth, alongside the Black Sea Energy Research Centre, is actively exploring renewable district heating solutions for Tsarkva. Meanwhile, Greenpeace Bulgaria has been a vocal critic of TPP Republika, campaigning for the closure of the coal power plant and exposing Kovachki's practices. The World Wildlife Fund has also contributed to the region's just transition efforts, organising youth assemblies to discuss environmental issues.

Challenges with data collection

Data collection for this project has been a significant challenge, as not all necessary information is readily available in national and municipal documents. As a result, researchers have had to rely on a combination of map analysis and calculations based on their own field research in Tsarkva to gather the required data.

Who will benefit from the intervention?

The residents of Tsarkva stand to gain significantly from the implementation of renewable heating and cooling solutions, as well as renewable electricity generation. The municipality of Pernik could also reap the benefits of establishing an energy community involving public buildings in the area. Beyond the immediate impact on Tsarkva, a wider positive effect is expected as reduced reliance on hard fuels like wood and coal for heating will lead to decreased air pollution in the region.

The local preschool in Tsarkva (photo: Petar Kamburov).

Proposed solutions

Six potential scenarios were considered for renewable energy solutions in Tsarkva:

1. Biomass: Discarded due to air pollution concerns and low efficiency.
2. Geothermal energy: High potential, particularly when combined with solar photovoltaic and thermosolar systems for optimal heating and cooling.
3. Waste heat from industry: Leveraging waste heat from Stomana Industry, a Pernik-based steel company, could provide 3 to 4 megawatts (MW) of energy for heating and hot water.
4. Solar energy: Solar panels can be used for both hot water production and electricity generation.
5. Heat pumps and solar energy: A combination of solar panels and heat pumps is the preferred scenario, offering significant economic and environmental benefits.
6. Wind power and heat pumps: Low potential due to the area's wind conditions.

Heat pumps and solar energy are the preferred solution

Economic impacts

The implementation of solar water heating systems in the domestic sector would result in annual savings of approximately EUR 796 514, equivalent to EUR 118 per resident. If the full energy potential of photovoltaic installations is used, less than half (47.2 per cent) of the electricity produced would be required to cover heat pump installations. The remaining electricity could be fed into the grid, generating an additional annual income of around EUR 1.08 million.

With a domestic electricity price of BGN 0.237 per kilowatt hour (kWh), the potential annual electricity cost savings amount to just over EUR 2 million, with residential buildings contributing the lion’s share at 96.9 per cent. This translates to electricity savings of EUR 296 per resident in the village.

Environmental impacts

The adoption of renewable energy systems would result in a significant reduction in carbon dioxide (CO_2) emissions, totalling 19,000 tonnes per year. The breakdown of emission reductions is as follows:

- Heating from photovoltaic sources would cut emissions by 3,195 tonnes of CO_2 annually.
- Heat pump installations would reduce emissions by 4,397 tonnes of CO_2 per year.
- Photovoltaic energy production would further decrease emissions by 8,273 tonnes of CO_2 annually.

Estonia

Ida-Virumaa, one of fifteen counties in Estonia, is situated in the northeast of the country on the Russian border. Spanning an area of just under 3,000 square kilometres (km^2), Ida-Virumaa occupies 6.5 per cent of Estonia's total land mass. It is among the most urbanised regions in the country, hosting 3 of Estonia's 10 largest cities: Narva, Kohtla-Järve, and Sillamäe. The administrative centre of the county, Jõhvi, located in the north, lies 165 km from Tallinn.

According to the 2021 Estonian census, the county had a population of 132,741. Of this, 26.2 per cent (34,837 people) were aged 65 and over, while 12.9 per cent (17,090 people) were under 14. The county faces an unfavourable demographic situation, mirroring national trends. On 1 January 2006, the population stood at 173,777, of which number 44.8 per cent were male and 55.2 per cent female. However, a negative natural population increase has been persistent. In 2005, the birth rate was 9.4 per cent, while the death rate was 15.3 per cent, resulting in a net decrease of 5.9 per cent. The population has continued to decline steadily in recent years. On 1 January 2015, the population was 144,941, decreasing to 132,741 by 1 January 2022. The largest declines were observed in the rural municipalities of Lüganuse and Alutaguse.

A distinctive feature of the county is the predominance of citizens of Russian descent and Russian-speaking residents. The 2021 census reported that 73.3 per cent (97,231 people) of the county's population were of Russian descent, while 18.5 per cent (24,490 people) identified as Estonian. The regional economy is primarily based on the extraction and processing of oil shale, the production of electricity and thermal energy, and the chemical industry.

A quiet street lined with historic buildings in Narva, Ida-Virumaa (photo: Kertu Laherand).

Current situation

Ida-Virumaa's outdated energy supply system, reliant on the combustion of fossil fuels (mainly oil shale), is in urgent need of replacing. Considering the available technologies and their potential applications, one highly promising solution is the production of green energy within the framework of energy communities.

The housing stock and associated infrastructure are ageing. Unfortunately, only minimal progress has been made in bringing new housing into use or modernising existing buildings. As a result, energy efficiency and energy communities have become hot topics that need to be incorporated within the future provision of the regional energy supply and the organisation of local energy production.

Implementing such solutions offers substantial benefits, including the ability to generate energy independently, ensuring energy security and sovereignty, and providing various economic advantages. These measures also reduce the burden on distribution networks, minimise losses associated with their use, and consequently lower the energy generation required. Collectively, these improvements lessen negative impacts on the environment.

What progress has been made and who is working to address the problem?

Estonian Green Movement is dedicated to ensuring that the just transition process is equitable from both environmental and social perspectives. Research supporting this effort, commissioned by the Estonian Green Movement, was conducted by the Virumaa Innovation Centre of Digitalisation and Green Technologies (ViruTech).

Currently, one pilot project involving an energy community in Alutaguse has been launched. Additionally, several outreach and engagement events have been held, and preparations are underway to launch more pilot projects. However, there are not yet any established good practices to draw upon from the region.

The study included all potentially interested parties. Interviews were conducted with representatives from local governments and all county municipalities, as well as public sector organisations, regional cooperation and support organisations, and non-profit communities promoting regional development. Private sector stakeholders were also involved, including enterprises with potential for implementing renewable technologies, energy network enterprises, cooperative housing associations, horticultural cooperatives, and other non-profit organisations related to shared real estate usage. The research encompassed all areas within Ida-Virumaa.

Challenges with data collection

The data was collected through all available means. Official requests were sent to all relevant organisations, enterprises, and institutions. Both working and final versions of previous studies conducted in the region were analysed. The data collection process also involved an extensive search for available information on the internet and within research and educational institutions. Additionally, more in-depth information was gathered through interviews with the stakeholders and through market research.

The limited number of relevant studies and the low level of interest from several individuals, organisations, and companies in participating in the study posed challenges in gathering data. However, representatives from local governments and public sector organisations were the most engaged participants in the process.

Main social issues

The region is facing a number of serious social issues, including:

- an ageing population and population decline caused by outmigration and a low birth rate;
- relative poverty among both the population and municipalities;
- poor Estonian language skills;
- low levels of business and social activity;
- limited awareness among residents about renewable energy and community energy; and
- low levels of cooperation among residents.

In addition, a significant part of the population has been employed in the oil shale sector and the shrinking of the industry has aggravated these problems. As a result, there is a pressing social need to identify alternative economic activities to replace the region's previous main sources of income.

Proposed technical solutions and community support

As part of the research, three solar panel capacity variants for energy communities were analysed. The selection was made based on the readiness of technologies, the state of the market and infrastructure, as well as the limitations and challenges posed by the region's specific characteristics.

In addition to solar panels, other technologies under consideration include vertical wind turbines, solar collectors, geothermal heat systems, alternative energy storage devices for electricity (such as gravitational and mechanical storage), heat storage solutions, and hydroelectric technologies.

The preferred option is determined on a case-by-case basis, taking into account the following scenarios:

- the available grid connection power;
- the available area for a solar panel park and its characteristics;
- the consumption needs of the developer;
- the financial resources available; and
- organisational and legal restrictions or opportunities, as well as external restrictions, such as those at the national level.

Our research clearly showed that general awareness of renewable energy and community energy among residents is low. There is a significant amount of prejudice and mistrust, with some people still believing that oil shale is the only reliable energy source, due to the fact that many have worked in the industry.

Additionally, poor proficiency in the Estonian language hinders access to relevant information. The county also faces several restrictions that obstruct the installation of solar panels or wind turbines. As a border area, national defence restrictions are a key obstacle, and the existing electricity infrastructure is insufficient to accommodate new connections in many locations.

Therefore, it is important to increase general awareness among the residents of possible solutions and support community actions to develop positive experiences and examples.

Recommendations for Ida-Virumaa

- Prioritise the topic of community energy at the county level, given that no concrete actions have been taken despite county development plans highlighting its importance.
- Develop support measures for energy communities, creating positive examples in the county and making them widely known.
- Agree on and develop an organisational county support structure to support community energy activities, offer advice, and prepare instruction materials.
- Launch regular outreach activities in both Estonian and Russian, and develop and implement a corresponding communication and action plan.

How residents will benefit from energy communities

The residents of Ida-Virumaa stand to benefit significantly from the development of energy communities, with the proposed scenarios largely yielding positive impacts, although some negative effects may also arise. Local communities may benefit from:

- producing their own green renewable energy, which would replace energy derived from fossil fuels;
- reducing losses in heat and power networks;
- lowering network investment requirements by prioritising local or on-site renewable energy production; and
- fostering a culture of rational energy use

By generating their own energy, communities in Ida-Virumaa can achieve greater energy security, including in emergency situations, while reducing their dependence on fluctuating energy prices with the potential for profit. Making the switch would enhance quality of life, lower costs, and ensure a reliable energy supply. These initiatives would also help attract attention and improve the community's image.

Slovakia

Located in Slovakia's Upper Nitra region, Partizánske is a town with approximately 20,000 inhabitants. The region has a rich mining history associated with the extraction and processing of brown coal, which has left significant negative environmental impacts. The town is part of a region undergoing a just transition. Like many Slovak towns, Partizánske faces the challenge of outdated district heating infrastructure.

Availing of opportunities offered by the Just Transition Fund and other financing options, the town plans to reconstruct its system into a modern, decarbonised fourth-generation system. The goal is to improve the quality of life for residents and contribute to a cleaner environment. By decarbonising its heating system, Partizánske aims to reduce emissions and serve as an example for other towns in the region. Taking this step will likely contribute to a sustainable future for Upper Nitra and serve to redress the negative effects of its coal-mining past.

Energy efficiency renovations in Partizánske (photo: Vanda Mesiariková).

Current situation

Like many other towns in the region, Partizánske is burdened with a significant modernisation debt. Its existing district heating system has become uncompetitive, a situation exacerbated by the tendency for consumers to disconnect from the central system. However, the energy crisis that began in 2022 demonstrated that district heating systems can protect consumers more effectively. Recognising the benefits of district heating, Partizánske decided to address the current state of its district heating system by setting a goal to develop a carbon-free system that aligns with the EU's green policies.

Historically, district heating has been one of the main causes of emissions in the town. The decision to modernise the system will bring substantial benefits not only for the environment but also for residents, offering stable and predictable heat prices. Additionally, since the town has full control over the heating

system, it can choose the most suitable path from all perspectives without focusing solely on the economic aspect of the intervention.

What progress has been made?

The current district heating system is highly decentralised, consisting of several separate circuits and over two dozen individual boiler rooms. Many of these are at the end of their life cycle. As the administrator, the town is now faced with the arduous task of modernising its heating plants. Regrettably, previous reconstructions and repairs were conducted based on incoherent plans that failed to consider future environmental requirements and largely ignored sustainable heat sources.

Although the town's outdated and non-functional gas plants were replaced with more efficient facilities, the plans contained no measures for the future use of heat pumps, leftover heat from industry, or sustainable renewable heat sources such as solar thermal or geothermal.

Old and new heating distribution systems in Partizánske (photo: Vanda Mesiariková).

Who is working to solve this problem?

The Slovak non-governmental organisation Friends of the Earth–CEPA is the driving force behind the reconstruction of the district heating system. After presenting the issue to local town representatives and organisations, employees of the local authority joined the effort, bolstered by strong support from the town's leadership. The project has also received backing from rank-and-file employees in the town, which

should accelerate progress. Through the Just Transition Fund, scientific institutions have been brought on board to conduct the research needed to steer the project to a successful outcome. Friends of the Earth have also been instrumental in establishing a professional working group comprising town council members and representatives from the business sector. This broad collaboration is expected to enhance public acceptance and mitigate risks of unforeseen obstacles, including potential protests from the public and private sectors.

Issues with data collection

Data collection poses a significant challenge. In post-Soviet countries, district heating systems are often more than 50 years old, representing a considerable modernisation deficit. Before the energy crisis in 2022, there was little emphasis on data collection or evaluation for system optimisation. As a result, data on these systems is scarce, outdated, and in non-digital formats. Consequently, archives need to be consulted, digitised, and organised to make them useful for future work. Given the incomplete data, this study has had to partly rely on qualified estimates.

Main social issues

Slovakia's energy sector is currently struggling with an ageing workforce, an issue that particularly affects municipally owned companies. A significant problem is the loss of continuity in transferring information and expertise on heating systems, which is exacerbated by low levels of digitisation. As a result, employees lack information, reducing their motivation to make informed decisions or accept responsibility, which leads to further stagnation and leaves the sector in an unattractive light.

This situation is compounded by a lack of funds available to towns and municipalities, mainly because the public sector cannot financially compete with the private sector for skilled professionals. Another factor affecting the efficiency of heating companies is overstaffing, due to outdated technology and a low degree of process automation.

Who is affected and who will benefit from the intervention?

The reconstruction will impact heat production and operations, affecting every consumer in the town. During the construction phase, residents are likely to experience temporary inconveniences, such as disruptions in public spaces due to pipeline reconstruction. However, despite these short-term challenges, the project promises to benefit residents in the long run, including providing a more pleasant living environment.

Additionally, the new heating system will combine different energy sources, resulting in more predictable and stable bills for consumers. The production process will also improve, becoming less dependent on human factors and allowing employees to focus more on developmental projects rather than just operational activities and maintenance.

Proposed technical solution

The preferred solution is to transform the existing decentralised system into a modern, low-temperature, centralised fourth-generation system. This will require the integration of separate heating circuits into a

single unit, enabling energy transfer between sources based on current production efficiency. A key advantage is the existence of two geothermal wells, which will be integrated into the district heating system to increase the share of renewable heat sources. However, as the water temperature from the wells alone is insufficient, heat pumps will also be required.

To achieve maximum efficiency, various types of heat pumps will need to be thoroughly evaluated. Additionally, due to the diverse heat sources, which will include geothermal and wastewater heart, the value of heat accumulation solutions such as storage tanks will need to be assessed.

There will be a significant focus on utilising waste heat from wastewater treatment plants and industrial and commercial operations, as well as harnessing solar energy through photovoltaic power plants or thermal solar fields. To this end, a former landfill site, which has limited alternative legal uses, is expected to be repurposed for the construction of a solar farm. Local experts are currently collaborating with experts from the European Investment Bank to identify the most effective solution before deciding on the final scenario.

The result will be a largely decarbonised system, mainly powered by geothermal energy (involving the recovery of gases and reinjection of water), waste heat, solar energy and, as a last resort, secondary forest biomass. Existing fossil gas boilers will be replaced with decarbonised sources as soon as practically possible. Until then, they will only be used as a backup in unforeseen situations.

Inspecting equipment at the heat exchanger station in Šipok, Partizánske (photo: Vanda Mesiariková).

Economic and social impacts of the proposed solution

The proposed solution offers both positive and negative economic impacts. On the one hand, it will affect the turnover of the technical services company tasked with implementing the project and, by extension, the local economy as a whole. On the other hand, it will impact consumers through changes in heat pricing. All variants of the proposed solution entail significant financial demands, which will inevitably have a sizeable economic effect. However, these challenges can be addressed through the use of non-repayable financial sources, such as the Modernisation Fund and other EU funding channels, which would cover a substantial portion of the costs.

To address the potential negative impact on heat prices, the proposal focuses on improving efficiency through targeted investments. Connecting networks and constructing new pipelines will reduce thermal losses, which, in turn, will lower heat production costs. Although these systems involve multi-million-euro investments, the long-term nature of the project – spanning 30 years or more – means that expenses will be gradually amortised, making them a small fraction of the overall costs.

The introduction of geothermal energy will provide an opportunity to utilise cost-effective energy, creating space for price reductions. These savings will help offset the necessary investments in heat pump technologies required for geothermal energy. Similarly, using waste heat will involve high initial costs, but the ability to produce and supply cheaper heat will balance out these investments.

Photovoltaic power plants, when co-financed, significantly contribute to reducing heat prices. However, in the case of Partizánske, there is a risk that the availability of support schemes for photovoltaic installations will be limited. In this event, the town's financial resources would come under significant pressure, potentially increasing its debt burden.

Environmental impacts of the proposed solution

Each of the proposed scenarios has a significantly positive impact on the environment, as they largely replace fossil gas with cleaner energy forms, including geothermal energy, residual wastewater heat, and output from heat pumps. The existing biomass boiler, which burns secondary biomass to meet peak demand and add flexibility, comes with major disadvantages, including air pollution and carbon dioxide emissions.

As energy efficiency in buildings improves and other cost-effective heating technologies become available, biomass should be phased out of the system. Solar photovoltaic fields, which provide the cleanest forms of heat and electrical energy, will play a key role in bringing about the complete decarbonisation of the heating system. Lastly, measures to reduce consumption among consumers will also drive the elimination of system emissions.

Czech Republic

Jiříkov is a town located in the Ústecký coal region near the German border. In the 1830s, the first textile and engineering factories in the region were established, leading to a period of massive industrialisation and economic growth. The area experienced its greatest development at the turn of the 19th and 20th centuries when the population reached 10,000. However, the 20th century ushered in several challenges, including the economic crisis of the 1930s and the subsequent removal of the German population. These events led to long-lasting economic and social problems, the consequences of which have persisted for decades.

The town hall in Jiříkov (photo: Zuzana Vondrová).

Current situation

The town of Jiříkov, with a population of approximately 3,500, currently meets its heat demand through gas and solid-fuel boilers. For electricity, the town relies almost entirely on central sources within the regular distribution network.

The total electricity consumption in selected municipal buildings is 205 megawatt hours (MWh) per year, with fossil gas consumption amounting to approximately 1,010 MWh annually. However, these figures reflect metered consumption only, as the city lacks records of energy usage in residential units. The calculated heat demand for the selected municipal buildings is approximately 5,300 gigajoules (GJ).

Jiříkov is not currently connected to a centralised heating system, and most of its buildings rely on local boilers, primarily powered by fossil gas, with some using solid fuels and electricity. The trends in electricity and gas consumption are relatively stable, with a slight decline in fossil gas use.

Proposed technical solutions

The viability of any investment in district heating depends on maintaining a competitive heat price for end users, ensuring they are not incentivised to switch to separate, off-grid heat sources. Currently, this competitive threshold is around CZK 1,000 per GJ excluding value added tax.

However, all of the proposed options modelled for end-consumer prices exceeded this threshold. Consequently, subsidies will likely be required to make the district heating system competitive with conventional sources like fossil gas boilers. This financial constraint has significantly influenced the selection of energy sources considered in the study. The following options were evaluated:

1. a biomass gasification unit;
2. a combined heat and power (CHP) unit running on bio-liquefied natural gas (bioLNG);
3. a ground/water heat pump;
4. a ground/water heat pump with a fossil gas CHP unit; and
5. a mobile biogas plant with a cogeneration unit.

All proposed variants envisage the installation of a photovoltaic system, with an installed capacity of 100 kilowatt peak (kWp) for variants 1, 2, and 5, and 120 kWp for variants 3 and 4. The electricity generated by these systems would primarily serve the energy needs of selected municipal buildings and the central heat supply network, forming an integrated energy community.

From Bankwatch's perspective, not all of the proposed energy sources meet sustainability criteria. Option 4, which involves the construction of a fossil gas CHP unit, is unacceptable due to its reliance on fossil fuels. The acceptability of options 1, 2, and 5 is contingent on the use of locally sourced feedstock derived solely from residues. These options must explicitly avoid using primary biomass or crops grown specifically for energy production, as this could undermine sustainability goals.

Additionally, the energy demands associated with the liquefaction process for bioLNG (liquefied biomethane) raise concerns about the overall energy intensity and efficiency of this option. For option 5, the feasibility of a biogas plant depends heavily on the town's ability to source vegetable and kitchen waste at minimal or no cost. Without access to low-cost feedstock, this option would likely become economically unviable.

The source options proposed were further modelled using three potential system sizes, all of which represent relatively small-scale and limited district heating systems:

1. Central heat supply network (maximum)
    - Largest variant spanning a total of 15 sites
    - Total length of heating pipeline: 1,350 metres
2. Central heat supply network (variant A)

- Smallest variant serving only buildings near the town's primary school
- Total length of heating pipeline: 420 metres

3. Central heat supply network (variant B)
    - Mid-sized variant balancing the two options above
    - Total length of heating pipeline: 900 metres

Given the wide variety of advantages and disadvantages associated with each technology and configuration, the study does not identify a single most suitable option. Instead, it provides an overview of each scenario, leaving the ultimate decision to the preferences and capabilities of the investor.

Romania

Petroşani, one of six cities in the Jiu Valley region of Hunedoara, Romania, is undergoing a just transition away from its coal-based economy. As of 2021, it is the most populous municipality in the region, with over 30,000 residents.

In 2018, a total of 2,265 apartments were connected to the city's thermal energy distribution network, along with 33 individual households, 11 public institutions, and 187 businesses. Thermal energy distribution involved the use of 33 heat distribution nodes with a total installed capacity of 78.18 gigacalories (Gcal) per hour, divided into 68.15 Gcal for heating and 10.03 Gcal for hot water. The distribution network spanned 54,804 metres.

Thermal energy had been supplied by Termoficare, a local district heating company that sourced energy from the Paroşeni power plant. However, due to accumulated debts, the company became insolvent, leading to a significant reduction in thermal energy distribution. As a result, many residents have transitioned to alternative energy sources, primarily fossil gas, installing individual gas boilers.

A mine-turned-museum in the town of Petrila, about 10 km northeast of Petroşani (photo: Eliza Barnea).

Current situation

The major issue facing Petroşani's population is energy poverty, specifically the affordability and accessibility of heating energy. This challenge stems from the decline of the centralised thermal system, an ageing housing stock, and a lack of new developments.

Energy efficiency interventions are needed to address these issues by reducing energy consumption and costs, making heating more affordable and sustainable for residents in the long term. This situation has been driven by a number of factors.

Decline in centralised heating services

Ever since Termoficare went out of business, thermal energy distribution in Petroșani has significantly declined. As centralised heating services diminished, residents were compelled to seek alternative sources, predominantly through individual fossil gas-fired heating systems.

This transition highlights an ongoing struggle for affordable and stable heating solutions, with consumers becoming increasingly dependent on alternative, unsustainable energy sources that may not be accessible or cost-effective for all residents.

Ageing infrastructure

Most of the housing stock in Petroșani is old and inefficient in terms of energy use, with very few residential developments coming to market in recent years. Between 2015 and 2019, only 57 building permits were issued, with just 3 for collective residential buildings.

There was a peak in new housing in 2016 with 16 units, followed by a decrease to only 5 in 2018, underscoring the near-static nature of the housing stock with minimal upgrades. The ageing infrastructure of these buildings also contributes to energy inefficiencies, causing higher energy and heating costs and exacerbating energy poverty.

High energy demand and limited efficiency

The residential buildings in Petroșani occupy a collective living area of 806,334 cubic metres (m^3). This substantial coverage is mostly taken up by privately owned properties (791,663 m^3). However, without significant renovations or retrofitting, these extensive residential spaces incur high heating costs, especially in an environment where centralised, affordable heating solutions are no longer widely available.

Recognising the urgent need to improve energy efficiency in residential buildings, the municipality has launched a number of projects funded by the 2014–2020 Regional Operational Programme. These initiatives have sought to reduce the financial burden on residents by improving insulation, window quality, and other energy-saving measures.

Vulnerability to energy poverty

With the current shift to more expensive and individual heating systems, the population of Petroșani is at elevated risk of energy poverty, a condition in which households are unable to afford necessary energy services, impacting their overall quality of life and well-being.

This limited access to affordable energy resources, coupled with financial challenges and a low rate of new energy-efficient building projects, compounds the vulnerability of Petroșani's residents to this form of poverty.

Ageing apartment buildings in Petroșani (photo credit: Eliza Barnea).

What progress has been made?

Progress on heating has been limited, with residents still lacking access to district heating systems. For energy efficiency improvements in the residential sector, local authorities have utilised various financing sources to enhance household energy efficiency. These efforts have been supported by funding mechanisms such as the EU's 2014–2020 financing package, the Recovery and Resilience Facility, and the 2021–2027 Regional Operational Programme.

Both Petroșani and Romania as a whole have primarily relied on temporary financial support, such as heating aid, which has impeded progress on mitigating energy poverty over the long term. These measures provide only short-term relief and fail to tackle the underlying causes of energy poverty.

Complicating matters, national legislation remains insufficient and lacks effective tools to identify vulnerable households and implement targeted support measures or financing schemes. Consequently, the absence of a more comprehensive legal framework has made it challenging to address this issue effectively.

Who is working to address these issues?

The mayor's office and its affiliated institutions have been actively supporting the research proposed by Bankwatch Romania, recognising the significant potential to boost energy efficiency investments. By focusing on energy poverty, they aim to gain a deeper understanding of the local situation and prioritise investments for those most vulnerable.

Local non-governmental organisations and homeowners' associations have also been involved in the discussions, offering a grassroots perspective on energy poverty and energy efficiency challenges. Their input is helping shape more targeted investments and solutions to address identified bottlenecks. Some

organisations have even proposed solutions for energy independence, such as the creation of energy communities.

Problems with data collection

Bankwatch Romania sought support from the mayor's office for data collection, a process that took longer than anticipated. The information we requested was eventually gathered and is currently under assessment, which will hopefully allow the analysis to move forward. The delays were mostly due to the considerable work required of city hall employees to compile the necessary datasets.

The situation highlights the municipality's limited administrative capacity and underscores the absence of a coordinated effort to fully examine the factors influencing energy poverty. In addition, it reflects the lack of centralised data on this pressing issue.

Proposed solutions

The municipality is considering three potential solutions for implementing heat pumps in Petroșani:

- a decentralised heating system involving the installation of ground-source heat pumps at the apartment building level;
- a semi-centralised heating system involving the installation of ground-source heat pumps at district heating points; and
- a centralised heating system involving the installation of water-source heat pumps at the municipal level.

The following three configurations were evaluated for each solution:

1. heat pumps only;
2. heat pumps combined with solar panels; and
3. heat pumps, solar panels, and batteries.

Decentralised heating system

Under the first solution, district heating would not be an option given that each residential building would be equipped with its own ground-source heat pump. The heat collector system would utilise deep vertical tubes, with depths ranging from 100 to 200 metres.

For estimation purposes, a typical building was considered to consist of 36 apartments, each with a 50 m^2 area, giving a total of five storeys, including the ground floor. Based on these figures, the roof area would cover 360 m^2. Of this total area, 70 per cent (252 m^2) would be suitable for installing solar panels. With an average power output of 200 watts (W) per m^2, the total installed power of the solar panels would be 50.4 kW. One of the most challenging aspects of this solution is determining the amount of land required for installing the collector tubes.

Semi-centralised heating system

The second solution would involve installing a ground-source heat pump at each of Petroşani's 33 heat distribution nodes. Based on publicly available information, an assessment of these nodes has already been conducted.

The capacity of each heat pump was calculated by multiplying the required capacity per apartment by the number of apartments potentially connected to the respective heat distribution node. Each pump was also oversized to compensate for energy losses in the associated network, excluding losses within the heat distribution node itself, as many of the installations causing these losses are assumed to become redundant.

Network losses vary significantly, from as low as 1.18 per cent to as high as 64.11 per cent across the nodes. The analysis determined that the total number of apartments potentially connected to all 33 heat distribution nodes is 10,908, representing around 84 per cent of all apartments in Petroşani.

In comparison, under the decentralised scenario, all 13,000 apartments in the city could be served by heat pumps. However, the semi-centralised scenario would only cover 83.7 per cent of apartments unless significant modifications are made to the existing district heating network structure.

Centralised heating system

The third solution would involve installing a large-capacity water-source heat pump capable of generating sufficient heat to serve all 10,908 apartments potentially connected to the heat distribution nodes.

This assumes that both the primary and secondary networks from the city's main supply point to the heat distribution nodes, as well as the nodes themselves, are operational and in good condition.

Economic impacts of the proposed solutions

The decentralised heating system, relying solely on heat pumps, represents the option with the lowest initial investment—approximately EUR 57 million at the municipal level. These investment costs exclude real estate expenses, such as land acquisition, concessions, and leases, and other associated costs, including feasibility studies and required approvals.

Implementing a heat pump in an unrenovated building – classified as energy performance class E – results in a 27 per cent reduction in annual costs compared to the initial baseline. For renovated buildings, the reduction increases slightly to 28 per cent.

When solar panels are added to the system, annual cost reductions rise to 45 per cent for unrenovated buildings and 56 per cent for renovated ones. If batteries are also included, the reductions further improve to 47 per cent for unrenovated buildings and 58 per cent for renovated buildings. Similar analyses for all three solutions are summarised in the table below:

	Decentralised heating system	Semi-centralised heating system	Centralised heating system
Heat pumps	EUR 57 million	EUR 82 million	EUR 69 million
Heat pumps and photovoltaics	EUR 85 million	EUR 107 million	EUR 94 million
Heat pumps, photovoltaics and batteries	EUR 129 million	EUR 134 million	EUR 125 million

Environmental impacts of the proposed solutions

The reduction in emissions was calculated as the percentage reduction from the reference point of 55,131 annual tonnes of CO_2 for the municipality of Petroşani.

	Decentralised heating system	Semi-centralised heating system	Centralised heating system
Heat pumps	75%	76%	58%
Heat pumps and photovoltaics	83%	83%	64%
Heat pumps, photovoltaics and batteries	85%	84%	66%

The decentralised heating system would lead to the largest reduction in emissions, particularly when heat pumps, photovoltaic panels, and batteries are all implemented together, resulting in an 85 per cent reduction in emissions.

Note that the source of emissions associated with the operation of the heat pump is estimated based on the carbon footprint of electricity from the national grid. For this calculation, a value of 333 kilogrammes of carbon dioxide per megawatt hour (kg CO_2/MWh) was used, reflecting Romania's energy mix in 2020.

Hungary

Miskolc is the fourth-largest city in Hungary and the administrative centre of Borsod–Abaúj–Zemplén, a county in northeastern Hungary. Miskolc is also the largest city and an important industrial centre in the Northern Hungary region. However, with the decline of socialist-era industrialisation, coal mining and iron metallurgy ceased in Miskolc and its surrounding areas. Since the 1990s, the city's population has decreased by more than 50,000 and now stands at around 144,000, continuing to decline due to an ageing population and migration. This considerable drop in numbers, coupled with Miskolc's poor socio-economic status, stem from the city's long-standing failure to implement industrial restructuring.

Current situation

In the city, especially in the Kilian and Bulgárföld districts – the main focus of the study – many residents are retirees or energy-poor families who cannot afford energy-saving measures or renewable energy investments on their own. However, several non-governmental organisations active in the area are making efforts to improve the situation. Additionally, various state-owned and state-run local institutions as well as energy providers, such as MIHŐ (district heating), MVM (electricity), and Opus Tigáz (gas), are exploring energy development opportunities, including energy-saving measures under Hungary's Energy Efficiency Obligation Scheme.

As part of the EU Missions platform, Miskolc is one of 100 EU cities that has committed to becoming a climate-neutral and smart city by 2030. As part of the recently launched CoolMiskolc programme, various stakeholders have proposed the idea of establishing community energy schemes, demonstrating that the city and its partners are open to planning and supporting community energy projects.

What progress has been made and who is working to address the issue?

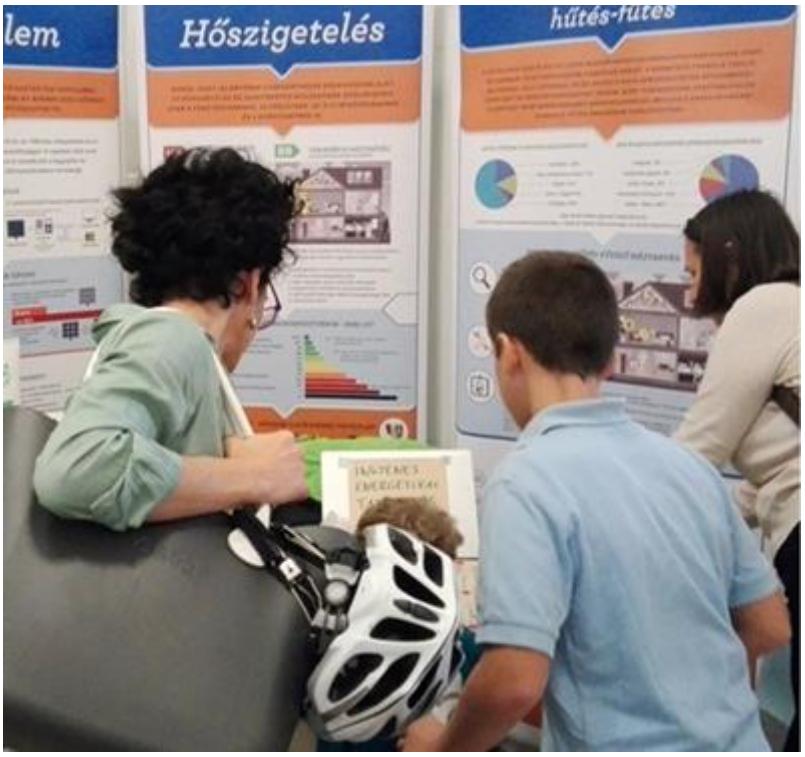
Experts reviewed and consolidated information obtained from existing Miskolc-related plans, including the CoolMiskolc programme. This process was supported by working groups involving the National Society of Conservationists – Friends of the Earth Hungary (Magyar Természetvédők Szövetsége) and other expert contributors, resulting in several recommendation documents. Under the CoolMiskolc programme, local communities, citizens, businesses, institutions, and non-governmental organisations in Miskolc have pledged their support to help Miskolc achieve climate neutrality.[2] In March 2024, the National Society of Conservationists signed a climate contract agreement with Miskolc municipality. This agreement involves 2 studies and 16 events as part of the LIFE RePower the Regions project. Miskolc has also published a sustainable energy and climate action plan and a climate adaptation plan.

Unfortunately, much of the data in the Miskolc plans is unreliable, outdated and lacking in granular detail. To gather more comprehensive information, the study experts directly engaged with three local target groups from the Kilian and Bulgárföld districts: residents, institutions, and small and medium-sized enterprises. This achievement was made possible through the active involvement of:

[2] Miskolc Municipality, Városi Klímaszerződés 2024, *Miskolc Municipality*, 14 March 2024.

- Miskolc mayor's office, Miskolc municipality, and associated institutions working in the target districts, including social, educational, and sports organisations.
- non-governmental organisations in Miskolc, particularly those active in Kilian and Bulgárföld
- households and housing associations in Miskolc that focus on the 12,000 residents of Kilian and Bulgárföld; and
- local firms and businesses.

The first stage of the research highlights the most promising project ideas at the local level. The second stage focuses on creating business plans and exploring financial opportunities with the aim of supporting these projects and bringing them closer to implementation.



Raising awareness of household energy efficiency in Miskolc (photo: MTVSZ).

Problems with data collection

Data collection began with a search of the publicly available information from various databases, as well as data provided by the municipality and its affiliated companies. Using this information, the authors of the study gathered data on energy consumption, and conducted online and in-person surveys to evaluate the awareness and attitudes of residents on the topic. In parallel, institutions and businesses operating in the area were contacted with the purpose of obtaining energy consumption and production data. Field visits were also carried out to assess the energy performance of housing and public buildings. Energy-focused and social interviews were conducted with community representatives and managers of homeowner associations.

The main difficulty encountered was the lack of a data provision culture, with a low response rate compared to the number of people contacted. In many cases, the municipality were not able to provide up-to-date data, while public institutions and businesses were caught up in high levels of bureaucracy. Additionally, the ownership and handling of energy data proved complex in several instances.

Scenarios, solutions and projects

Six community energy project models were identified (listed below). Those with the greatest potential for energy savings and emissions reductions, along with the highest level of public involvement, are presented first. The list is followed by concepts involving local public institutions and, finally, large local businesses and enterprises.

1. Proposals for residential community energy developments

1A. Heating upgrades for residential apartments connected to the district heating system

In many apartment buildings in Miskolc connected to the district heating system, residents are still reliant on outdated, non-thermostatic iron radiators to heat their homes. These buildings are connected to the local district heating system (operated by the Miskolc-based district heating services supplier MIHŐ) at a central metering point, which calculates total heat consumption. Individual heating costs are then distributed among the residents based on the size of their apartments.

The two main aims of this proposed community energy model are to replace the old radiators in each apartment with modern radiators equipped with thermostatic radiator valves and to clean the entire district heating pipe network. The estimated material cost would be approximately EUR 363 per apartment.

In the event an agreement was reached with MIHŐ, the radiators in all of the apartments in each residential development would be replaced simultaneously, resulting in a substantial 40 to 50 per cent reduction in heat demand and significant energy cost savings for residents. Additionally, MIHŐ would benefit from the surplus heat capacity, enabling it to supply other institutions and residential buildings in Miskolc while reducing fossil gas consumption for heating hot water. This in turn would contribute to a further lowering of greenhouse gas emissions.

However, despite the considerable projected savings, this proposal would not result in the complete decarbonisation of the district heating system. For this to happen, further interventions would be required.

1B. Prosumer energy community model for residential buildings

A recent amendment to Hungary's Electricity Act, effective from 1 January 2025, will allow electricity to be shared within residential buildings. This means that if a building is equipped with a photovoltaic system, residents can collectively decide how to use the generated electricity beyond covering the needs of their collective consumption.

In this case, residents could pursue either of the following three options: Sell the surplus electricity to a nearby large consumer, such as an institution or business; use the surplus electricity without installing smart metres to benefit from a discount on system charges for the locally produced and consumed energy;

or install smart meters in addition to consuming the excess electricity under an energy-sharing agreement, thereby avoiding system charges entirely.

Each building can install a photovoltaic system with a capacity of 60 kWp on a 50 kWp inverter at an approximate cost of EUR 60 000. Taking financial and social considerations into account, this cost would then be shared among the residents who would serve as energy community members. If it were to be combined with central heating and domestic hot water production, the photovoltaic system would pay for itself within five years.

This concept promotes the decarbonisation of heating and local electricity generation, fosters community investment, and ensures the most efficient use of the electricity generated.

The Kilián and Bulgárföld districts in Miskolc (photo: MTVSZ).

2. Community energy concept for the Gasztro Centrum restaurant in Miskolc

Gasztro Centrum is an iconic restaurant in the city, serving local people and tourists alike for decades. In 2023, the site was completely renovated with modern equipment and now serves as a vocational training centre to support the tourism and catering sectors. This transformation was made possible through support from an EU project and the Hungarian government, with the goal of enhancing local vocational training and preparing young people for careers in the catering industry.

Under the proposed community energy model, Gasztro Centrum would benefit from electricity generated by the surrounding apartment buildings. Photovoltaic electricity production is estimated at 83,000 kWh annually per apartment building. With eight such buildings in close proximity to the centre, the total potential energy generation is 664,000 kWh per year. This translates to potential energy cost savings of approximately EUR 13 822 per year.

Annually, the centre could receive up to 9,300 kWh of green electricity generated by the surrounding apartments through one of two energy community models:

- Power purchase agreement: Apartment buildings near the restaurant install rooftop solar panels and sell the electricity generated directly to the restaurant.
- Shared electricity model: Apartment buildings generate electricity using a rooftop photovoltaic system. The electricity is then shared among the residents (as described earlier in the prosumer model), with the surplus sold to the restaurant.

3. Community energy initiative for the Miskolc Unified Social, Health and Child Welfare Institution

The Miskolc Unified Social, Health and Child Welfare Institution is a social welfare organisation that provides various services such as home care, meals, day care, and support for people with disabilities, families, children and older people. The building the organisation operates from is burdened with a high annual electricity consumption of approximately 118,000 kWh.

The roof of the building could theoretically host a photovoltaic system with an estimated capacity of 122 kWp, capable of generating around 134,400 kWh per year. This would not only meet the building's electricity needs but also offer surplus energy for other uses.

The site also includes a laundry facility that serves multiple locations. The estimated investment cost for installing the photovoltaic system and improving energy efficiency ranges between EUR 150 000 and 250 000, excluding value added tax of 27 per cent. The projected annual energy cost savings amount to EUR 22 552.

Potential funding sources include the Environmental and Energy Efficiency Operational Programme Plus, although there are currently no open calls for applications. As both the building and the institution are owned by Miskolc municipality, the city and the institution would serve as the contracting parties when forming the energy community.

4. City-wide community energy model for the DVTK stadium and sports complex

Opened in 2018, the DVTK stadium is a multi-purpose stadium and the home ground of Diósgyőri VTK football club. The surrounding sports complex is one of the main centres of electricity consumption in Miskolc. Facilities at the complex include a day surgery, a training centre, and a basketball hall, all of which rely on air conditioning for ventilation, leading to the high electricity demand.

The training centre is scheduled for redevelopment and will soon feature a dormitory, making it an ideal candidate for energy efficiency investments. The football stadium itself has a low base load during the summer months. In winter, however, the 7,000 square-metre (m^2) heating system beneath the turf consumes a significant amount of energy. While the heating is provided by the local heating company, there are opportunities to reduce consumption levels.

The DVTK stadium plays a central role in Miskolc’s sporting life, with a committed fanbase and a strong sense of community. Establishing or joining an energy community would enable the owners to strengthen fan engagement and foster collaboration with local businesses, stadium office renters, and

service providers. This model could promote local businesses as donors and encourage a shared commitment to decarbonisation and sustainability.

Of the facilities in the sports campus, the roof of the training centre appears the most suitable location for a solar system. A photovoltaic system of approximately 115 kWp installed on the roof could generate about 127,000 kWh of electricity per year, translating into annual energy cost savings of EUR 19 399.

The basketball hall has a particularly high electricity demand due to its ventilation system. Its roof area could accommodate a 499 kWp photovoltaic system, capable of saving EUR 96 998 in annual energy costs. This system could supply electricity to the basketball hall, the training centre, and even support the stadium's air systems without creating significant overcapacity.

5. Community energy initiative to upgrade tram stops using solar panels

The transport management department of Miskolc City Transport Company, the city's public transport operator, has confirmed that tram stops in Miskolc are technically suitable for the installation of solar panels. The proposed solution would involve the deployment of island photovoltaic systems at selected tram stops. These solar panels would generate electricity, offering various community benefits, including cooling systems to provide relief to waiting passengers on hot summer days, ports for charging electrical devices, vending machines offering newspapers, soft drinks, and tickets, and the charging of small batteries to power lighting at tram stops and traffic lights.

6. Tripartite community energy cooperative

Naszálytej, one of Hungary's leading dairy companies, operates a significant dairy factory in Miskolc with notable solar energy potential, dominating the northern part of the city. The main facilities have an estimated annual generating capacity of 490,360 kWh. Alongside the mostly flat-roofed building complexes nearby, a photovoltaic system could be installed that would supply energy to Naszálytej's operations and, under certain conditions, also support local residents, businesses, and institutions.

The Blue Line Child Crisis Foundation (Kék Vonal Gyermekkrízis Alapítvány), a non-governmental organisation active in the area, has expressed their commitment to serve as a social organiser and partnership coordinator of a new community energy model. They would channel the interests of the local community by operating a green energy office in a community space within the locality. This office would provide information, education, and advice while also offering incubation services to support the development and implementation of additional community energy solutions.

The proposed tripartite collaboration is to be explored further through additional planning discussions with Miskolc municipality's community engagement office and the technical climate team tasked with implementing the CoolMiskolc programme.

Latvia

Latgale, located in eastern Latvia, has a population of 264,875 and is one of Latvia's designated just transition regions. Rēzekne county, located within Latgale, is the third-largest rural administrative area in the country, with only one small town, Viļāni, which has a population of 2,800. Another Latgale municipality that this research focused on is Daugavpils city, the second-largest city in Latvia, with a population of 78,850.

From an economic perspective, the Latgale region lags behind other parts of Latvia, making it more difficult to invest in decarbonisation schemes. For instance, Daugavpils, unlike other Latvian municipalities, has very few insulated multi-apartment buildings. Progress on decarbonisation remains sluggish at the local level, underscoring the urgent need for transformative regional projects that showcase the potential for sustainable change.

Current situation

Daugavpils municipality chose to focus on the city's cycling infrastructure. The city is already planning to develop a mobility plan, which will benefit from the cycling infrastructure research. A 2019 study ranked Daugavpils 62nd out of 119 Latvian municipalities (from a total of 119 at the time) based on the length of bicycle infrastructure per 1,000 inhabitants. Unfortunately, the existing cycling infrastructure in the city does not encourage residents to switch from private car use to cycling due to several factors: a lack of safety, poor connectivity between city districts, and an absence of storage facilities, such as bicycle stands at public buildings and multi-apartment complexes.

In consultation with local stakeholders, the Rēzekne county administration chose to focus on transport poverty, particularly its connection with public transport services. As the third-largest administrative region in Latvia, with a low population density and a declining number of residents, Rēzekne county faces increasing mobility challenges and significant transport poverty. Regrettably, this long-standing issue is expected to worsen once the second phase of the EU Emissions Trading System becomes operational in 2027. As in many other rural areas, local residents in Rēzekne county are heavily dependent on private fossil-fuel-based vehicles. Therefore, it is crucial for the municipality to understand the existing situation and identify the most suitable measures for mitigating transport poverty.

Latvian non-governmental organisation Green Liberty has been collaborating with local public administrations on both of these topics to provide research and support for decarbonisation planning. The aim is to help local authorities better understand the challenges they face and prioritise the most effective solutions. The study on transport poverty is notable, as it is the first of its kind in Latvia and offers valuable insights for other municipalities with large rural areas. To carry out the research, Green Liberty partnered with national experts from Riga Technical University.

What progress has been made?

Despite previous efforts to develop cycling infrastructure plans and invest in cycling routes, Daugavpils municipality has yet to implement a comprehensive and coordinated approach. To date, cycling infrastructure has not been a municipal priority, resulting in unsafe conditions for cyclists, fragmented cycling paths, and ill-conceived technical solutions. And while cycling infrastructure initiatives have been

incorporated into current and previous development programmes, progress in implementing these plans has been slow and inconsistent.

Similarly, Rēzekne county municipality has yet to adopt a comprehensive approach to addressing transport poverty, despite implementing some measures to partially alleviate the issue. For instance, a well-functioning school bus network has been established, and the municipality has attempted to initiate changes in national legislation to allow these buses to serve other passengers as well. The municipality also operates an on-demand social bus service, which people with illnesses or disabilities can use to travel to medical appointments or run essential errands. These services complement the county's regular public transport routes.

However, the municipality has struggled to secure financing and has neglected to seek input from locals on how to improve routes and schedules. While online transportation surveys are conducted almost every year, the data gathered has never been detailed enough to inform specific route and schedule improvements. Additionally, the most vulnerable residents tend not to take part in surveys of this kind.

Cyclists in Daugavpils, Latvia (photo credit: @visitdaugavpils.lv).

Problems with data collection

For the Daugavpils research, data was collected from publicly available information and materials provided by the municipality. Interviews were conducted with municipal employees, the staff of municipal enterprises, experts from the University of Daugavpils, members of a tourism club focusing on outdoor leisure activities, talking with inhabitants who attended citizens' forum. Additionally, the researchers visited physical sites to assess infrastructure, mapped residential street networks, and carried out a case study of the 'Chemists' district in the city. However, engaging with Daugavpils residents proved challenging, as a culture of citizen activism and involvement in city and neighborhood planning has yet to be established in the city.

The availability of public transport and other forms of transportation affects all residents of Rēzekne county, although to a lesser extent for those who own private vehicles. However, there is currently no established number or estimate regarding the individuals affected by transport poverty.

The proposed interventions are expected to have an indirect positive impact on all residents of the municipality, primarily through the economic development of the county. Nevertheless, the number of individuals directly affected remains unclear.

Who is affected and who will benefit from the intervention?

Rēzekne county

The availability of public transport and other means of transportation, affects all the inhabitants of Rezekne county, although to a lesser extent the owners of private vehicles, However, when it comes to those affected by transport poverty, no number or estimate has yet been established. The proposed interventions will have an indirect positive effect on all municipality inhabitants, at least through the economic development of the county. The number of those directly impacted is also still to be defined.

A bus stop in Rēzekne county (photo: Antra Viļuma).

Daugavpils

The implementation of proposed improvements to the cycling infrastructure in Daugavpils will have an indirect positive impact on all residents. For some, this will involve a change in mobility habits and increased opportunities for cycling, leading to reduced reliance on private passenger vehicles. For others, it will mean an improved urban environment with fewer cars in the city centre, reduced air and noise pollution, enhanced safety on the streets due to slower traffic, and greater priority given to pedestrians and cyclists. However, the number of residents expected to be directly affected – namely, regular cyclists and those who could be encouraged to switch to cycling – has yet to be established.

Proposed solutions

Rēzekne county

The region requires targeted and strategic improvements to its public transport system, focusing on enhancing routes, schedules, and the availability of accurate and accessible information. The following measures should be taken to ensure these needs are met:

- Improve public transport stops by including parking areas for cars, secure bicycle stands, adequate lighting, and shelters.
- Introduce transport-on-demand options to increase flexibility and accessibility for residents.
- Subsidise or support local taxi services to ensure affordable and reliable transportation options.
- Enhance cycling infrastructure by establishing safe cycling paths, providing bike stands, and creating long-term docking facilities.
- Upgrade local roads in general to ensure safer and more efficient travel for all users.
- Amend national legislation to permit school buses to carry additional passengers outside school hours.
- Promote the availability of bicycle, electric bicycle, and car rental services to provide alternative and sustainable transport options.
- Ensure service availability in local villages to reduce the need for residents to travel long distances to larger towns or cities.

Daugavpils

Safety is an important indicator of the quality of cycling infrastructure, and it is also the most frequently mentioned parameter in surveys conducted with citizens. According to the 2023 Municipal Road Safety Assessment Index,[3] Daugavpils is ranked sixth out of seven Latvian cities, highlighting the need for significant improvements.

Safety should be a priority not only during the renovation and repair of streets but also in the enhancement of the existing cycling infrastructure. Currently, schemes are being finalised for the optimal placement of cycling routes and the development of proposed pedestrian zones in the city centre.

[3] Ministry of Transport of Latvia, 2023. gada ceļu satiksmei drošākās pašvaldības – Ventspils un Valkas novads, *Ministry of Transport of Latvia*, 28 August 2024.

Ukraine

The selected municipality – Novovolynsk, and the two neighbouring villages – Lytovezh and Poromiv – have populations of 58,000, 4,000, and 5,000, respectively. These communities have historically been coal-mining communities since the 1950s, especially Novovolynsk, which was specifically built to service the mines.

After the first mines began to close in the 1990s, just transition measures were not sufficiently planned to support the affected communities. Now that the last mines are set to close, decarbonisation has become an urgent issue. It is essential that local communities have the safety net of a well-planned transition to overcome the economic and social challenges associated with the decarbonisation process.

Slag heap being recultivated in Novovolynsk (photo: Anastasiia Bushovska).

Current situation

The region faces numerous challenges, ranging from investment difficulties to inefficient buildings and outdated heating systems. In Novovolynsk, central heating relies on fossil gas and suffers from significant losses of approximately 40 per cent. Additionally, a large proportion of the population in Novovolynsk, Lytovezh, and Poromiv depends on individual heating systems.

Novovolynsk, Lytovezh and Poromiv have developed sustainable energy and climate action plans. Novovolynsk also has an established energy efficiency strategy and plans to renovate a significant number of its buildings. However, the communities face challenges such as limited financial and technical capacity, gaps in knowledge, and the absence of a clear long-term vision for the future of heating solutions. Despite these obstacles, the following stakeholders have a role to play in improving the heating situation in the region:

- Novovolyskteploenergo, the central heating operator,
- Novovolynsk city council,
- Lytovezh village council,
- Poromiv village council; and
- co-owners associations of various apartment buildings.

Ecoaction supports the just transition of coal-mining communities in Ukraine, particularly those in the Volyn region. Heating was identified as a major cause for concern, one that significantly impacts these communities. However, no proper plan has ever been formulated to address this pressing issue. Since Novovolynsk, Lytovezh, and Poromiv are neighbouring coal-mining communities that share many similarities and challenges, here they are treated collectively as a single project. Successful implementation of this initiative could potentially serve as a model to support similar actions in other coal-mining communities.

The research plan for the first year of the project took the form of a survey, in order to gather detailed information on household heating systems and gauge the knowledge and expectations of residents on the subject of heating decarbonisation. The findings will be used to provide more targeted recommendations for the development of sustainable heating solutions. This initial phase will be followed by an assessment of the potential of various solutions for both centralised and individual heating systems.

An unfinished legacy: Novovolynsk coal mine in Poromiv never became operational (photo: Anastasiia Bushovska).

Current heating systems used in the region

The heating systems in individual apartments are closely tied to building type. In apartment buildings in Novovolynsk, centralised heating systems are the norm, while private houses tend to be equipped with individual heating systems such as boilers. In the private houses of the Lytovezh and Poromiv communities, it is common for different heating devices like heaters, stoves, and convectors to be installed in individual rooms. Vulnerable groups tend to use these devices more frequently than the general population.

Though the most common individual heating systems are gas boilers, a significant proportion of homes in the Lytovezh and Poromiv communities also use solid-fuel boilers. The recent rise in gas prices has prompted many residents to install and use solid-fuel boilers in addition to their existing gas boilers.

Attitudes towards heating decarbonisation

To understand the perspectives of local communities on the topic of heating decarbonisation, the first stage of the research involved conducting a survey to gather opinions and assess existing knowledge. The results of the survey will inform the second stage of the research, which aims to propose solutions for the decarbonisation of the local heating systems.

Knowledge of decarbonisation principles was generally low across all groups of respondents. For most respondents (67 to 87 per cent), this was the first time they had ever heard of the term ‘decarbonisation’. Nevertheless, the Poromivska community demonstrated a slightly higher level of awareness compared to the others. Interestingly, among vulnerable groups, the level of knowledge was marginally higher than that of the general population.

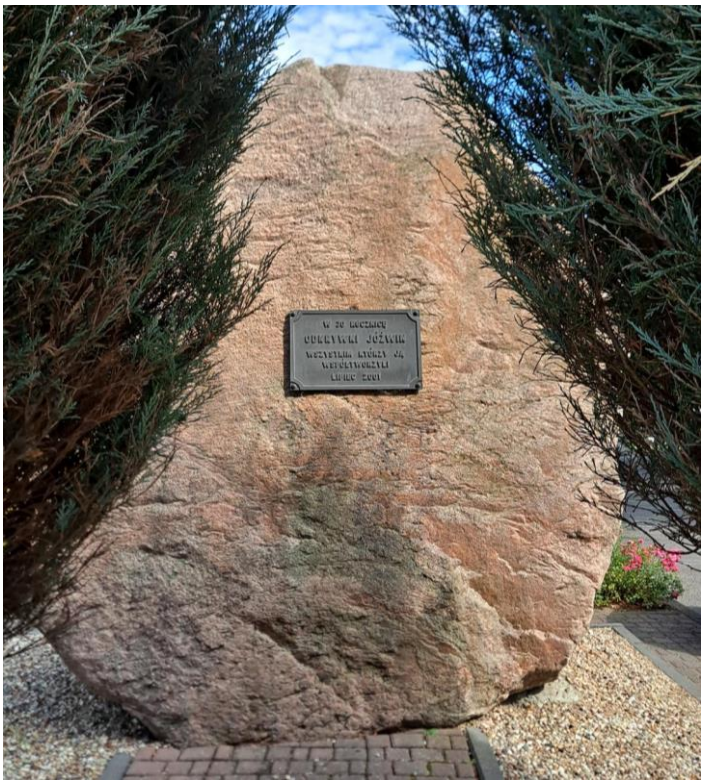
General familiarity with the principle of decarbonisation (percentage of respondents)						
Response	**Total population**			**Vulnerable groups**		
	Novovolynsk	**Lytovezhka**	**Poromivska**	**Novovolynsk**	**Lytovezhka**	**Poromivska**
I’ve a very good understanding and can explain it to others	1%	1%	1%	0%	0%	0%
I’ve some knowledge, but I’m not too sure of the details	6%	8%	18%	5%	6%	11%
I’m familiar with the name but not the concept itself	11%	8%	12%	6%	6%	5%
This is the first time I’ve heard of the concept	80%	82%	67%	87%	85%	78%
I’m unsure or unwilling to answer	2%	1%	2%	2%	2%	5%

Interestingly, the level of awareness of the various heating technologies was notably high. For example, more than 75 per cent of respondents were very or somewhat aware of electric heating and solar heating solutions. Heat pumps and biogas technologies were more widely known among the Novovolynsk and Poromiv communities, with about half of the respondents claiming to have knowledge of these technologies. In contrast, awareness was lower among the Lytovezh community, where about a third of respondents reported to be familiar with these technologies. Overall, the technology that the general population was least aware of was the utilisation of mine heat and residual heat from industrial facilities.

Residents with some level of familiarity with the proposed heating technologies (percentage of respondents)						
Technology	**Total population**			**Vulnerable groups**		
	Novovolynsk	**Lytovezh**	**Poromiv**	**Novovolynsk**	**Lytovezh**	**Poromiv**
Electric heating	92%	84%	87%	89%	87%	87%
Solar-panel heating	83%	80%	90%	79%	75%	78%
Heat pumps	49%	29%	52%	44%	32%	47%
Biogas heating	52%	27%	49%	42%	34%	44%
Utilising mine heat and residual heat from industrial facilities	38%	31%	47%	27%	40%	50%

Poland

Kleczew, a small town located in the Konin district within the Eastern Wielkopolska region, has a population of just under 10,000. The coal industry has long played a key role in the economy and development of the region. However, in recent years, Eastern Wielkopolska – one of Poland's designated just transition regions – has started to phase out lignite mining. Following this path, the municipality of Kleczew is now seeking support as it sets out on its own journey of renewable development. To this end, the municipality has become involved in the EU-funded climate neutrality projects LIFE After Coal[4] and RePower the Regions.



Rock commemorating 30 years since the closure of the Jóźwin mine outside Kleczew (photo: Miłosława Stępień).

Current situation

Heating is a major issue in the region as the majority of buildings in Kleczew are heated using traditional methods, mostly coal-based. Given the planned transformation of the region, upgrading these heating systems is key to reducing greenhouse gas emissions and improving energy efficiency. The introduction of greener solutions, such as heat pumps and photovoltaic installations, is likely to have a significant impact on reducing energy consumption and running costs.

The municipality recently launched a number of projects aimed at modernising heating systems in the town, notably through the Clean Air programme,[5] which allows residents to submit applications for energy

[4] Life After Coal PL, Project Life After Coal PL, *Life After Coal PL*, accessed 10 December 2024.

[5] With the primary goal of combatting air pollution, Clean Air is the first programme in Poland to subsidise the replacement of outdated heating systems and the insulation of single-family homes.

support directly through the municipality. In addition, climate counselling, a service provided under the LIFE After Coal programme, supports residents in taking action to modernise their home heating systems.

Who is working to solve the problem?

The municipality is responsible for managing the energy transition and overseeing the implementation of renewable measures. A climate advisor from the LIFE After Coal programme has been tasked with supporting the municipality in its efforts to develop a climate-neutral strategy, providing expert input on the technicalities of modernising heating systems.

The Polish Green Network commissioned this study to support local authorities in their decarbonisation efforts. The organisation also aims to encourage the municipality to adopt a data-driven approach, emphasising the importance of conducting comprehensive analyses and collecting data before developing plans and making investments.

Malta Park in Kleczew: A revitalised former mining site (photo: Miłosława Stępień).

Challenges with data collection

During the analysis, it became apparent that a uniform database listing buildings and their energy efficiency ratings was lacking. Data from the Central Emission Register of Buildings, which obliges each building owner and manager to submit a declaration on heat sources and fuel combustion to the register, was incomplete. Complicating matters, access to detailed information required the involvement of authorised municipal staff and compliance with general data protection regulations.

As a result, we were unable to fully engage with the municipality to obtain the necessary data. In addition, we identified a number of issues involving the integration of local heat supply plans with national energy efficiency and climate strategies.

Social and economic issues

Energy poverty, a major socio-economic challenge for the energy transition, occurs when households struggle to maintain an acceptable level of thermal comfort at an affordable cost. In places like Kleczew, this issue is exacerbated by energy-inefficient buildings, outdated heating systems, and limited access to modern, low-emission energy solutions, all of which generate high operating costs.

Costs associated with the energy transition can pose a significant burden, particularly for low-income households. Replacing heating systems, modernising buildings with thermal upgrades, and investing in renewable energy technologies like heat pumps and solar panels require significant financial outlays. Even with state support from schemes like the Clean Air programme, many low-income residents still struggle to cover their share of the costs. Without effective coordination with social policies, the energy transition could lead to a further rise in social inequalities.

One potential solution to this problem is to introduce dedicated support programmes for households affected by energy poverty, such as tax breaks, non-repayable subsidies or preferential loans. It is also important to develop local energy consulting points that will help residents choose appropriate solutions and apply for funding, while raising public awareness of the benefits of improving energy efficiency and the availability of financial support. The joint actions of local authorities, residents and supporting organisations can significantly contribute to mitigating the effects of the energy transition and reducing energy poverty.

Proposed solutions

Thermal modernisation of public and private buildings

In order to improve the energy efficiency of buildings, we recommend introducing financial support mechanisms and technical advice for investments related to energy modernisation. Existing programmes like Clean Air and Stop Smog[6] should be expanded to include dedicated solutions for smaller municipalities that struggle with limited resources.

Replacing heat sources with renewable energy sources

The priority is to co-finance the installation of heat pumps and photovoltaic systems in residential and public buildings. Particular attention should be paid to facilities with the lowest energy class, where modernisation is likely to deliver the greatest benefits.

Improved monitoring and management of energy consumption

The introduction of intelligent energy consumption monitoring systems, supported by mobile applications and energy management systems, would allow energy consumption in buildings to be inspected and optimised on an ongoing basis. These solutions may be particularly helpful for municipalities and residents looking for savings and better cost management.

Education and changing social awareness

A key element of the energy transition is to increase public awareness of energy efficiency and renewable energy sources. For this purpose, information campaigns targeting both residents and enterprises should be prioritised, in addition to partnering with non-governmental organisations to strengthen social and technical competences.

Supporting local energy communities

Promoting and financing energy cooperative projects and energy clusters can significantly contribute to the development of decentralised energy systems, especially in rural areas. These initiatives promote greater energy independence and social integration.

Development of advisory systems

Establishing local consultation points staffed by experts is crucial. These centres can provide advice on energy efficiency, renewable energy technologies, and the availability of financial support mechanisms. Serving as one-stop shops, they also make it easier for residents to access these programmes.

[6] The Stop Smog programme shares the same objectives as the Clean Air programme. However, unlike Clean Air, applicants for the Stop Smog are municipalities or districts rather than individual residents.

Research challenges and recommendations

Lack of data availability

A major challenge in conducting in-depth decarbonisation research in most of the municipalities analysed, particularly those in the Czech Republic and Poland, is the lack of readily available data. Often, there is no systematic record of energy consumption or the building stock, with only sporadic, ad hoc studies conducted over time.

For many municipalities, such as those in Bulgaria, the Czech Republic, Estonia, Poland, and Romania, our research was the first comprehensive effort to gather such data. This limited data availability significantly hindered our ability to achieve meaningful results within the given time frame. Even when considering specific projects or technical assistance initiatives, the data is typically scarce, outdated, and in a non-digital format, posing substantial challenges.

Absence of a data provision culture

Gathering data from relevant stakeholders, including official institutions and civil servants, can be challenging due to their reluctance to allocate time, energy, and resources. Without their involvement, developing a comprehensive decarbonisation plan is nearly impossible. However, our research indicates that municipal, national institutions, and research centres often show interest in supporting data collection.

This suggests potential for improvement, but those willing to conduct data collection and provision need to actively reach out to the places that need them most. Engaging with citizens can be difficult, as they may be unwilling to dedicate time to share relevant data.

Municipalities need more support and input in the discussion

One reason for the reluctance of some municipalities, especially smaller ones, to support data collection is understaffing. Many lack expert staff to handle data collection or the funds to hire external experts. This also hinders their ability to seek support, as they often lack the staff to understand technical assistance or funding options, complete paperwork, and coordinate cooperation. Municipalities also tend to prioritise day-to-day administration over applying for available support.

National and international researchers can play a crucial role in filling this knowledge gap and improving data availability and support in these regions. The growing interest of academia in supporting on-the-ground initiatives and field work in these regions offers hope. However, a dedicated stakeholder or organisation is needed to lead or significantly support this process.

In addition, there is often a disconnect between the local level and the EU. Local stakeholders need a better understanding of Europe's direction and how to achieve decarbonisation goals. Conversely, Brussels could benefit from a better understanding of how EU regulations impact municipalities and regions, and what is truly needed to realise EU plans, especially considering the needs of smaller stakeholders.

Inadequate studies and technical assistance

Another reason for the reluctance to work on data provision or decarbonisation planning is the negative experiences with previous technical assistance or studies. Despite requiring significant local involvement, some past interventions have resulted in generic or unhelpful support, a lack of follow-up, or situations where municipalities struggled to secure funding for implementing the proposed plans or activities.

Experts working in these regions should prioritise providing relevant, tailored support for each municipality. A clear plan, ideally with support, should be provided for utilising the data and securing funding for proposed activities.

Need for comprehensive planning, relevant legislation and funding

Many of the issues highlighted in this review stem from insufficient national-level planning and support. While international technical assistance has helped enhance local capacities in just transition regions, the lack of national government support leaves many municipalities, especially smaller ones, with limited expertise and resources to manage complex decarbonisation processes.

Often, national-level strategies and plans are poorly defined or absent altogether. This lack of direction at the national level hinders local decarbonisation efforts. Furthermore, inadequate or absent national-level legislation and funding can impede the implementation of renewable energy and energy efficiency measures.

The requirement for municipal co-financing for grants and loans can be a significant burden, particularly for smaller municipalities. In contrast, national government support can facilitate local decarbonisation efforts.

When allocating just transition funds, many countries prioritise large-scale projects and major companies. International financial institutions often follow suit, favouring larger stakeholders and encouraging smaller entities to form joint applications. However, smaller-scale projects are often better suited to address the specific needs of local communities. Therefore, just transition fund allocations should better account for the needs of smaller-scale initiatives.

Place-based support

Each of the nine just transition regions faces unique challenges and requires tailored solutions. Different cities have distinct needs, and even within a single municipality, diverse communities may have different expectations from the just transition process. While some general themes may overlap, the specific local challenges vary significantly. For instance, many regions identified district heating as a priority, but the approaches to addressing this issue differed.

All regions have encountered difficulties in securing support for developing decarbonisation plans and funding for implementation. Understanding local specificities is crucial for a successful just transition. Civil society should play a key role in this process, as it can help bridge the gap between policymakers and local communities.

Raising public awareness about potential decarbonisation solutions and their benefits is essential. Supporting community-led initiatives can help foster positive experiences and create tangible examples of successful transition.

Complex renewable energy solutions require substantial investment and planning

Investing in clean district heating requires significant long-term commitments. Developing such plans at the municipal level can be challenging. While funding mechanisms are increasingly available for modernising district heating networks and introducing fourth-generation heating solutions, smaller municipalities often face limitations. However, various EU funds, international financial institutions, and other donors can provide initial support for technical assistance and project development.

Despite the availability of funding, municipalities may opt for fossil-fuel-based solutions due to their perceived ease of implementation. To encourage sustainable options, policymakers should prioritise their availability and provide necessary subsidies.

Another significant challenge for energy communities and renewable energy projects is grid access. While local communities are often receptive to these solutions, the lack of grid modernisation to accommodate increased renewable energy input hinders their implementation.

Policy recommendations for decarbonisation planning

Improve data collection

- Introduce detailed data collection requirements.
- Increase funding and support for data collection.
- Increase funding for quality data collection with active citizen involvement.
- Raise awareness among citizens about the importance of data collection.
- Prioritize data digitisation relevant to decarbonisation planning.
- Ensure data accessibility for local municipalities.
- Align data collection efforts with local needs.

Increase support for local municipalities

- Increase administrative capacity through funding for expert hiring or contracting.
- Expand capacity-building activities on decarbonisation topics, funding, and technical assistance.
- Streamline funding and technical assistance programs for smaller municipalities.
- Increase targeted, place-based, and tailored technical assistance.
- Support awareness-raising campaigns to promote clean decarbonisation solutions.
- Prioritize inclusive and transparent decision-making processes with strong community engagement.
- Highlight the benefits of decarbonisation projects for local communities.

Develop transformative potential for decarbonisation

- Establish national policy frameworks with clear, ambitious goals, measures, and supporting instruments for real, long-term decarbonisation solutions.
- Prioritize the introduction of favourable legislative frameworks for clean decarbonisation solutions.
- Make subsidy schemes for renewables readily available.
- Identify, categorise, evaluate, and supplement financing mechanisms as needed.
- Provide national government support for municipal co-financing needs in decarbonisation planning and implementation.

Conclusion

The first stage of the LIFE RePower the Regions project has highlighted both the scale of the decarbonisation challenge and the value of community engagement. By listening to local concerns, hopes, and dreams, we can support communities in their journey towards a climate-neutral future.