PROJECT PARTNERS

GENERAL INFORMATION

Title of the case

Redevelopment of European mining areas into sustainable communities by integrating supply and demand side based on low exergy principles (Remining-Lowex)

Sales pitch

Demonstrating the use of local available low-valued renewable energy sources from water in abandoned mines for heating and cooling of buildings, based on low exergy (energy available to be used) principles, facilitated by an integrated design of buildings and energy concepts.

Organisations

- University of Ljubljana, Faculty of mechanical engineering, Laboratory for sustainable buildings
- Municipality of Zagorje ob Savi
- Mine Zagorje

Country

Slovenia (+ Netherlands, Bulgaria, Poland, Germany, France)

Authors

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Nature of interaction

University-city engagement project addressing city challenges

Level of mechanism

☑ Government policy (e.g. law, funding framework)

☐ Organisational strategy (e.g. university/business/agency)

☑ Structural element (e.g. centre, lab, office)

☑ Operational level (e.g. activity or programme)

Length of programme

Not specified	Formality	Informal

Curricula-bound, co or extra-curricular?

Curricula	Level of initiative	Subject level, inter-institutional

Summary

Remining-lowex was a project of the European Union's 6th framework CONCERTO II research program. The project intended to use locally available, low-temperature geothermal energy from abandoned mines as energy source for heating and cooling of buildings. The project ran between June 2007 and June 2014, and was focused on the redevelopment of European Mining Areas into Sustainable Communities by Integrating Supply and Demand, based on Low Exergy Principles. The participating communities were Heerlen (the Netherlands) and Zagorje ob Savi (Slovenia). Associated communities were Czeladz (Poland) and Bourgas (Bulgaria). The project involved 16 partners, including municipality public organisations, universities, and industry partners. University partners (including academic staff, researchers, and students) were engaged in the research and development activities within the project.

The four communities demonstrated the use of local available low valued renewable energy sources from water in abandoned mines for heating and cooling of buildings, based on low exergy principles, facilitated by an integrated design of buildings and energy concepts. They realized 2 sustainable mining communities (Heerlen and Zagorje) with 50 to 100% CO2 reduction and 60% RES compared with standard national practices.

REMINING aimed to link new developments to old industry areas by using the old mine as a renewable source of energy and revitalizing the community by revitalizing the pride of their heritage. An innovative communication strategy demonstrated that it is possible to take community emotions among which often (past, forgotten) traumas and other socio-economic issues of the mine-workers communities into account thus leading to an increased quality of life and social welfare. The present case study analysis focuses in more detail on the Slovenian part of the otherwise large-scale project.

CASE STUDY PROFILE

BACKGROUND

The foundation of the European Union (EU) lies in coal and steel: the EU started as the European Coal and Steel Community (ECSC) in 1951. Two motives for the establishment of the ECSC were to promote cooperation, eradicate rivalry, and to improve standards of life, to which we can now add assuring sustainable development. Fifty years later, the ECSC Treaty expired (July 2002) and all over Europe mines are being closed because of difficult geological conditions and strict social insurance rules. However, in an echo of the founding principles of the EU, energy can again be extracted from these closed mines, i.e. the large volumes of water in abandoned mines are a valuable source of low-valued geothermal energy. These mines become a source of future sustainability and a catalyst for area regeneration and rehabilitation.

CONTEXT

The Remining-Lowex project was carried out as a research, development and demonstration project, co-funded within the EU 6th Framework Programme (FP6). The project was coordinated by Cauberg-Huygen Raadgevende Ingenieurs B.V. (NL) and had 15 participating project partners, which included municipalities or local community councils (Bourgas Municipality, Council Zagorje ob Savi, Czeladz Council, Heerlen Council), research institutes, industry partners, and two university partners (University of Ljubljana and University of Silesia). Feasibility and demonstration projects were first implemented in the two demonstration sites (Herlen and Zagorje ob Savi), leading to implementation also in the two sites with observer status.

The two demonstration sites contained: 440 new houses, 276 existing houses, 57000 m2 non-residential new buildings, 43500 m2 non-residential existing buildings, and 3 existing prepared buildings to connect with the mine water grid in Heerlen and 6500 m2 existing buildings in Zagorje ob Savi.

The feasibility of Renewable Energy Sources (RES) in the area of Municipality Zagorje ob Savi was studied in a preliminary phase. The final potential of local RES in the area of Municipality Zagorje ob Savi was elaborated. Therefore, the potential and technologies for mine water exploitation on local level was certified in order to accelerate the using of mine water through best case practice. Once these characteristics were known, the next step was to demonstrate the multiple effect of RUE (rational use of energy) and RES on energy conservation and fossil fuel replacement in buildings best case practice. It was the first steps in a transition to a sustainable development of Municipality Zagorje based on the use of local RES resources in combination with RUE in new and renovated buildings. An important part of this sustainable development was to establish the energy consumption monitoring in Municipality Zagorje with emphasis on the building sector and the development of an energy conservation plan in public buildings to initiate Directive on the Energy Performance of the buildings and new National acts.

In the next phase, studies for a further development of an operation plan were prepared for a district heating system CHP (combined heat and power), using biomass to secure stabile and sufficient supply of local produced biomass (for example, wood waste from local furniture industries). As part of the dissemination on local scale the RUE and RES were promoted in neighbourhood communities with comparable economic and social conditions.

OBJECTIVES AND MOTIVATIONS

The motivation of the project partners in conducting the project was to:

- demonstrate the use of low-valued renewable energy sources for heating and cooling of buildings (based on low exergy principles), facilitated by an integrated design of buildings and energy concepts;

- demonstrate the economic viability and sustainability of the local use of geothermal energy in combination with heat and cold storage available from hot and cold water generated in and extracted from abandoned mines for heating and cooling purposes in new and retrofitted buildings by the realization of a large and visible demonstration projects in typical mining areas. The scale is that of a whole community or housing district;

- contribute to EC energy objectives (such as CO2 reduction and security of energy supply) and other policies of the REMINING project and to demonstrate the potential in all EU mining areas;

- demonstrate the contribution of the used technology and communication approaches for the development of sustainable communities in and the revitalizing of mining areas, and to prepare the next steps in the further market development;

- improve quality of life in mining and former underdeveloped mining areas in Europe by a sustainable (re)development.

STAKEHOLDERS

The key stakeholders in the Slovenian part of the project were:

- Students and professors of University of Ljubljana (Faculty of mechanical engineering, Laboratory for sustainable buildings and environmental technologies)
- District heating utility
- Housing company
- Industry representatives
- City representatives (Zagorje council)
- NGOs (association for sustainable energy)
- Residents in Zagorje ob Savi

PROCESS

INPUT

• Funding (FP6) – research work and investments in infrastructure and demonstration activities (overall project budget: 39 565 400 EUR; EU budget contribution: 7 226 357 EUR)

• Academia as knowledge provider and integrator of solutions (4 academic and research institutions, including academic staff and student researchers)

• Industry as solution provider and implementor (5 industry partner organisations)

• Municipalities as co-financers and network providers (4 municipalities)

ACTIVITIES

To show the feasibility of mine water use and the low exergy design principles, the project focused on pilot implementations, supported by research, training and dissemination activities.

Joint and multidisciplinary R&D (university, industry and city cooperation)

The project consortium consisted of university/research organisations, industry partners and local community organisations (municipalities/councils), which formed clusters around each of the four demo cases. Each contributed with their specific expertise and context: local councils and municipalities had the knowledge of the local inhabitants, their specific challenges and local specific challenges (nature, energy, building fund). They are also the local policy-maker with a level of authority. Academic partners contributed with research, studies, and proposed solutions to the identified challenges that were in the focus of the project (sustainable energy, low exergy technologies, etc.). Research and development activities involved students of the University of Ljubljana (Faculty of Mechanical Engineering) from the beginning of the project: they participated in all phases, from planning, to research, measurements, design of solutions, acquiring offers from technology providers. The students carried out field research as part of their lab assignments and were regularly present at the demonstration site. Industry partners, on the other hand, had the capacity to implement the developed solutions in practice as innovative demo cases.

Construction and energy refurbishment of public and private buildings.

In Zagorje, public buildings were renovated within the project, including the local kindergarten, municipal headquarters, and the cultural centre. The process included deep energy refurbishment, building control and monitoring systems, installation of PV power plants. In addition, over 50% of multi-apartment buildings in the town of Zagorje were refurbished and the community energy systems were expanded and modernised (district heating system) in cooperation between the three key project stakeholders/partners (council, university, industry).

Training

Training on low exergy technologies and RES utilization was prepared and carried out within the project for businesses, students and pupils, with the aim of expanding the understanding of renewable energy sources, rational use of energy, and low exergy technologies.

Demonstration of advanced technical solutions in practice – in Zagorje, the project team designed a mobile research unit OELA - a low-energy self-sufficient mobile unit for demonstration of new concepts of low exergy technologies on the basis of renewable sources, and use of mine water for heating and cooling residential or public buildings. Unit serves to carry out regular events related to renewable energy and energy efficiency, and as a demonstration and training facility. The presented technological innovations are associated with the culture of mining, at the same time transcending it to show and promote sustainable energy systems. The interiors as well as the envelope of the unit mimic a mining shaft and are adapted to mining architecture. The mining heritage that shaped the region for 250 years is thereby kept alive. The research unit OLEA demonstrates the transition between a black, carbon-based history and a green sustainable future in the municipality and wider region.

OUTCOMES AND IMPACT

OUTPUTS

The result of the REMINING project is the demonstration of retrofitting buildings and building new urban areas within old mining communities and climatizing these buildings with local available low valued energy resources by an integrated design approach based on low energy principles. Derived specific results are the improvement of spatial planning, environmental effects, and economic performance of the area by providing affordable sustainable energy supply to the new development and integral approach of an (urban) development using attractive design and low energy costs as magnets for new businesses and to attract people (residents) to and keep residents in the area.

The added value on EU level is the demonstration of the use of local available low valued energy sources in the built environment (new buildings as well as retrofitted buildings) by an integrated design approach, balancing demand and supply side by following low exergy principles. In the REMINING project the use of geothermal heat and heat/cold storage in water in mine shafts is combined in a sustainable hybrid energy supply with other renewable energy sources, such as biomass or conventional very low carbon sources (e.g. when linked to Combined Heat Power CHP).

Concrete outputs include all project studies and reports, which were part of the funding requirement, some of which are available at OLEA website, as well as:

- The building initially intended for youth centre was equipped with a photovoltaic system. The first solar power plant of the municipality was connected to the national power grid. Its capacity is 13.88 kW peak and an annual production of about 15,000 kWh was predicted.
- The University of Ljubljana (Faculty of Mechanical Engineering) finalised the sustainable energy action plan for the local community of Zagorje. It detailed the technical potential of renewable energy sources and energy efficiency measures by sectors, together with an action plan and financial aspects until 2020. The goal was to ensure an energy supply for the community, which is economically and environmentally efficient in the long term. The study incorporated detailed analyses of current consumption and suggestion of measures in buildings (public and private), public lighting, industry, commercial sectors and traffic.
- Two extensions of the district-heating grid and the capacity of biomass boilers (all biomass provided from local wood industry) feeding the grid had been enlarged.
- In August 2011, the first charging station for electric vehicles was officially opened. In particular, the model of the project's cooperation with companies was an exemplary model layout for initiate the entire network for charging electric vehicles in Slovenia.
- In the demonstration area, 25 building blocks are connected to district heating, and 3 blocks with local heating to the biomass district-heating grid. In all blocks the DHW (domestic hot water) used to be generated by electric boilers, which were replaced by heat exchangers connected in the grid. At a certain number of the blocks the building

envelope was retrofitted according to CONCERTO standards. The installation of energy monitoring via telemetry was completed in three public buildings.

- Retrofitting residential buildings: from 2009 until 2011 more than 250 existing dwellings were partly retrofitted according to the CONCERTO standard.
- Student outputs (a number of seminar assignments lab exercises on the field, as well as one BA thesis, one MA thesis and a MSc thesis)
- Academic outputs (research, scientific publications)
- Research and Demonstration unit (OLEA)
- ICT Multiutility control system (backbone for smart cities)
- Public PV power plants (municipality)

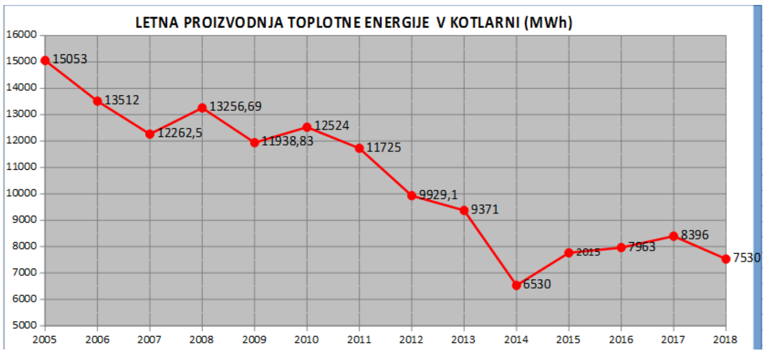
IMPACTS

Zagorje showed that locally available, low-valued renewable energy resources could be utilised. In Zagorje´s case, this energy was contained in water from abandoned mines.

Building using mine water and 1,154 existing houses that were connected to the district heating network fed by a biomass. (See also outputs chapter above).

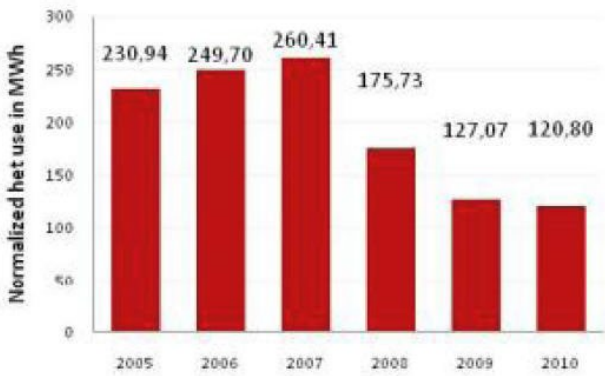
Other impacts include:

- Awareness raising (sustainable energy)
- Community impacts, which contributed to lowering the use of energy and improving the quality of life in the demonstration community:
    - lower energy use (district heating system supplies significantly less heat – see graph 1 below, demonstrating the drop of yearly production and need for heat in the heating plant; and graph 2, which shows the reduction of consumed heating energy for the years 2005 until 2010 in Polje Street)
    - renewable energy production (two new PV power plants on public buildings and demonstration unit heating with mine water);
    - large scale energy refurbishment of multifamily buildings



- New business opportunities for industry (novel technologies): company Telfex is still selling the communication system, which was developed for the project; all solutions integrated in Olea are still being sold today, while they were only entering the market at the time of project implementation (the aim of the project was to integrate in an innovative way the existing, available, and innovative solutions).
- Acceptance of new sustainable technologies: when the PV power plant was being installed, there were a number of doubts and fears raised by the local community

(reflection, glaring, potential dangers during thunder storms etc.). However, after the installation, training activities and dissemination of project activities, the acceptance of sustainable energy technologies had significantly improved.



SUPPORTING ENVIRONMENT & SYSTEM

SUPPORTING MECHANISMS

Co-financing of investments by Zagorje municipality – the investments were not financed fully by the EU project funding; only what was beyond the national regulation (for e.g. thermal protection of buildings). This meant that the municipality had to finance a significant part of the project activities, in particular the investments in building retrofit. To implement these public investments on such a scale, they also needed to justify them well in the political sense and secure public and political support.

Local energy action plan (strategic mechanism) – was elaborated in the project duration and gave the guidelines for the municipality's energy future.

Eco fund - co financing measures mostly in multifamily buildings, up to 100% subsidy for low income households.

Support from University of Ljubljana (Faculty of Mechanical Engineering) during the implementation of the retrofit and RES measures, in the form of analyses, studies and measurements.

As this was a FP6 project, there was a systematic monitoring through building energy specification tables and handout certificates for each co-financed and implemented energy efficiency and renewable sustainability measure. Evaluation also included project reports, submitted to the co-financer (EU). There were two technical revisions carried out on the spot in addition to the financial revision, all positively evaluated.

BARRIERS AND DRIVERS

Key barriers:

- the project (on international level) was very complex and large-scale, which imapcted both the project management processes, and the implementation on local levels;
- poor understanding of advanced solutions (municipality and other local stakeholders);
- language: local community/stakeholders did not understand English properly, which was a barrier at consortium meetings as well as in general during the implementation of the project;
- municipalities did not have much experience in large-scale project management;
- low acceptance for change or pessimism towards change (while the support and engagement from the municipality of Zagorje was high, other local public organisations, i.e. stakeholders in the implementation of project activities, were less inclined or less optimistic about planned and implemented solutions)

Key drivers:

- Staff, skills and motivation
- Good relationships among key staff involved in project
- Available co-funding.

LESSONS LEARNED

CHALLENGES

Key challenges of the project were:

- location (distance between University and the demonstration town Zagorje);
- lower post-project funding;
- sustainability of cooperation and long-term motivation;
- some of the implemented and proposed the solutions were too advanced for the local community to fully understand, and thus support.

KEY SUCCESS FACTORS

Key success factors in the Zagorje demonstration case were:

- strong support from mayor and co-funding from the municipality, as well as their commitment to participate in project activities, which secured political and community support for the project and its activities, and also resulted a strong ownership of the project implementation and project outputs. The key turning point for successful implementation was a new young person employed at the municipality that took the initiative and carried out the required tasks.
- the project would also not be feasible without the EU funding (FP6).

Utilisation of CONCERTO initiative (now Smart cities) sustainability guidelines – all relevant social measures, energy measures tackled within the project had to adhere to these guidelines. A number of project outputs were developed as part of the project's sustainability plan, including the research unit OLEA, which still exists and functions as a demonstration, research and training site. Public and private buildings were renovated with a sustainable energy use principle, which had a long-lasting effect on the use of energy. The control system's backbone and concept (for a multi-modal utility, controlling public water, sewage water, wastewater treatment plant, public lightning system etc.) was developed with the aim to be owned and used by the municipality, and it is also continuously being upgraded. Two PV power plants operate until this day.

FURTHER INFORMATION

AWARDS AND RECOGNITION

None to our knowledge.

TRANSFERABILITY

Yes – other European cities (especially with mining heritage). The innovative application of new technologies and new renewable energy resource can be replicated all over Europe, not only to be disseminated for replication throughout the older EU-countries in, but truly as a pan-European dissemination especially including the new member states.

PUBLICATIONS

Sager, C., Schurig, M.,and Kaller, A. (2011). *Training: LowEx-Method.* thttps://smartcities-infosystem.eu/sites/www.smartcities-infosystem.eu/files/remining-lowex_training_lowex_method.pdf

Project handouts, studies and reports are available at:
http://olea.si.da05.hosterdam.com/dokumenti/

LINKS

https://cordis.europa.eu/project/rcn/85695/factsheet/en

https://smartcities-infosystem.eu/sites-projects/projects/remining-lowex

http://olea.si.da05.hosterdam.com/

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