

Perspective

Implementing SDGs to a Sustainable Rural Village Development from Community Empowerment: Linking Energy, Education, Innovation, and Research

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Abstract: Rural depopulation is a worldwide fact and has a domino effect on medium and small cities, which act as a nucleus of reference for small towns. Moreover, the United Nations (UN) stressed that disparities between rural and urban areas are pronounced and still growing over time. Globally, people in rural areas lack access to modern energy services, which affects productivity, educational and health services, exacerbating poverty, among other things. Given this reality, the following research questions arise: how can we act to reverse this reality? Are there examples of transformation in rural contexts where community empowerment is a key strategy? This paper aims at describing the transformation process of a small rural municipality towards a sustainable development, in parallel to the activation of the local productivity that helps to eliminate the effects of rural depopulation. Therefore, the project ALMIA was established as an example of a sustainable village that is Almatret (Catalonia-Spain). The backbone of such project is the commitment to community empowerment, where the main results are the generation of networks with experts and researchers to help the municipality's energy transition, the involvement of the local administration, the commitment to technological development, as well as the socio-community development. Moreover, the activities developed within the project ALMIA are aligned with the UNs Sustainable Development Goals, alignment that is analyzed in detail. Thus, this paper aims to further highlight existing sustainable development practices related to community empowerment in order to promote similar practices.

Keywords: community empowerment; energy transition; rural depopulation; sustainable development; Sustainable Development Goals (SDGs)



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1. Introduction

In 2015, the United Nations (UN) and its member states adopted by resolution the 2030 Agenda for Sustainable Development [1] with the overall goal of providing a path to peace and prosperity. This agenda ensures that all countries develop in relation to economic growth. At the same time, it aims to improve health and education, reducing inequality and tackling climate change.

All of this is implemented in 17 Sustainable Development Goals (SDGs) that include targets and actions to achieve this ambitious overarching goal.

These objectives are based on a modern conception of human development that gives relevance to health and education, overcoming the old conception that considered development as “a process of continuous economic growth, which ensures a lasting surplus of all kinds of goods, which can be used to meet human needs and enhance greater well-being” [2]. Thus understood, human development seeks the welfare and quality of life of people.

We speak of Sustainable Development because the person is at the center of all policies and efforts to improve conditions in each social context. To achieve this, three key

principles must be taken into account: (i) the promotion of remote human and socially equitable development for all humanity based on inclusion, (ii) the guidance of economic development at the service of human development, and finally, (iii) the promotion of responsible use of the planet's natural resources [3].

The 17 SDGs are inter-related and mark inclusion, security, production, and consumption as core issues for the sustainable development of human settlements (cities, towns and villages) [4]. The creation of viable human settlements becomes a clear indicator of socially and economically sustainable development.

This article focuses on rural settlements and how the SDGs can be applied to these currently vulnerable populations. It is interesting to know how we can act in these populations to promote their sustainable development by basing their transformation on community empowerment as a key strategy.

Thus, the aim of this paper is to describe the transformation process of a rural municipality towards sustainable development in parallel with the activation of local productivity that helps to reduce or eliminate, among others, the effects of depopulation. In order to do so, the global situation of rural settlements, the problems they face and the consequences that arise from them will be contextualized. Subsequently, it will be argued that it is important to focus on these settlements in order to make the development of the 2030 Agenda globally effective.

The municipality of Almatret is presented as a current example of a positive and sustainable village and the ALMIA project as a strategic plan designed for the transformation of the municipality. It is important to understand how the ALMIA project is aligned with the global implementation of the 17 SDGs, and specifically with some of them.

2. Towards a Sustainable Village

The dramatic rapid growth of cities has been a constant during the last years. It is estimated that by 2030, almost 60% of the world population will live in urban areas. This strong expansion will occur in 95% of developing countries.

This has generated problems such as high levels of exclusion and citizen insecurity, pressure on water supply, waste generation and, in short, uncontrolled production and over-consumption. These problems are even expected to become even more accentuated in the coming years.

These are the questions that SDGs eleven and twelve of the 2030 Agenda seek to address. Both goals propose that cities and human settlements in general should be inclusive, safe, resilient, and sustainable by promoting controlled production and moderate consumption.

On the other hand, rural depopulation is a fact worldwide and has a domino effect also for medium and small cities that act as a nucleus of reference for small towns [2]. A reduction of inhabitants in the region means that the supply of services, leisure, health, or education becomes meaningless, and with them, the corresponding jobs disappear. All this generates a chain effect that leads the population to seek opportunities in large cities [5]. These large concentrations of population can become unviable and unsustainable.

It is essential to have better and more sustainable cities, but it is also important to have an impact on rural populations, which are generally limited in terms of roads, electricity supply, telecommunications and other types of infrastructure that are of key importance for their development and growth. All these factors mean that the rural population receives more limited educational, health and social services, which has a negative impact on their well-being.

Let us remember that agriculture is still the main economic activity in rural territories, and despite being an activity with a high potential to support environmentally sustainable growth, there is evidence that the current form of food production is one of the main drivers of climate change [6,7]. In addition, the economic income it generates is low, and gender inequality is exclusionary [8,9].

The 2030 Agenda recognizes that rural settlements are determinant for the achievement of its goals and that public policies cannot forget that development also involves rural

areas. According to UN-Habitat (2006), sustainable human settlements involve providing adequate shelter for all inhabitants, and this involves improving management by:

- Promoting sustainable land-use planning and management.
- Promoting the integrated provision of environmental infrastructure: water, sanitation, drainage, and solid waste management.
- Promoting sustainable energy and transportation systems
- Addressing planning and management in disaster-prone areas
- Encouraging sustainable industrial and construction activities.
- Promoting sustainable human resource development.

SDG two devotes specific attention to rural areas by proposing increased investment in infrastructure, agricultural research and extension services, technological development and plant and livestock gene banks. This is the only way to reduce inequality between rural and urban areas.

We must prevent the population of rural settlements from lacking access to modern energy services because it affects productivity, educational services and even the health of the population, aggravating poverty [10].

Recently, new approaches to sustainable rural development have emerged, emphasizing the nexus between energy, health, education, water, food, gender, and economic growth.

The focus is on inclusive and sustainable development. It is about increasing productivity, creating jobs and generating income. All of this is based on social inclusion, gender equality and decent employment for young people. Development must focus on the creation of added value through the application of research and innovation (R&D&I).

On the other hand, there is a growing concern about economic and environmental development, intensified by the global energy, food and financial crises, and the COVID-19 pandemic. All this translates to a continuous warning about the transgression of planetary or ecological limits, reflected in climate change. The green economy is the proposed alternative to catalyse new national policies in support of sustainable development.

Access to affordable, reliable, sustainable, and modern energy for all would create new job opportunities, empowerment of women and youth, better education and health, and ultimately more sustainable settlements using a powerful climate change strategy.

Education is an integral element of sustainable development, not only ensuring quality, inclusive, and equitable education for children, but also including lifelong learning opportunities. Education can build sustainable societies by actively integrating citizens' education into sustainable development.

Isolation, lack of infrastructure, scarce diversification and access to services can affect the health of the rural population.

Finally, we must focus on sustainable consumption and production as key factors for the proper management of natural resources. The rational use of aquifers, the reduction of waste production and its recyclability and reuse are part of what is being called circular economy, which affects sustainable development.

At this point, is it possible to reverse reality in order to achieve sustainable development? How can we act in rural settlements to promote their development? Are there examples of transformation of rural contexts where community empowerment is a key strategy?

There are some examples of sustainable cities and towns that are making the achievement of the SDGs possible: from the Middle East (Education City to Qatar and Masdar City in Abu Dhabi), the Far East (Dongtan Institute in China, Nova Songdo City in Korea South), Ruhr, Feldheim, and Freiburg (Germany), Vancouver (Canada), Brighton (United Kingdom), Genk (Belgium), Stockholm (Sweden) [11–14]. Considering the number of existing large cities (400) and mega cities (23) [2], it is necessary to rethink their sustainability. There are also energy transition initiatives towards sustainability in small towns such as in Poland (Biskupiec, Nowe Miasto Lubawaskie, Nowy Dwór Gdąnski, Górowo Ilaweckie, Goldap or Ryn), Scandinavia (Danish Svendborg, Norwegian Skotterud, or Swedish Falköping), and Germany (Marihn, Meldorf, or Penzlin) [15]. In Spain, the island of El

Hierro has become, through renewable energies, the first self-sufficient island in terms of energy [16]. These initiatives seek to achieve local sustainable development [17,18].

An example of interest is the case of “East Village at Knutsfod” (EVK) [19], located 1.5 km from the central business district of Fremantle (Western Australia). The project aims to create semi-detached houses that incorporate solar energy storage through photovoltaic solar systems (designed to produce more energy than is consumed in the domestic environment), a battery deposit for charging electric vehicles and integration of the urban water management (through stormwater infiltration, alternative urban supplies, and biophilic urban designs) to reduce dependence on centralized water sources. With this, it is intended that the town ends up using 100% renewable energy for daily consumption [20].

In this context, the municipality of Almatret has developed the project ALMIA, with the aim of increasing its sustainable development by becoming a net positive energy village. This document presents the process that the village is undertaking and how it links all its actions (past, present, and future) to the SDGs. The objective of this article is to present the ALMIA project and the processes of transformation into a sustainable development village.

3. Almatret, an Example of a Sustainable Village

3.1. Description of the Municipality

Almatret is a small village located in the southwest of Catalonia, Spain (Figure 1) [21], next to the river Ebro in the limit with Aragon. Today, it has around 300 inhabitants in a surface area of 56.83 km². Almatret has a very rich history because Iberians, Romans, and Arabs lived in its area. The village is considered to be founded in 1301.



Figure 1. Almatret map (Google Maps, 2021) [21].

Today, Almatret’s main industry is agriculture, mainly olive and almond, and livestock industry, mainly pork industry. During the XIX century, Almatret had a lot of coal mines, when the population was as high as 2000 inhabitants.

Almatret is classified within the Continental Mediterranean climate, Bsk in the Köppen-Geiger climate classification [22]. Therefore, the town climate is characterized by having a very marked seasonality (in distribution of temperature and rainfall). In other words, summers are hot and dry, and winters are very cold [23]. Its agriculture is dry land where the almond tree occupies 41% of the cultivated land (43% of the municipal total). In addition, olive and barley are grown. Industrial activity is concentrated in the production and elaboration of olive oil. During the 20th century, there was great economic activity promoted by the exploitation of small deposits of lignite, although, at the end of the century, it went into decline.

During this time of mining splendour, there was an expansion of Almatret with the construction of a large part of the town houses, as also happened in the Apuseni (Romania) [24]. There was an increase in the population that rapidly decreased due to the abandonment of this activity with the emigration of its inhabitants to nearby centres with more services. At present, Almatret is a municipality of less than 350 inhabitants.

Its geographical location makes it ideal for the installation of wind farms. In 2003, more than 25 turbines with a nominal power of more than 50,000 kW [25] were installed, to which the last project, the Vencills wind farm, consisting of only four mills, but of a size and a higher power (24 MW), was added. Almatret is located in a geographic pool of energy production, a few kilometers from the Ribaroja reservoir and the Maquinenza thermal power plant. Moreover, from the Asco nuclear power plant and also the settlement of various solar parks, a landscape conformed oriented to the production of energy, from a past with lignite mines to the present with the different mentioned alternatives sources.

3.2. The Project ALMIA

Around 2010, the municipality of Almatret decided to initiate a new project with the aim of reversing the loss of population, jobs, and quality of life in the municipality. This led to the creation of the ALMIA project, which develops a series of actions based on three basic principles:

1. The knowledge and involvement of the inhabitants of the municipality from the community empowerment [26]. To ensure the social dimension of sustainable development, it is important to enhance social participation, the capacity for initiative and co-responsibility. Only by building a local project, such as ALMIA, with the active participation of the population, will it be possible to generate social transformation.
2. Involvement and leadership of the local administration. It is important to develop a transformational leadership [27] that motivates and encourages the community to generate changes towards sustainable development.
3. Importance of creating collaborative networks to support transformation. Networks help to eliminate isolation in rural areas and to bring innovative proposals closer.

Therefore, the actions proposed in the ALMIA Project are developed as follows:

- Production and access to sustainable, reliable, and modern energy.
- Almatret today is a net positive energy village building because it produces more energy than it uses. As mentioned above, Almatret currently produces almost 150,000 MWh per year, and its energy consumption is very low. However, the homes use wood from the area around the village as a source for space heating and domestic hot water. Moreover, most homes do not have air conditioning due to the climate conditions and the building envelope (low cooling demand). Seeking not only a production, but also a sustainable consumption, the aim is to achieve a zero-carbon village, avoiding the use of fossil fuels. For this purpose, there is a first action with the future installation of electricity chargers and providing free electric vehicles within the village to go to the nearby city of Lleida, where most services are located (hospital, university, governmental services, etc.). The other big action is the production of renewable heat both from solar energy (see below the demonstration pilots from H2020 ongoing projects) and from biodigestion of livestock wastes. This action also requires installing a district heating system to distribute this energy to the municipality households.
- Sustainable development from research and innovation and improvement of infrastructures.
- Recognizing that only through innovation such changes are possible, the municipality of Almatret involved the University of Lleida in this project from the very beginning. Very soon, the possibility to involve Almatret in the European funded project Innova MicroSolar [28], installing the demonstration site in Almatret. The aim of the project is to develop a system to generate electricity and heat based on solar energy. A linear Fresnel solar field (Figure 2) is able to heat up oil up to 280 °C to expand an Organic Rankine Cycle (ORC) to generate 2.3 kW of electricity. The condensation process inside the ORC delivers 25 kW of heat to the youth hostel building for space heating

and domestic hot water applications. Moreover, a latent heat thermal energy storage system of 100 kWh of capacity is used to expand the ORC 4 h after solar availability. The system relies on the use of heat pipes to transfer the heat from oil to PCM and the way back.



Figure 2. Fresnel solar field and youth hostel building.

Shortly after, Almatret started its participation as full partner in the European funded project HYBUILD [29], again hosting one of the three demonstration sites. Within HYBUILD, two innovative hybrid storage concepts are developed and tested: one for Mediterranean climate, focused mainly on meeting the cooling demand in residential buildings, and one for Continental climate, for which the main focus is to provide heating and domestic hot water in residential buildings. Innovative components are integrated in both systems, such as a high-density latent storage, a reversible vapor compression heat pump, a DC bus connected with PV panels to run the heat pump in DC. Moreover, the Mediterranean climate system also contains a compact sorption module and a field of Fresnel solar collectors. Other than the thermal energy storage components, an electric storage is also used to store the surplus of electricity production of the PV system. An advanced control and building energy management system (BEMS) is also implemented in the systems to ensure a proper and efficient operation. The demonstration site in Almatret is a single-family residential building (Figure 3) where the Mediterranean climate system is implemented and tested for future assessment and validation.



Figure 3. Residential building where the HYBUILD Mediterranean system is implemented.

- Community empowerment and dimensioning of the ALMIA project from an educational perspective.

The vision of renewable energies as an integrative alternative to socio-economic and environmental challenges, together with the commitment to open innovation where citizens are participants in the advances in research in energy systems, is the commitment of the proposal of the Energy Interpretation Center (EIC) and the ALMIA museum that is being developed in Almatret. This current of openness about technological scientific advances coincides with the establishment of participation mechanisms in science and innovation that allow citizens to have information and be part of the innovation system. In addition, these initiatives seek to influence the economic and social revitalization of a territory that in recent decades has been immersed in unprecedented depopulation.

The objectives of EIC are, among others:

- To promote education in renewable energy and energy efficiency.
- To contribute to formal and non-formal participatory scientific education and open to all public.
- To preserve and value the scientific, industrial, and technological heritage and its integration with the territory.
- To disseminate, communicate and enhance the research and innovation activity in the field of renewable energies.
- To investigate energy efficiency technology solutions in a participatory way.
- To act as a benchmark for social cohesion, integration, and sustainability for the municipality of Almatret.

This interpretation center is based on the inclusion of contextualization elements of the existing active energy facilities such as the wind farm and photovoltaic solar installation, as well as the recovery of the territory heritage. It will also have a museum area with exhibition, educational, and research programs that allow the carrying out of education, communication, and heritage preservation activities. The creation of a research program for the generation of integrated solutions for renewable energy and energy efficiency and the possible application of these solutions in the municipality will allow the transfer of knowledge in this area and the participation of citizens in the innovation process. The technological facilities that currently exist in Almatret are the best starting point for the visitor to find inspiration in the curiosity for science and technology, in formulating questions about the impact on their past and present life, thus stimulating reflection and knowledge. EIC, in short, is an open and public space dedicated to scientific and technical knowledge, based on rigor, credibility, accessibility and understandability.

The pedagogical paradigm that frames the ALMIA proposal focuses on the empowerment of citizens [30,31] as active actors of the project, generating a committed implication and running with responsibility. This citizen empowerment begins with the generation of a promoter group that helps to start this community process. The promoting group is made up of specialists and experts in the field (teachers and researchers) as well as technicians from the local administration. This promoter group will guide the community diagnosis phase, prioritizing the intervention strategies, planning the actions that will be put into practice to finally evaluate the process and the impact. It is very important that the inhabitants of Almatret know about the project and are involved in all phases of development. The promoter group encourages this participation, but at the same time it must establish a network of entities and organizations that help to disseminate, implement and consolidate the project. ALMIA is planted from its socio-educational aspect as an example of community development with the involvement of citizens. At present, educational activities for schoolchildren have already been generated, educational material has been generated and different practical workshops have been piloted. All this begins an educational and scientific tourism [32] oriented to the interpretation of the different sources of energy that exist in the municipality.

All these activities created the first quality jobs, one for an engineer or similar, to be able to manage all the new systems installed in the village, and a second one to lead the educational activities and the relation with schools.

4. Consistency between the SDGs and ALMIA

The Action Plan for the Implementation of the 2030 Agenda in Spain [33] clearly states that “it is not possible to achieve the SDGs by leaving rural areas and their inhabitants behind”.

ALMIA is presented as a strategic project which develops a series of specific actions within the framework of SDG deployment, which are specified in Table 1.

Table 1. Summary of the relationship between the ALMIA project and the SDGs.

SDGs	Description	Actions in Almatret (ALMIA)	First Results
SDG #1	Eradication of poverty.	Creation of jobs to fix the population to the territory.	Jobs to develop the EIC and attend visitors: one contract.
SDG #2	Attention to rural areas, investment in rural infrastructure, agricultural research, and technological development.	Generation of infrastructure to support technological development and modernization of the municipality.	Innovation infrastructure linked to the Innova MicroSolar and HYBUILD projects.
SDG #4	Education as an integral element of sustainable development ALMIA-Educational.	To generate educational and training activities for and in favor of sustainable development.	Group promoting the ALMIA-Educativa educational program to be developed with educational centers and the visiting public in general.
SDG #7	Clean and affordable energy ALMIA-Energia.	Transformation towards a positive energy village towards a zero-carbon village.	Positive village: produces more energy than it consumes: produces 150,000 MWh per year.
SDG #8	Sustained, inclusive and sustainable economic growth.	Sustainable tourism. Creation of EIC as a pole of attraction for sustainable, educational and research tourism.	Visits by educational centers during 2021 (approximately 250 people). Expansion of the visit program for the 2021–22 academic year to 1500 visitors.
SDG #9	Inclusive and sustainable industrial development.	Promotion of R&D&I with the involvement of the municipality in international projects in collaboration with university research groups.	European projects Innova MicroSolar and HYBUILD.
SDG #11	Sustainable transport.	Incentivize clean and sustainable transport related to all activities in Almatret (i.e., agriculture, mobility, tourism). Electric vehicles.	Charging points in the municipality and electric transport.
SDG #12	Ensure sustainable consumption and production patterns.	Energy transition of the municipality: transformation of energy sustainable buildings.	Refurbishment of municipal buildings for energy transition such as schools. Passive Haus construction.
SDG #13	Action against climate change.	Commitment to clean and sustainable energy generation with the creation of solar fields and wind turbines.	Solar fields, wind turbine fields, production of renewable heat from solar energy and from the biodigestion of livestock waste.

Rural development involves empowering the rural population and formulating policies that generate synergies between institutions, seeking common objectives to advance sustainable development, ensure quality of life and a better balance in population distribution [34].

When rural people are empowered, they are able to participate, decide, negotiate, influence and control so that they can strengthen their family and productive environments in the face of the invisibility imposed by the current socio-economic evolution.

Distributed and committed leadership is important, as in the case of the ALMIA project, where the city council assumed this role. It also seeks complicity with external agents such as the University of Lleida and the Provincial Council. In short, the role of the local administration is fundamental as an agent to lead the change and transition in the municipality towards a type of circular and sustainable economy.

In line with SDG #7 and SDG #13, a clear commitment has been made to the production of renewable energy, taking advantage of available local resources, in this case its privileged orographic situation. In addition, ALMIA represents a step forward in the research, development and application of new energy techniques that lead us to zero consumption of finite resources that are not very respectable with the environment. From this scientific, engineering and research dimension, ALMIA responds to SDG two and SDG nine with three projects funded by the EU:

- Innova Microsolar (2016): <http://www.innova-microsolar.eu/> (Accessed on 31 July 2021)
- HYBUILD (2017): <http://www.hybuild.eu/> (Accessed on 31 July 2021)
- Passive Haus construction: <https://passivehouse.com/> (Accessed on 31 July 2021)

Aligned with SDG 11 and from this scientific and technological dimension, different proposals are being projected in the municipality to transform buildings into sustainable buildings with an important integration of renewable energies, promoting the consumption of this type of energy: rural buildings under self-consumption, means of transport, systems heating of homes, etc. It would be a balanced use of different renewable energies that are generated by the municipality, both those that have a greater technological maturity (wind and photovoltaic) and those that are more manageable (solar, thermoelectric, biomass, among others), always taking advantage of local resources and minimizing the environmental impact and in the territory.

It is also necessary to highlight the socio-educational dimension of this project. The aim is to turn the EIC into a pole of attraction for educational centres to influence the education of young people. To this end, activities are planned that involve the municipality, generate jobs and help disseminate scientific knowledge, laying the foundations for raising awareness and involving young people in the implementation of the 2030 Agenda and the ESD 2030.

The EIC, aligned with SDG four, becomes a Learning Camp open to students from different educational stages and levels, and to the general public. The added value is to learn in situ about energy production, transport, storage, energy transition, and responsible energy consumption.

The museum part of the project adds value to the scientific and technological dimension of ALMIA. The same inhabitants will help to create a local inventory of heritage resources (natural and cultural, tangible and intangible).

This is aligned with SDG eight where the rural nucleus is transformed into a good to know and to protect. To all this, other additions are:

- To contribute to a formal and non-formal science education that is both participatory and open to the public.
- To preserve and value the scientific, industrial, and technological heritage and its integration with the territory. It would try to revalue the heritage of the municipality of Almatret.
- To disseminate, communicate, and value research and innovation activity in renewable energy matters.
- To investigate energy efficiency technology solutions in a participatory way.
- To act as a benchmark for social cohesion, integration, and sustainability for the municipality of Almatret.

5. Discussion and Conclusions

The UN objectives cannot be achieved only with top-down actions. Bottom-up initiatives, such as the one presented and analyzed in the paper, are key and necessary to reach these challenges. Almatret is a clear example of a small village fighting to overcome

depopulation and doing a good use of local resources in a sustainable way [35]. The ALMIA project is a clear example of a strategic organization based on community empowerment that promotes participation by fostering a sense of community and belonging to the group [36]. It is based on available resources, with a broad vision of the concept of resources beyond the economic, also taking into account personal capital and the possibilities of the context/environment. It is necessary to mobilize all the opportunities and strengths of the rural context to promote transformations.

ALMIA promotes networking, not only with surrounding municipalities and institutions, but also with scientific experts from the University of Lleida. This networking helps to share information, resources, processes, consolidates the commitment between actors, etc., increasing the chances of success, and all this is from the distributed leadership exercised by the municipal council, in decision making and in the development of the work, which provides greater flexibility and agility in all processes and much more efficient results [26].

The commitment to clean energy in Almatret is not limited to an economic issue but goes beyond that and is committed to the production and energy transition of the municipality itself. The promotion of the rehabilitation of buildings towards the concept of passive houses, the installation of charging points to encourage electric transport and facilitating access to sustainable, reliable and modern energy are key aspects to achieve the goal of turning this town into a positive-energy and zero-carbon village [37]. This is an approximation to what some authors propose as a leap towards a smart village based on sustainable energy with the possibility of disconnecting from the grid and producing more energy than it consumes.

Sustainable development has also been promoted through research and innovation (through European projects such as Innova MicroSolar and HYBUILD) and the improvement of infrastructures. Networking with experts who provide technical advice helps to eliminate the isolation of rural areas and to bring innovative proposals closer together. Citizens are involved in scientific initiatives and raise the problems of the municipality to find solutions. This is an effective way of implementing the SDGs, with the collaboration of citizen science, which helps to strengthen research designs in the field of renewable energies, taking into account the interests and needs of citizens [38–40].

Finally, in this effort to effectively implement the SDGs, focusing on energy and linking research, innovation and education, ALMIA proposes the creation of the EIC as a strategy to address education in renewable energy and energy efficiency, contributing to formal and non-formal participatory science education and open to all audiences, although preferably to the student population [41–45].

The idea is to influence social transformation by generating knowledge among the population that will help to involve society in the promotion of Agenda 2030 and ESD 2030. This is part of the strategy known as education for global citizenship, which seeks to involve civil society in the transformation, and this is only possible if it is educated in the commitment to the wellbeing and quality of universal life.

Influencing the education of future generations to participate and take active roles, locally but also globally, makes them proactive contributors in responding to the challenges of today's society [46,47].

Currently, the ALMIA project is beginning to bear fruit: there is increased tourism to the village with organized academic visits (more than 250 in the last year and 1500 are expected for next year). Direct jobs have been created to revitalize the EIC and indirect jobs (opening of restaurants). The production, transport, efficient consumption and storage of clean energy has become a catalytic issue, contributing to the effective implementation of the SDGs in this rural village.

The ALMIA project presents specific limitations and barriers. It is difficult to reverse the isolation and depopulation of the municipality when it is a marked trend of the last decades. Depopulation has led to the suppression of services: schools, health services, commercial infrastructures.

The low public investment by the regional and state administration hinders the consolidation of the project, which is based on local funding and the voluntary work of the project's generators (municipal managers, university professors and researchers). The leadership of the local administration is important, but changes of government after elections can slow down the implementation of ALMIA.

The environment, the investment in renewable energies, and the enthusiasm of the population of the municipality support the project, although the lack of young people involved, because of an aging population, can endanger the continuity of ALMIA over time.

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Abbreviations

SDGs	Sustainable Development Goals. There are 17 Sustainable Development Goals (SDGs), which are an urgent call for action by all countries (developed and developing) in a global partnership
ESD	Education for Sustainable Development. This action empowers learners of all ages with the knowledge, skills, values and attitudes to address the interconnected global, environmental degradation, loss of biodiversity, poverty and inequality
BEMS	Building Energy Management System. It offers monitoring, metering, as well as submetering, functions which help collect energy data, giving property managers and owners a comprehensive insight on building's energy usage
ALMIA	Name of the project that aims at increasing the sustainable development of the village of Almatret by means of becoming a positive energy village. The acronym comes from joining the name of the village (Almatret) with the word energy in Catalan (energia), i.e., ALMatret+energIA
EIC	Energy Interpretation Center
DC	Direct Current

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