Ref. Ares(2025)3504348 - 30/04/2025

D5.4 Guide “Regional energy community standard model”

(First version)

Project Title	JOINING ACTORS FOR LOCAL DEVELOPMENT OF NEW LARGE-SCALE REGIONAL ENERGY COMMUNITIES
Acronym	LIFE21-CET-ENERCOM-JALON
Grant Agreement	101076395
Coordinator	Universidad Politécnica de Madrid

Deliverable title	D5.4 Guide "Regional energy community standard model" (First version)
Work package	WP5
Lead partner	UPM
Type	R - Document
Dissemination Level	PU Public
Due Date	30 April 2025
Version	1.0

Disclaimer
Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them.

Statement of Originality
This deliverable contains original unpublished work except where clearly indicated otherwise. Acknowledgement of previously published material and of the work of others has been made through appropriate citation, quotation, or both.

Content

1. Executive summary

This guide cannot be a guide. This statement may seem surprising, but this is because there is not yet enough experience to allow us to consider that a scientific paradigm exists for how a renewable energy community (REC) should be designed, established, and implemented on a regional scale. Section 3 of this document addresses why this paradigm does not yet exist. Therefore, this document, despite its title, is not a guide presenting a standard model that can be replicated with a guarantee of success. It is a sharing of the experience gained in the design, establishment, and implementation of the Renewable Energy Community of the Calatayud Region (CERCA), on a regional scale, with its positive lessons and, above all, its lessons of what should not be repeated. This experience is communicated with the intention and responsibility of contributing to a model of the new paradigm and of converting those who still inhabit the old paradigm.

Those who wish to replicate the CERCA experience without prior reflection on the paradigms should go directly to section 4 of this document, which summarizes the pillars of the CERCA renewable energy community design. A regional-scale REC established through participatory processes to ensure the genuine participation of its members, aimed at maximizing the positive local impact with the goal of reversing the depopulation trend in the villages of this region. Creating a single regional energy community has many advantages over each town establishing its own REC.

Finally, Section 5 summarizes the experience gained during two and a half years of designing, establishing, and implementing the CERCA renewable energy community in the Calatayud region. This experience is presented in the form of fact sheets containing the lessons learned so far in the various phases required to launch a renewable energy community: design, seeding the idea in the region, building commitment in the villages, financing, installation, and management of the renewable energy community. These lessons may or may not be useful to those who wish to follow a similar path. They may not be directly transferable, but they will certainly serve as inspiration and, hopefully, prevent from making the same mistakes we made.

2. Objective

The aim of this document is to serve as a basis for guiding steps in the creation and implementation of a bottom-up large-scale renewable energy community (REC) at county or regional level in depopulated rural areas of Europe. The goal of such an REC is to maximize the local impact by generating electrical energy by photovoltaic (PV) systems installed in the region, whose energy is consumed by the REC participants and can be aggregated, distributed, supplied, stored, and developing other energy services. The approach for such a purpose is based on the collaboration between citizens and local authorities to respond to the social expectations and local needs. Depopulated rural areas in Europe are, in general, characterized by:

- Low population density,
- Migration process to cities,
- Ageing population,
- Lack of basic services (education, health, communications, etc.),
- Poor organizational structures to implement local initiatives.

The implementation of a regional REC responds to the need to overcome these barriers, as compared to the option of implementing small local RECs, the regional REC has the following advantages

- It creates "community" since the REC joints regional actors for a common purpose.
- It allows the participation of every village, even the smallest, which does not have the organizational capacity to create and manage a REC.
- PV systems are cheaper due to economies of scale through joint purchasing.
- It centralizes the administrative management to obtain permits, legalize facilities, and in general, it assumes the role of interlocutor with the local and regional authorities and the electricity distribution company.

3. Introduction: Is there an established paradigm for RECs?

Developing a guide for the design, establishment, and implementation of a regional renewable energy community (REC) presupposes knowledge of how to implement it according to an established and widely recognized model. In other words, there is an established paradigm for how a REC should be developed.

Therefore, it is appropriate to reflect on whether such a paradigm exists.

Background: Absence of paradigm

The speed of the changes we have witnessed lately reveals one of the paradoxes of human beings: that they are too small for the great time and, however, too large for the small time[1]. Our personal micro-existence is too brief to properly appreciate the temporal dimension of the evolution of our planet and the species on it. However, at the same time, our lives are too broad to be able to healthily assimilate the urgent changes to which our own civilization is subjecting us.

One might expect that human beings, also subject to Darwinian laws, would have survived this stress through the overcoming that comes with patient adaptation over the years. But no; once again, human beings, the centre of nature, suffer the paradox of being a newcomer to it, of being the species awarded last place in the race to appear on the terrestrial scene. And so, of the 4.5 billion years of Earth's existence, it has only been a million and a half years since a being that can be called a terrestrial human existed; only 200,000 years (the Palaeolithic) since the emergence of Homo sapiens; barely 10,000 years since the great qualitative leap of the Neolithic, when the first sedentary groups of farmers and ranchers appeared; and only 5,000 years since the emergence of history's first great cultures and religions. It could be said, then, that (taking a small, though more than dubious, etymological leap) the term homo (which really comes from humus, earth) derives from "humo" (smoke in Spanish), a symbol of ephemeral temporal existence, and that in this great time of our mother Earth, we have done nothing other than reach the smoke of candles, although, yes, with great force.

Well, it is so, following Carlos Díaz [2], we can affirm that the human being is an animal that has not yet been established, of recent arrival and, therefore, in evolution, and that, nevertheless, has made great technological progress. To illustrate, it's enough to imagine "the beginning of history 50,000 years ago, and that, during that period, life expectancy would have been 62 years. Well, today we would be in our 800th lifetime, of which 650 would have been lived in caves; all generations up to the 70th before us would have been ignorant of the written word; only in the last 6 would the printed word have been made available to the general population; only in the last 4 would exact time reckoning have existed; only in the last 2 would we have enjoyed the electric motor and, therefore, household appliances; and only 1, ours, number 800, would have known most consumer goods, within which, exclusively in the last three decades, telematic and communication networks have spread." Suffice it to say that the parents of this writer didn't know television until well into adulthood, and that personal computers didn't exist in our childhood.

[1] C. Díaz, *Las claves de los valores*, EIUNSA, 2001.
[2] C. Díaz, *El hombre, animal no fijado todavía*, PPC, 2000.

This exponential evolution in the field of technological knowledge leads to anecdotes such as the following:

"In 1825, newspapers, faced with the newly opened 40 kilometres per hour railway, wrote: "with that speed, the blood pressure of travellers will rise, and cows grazing peacefully will get dizzy".

In 1876, a Boston newspaper commented on the invention of the telephone: "Well-informed people know that it is impossible to transmit voices over wires, and that if it were possible to do so, it would be of no practical value".

In 1878, after observing electric light at a universal scientific exhibition, a British professor wrote: "When the Paris exhibition ends, the electric light will be gone, and will no longer be heard of".

In 1895, the mathematical physicist Lord Kelvin declared: "Flying machines heavier than air are absolutely impossible".

In 1899, Charles Duell, no less than the director of the US patent registry, commented: "everything that can be invented has already been invented," which is why he advised the White House to close the registry.

On August 2, 1968, Business Week wrote: "With more than fifty foreign brands of cars already being sold in the U.S., it is not at all likely that the Japanese auto industry will capture even a small percentage of the American market.".

In 1977, Ken Olson, then prominent president of Digital Equipment Corporation, proclaimed: "There is no reason for an individual to have a computer in his own home"[2].

If we look more closely at the history of electrification, and more specifically, the emergence and evolution of photovoltaic technology, we can see that they do not escape this frenetic contextualizing framework.

The journey of electricity begins in the not-so-distant year of 1821 with Faraday's discovery of the phenomenon of electromagnetic induction. He demonstrated that the movement of a magnetic field produces an induced current, the foundation of future power plants. But it wasn't until later, with the introduction of the first incandescent electric light bulb in 1879, that Edison paved the way for domestic lighting in large cities. One of the earliest recorded forms of power transmission is the 1.35 kV line between the towns of Miesbach and Munich, 57 km apart, inaugurated in 1882 for the International Electrical Exhibition in Munich. It was during this period that pioneering household appliances first appeared in history, as we can read in a contemporary publication[3]:

"At the 1896 Electrotechnical Exhibition held in Stuttgart, the Schuckert company had installed a very unusual electric stove. According to a German publication, the stove was much smaller than the so-called economy stoves because the wires took up much less space than the oven and chimney. In addition to the water tank, it had special compartments for frying, heating, and roasting food. A series of appliances for beating eggs, peeling potatoes, washing dishes, etc., were powered by electricity. The water

[3] J. Broutá, *La Ciencia Moderna,* Montaner y Simón Editores, p. 244, 1897.

contained in a large washing-up tank could be heated to 50 degrees Celsius in just a few minutes, using electricity. The entire kitchen was a true gem. No smoke, no stench, no heat, no unpleasant odours could be perceived, and everyone who visited it was convinced that it was an ideal kitchen, the kitchen of the future. Now readers will ask: Why aren't electric stoves adopted everywhere? Well, simply because they are still expensive".

The first reports of electric lighting in Spain date back to 1858, when the Plaza de la Armería and the Congress of Deputies in Madrid were illuminated with electricity supplied by a galvanic battery. By 1886, Girona was already being hailed as the second fully illuminated city in Europe, and in 1901, the first alternating current transmission line was developed between the Molino de San Carlos and Zaragoza, a 3-km long line. In the El Imparcial newspaper of March 26, 1897, the following definition of electricity could be read, a faithful reflection of the admiration this type of energy aroused in the country: "Electricity, that marvellous fluid for generating light, for generating heat, for transporting power, for performing tasks, from the most subtle, from those requiring the fingers of a fairy to those requiring the muscles of a titan, is the ultimate form of human progress in all matters relating to industry"[4]. In 1917, there were eight electric lamp factories in Spain, producing 848 GWh of electricity annually, and consuming approximately 50,000 tons of oil. Today, barely a century later, we produce more than 262,000 GWh of electricity, consume 59,580,000 tons of oil, and, to give an example, we have more than 1,400 hydroelectric power plants, a reservoir capacity of more than 56,000 Hm^3, and approximately 800 reservoirs. Nuclear energy also contributes to this, with the first Spanish nuclear power plant (Zorita, Guadalajara) being installed in 1968, just 30 years after the discovery of atomic fission. This creates a global energy consumption reality in which, in every 14-year period, humanity consumes as much energy as it had consumed in all of previous history.

Much more modest, photovoltaic solar energy also did not escape this dizzying growth. Although the photovoltaic effect was discovered by Becquerel in 1839, the first known solar cell was not built until 1941. Its application was restricted to military space use until, with the 1973 oil crisis, its use for terrestrial applications was boosted. Since then, the photovoltaic market has grown spectacularly: while at the beginning of the 1990s barely 50 MWp of photovoltaic panels were produced, by the end of that same decade the production figure had tripled[5]. The developed country market is experiencing rapid growth due to grid-connected installations, strongly driven by various programs. Spain, which manufactured its first industrial module in 1982, developed the first major rural electrification program to supply remote areas not yet served by the grid. Today, Spain is one of the countries with the largest installed photovoltaic capacity in the world.

This exponential growth of technological innovations means that more innovations are being thrown at us than all of past humanity combined, and the only thing we can predict about the future is precisely its unpredictability. We are a species from which anything can be expected, which lives in a continuous race against time, for which there is no longer a past, nor even a present, but everything is future. Let's see who dares to predict the future, if every morning begins anew, if every surprise is dispelled by a greater surprise, if we are permanently starting a new human species. The dawning tomorrow is so immense and overwhelming that the past seems tiny and distant. Those who look to

[4] J. Broutá, *La Ciencia Moderna*, Montaner y Simón Editores, p. 241, 1897.

[5] International Energy Agency, *Trends in photovoltaic applications*, Informe IEA-PVPS T1-08:2000, 2000.

the past are left behind in the technological race; only research into what is yet to be discovered is funded; the future prospects for technological values rise on the stock market; those who don't know how to access the Internet are considered illiterate... we live in the realm of obsolescence, progress, and the future.

However, this technologically developed human being has not evolved equally in other areas, especially morality. Science and technology have managed to achieve universally accepted axioms, yet in ethics, what is good for some is bad for others, and for the majority, it depends. And so, what is difficult (such as reaching the moon or generating electricity with the sun) becomes easy, and what seemed easy (being good) becomes complex, with great social cost for the majority of humanity, who die of hunger, suffer thirst, or remain without light, when, technologically, there would be a solution. It is true that the basic consensus on the Universal Rights of Man has been reached, but agreement on the duties that must be assumed for these rights to be such in practice is far from being achieved. We are, then, an etymologically sick animal (“enfermo”,in-firmis, not firm), since one of our supporting legs is hypertrophied, the technological one, while the other, the ethical one, remains atrophied (and sometimes seems to be in retreat). Beyond our time on the terrestrial stage, it is in this imbalance that our evolutionary infancy as a species lies.

The panorama formed by, first, being a young species on the evolutionary scale, needing time to mature; second, by the acceleration of technological progress, which makes it difficult to take into account accumulated past experience; and finally, by the lack of universality in ethical criteria, which leads to different positions regarding reality, makes it difficult to establish reference models to follow in any field, and even more so in those that science has recently placed in our hands. Regarding rural electrification with solar photovoltaic energy through renewable energy communities, this lack of paradigms is evident. If we consider the number of people who share solar photovoltaic energy through renewable energy communities and compare it with those supplied by the conventional electricity system, the resulting ratio is extremely low, indicating that we are at the beginning and that the solutions we are providing are nothing more than attempts to find paths in an unexplored jungle.

This reality is compatible, however, with the frequent folly of those who, either through a lack of looking to the past, or through being caught up in the whirlwind of the future, or through adolescent self-assertion, believe they have found the philosophic stone of rural electrification with renewable energy communities, proposing their model as a universal reference model without even waiting to analyse the results of their initiative. Anyone who has dedicated their professional life to this field will be able to relate these supposed role models to the dominant trends, typically in economics and regulatory policy, and will be able to engage in the interesting exercise of reviewing what has been considered "politically correct" in the short history of renewable energy communities. Thus, programs to promote CER have been implemented even before regulating them, both publicly and privately, in a centralized and decentralized manner, free of charge or at great cost to the user, with large and small systems, with productive applications or only with domestic services, ... The most that can be said is that the results of these experiences have been mixed and that, in any case, they have not been sufficiently evaluated or analysed to know, firstly, what effects have been derived from them, and secondly, what factors have contributed to the positive aspects and what elements have caused the negative ones.

In other words, those who handle the theory of introduction of innovations[6], the RECs have only electrified a smaller number than this theory considers necessary for the innovation to be accepted by the social framework (that is, for the market alone to allow its evolution) and, therefore, have only reached the so-called "innovators", those considered eccentric by the rest of the population, open to innovations, and with sufficient economic capacity to allow themselves the risks of the unknown. The number of RECs would have to be much greater and reach a much larger population for this phase to be overcome and a paradigm to be reached that would allow the autonomous expansion of the RECs.

Finally, in ethical terms, there are no paradigms for RECs either. We are currently witnessing political and social dogmas and ideological positions that defend development and implementation strategies and models that are not supported by the success of past experiences. Therefore, beyond their claims to universality, they can only be valued as new attempts to find solutions to the problems posed today by the challenge of the energy transition, but whose aspirations will only be confirmed by time.

This document is intended as nothing more than a contribution to the search for a paradigm that allows for reliable implementation of RECs with solar photovoltaic energy in rural areas, with high levels of service quality, and sustainable over time. Obviously, we do not ignore the analysis made above and share the hypertrophies and atrophies characteristic of our time. Therefore, we seek only to make a contribution to this search based on the premises that our fieldwork on rural electrification projects in different countries around the world, in the quality control of large photovoltaic power plants, and our experience developing RECs have led us to. We will not fall into the oblivion of the past: the analysis of the reality of RECs based on our experience designing, participating in, and evaluating numerous rural electrification programs in rural areas of the impoverished world and developing RECs in the Calatayud region, has been the platform for learning and reflection that informs these pages. Nor is it an ethically sterile endeavour (one might wonder if any endeavour can be neutral in this area). We start from the fact that people are central to the Universe, including those living in increasingly depopulated rural areas, and this guides our strategy of searching for electrification paradigms with renewable energy sources. Therefore, approaches that do not safeguard the basic dignity of the person will not be ours. Our experience over these years tells us that this approach has not only kept us from the state of the art in photovoltaic systems, but has led us forward along paths where technical excellence and human dignity can go hand in hand. This path, moreover, has given us as traveling companions a number of very knowledgeable friends of photovoltaic technology and experts in its implementation in rural settings.

In the absence of paradigms, asking the right questions

A reality characterized by the absence of reference models runs the risk of disorientation. This loss of direction lies not in the absence of answers on which to base our action, but rather, precisely, in the confusion when it comes to presenting the questions that have to do with the resolution of the problem at hand. It happens, then, as with that army fighting against an invisible enemy, and despite having weapons of unparalleled capacity until then, they fired at will in any direction, being themselves wounded by their own

[6] E.M. Rogers, *Difussion of Innovations*, Free Press, 1995.

bursts. This inability to aim, to distinguish relevant from irrelevant questions when directing action, was already masterfully expressed by our brilliant Cervantes:

"... que hay algunos que se cansan en saber y averiguar cosas que, después de sabidas y averiguadas, no importan un ardite ni al entendimiento ni a la memoria...." ("...that there are some who tire of knowing and finding out things that, once known and found out, do not matter a jot to either understanding or memory....", Quijote II, cap. XXII).

If we carefully analyse the reality of rural photovoltaic electrification with RECs, we will observe that it does not escape this defect:

- The irrelevant questions:
  - If we look at consultants or companies in the sector, there will be only one predominant concern: how to design a photovoltaic system in terms of the size of the generator and battery to meet a given energy demand while minimizing costs. We have invested so much time studying the consumption of those interested in participating in the REC to recommend the size of the photovoltaic generator that would maximize the profitability of their investment! Since this criterion led to relatively small systems that, while leading to self-consumption rates of 60%, only covered 30% of their bill, the interested people told us, "Thanks for the study, but I want a larger installation." Our question did not interest them.
  - Identifying REC with photovoltaic self-consumption is a reduction that disables the REC from its true dimension and diminishes its impact..
  - Another irrelevant question is how to obtain a grant so that potential participants will eventually join the REC. The deadlines for these grants are so tight that they fail to respect either the social processes or the time required for the REC to be characterized by real member participation. And the most curious thing is that these grants contribute almost nothing to the economic viability of the REC.
- The relevant questions:
  - All REC business plans are long-term and show very interesting indicators in economic terms and CO2 savings in environmental terms. But they assume a hypothesis that rarely occurs: that the means are in place to ensure the photovoltaic system is of the quality that it will function as expected over the long term. How to ensure this long-term quality is, therefore, a very relevant question. Training local installers, including technical specifications in the contract, and quality control procedures are well-known but rarely implemented measures to guarantee this high quality.
  - The REC is not only a vehicle for the energy transition but also for social mobilization in the face of problems such as the trend toward depopulation in rural areas. But to achieve this, it is necessary to preserve one of the defining characteristics of RECs: the genuine participation of their members. How to reach them, raise their awareness, and engage them in REC are questions that need to be answered for the success of REC as a REC.
  - The REC is integrated into an existing social system, on which it depends and with which it must interact. This is especially true regarding its integration into the electricity system and the procedures and permits for its installation and legalization. Failure to consider these aspects seriously

affects the viability of the REC and, in the best-case scenario, leads to significant delays in its implementation.

- At a historic moment marked by climate change and the crisis of fossil fuel depletion, RECs are taking on a new dimension: that of providing energy security. Making RECs a vehicle for securing electricity supply in the event of potential power outages from the conventional system is, although not yet widely understood, one of their main tasks.

There are many other relevant questions, and even more irrelevant ones. Identifying the relevant ones and discarding the irrelevant ones is a matter of avoiding prejudices and preconceived ideas and knowing how to listen to reality.

In the absence of paradigms, share the experience

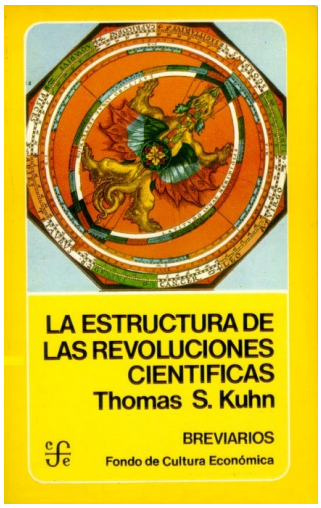
Thomas Kuhn[7], with his best-known work, *The Structure of Scientific Revolutions*[8], provides a framework for reflecting on changes in scientific paradigms and the application of technology. It promotes a conception of science that rejects the idea that scientific progress is cumulative and instead emphasizes the revolutionary process that leads to the rejection of an old theory and its replacement by a new one, incompatible with it.

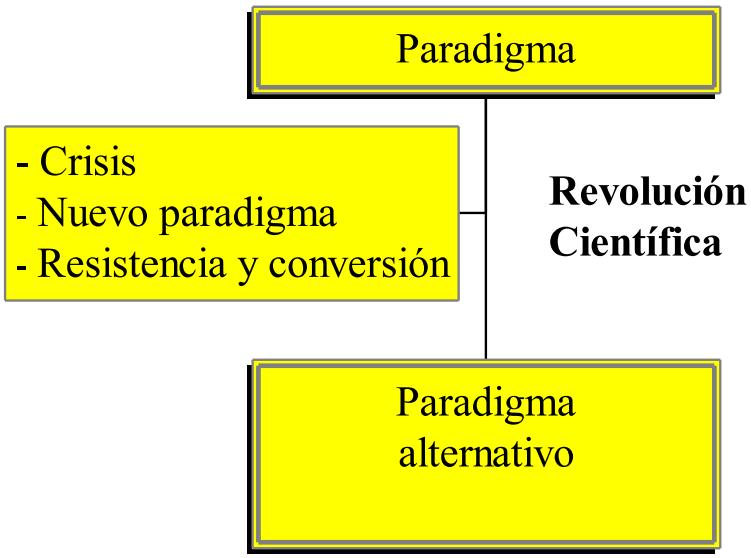
Kuhn's sociological approach to scientific change represents a revolution in the study of science. From this perspective, Kuhn asserts that science does not develop through the accumulation of individual discoveries and inventions, but rather that a scientific revolution is an episode in the non-cumulative development of science, in which the scientific paradigm is replaced by a new and incompatible one. In this way, Kuhn introduces the concepts of paradigm and scientific revolution.

Kuhn helps us understand how we transition from one scientific paradigm to another. Just as political revolutions arise after widespread public discontent over the poor functioning and abuse of existing institutions, scientific revolutions begin when, at least within the scientific community, dissatisfaction with the poor functioning of the accepted paradigm spreads (Crisis). Secondly, just as political revolutions generate new institutions that replace the old ones, scientific revolutions also end with the acceptance of paradigms incompatible with the old ones, with resistance from those who remain attached to the old paradigm (Resistance). And thirdly, similarly to how, in political revolutions, the opposing sides resort to techniques of mass persuasion (including violence) to defeat each other, in scientific revolutions, in addition to logic and experience, techniques of persuasion, proselytist or recruitment of followers that end in conversion to the new paradigm (Conversion) are very effective. Crisis, resistance to new ideas and conversion to them are social phenomena that accompany scientific revolutions.

[7] Seguiremos aquí a A. Rivadulla, en el capítulo "*El enfoque sociológico de Kuhn de las revoluciones científicas*", dentro de la obra coordinada por W.J. González, *Aspectos metodológicos de la investigación científica*, Secretariado de Publicaciones, Universidad de Murcia, 1988.

[8] T.S. Kuhn, *La estructura de las revoluciones científicas*, Fondo de Cultura Económica, Madrid 1975.





According to Kuhn, a symptom of crisis is the proliferation of versions of a theory. Crisis, which is a prerequisite for the emergence of new theories, reflects the prevailing confusion surrounding a paradigm. Its end coincides with the emergence of a new paradigm, the acceptance of which requires the community to develop a campaign to recruit followers. Kuhn, in his work The Copernican Revolution, cites as an example of crisis the situation faced by Ptolemaic astronomy in the early 16th century, whereby the Earth was considered the centre of the universe. Ptolemaic astronomy explained the motions of the planets with a high degree of accuracy, but there were a small number of unexplained cases. This led to the emergence of variations on Ptolemaic theory, all under the same paradigm, and also motivated Copernicus in his search for alternatives: "*After thirteen centuries of fruitless research, a restless astronomer (Copernicus) might well ask himself whether other attempts might not have a better chance of success*"[9].

How can revolutionary scientists convince others that their way of seeing science and the world is the correct paradigm? Kuhn asserts that two circumstances favour the assimilation of the new paradigm in an individual's mind: "*Their attention has been intensely focused on the problems that provoke the crisis; moreover, they are usually so young or so novices in the field in crisis that practice has committed them less deeply than most of their contemporaries to the worldview and the rules determined by the old paradigm*"[10]. But, as we have already mentioned, the new paradigm is incompatible with the first, hence the inevitable resistance. It is the theoretical and methodological commitments, the accepted theories and rules, which, when considered as norms, provide the criteria for accepting hypotheses and explain resistance to innovations. In other words, what Kuhn asserts, and calls resistance, is that scientific work is guided by the accepted paradigm, since professional recognition is obtained primarily by contributing to the subsequent articulation of the paradigm within the limits set by established technical and cognitive norms.

[9] T.S. Kuhn, *La revolución copernicana*, Ariel, Barcelona, p. 192 1978.
[10] T.S. Kuhn, *La estructura de las revoluciones científicas*, Fondo de Cultura Económica, Madrid, p. 224, 1975.

The process that, according to Kuhn, overcomes resistance is conversion. But how does this happen? How is it that the transition from one paradigm to another takes place through a process of conversion, that is, outside of any rational explanation of the matter? Kuhn responds that the competition between paradigms is not the kind of battle that can be resolved through proofs. However, he clarifies that the assertion that logic is not decisive in the choice of a theory does not imply that logic can be dispensed with, nor that there are no good reasons for the choice. The problem is that these reasons are merely values to be taken into account in the choice of a theory, not rules for the choice itself. It is the incompatibility of competing paradigms that makes the resolution of scientific revolutions not at all like a logical or mathematical proof, but rather like a process of individual conversion. That's why Kuhn speaks of a scientist who adopts a new paradigm must have faith that it will succeed in the face of the many problems it must face and must gain new followers: "*For a paradigm to triumph, it must gain some initial adherents, men who will develop it to the point where tenacious arguments can be produced and multiplied. (...) What occurs, rather than the conversion of a single group, is an ever-increasing shift in the distribution of professional loyalty. At first, a new candidate paradigm may have few supporters, and sometimes the motives of those supporters may be suspect. However, if they are competent, they will improve it, explore its possibilities, and show what it would be like to belong to the community guided by it. As this process continues, if the paradigm is destined to win the battle, the number and strength of the persuasive arguments in its favour will increase. Then more scientists will be converted, and the exploration of the new paradigm will continue. Gradually, the number of experiments, instruments, articles, and books based on the paradigm will multiply. Still other men, convinced of the usefulness of the new vision, will adopt the new method for practicing normal science, until finally there will be only a few who continue to resist it*"[11].

We can analyse the problem of the absence of a paradigm for the design, constitution and implementation of RECs in light of Kuhn's Crisis, Resistance and Conversion cycle.

The old paradigm of the electrical system is centralized, based on large power plants that use fossil fuels to generate electricity, which is distributed through long distribution lines to the points of consumption. This system and its paradigm are strategic for a country as they are the foundation of its organization. In this sense, paradigm and civilization go hand in hand.

This paradigm has entered into crisis for two fundamental reasons. The first is the combination of climate change and the depletion of fossil fuels. The second is the emergence and lowering of electricity generation technologies that do not require concentration for efficient production (renewable energy), thus opening the door to distributed generation.

It is precisely the emergence of these renewable technologies that has allowed the proposal of a new alternative paradigm: a decentralized one in which electricity can be produced where it is consumed with renewable technology.

Within this new paradigm, different models are being developed: distributed photovoltaic self-consumption systems, large photovoltaic power plants and wind farms, with or

[11] T.S. Kuhn, *La estructura de las revoluciones científicas*, Fondo de Cultura Económica, Madrid, p. 245-246, 1975.

without integrated storage, renewable energy communities, etc. There are also different promotion and management models: those based on the leadership of governments and traditional electricity companies (top-down) and those led by civil society initiatives (bottom-up). The energy transition process driven by Europe is a manifestation of this alternative paradigm promoted from above. And the REC is one of the main examples of an energy transition designed from the bottom up.

Resistance takes various forms even in a context of energy transition driven by the effects of climate change:

1. The most straightforward approach is to use the old paradigm but with new technology, that is, to reproduce the centralized system but this time with large photovoltaic and wind power plants. Nothing changes; it remains centralized, still uses complex and expensive distribution systems, and is still promoted from the top down by governments and large electric companies.
2. Creating top-down RECs, without real participation. This is a large part of the RECs we know so far. The same electric companies from the previous paradigm install a photovoltaic system in a neighbourhood of a large city and offer its residents electricity from this system. Another variant is a city council that installs a photovoltaic system for its various supply points and calls it a REC. In none of these alternatives is there real participation from its members, nor bottom-up processes, nor any other characteristic that defines RECs.
3. Believing that RECs are just a small thing and that the big thing, the thing that really provides reliable energy, can only be done by the previous paradigm.
4. Campaigns against renewable energy are fortunately disappearing as these technologies become cheaper.

Is there a conversion? We can answer affirmatively, although still only among early adopters, what Kuhn calls the first believers. We are still in the phase of the emergence of multiple models, without any of them having taken hold and without a new stable paradigm having yet been established from which we can boldly call for the conversion of those still attached to the old paradigm.

In this scenario, the only option is to share experiences that are attractive and that contribute to jointly establishing a model that prevails.

This document, despite its title, is not a guide presenting a standard model that can be replicated with a guarantee of success. It is a sharing of the experience gained in the design, constitution, and implementation of the regional Renewable Energy Community of the Calatayud Region (CERCA), with its positive lessons and, above all, its lessons of what should not be repeated. This experience is communicated with the intention and responsibility of contributing to a model of the new paradigm and of converting those who still live in the old paradigm.

This "non-guide" guide presents below the organizational and technical model that CERCA has adopted and the lessons learned in the different phases of its design, constitution and implementation.

4. CERCA Renewable Energy Community Model

History of its conception

The Renewable Energy Community of the Calatayud Region, "CERCA," was born out of concern among a group of residents of the Calatayud Region for the future of their villages in the face of depopulation and the relocation of their companies. Calatayud is located in one of the regions of the so-called empties Spain.

This concern prompted them to visit the Photovoltaic Systems research group at the Solar Energy Institute of the Polytechnic University of Madrid (IES-UPM) with the following questions: Could energy communities contribute to the future of our villages? If so, would you help us?

IES-UPM travelled to the Calatayud region on several occasions to learn about its situation, the perceived needs of its residents, associations, businesses, and town councils, its economy, and its depopulation problem. With the information gathered, IES-UPM reflected on the possibility of creating renewable energy communities in that area and their characteristics to address the stated problem. The conclusion was that renewable energy communities could indeed contribute to reversing the depopulation trend in their villages, provided they met the following characteristics:

1. *Regional energy community*: a single large-scale energy community in the region to facilitate self-production and shared consumption of energy from photovoltaic systems to be installed in the various villages in the region with technical solutions at the village level and technical solutions at the regional level.

   At the village level, a resident belonging to the energy community will be able to invest through the energy community and install a photovoltaic system on their roof and share the surplus energy they do not consume with their neighbours in the energy community who do not have a well-oriented roof, or with businesses or companies that do not have roofs, or with the City Council, for example, for public lighting or other common services (pavilion, cultural centre, etc.).

   Residents who share their surplus energy will receive financial compensation, and those who consume will pay a significantly lower price than they currently pay to the electricity company. This way, everyone wins.

   In addition, residents, businesses, companies, the Town Council, and village associations belonging to the energy community, who so wish, will be able to make small financial investments in a photovoltaic installation on village land to share and sell electricity to other consumers in the village. Investors would receive a small return, and consumers would have access to clean, significantly cheaper electricity than the current one.

   At the regional level, members of the regional energy community will be able to make small investments in medium-sized photovoltaic plants at strategic locations in the region to share and sell renewable, low-cost electricity at a fixed price for 20 years to regional companies through peer-to-peer agreements. The energy price will be an incentive for local companies to grow and generate employment in the area and will also attract new companies to the region.

2. *Establishment through participatory processes*: The underlying motivation behind the new energy community promoted by the European Commission is for citizens to actively participate in the energy transition by self-producing and self-consuming

clean electricity, but also by changing their energy habits to become "close to zero-emission citizens." Therefore, a genuine energy community must be established through participatory processes involving the citizens themselves, and in this case, within the Region. This ensures that the design of the energy community, the levels of participation, the organization, and the technical and legal solutions respond to their needs and initiatives.

3. *Real participation*: In addition to participatory processes, the litmus test of real participation is the funding. Therefore, at least 40% of the investment in the energy community's photovoltaic installations will be made through microinvestments from residents, municipalities, businesses, industries, and associations that wish to participate. These microinvestments are the key to entering the energy community. Investment will not only be required in photovoltaic installations, but also in land and other goods and services necessary for self-production and self-consumption. Those who donate these assets will have a stake in the energy community based on the value of those goods and services.

   The fact that the regional energy community is based on micro-investments from its participants does not mean that subsidies and/or external investments should be waived, but it does mean that the micro-investment of the participants must be significant.

4. *Members of the regional energy community*: The future of the region's villages has several dimensions, such as the social and environmental, but when the people of the region express their concerns, they are primarily referring to the loss of population, economic activity, and employment. For self-generation and self-consumption of electricity at the regional level to materialize into sustainable economic activity and to establish a stable population, it is absolutely essential that all stakeholders in the region participate, including economic stakeholders: residents, town councils, businesses, industries, and associations. They must be on equal terms and comply with the rules and organization resulting from participatory processes.

5. *Promoting regulatory changes*: As expected, the regional energy community has been established in accordance with current legislation, particularly with regard to shared self-consumption. However, participatory processes should discuss the regulatory changes that should be demanded and promoted to adapt the regulations to the specificities of the decentralized rural areas of the emptied Spain. We have identified these changes:

   a. *Dynamic distribution of surpluses*: Currently, only a static distribution of surpluses from a photovoltaic installation is permitted among a certain number of residents and in a fixed amount. This distribution can be changed four times a year. Our towns, with populations that fluctuate throughout the week and throughout the year, and with seasonal economic activities, required a dynamic, real-time allocation of surpluses among potential consumers of the energy community.

   b. *The pooling of generation and consumption among community members*: currently, this is only permitted through intermediaries registered with the various electricity system institutions. However, to fully utilize the decentralized generation in our villages and optimize self-consumption across the region, the regional energy community itself must be able to

aggregate energy. Otherwise, only urban and centralized sources can be optimized.

c. The sale of electricity between a generating point in the region and a distant consumption point within the region under a long-term fixed-price arrangement (called a PPA contract) is only possible if the consumer is direct, which is not the case in our villages. *To establish the microPPA contracts for non-direct consumers* that we need in decentralized rural areas, it is necessary to promote this.

Creating a single regional energy community has many advantages over each town creating its own community:

- On the one hand, it greatly *simplifies the administrative procedures* for establishing and managing the community: there is only one energy community for the entire region, so all administrative management is simplified.
- On the other hand, *lower prices can be obtained* by purchasing photovoltaic systems together. We even plan to train local installers and electricians to undertake projects in the region.
- Third, *technical specifications and quality control procedures* can be implemented to ensure the quality of the components and photovoltaic systems installed in the region. In a context of a boom in self-consumption photovoltaic installations, poor implementation is a real risk.
- Fourthly, *resources can be used much more efficiently* by pooling energy production and consumption across the region..
- Fifthly, it allows the *promotion of economic, social and environmental projects* at the regional level that would otherwise be impossible.
- And finally, *villages* that, due to their *small size* and management capacity, could not do so alone, *can benefit from this opportunity*.

Due to the decentralized nature of rural areas, fragmented solutions are often proposed by village to address problems that are common to all. However, a joint regional solution, on a larger scale, allows objectives to be achieved more quickly and with greater impact.

What's needed, in return, is organizational capacity. And this is the great asset of a single energy community in the Calatayud region: it can act as a driver to organize its 67 towns and 101 associations.

Search for funding to develop the idea

The conclusions presented by IES-UPM excited the residents of the region who decided to be its promoters.

The first step was to seek the necessary funding to develop the idea. Two project proposals were prepared and submitted to the European Commission's LIFE program (JALON project, Life-2021-cet-enercom call) and to the IDAE's Implementa program (CE Implementa (>€1M)). Both were highly regarded and awarded.

This made it possible to assemble a highly specialized and complementary consortium to execute the project: La Devanadera: the people from the region represented in this association; the Polytechnic University of Madrid and the University of Zaragoza to

provide expertise on RECs and photovoltaic systems; the law firm Holtrop to provide legal support; CIMAC and the University of Évora to replicate the experience of Calatayud in the Alentejo region of Portugal; and EURAC to replicate the experience in the South Tyrol region of Italy.

Cooperative vs. Foundation

The granting of the IMPLEMENTA aid to subsidize approximately 40% of the cost of the photovoltaic systems to be built in the REC, accelerated the constitution of the Renewable Energy Community of the Calatayud Region (CERCA), since it was a requirement to be constituted for its concession.

The local promoters met with HOLTROP and IES-UPM to decide on the most appropriate legal form for CERCA. HOLTROP and IES-UPM recommended a Foundation, as it was the means that best preserved the principles that motivated this initiative while ensuring member participation. However, the promoters preferred to adopt the legal form of a non-profit cooperative, which, despite the negative experiences in the region with this type of business, was seen as the most democratic.

Participation models

Within the framework of the JALON project, and led by HOLTROP, the participation models for citizens, associations, businesses, companies and town councils in the CERCA cooperative were developed.

The main design criterion for CERCA's participation models is that the REC should adapt to the needs and specific characteristics of its potential participants (citizens, associations, businesses, companies, and municipalities) and to the dispersed rural environment, and not the other way around. Furthermore, these participation models seek to attract, through multi-level participation, individuals and legal entities close to the production facilities to a more intense participation in the REC and its projects.

Based on this criterion, there are six participation models. These are arranged according to the participation of local stakeholders in the REC, from most intense to least intense. In this sense, they range from a model of full membership and participation in the REC to a model of participation through mere capital investment in the project:

I. *Model 1: CERCA member contributing rights and/or money to permit and/or finance CERCA-owned PV installations*: The participant becomes a member of the CERCA cooperative and also makes a contribution of money, rights, or assets to provide the REC with resources to carry out its photovoltaic installations. In return, they receive remuneration in energy or money.

II. *Model 2: CERCA member owning their own PV installation and contributing their surplus energy to the REC*: The participant becomes a member of the CERCA cooperative and owns their own PV installation. This installation is not transferred to the REC, but the REC, which sometimes acts as a marketer, manages the member's surplus energy.

III. *Model 3: Collaborator owns his own PV installation and contributes his surplus energy to the REC*: The participant does not become a member of the CERCA

cooperative, but is the owner of his own PV installation. This installation is not transferred to the REC, but the REC, which sometimes acts as a marketer, manages the participant's surplus energy.

IV. *Model 4: CERCA member supplied by the REC*: The participant becomes a CERCA member, but neither makes a contribution nor has its own PV plants. CERCA, as a retailer, supplies its electricity at a reduced price.

V. *Model 5: Collaborator supplied by the REC*: The participant neither becomes a member of the REC, nor makes a contribution, nor has its own PV plants. CERCA, as a retailer, supplies its electricity at a reduced price provided that the participant lives near the territory where CERCA operates.

VI. *Model 6: Investor collaborator in CERCA's activity*: The participant does not acquire CERCA member status. Their only participation in the REC is to invest capital in CERCA's activity.

These models are structured along two main axes. The first axis distinguishes between Models I-II and IV, on the one hand, and III and V-VI, on the other. In this sense, the first two involve more intense cooperation with the REC, since the participants are CERCA members. In contrast, collaboration in Models III and V-VI does not require CERCA membership.

The second axis through which these models are structured is the contribution to the REC. In this sense, in Model I, the member makes a contribution that allows the CERCA to develop its own PV projects. In Models II and III, the member/collaborator has its own facility and contributes only its surplus to the CERCA. Finally, in Models IV and V, the collaborator only receives renewable energy produced by the CERCA, and in Model VI, the collaborator only invests money in CERCA's activities in exchange for future remuneration..

The models are described and analysed in more depth in the document at the following link:

https://jalon-ce.eu/wp-content/uploads/2025/04/CERCA-Participation-models-ES.pdf

Self-consumption and electricity marketing company

It is worth mentioning that CERCA is a cooperative that will also be established as an electricity supplier. CERCA requires this dual status, as both a REC and a supplier, because the REC status, which originates in European Union law, has not been properly implemented in Spain. Consequently, many of the activities that, according to European regulations, this entity could carry out are not currently possible under the legal regime applicable to RECs. To resolve this situation, at least until the regulations applicable to RECs are supplemented, it is necessary to establish CERCA as a supplier (electricity marketing company) in order to carry out the activities necessary to develop the REC. Otherwise, under current regulations, the REC would be limited to only shared self-consumption.

As REC, CERCA will carry out individual and collective photovoltaic self-consumption, with and without simplified compensation in the bill, as well as medium-sized photovoltaic plants for sale to the market or for point-to-point sales through PPA contracts.

On the other hand, becoming an electricity marketing company will also allow CERCA to connect with participants who have chosen to retain ownership of their energy-producing facilities instead of transferring them to CERCA. In this case, the cooperative may acquire ownership representation—but not ownership—of the facilities and act as a producer in relation to them. In this way, CERCA will be able to structure the sharing of surplus energy produced by the facility through shared self-consumption with other REC members..

Due to the multifaceted nature of CERCA and the different legal regimes that apply to each type of entity in the electrical system, it will be necessary in the different participation models to differentiate between the activity carried out by CERCA as a REC, those carried out as an electricity marketer, and those carried out as a producer. In the case of CERCA's activity as a producer, it will also be necessary to differentiate between cases in which the cooperative is the owner and holder of the production facilities and those in which it only holds ownership representation.

A detailed explanation of self-consumption, REC, and marketing within the current regulatory framework and their relationship with the various participation models proposed can be found in the downloadable document at the following link: https://jalon-ce.eu/wp-content/uploads/2025/04/CERCA-Participation-models-ES.pdf

State of execution (April 30, 2025)

At the time of writing, CERCA, as a REC, is already present in 15 municipalities in the region, with 18 different photovoltaic systems totalling 825 kWp and involving 150 residents, businesses, industries, and town councils. The energy generated by the REC is shared among 180 CUPS (energy meter identifiers). The total investment has been more than €625,000.

The following table summarizes this degree of execution:

	Installation	Power (kWp)	Village	Cost (€)	Participants	Quantity	CUPS
1	CHERRYWORLD	104,4	Munébrega	63.565,50 €	Industry	1	1
2	CODOS	72,6	Codos	65.033,79 €	Collective	15	20
3	EMPRESA MEDIAVEGA	69,85	Calatayud	38.713,85 €	Collective	4	4
4	RUESCA	29,97	Ruesca	22.926,04 €	Collective	14	17
5	MIEDES DE ARAGÓN	22,2	Miedes de Aragón	17.497,10 €	Collective	8	9
6	CARENAS	97,68	Carenas	84.134,40 €	Collective	6	6
7	BUBIERCA	44	Bubierca	30.205,18 €	Collective	17	18
8	POZUELARIZA	11	Pozuel de Ariza	7.736,49 €	Collective	9	10
9	MUNÉBREGA	16,5	Munébrega	15.298,62 €	Collective	9	12
10	ASOCIACIÓN AMIBIL	64,5	Calatayud	40.693,59 €	Association	1	1
11	MALUENDA + RAÍCES IBÉRICAS	116,48	Maluenda	88.039,63 €	Industry and collective	24	25

12	CERVERA CAÑADA	12,3	Cervera de la Cañada	15.157,81 €	Collective	7	10
13	VALTORRES	35,2	Valtorres	24.657,13 €	Collective	9	10
14	ARIZA	15	Ariza	13.158,17 €	Collective	1	4
15	URBANIZACIÓN GOLF	6,82	Calatayud	5.935,00 €	Individual	1	1
16	BELMONTE	14,175	Bemonte	15.724,38 €	Collective	8	9
17	MEDINACELI PUEBLO	83,655	Medinaceli	68.076,31 €	Collective	15	20
18	TORRIJO	8,8	Torrijo de la Cañada	9.010,72 €	Collective	1	3
	TOTAL	**825,13**		**625.563,71 €**		**150**	**180**

CERCA, as an electricity marketer, is utilizing surplus energy and supplying 100% renewable electricity. As of the date of writing this document (April 30, 2025), there are 113 supply contracts for a total contracted capacity of 850 kW. This information is detailed in the following table.:

VILLAGE	Number of supply contracts	Contracted power (kW)
Codos	0	-
Miedes	8	33,19
Ruesca	1	-
Pozuel de Ariza	0	-
Bubierca	11	63,92
Ariza	4	35,72
Calatayud	2	63,50
Munébrega	12	194,55
Carenas	6	31,90
Maluenda	25	187,41
Cervera de la Cañada	9	39,15
Valtorres	19	85,45
Belmonte	9	65,81
Medinaceli	0	-
Torrijo de la Cañada	0	-
Mediavega-Calatayud	4	37,66
Otros	3	12,35
TOTAL	**113**	**850,60**

Both on the JALON project website (https://jalon-ce.eu) and on the CERCA website (https://cercaenergia.com), as well as on their respective social networks, you can find photo reports and videos about these photovoltaic installations.

5. The CERCA Experience – Lessons Learned

The experience gained over two and a half years of designing, establishing, and implementing the CERCA renewable energy community in the Calatayud region has allowed us to learn a series of lessons that may or may not be useful to those who wish to follow a similar path. They may not be directly transferable, but they will certainly serve as inspiration and, hopefully, will help us avoid making the same mistakes we made.

We're going to describe the lessons learned in the form of worksheets. We're going to continue learning more lessons. With this worksheet structure, we'll be able to add more lessons to deliver an update to this "non-guide" guide in a year. We're going to organize the lessons learned worksheets according to the phases of building a REC: design, seeding the idea in the area, building commitment in the communities, financing, installation, and management of the REC.

5.1. Lessons learned – Design phase

Lesson: Don't start from scratch, make a clear proposal.		
Phase:	Design	**Nº:** D1
Leader:	Promoter group	

Description:
One of the main roles of the promoter group is to establish a clear proposal of the type of REC that they want to convey to the targeted residents, associations, businesses, companies and town councils.

There are many possibilities for RECs, and you have to choose one. They can be small (on a village scale) or large (on a regional scale); with little citizen participation or, on the contrary, trying to promote it; limited to photovoltaic self-consumption or with the ambition to offer all the services that the European directive grants to RECs; and they can be cooperatives, foundations, associations, companies, etc.

And it must also have a spirit that motivates the creation of the REC. This spirit is what drives the promoter group and must be passed on to potential participants. A spirit that is rooted in the need it seeks to address.

Problem:
If the promoter group does not establish a clear REC proposal, the discussion on said proposal will be transferred to the potential participants, generating noise, producing confusion and delaying the process with endless discussions.

This discussion should take place within the promoter group. If there are differing sensitivities within this group, they should be resolved before going out to plant the idea.

The CERCA experience

The CERCA promoter group suffered from a reality in the Calatayud region that is common to other regions of rural Spain: the lack of a future for its villages. The motivation for building a REC was so that its villages could have a future. And this is the spirit of CERCA: a REC whose impact is to contribute to the future of the villages of the Calatayud region and reverse the trend toward depopulation.

In accordance with this spirit, the REC should have these characteristics:

- Regional energy community: so that smaller villages without management capacity can also benefit from the advantages of a REC.
- With local impact: with cheap energy that is consumed locally and that allows residents to continue living there, businesses not having to close, companies to continue offering jobs, and local councils to continue offering services.
- True citizen participation: Without true participation, the social dynamism that can reverse the depopulation trend cannot be generated. It has long been known that the availability of cheap energy does not automatically translate into economic development; what is needed is the social dynamism that produces it.
- Push for regulatory changes: so that the regulation of RECs meets the needs of rural Spain, such as in relation to the distance at which energy can be shared or the dynamic allocation of energy distribution in collective self-consumption.

- Replication in other regions of Spain and Europe: the problem that inspires the spirit of CERCA is common to many other European regions and, therefore, CERCA wants to be an inspiration for them.
Material: The proposal for CERCA's design can be found in this document: https://jalon-ce.eu/wp-content/uploads/2025/04/CERCA-Participation-models-ES.pdf

Lesson: Surplus energy cannot be properly managed under the current self-consumption law ⇒ It is necessary to establish the REC as an electricity marketer		
Phase:	Design	**Nº:** D2
Leader:	Promoter group	
Description: According to the European directive, a REC can generate its own renewable energy, share it, distribute it, accumulate it, market it and consume it with the aim of obtaining economic, environmental or social benefits.		
Problem: RECs have not yet been regulated in Spain, so they are often identified with the only law that affects them: the Self-Consumption Law. Therefore, their function is often mistakenly equated with the creation of individual or collective photovoltaic self-consumption systems. This leaves aside the other functions contemplated in the European directive, and therefore, they no longer offer significant added value..		
The CERCA experience The CERCA promoter group, aware of this problem thanks to the advice of the Holtrop law firm, and wanting to maximize the local impact of the REC, decided to also adopt the form of electricity retailer, a legal entity that can provide the rest of the services according to Spanish legislation. In this way, surpluses that are not self-consumed in photovoltaic systems can be better valued, not only by selling them to the grid, but also by sharing them with other consumers or selling them point-to-point. Obviously, CERCA lacked the experience and capacity to operate as an electricity retailer. Therefore, it partnered with Zaragoza-based ASIC XXI to perform the retailer's back-office functions, while CERCA limited itself to performing the front-office functions, i.e., sales and customer relations. By establishing itself as an electricity supplier, CERCA can offer its participants renewable electricity supply contracts at the best price, since all the suppliers operate in the same electricity market and CERCA, due to its non-profit nature, does not impose additional business margins.		
Material: Details about CERCA as a electricity supplier can be found in this document: https://jalon-ce.eu/wp-content/uploads/2025/04/CERCA-Participation-models-ES.pdf		

5.2. Lessons learned – Idea seeding phase

Lection: The seeding phase takes much longer than initially imagined.		
Phase:	Idea seeding	**Nº:** S1
Leader:	CERCA implementing group	

Description:
Communicating the CER proposal established by the promoter group among residents, associations, businesses, companies, and town councils takes much longer than initially imagined. It requires interviews with mayors prior to the multiple visits to each village. The initial visits serve only to introduce the idea. The idea is discussed by the interlocutors in the villages, and questions arise, necessitating revisits.

This process, which seeks real participation through the appropriation of the idea by the final recipients, is long, requires a lot of time in the territory and a lot of dedication from a specialized team.

Problem:
A REC that aspires to truly engage its members must build awareness and commitment by spreading the word, spreading the REC spirit, and explaining the proposal in detail. This isn't done from a remote office; it requires numerous visits and a significant amount of time on the ground. This requires forming a local team to execute these actions and ensure a constant presence in the area. The financial means must be secured to maintain this local team for a longer period than previously imagined.

The CERCA experience
CERCA, with support from the European LIFE project JALON, hired a local team of four people with technical and social skills to visit the villages and spread the word. This team had the constant support of the JALON project partners, especially the La Devanadera association, the Polytechnic University of Madrid (UPM), and Holtrop.

Given that there are 67 municipalities in the region, more than a hundred visits to the villages were made during the first year of project implementation. It was a long year in which there seemed to be no results: attendance at meetings was low, there was no enthusiastic feedback, and time passed without generating any commitment or apparent results. This discouraged the local team, and the JALON project partners had to support them, not only financially but also emotionally.

It was not realized that this dark phase of sowing the idea is absolutely necessary for the harvest to be reaped.

Material:
The presentation in which the idea is presented to a village can be found at this link: https://jalon-ce.eu/wp-content/uploads/2025/04/Presentation-in-which-the-idea-is-presented-to-a-village.v2.pdf

Lesson: The real participation of neighbours, associations, businesses, companies and municipalities translated into microinvestments requires a lot of time in the territory.		
Phase:	Idea seeding	**Nº:** S2
Leader:	CERCA implementing group	

Description:
The REC proposal established by the promoter group is based on the real participation of residents, associations, businesses, companies, and town councils. This real participation translates, among other things, into these potential REC members providing money through microinvestments to build the photovoltaic systems from which they will self-consume energy.

The fact of making these microinvestments is a demonstration of their commitment and leads to an awareness of the issue of energy transition and the problem of the future of their people that cannot be achieved in any other way.

Thus, the REC wants to avoid 100% subsidies that condemn its members to a passive attitude..

Problem:
When money is involved, questions multiply, and multiple meetings are necessary to resolve them. These microinvestments are carried out through a complex contractual framework, a complexity that is necessary to ensure legal certainty, but which is difficult to understand and requires repeated explanations..

And this again requires a local team to conduct these meetings as often as necessary. Once again, a constant presence in the territory is necessary, which, again, takes longer than expected. The financial means to maintain this local team must be secured for this entire period..

The CERCA experience
CERCA, with the support of UPM and Holtrop, obtained a grant from the Ministry of Ecological Transition's Implementa program through the IDAE, covering approximately 40% of the cost of the photovoltaic installations. The remaining costs were to be provided by the participants through microinvestments injected into CERCA through a participatory loan agreement developed by Holtrop..

Explaining the requirement to provide this money to participate and the associated contract took longer and more meetings than expected. Getting these microinvestments for 18 photovoltaic installations in 14 different municipalities signed took more than a year and 93 meetings in the villages.

In addition, the signing process in an aging rural area with a high level of digital illiteracy makes the process difficult and lengthens it..

Material:
The participatory loan contract that regulates the microinvestment contribution can be found at this link:
https://jalon-ce.eu/wp-content/uploads/2025/04/6.-Contrato-de-Prestamo-Participativo.pdf
The PowerPoint presentation in which the microinvestment proposal is presented to a village can be found at this link:

https://jalon-ce.eu/wp-content/uploads/2025/04/Microinvestment-proposal-presented-to-a-village.v2.pdf

5.3. Lessons Learned – Building Village Engagement

Lesson: Real participation of residents requires the involvement of mayors		
Phase:	Building Engagement	**Nº:** C1
Leader:	CERCA implementing group	

Description:
You can't enter a village without the cooperation of its mayor. But mayors of small villages have to do everything; they receive many messages, and it's difficult to get their attention. The same thing happens to mayors of large villages, and even though they have well-equipped teams, they're always very busy.

Therefore, it is necessary to be creative to meet with mayors and attract their attention.

Problem:
Contrary to popular belief, the influence of politics is greater in rural areas than in urban areas. If the mayor isn't considered when entering a village, the mayor will resist and become a barrier to the project. Therefore, it's necessary to enter the village with the mayor, but it's not easy due to their workload, their lack of resources, and the large number of invitations they receive to multiple events. Thus, the invitation they receive from the REC gets lost in the multitude of messages..

The CERCA experience
The European JALON project included the La Devanadera association among its consortium partners, representing the region's associations. This association brings to the project a deep understanding of the region's reality, its people, and its institutions.

Thanks to this knowledge, La Devanadera always knew the mayor or someone close to the mayor, who allowed us to call a meeting. At that meeting, we explained the spirit of the project, CERCA's design, and how they could participate.

While the idea was very well received, it was difficult to continue it and prevent our proposal from getting lost among many others. Furthermore, during this process, the devastating fire in part of the region took hold, which focused the mayors' attention. Municipal elections also diverted their attention and led to changes in mayors who had already been contacted.

This process lasted a year with little feedback and no apparent results.

Material:
The initial presentation we made to the mayors can be found at this link:
https://jalon-ce.eu/wp-content/uploads/2025/04/Initial-presentation-made-to-mayors.v2.pdf

Lesson: Institutional support from the regional administration is essential		
Phase:	Building Engagement	**Nº:** C2
Leader:	Comarca de Calatayud	

Description:
You can't enter a town without the cooperation of its mayor. But mayors of small villages have to do everything; they receive many messages, and it's difficult to get their attention. The same thing happens to mayors of large villages, and even though they have well-equipped teams, they're always very busy.

Therefore, it is necessary to have the collaboration of the supra-local institution that brings together all the municipalities in the region so that the call for the meeting to publicize the REC comes from them. This way, the mayors will respond to the call and attendance will be well attended.

Problem:
Contrary to popular belief, the influence of politics is greater in rural areas than in urban areas. If the mayor isn't considered when entering a village, the mayor will resist and become a barrier to the project. Therefore, it's necessary to enter the village with the mayor, but it's not easy due to their workload, their lack of resources, and the large number of invitations they receive to multiple events. Thus, the invitation they receive from the REC gets lost in the multitude of messages..

The CERCA experience
The European JALON project included the Calatayud Region's own institution among its consortium partners, an institution that brings together the region's 67 municipalities. This institution was involved from the very beginning in the project's conception and spirit, and was very cooperative throughout.

After a year of visiting the towns with no apparent results, the turning point came with a call from the Calatayud Region itself to all its mayors and town secretaries for three workshops in which the mayors were explained the design and the economic impact that CERCA could have on their town councils and their residents (with the collaboration of the UPM), all the legal aspects were explained to the secretaries (Holtrop) and the technical aspects were explained to the town council technicians (University of Zaragoza).

The call was a success; all the mayors were familiar with the CERCA project thanks to the hard work of the previous year, and the support of the Calatayud Region institution gave them the confidence to join the project. After the workshops, the mayors and secretaries addressed the CERCA representatives, saying, "Come and present CERCA to my neighbours!"

Material:
The workshop presentations can be found at these links:
https://jalon-ce.eu/wp-content/uploads/2025/04/Workshop_Oct23_Energy_Communities.pdf
https://jalon-ce.eu/wp-content/uploads/2025/04/Workshop_Oct23_Economic-Aspects.pdf
https://jalon-ce.eu/wp-content/uploads/2025/04/Workshop_Oct23_Legal-Aspects.pdf

5.4. Lessons Learned – Financing

Lesson: Grants do not respect the timeframes needed for real participation		
Phase:	Financing	**Nº:** F1
Leader:	CERCA	

Description:
It's a widely held belief that subsidies are needed to encourage potential participants in a REC to participate. Indeed, from a commercial perspective, claiming a subsidy will reduce the cost of a photovoltaic installation is a very powerful argument.

However, subsidies impose very short implementation deadlines and, on the contrary, the work in the territory to create a REC with real participation of residents, associations, businesses, companies and town councils is very slow.

Problem:
Acceptance of the grant imposes rhythms that are not those of reality and distort the process of awareness and generation of commitment necessary for real participation in the REC.

This raises a difficult dilemma: do we accept a subsidy that we know will facilitate the incorporation of members into the REC at the price of jeopardizing the social processes of real participation?

The CERCA experience
CERCA applied to the IDAE for assistance under the Implementa program, which was granted. This resulted in a grant of just over €850,000 to construct approximately 1.3 MW of photovoltaic installations throughout the Calatayud region. The installations were to be completed within 14 months.

However, as we explained previously, the process of establishing the REC in the region alone took more than a year. From the meeting sponsored by the supra-local institution of the Calatayud Region, we only had two months to implement the facilities.

This caused several inconveniences:

- Force dialogue processes with the communities, which in some cases generated distrust. Some participants said, "*There must be something strange going on when these CERCA people are in such a hurry*".
- It forced us to make risky technical decisions, such as starting photovoltaic installations without knowing the connection conditions imposed by the distribution company. If we waited for the distribution company's response times, we wouldn't meet the IDAE deadlines.
- We subjected the local CERCA team in charge of visiting the villages to a stress that jeopardized their sustainability.

We have learned some very important lessons:

- Our recipients in this launch phase of CERCA are not those who are driven exclusively by economic aspects but rather the "early adopters" of the Region, the early adopters of this technological and social innovation, characterized by sharing the concerns and spirit of CERCA, already convinced of the need for the energy transition and willing to participate even if there are no subsidies.
- A newly created REC must start with the "early adopters" in their area. They are the ones who enable such a project to begin, and the rest of the population will join through contagion and imitation in a second wave.

- In objective terms, the price reduction effect of the subsidy on photovoltaic installations is much smaller than the clustering effect made possible by the REC. We'll explore this in more detail in a later lesson. - Therefore, it is better to dedicate the necessary time to ensure that early adopters actually participate in the REC than to neglect this process to comply with a grant.
Material: ----------

Lesson: It is very difficult to secure funding for a startup REC.		
Phase:	Financing	**Nº:** F2
Leader:	CERCA	

Description:
When a REC starts, it needs financing, for example, to be able to hire the local team that must visit the villages, or to advance the subsidy and VAT for the photovoltaic installations that it must carry out.

To achieve this, business plans are drawn up that demonstrate that the REC is economically viable if it reaches a sufficient size in terms of installed photovoltaic power and associated members.

This business plan is the one presented to financial institutions to request the subsidy.

Problem:
Because the REC is newly established and has no prior track record, the bank rejects the requested financing. The usual response is to request it when the REC has completed photovoltaic installations and has a revenue stream that demonstrates its solvency.

For the same reasons, a bridging loan is not even granted to finance the advance of the subsidy since it is liquidated once the justification required by the entity granting the subsidy has been made.

The CERCA experience
The "financial isolation" CERCA has faced during its founding and idea-seeding process, despite having received a grant from the IDAE, has been overwhelming. When we approached six different banks to request financing to advance us the subsidy for 40% of the installation costs, showing that we had already contributed the remaining 60% from the participants, allowing us to execute the photovoltaic installations, the response was unanimous: CERCA doesn't have enough experience, we can't approve the loan, come back when you have it.

The IDAE allows advance payments on the subsidy, but this requires a guarantee. CERCA was unable to obtain this guarantee from any entity.

This is despite the fact that CERCA had a business model that made it viable thanks to two sources of income:

- CERCA charges its participants a fee for electricity consumption from photovoltaic systems. This fee is used for the maintenance and operation of the photovoltaic systems and to maintain CERCA's structure.
- CERCA charges an amount for the 100% renewable energy it supplies as an electricity marketer to participants who sign an electricity supply contract with it from the conventional electricity market..

Faced with the threat of the project being blocked and dying before it was born, CERCA made two risky decisions related to self-financing through its participants, but they proved successful:

- He proposed to his "early adopters," who had expressed interest in microinvesting 60% of the cost of the photovoltaic installations, that they would finance CERCA, also upfront, the subsidy amount (the other 40% of the cost of the photovoltaic installations) and the total VAT. The response was very positive in most cases,

although they expressed their displeasure at having initially said one thing and then another. In response, CERCA was very transparent and explained what had happened. - To this end, a study was conducted for each of the participants in which it was quantified what each one had to microinvest and how much would be returned to them in the form of a subsidy and advanced VAT as soon as CERCA received them.
Material: An example of a report presented to participants for funding the facilities can be found here: https://jalon-ce.eu/wp-content/uploads/2025/04/001_Informe_CERCA_Residencia_6450kWp_v1.0_si_fin.pdf

5.5. Lessons Learned – Installation

Lesson: The best type of PV installation is one that allows grouping around collective self-consumption systems.		
Phase:	Installation	**Nº:** I1
Leader:	CERCA	

Description:
CERCA, with the support of the UPM, has been defining the most suitable photovoltaic installation topologies as it has gained experience. The conclusion has been that the most suitable typology is collective photovoltaic self-consumption, precisely because of the benefits offered by its clustering effect.

Problem:
Having learned that subsidies distort the process of real participation of REC members from a technical and social point of view, it is necessary to find a way to compensate for the disappointing effect of not having a subsidy, which could reduce the adhesion of potential members.

The CERCA experience
If each potential CERCA member were to install their own individual installation, due to their small size, it would cost between €1,500 and €1,800/kWp. If CERCA acts as a catalyst and aggregates all individual photovoltaic installations into a single centralized photovoltaic installation, for example on the roof of the municipal pavilion, if this exceeds 50 kWp, then its cost is reduced to €700/kWp, representing a self-subsidy of between 53% and 61%. The price to pay is to organize, but this is precisely what the REC makes possible.

If the IDAE subsidy of approximately 40% is applied to that cost of €700/kWp, this subsidy represents €280/kWp, which is not a significant amount that would limit the participation of a potential member. In return, waiving this subsidy allows for respecting the timeframes and processes for active and genuine participation.

Due to these benefits, CERCA has chosen to prioritize collective photovoltaic self-consumption, without giving up individual self-consumption when necessary.

Everything has a price: collective self-consumption is more complex to legalize with distribution companies and CERCA's experience is that it takes desperately long, as we will discuss later.

Material:
This link contains the presentation that explains to the communities the benefit of grouping together to create a collective self-consumption system:
https://jalon-ce.eu/wp-content/uploads/2025/04/Presentation-in-which-the-idea-is-presented-to-a-village.v2.pdf

Lesson: Involving local installers is a driver for the project		
Phase:	Installation	**Nº:** I2
Leader:	CERCA	

Description:
CERCA, with the support of UPM, chose to maximize local impact by involving local installers in the construction of CERCA's photovoltaic systems. Furthermore, these installers could become REC salespeople, thus benefiting everyone—both the installers and the REC.

Problem:
If CERCA's spirit is to collaborate so that the villages of the region have a future, we must boost the region's economic activity, including that of local electricians and installers of photovoltaic systems.

However, these installers are small, typically self-employed workers or micro-enterprises, very small in size, with limited capacity, and not always accustomed to meeting quality technical specifications. How can the local impact be balanced with the demand for high-quality photovoltaic systems that deliver their expected output for at least 25 years?

The CERCA experience
To involve installers and maximize local impact, CERCA chose to convene, train, and give them the opportunity to build CERCA's self-consumption photovoltaic systems.

With the support of the UPM, the university first invited local installers to express their interest in collaborating with CERCA by attending an information session. There, they were explained the CERCA project, the requirement to meet technical specifications, and the accreditation process. Finally, they were also explained that the process for awarding the installations to accredited local installers would involve a request for three bids, with the best technical-economic offer awarded.

The training and accreditation process consisted of several workshops with the ten installers who expressed interest in participating. These workshops presented in detail the technical specifications we would apply, the quality control procedures to verify compliance with the specifications, and a site visit to previously completed facilities by local installers to demonstrate on-site the areas for improvement based on CERCA's quality standards.

CERCA's experience with local installers has been good, and they have become CERCA "salespeople" offering their potential clients to build their photovoltaic systems under the CERCA umbrella.

There have also been negative lessons, such as the lack of experience some of them have in legalizing their facilities, which has led to delays in commissioning. Their reliance on external engineering has proven to be a weakness.

Material:
These links contains the presentations we use to train local installers:
https://jalon-ce.eu/wp-content/uploads/2025/04/Workshop-Installers_1.pdf
https://jalon-ce.eu/wp-content/uploads/2025/04/Workshop-Installers_2.pdf

Lesson: Technical specifications in contracts are key to ensuring the long-term quality of PV installations.		
Phase:	Installation	**Nº:** I3
Leader:	CERCA	

Description:
The profitability of microinvestments in photovoltaic systems depends on their continued performance for at least 25 years. This is only achieved if both the components and the system as a whole are of very high quality.

Problem:
The quality of photovoltaic systems is not a question of price but of ensuring good quality components and good practices in the installation of the system.

It is widely known that this is achieved through the application of rigorous technical specifications and quality control testing to ensure compliance. However, these technical specifications are very rarely included in the contract with the installer, especially if the photovoltaic systems are relatively small.

The CERCA experience
UPM has supported CERCA by developing technical specifications that transfer the experience gained in quality control of large photovoltaic plants to REC's self-consumption photovoltaic systems. These technical specifications include a description of the quality control tests that will be applied to verify that the installed PV systems meet the specifications. CERCA has included these specifications in its contracts with installers. In addition, UPM has trained local installers in these technical specifications. Here are some lessons learned from the implementation of these specifications.:

- Regarding system components, glass-glass PV modules should not be accepted if the glass is not tempered, nor should concrete supports be used to secure the PV generator to the ground due to the buckling of the PV modules.
- Investors must have an open API so their data can be extracted with any monitoring system.
- The definition of monitoring and communication systems must be improved to ensure the availability of system operating data.
- The cost of security and surveillance systems must be included in the overall installation offer. Fire extinguishers must also be included and a good internet connection must be ensured.

Material:
The document with the applied technical specifications can be found at this link: https://jalon-ce.eu/wp-content/uploads/2025/04/JALON.-Especificaciones-tecnicas-para-sistemas-fotovoltaicos-de-autoconsumo.pdf

Lesson: The legalization of collective self-consumption PV installations takes much longer than imagined.		
Phase:	Installation	**Nº:** I4
Leader:	CERCA	

Description:
The legalization process for a collective self-consumption PV system involves numerous administrative processes that depend on third parties and are very time-consuming..

Problem:
The excessive administrative burden, the excessively long deadlines, the inconsistencies of the distribution companies in the application of current regulations and the lack of diligence in the procedures mean that the legalization process of collective self-consumption PV systems takes a long time and, therefore, their implementation is delayed and those who made their microinvestments are disappointed by the delay in seeing savings on their bills..

The CERCA experience
CERCA, like any other REC, must carry out these 11 administrative steps for the installation, legalization and start-up of a PV self-consumption system:

1. Application for Grid Access/Supply Conditions from the distribution company.
2. PV installation project.
3. Construction permit.
4. OCA inspection certificate.
5. Construction Management Certificate.
6. Installation certificate (Bulletin).
7. Obtaining the CAU (Universal Self-Consumption Code).
8. Appointment of the Photovoltaic Self-Consumption Manager.
9. Distribution Agreement.
10. Surplus Compensation Contracts between Producer and Consumer.
11. Registration in the Regional Registry of Self-Consumption Installations (RADNE).

Most of these procedures depend on third parties, so CERCA loses control of the process. However, the FV self-consumption participants hold CERCA responsible, which puts the REC in a difficult situation..

In the case of the processing of the 18 PV installations that CERCA has been handling at the time of writing, the average time for the entire process is over six months, and in three of the installations, the process has already taken over a year. During this time, we have encountered the following difficulties::

- Surpluses: insufficient evacuation lines (small conductor cross-section)
- Inconsistencies in access and connection conditions.
- New electricity supply procedures: extremely lengthy process.
- Extremely long response times in CTA Contracts and Access and Connection Conditions.
- Distribution company inspections: inconsistencies in internal technical criteria.
- Erroneous (or biased) interpretation of the self-consumption law.

These difficulties have had the following consequences:

- Discouragement among participants due to delays in commissioning the facilities.

- Loss of credibility in CERCA.
- Excessive administrative burden for the local team.
- Loss of profitability due to the inoperability of the photovoltaic systems.

In order to speed up the process, we have learned these three lessons:

- If the installer has a good engineering background with experience in collective self-consumption, the process is accelerated.
- Installations under 15 kW are somewhat simpler to process.
- Avoid requesting a new electricity supply point to connect the self-consumption PV system.

Material:
This link contains a video explaining to CERCA members the delays due to the legalization process for PV installations:
https://jalon-ce.eu/videos/

5.6. Lessons Learned – Management

Lesson: The main threat to the sustainability of the REC is a structure based exclusively on volunteers		
Phase:	Management	**Nº:** G1
Leader:	Consejo Rector de CERCA	

Description:
While the REC's promoter group must be composed of local citizens mobilized around a clearly perceived need, the management and operation phase of the REC cannot rely solely on volunteer work. The scale of the REC, the technical complexity of managing photovoltaic systems, and the responsibility for managing relatively large volumes of microinvestments require a professional and well-compensated structure to sustain and provide the REC with the necessary stability.

Problem:
The main problem is a misidentification of real participation processes with volunteerism. By definition, volunteers have limited time and capacity. They have an important role to play, namely, maintaining the spirit that gave birth to the REC and maintaining it throughout its existence. But they often resist coexisting with a professional structure that is necessary when the REC enters its phase of maturity, consolidation, and growth. Achieving this transition to coexistence between volunteers and professionals is a challenge for the sustainability of the REC.

The CERCA experience
At the time of writing, CERCA is already present in 15 municipalities in the region, with 18 different photovoltaic systems totalling 825 kWp of power, and involving 150 residents, businesses, industries, and town councils. The energy generated by the REC is shared among 180 CUPS (energy meter identifiers). The total investment was more than €625,000. Furthermore, as an electricity supplier, CERCA manages a total of 113 supply contracts for a total contracted power of 850 kW. This is a large REC project that manages hundreds of thousands of euros and hundreds of participants, with the corresponding complexity and responsibility.

The business models developed indicate that for CERCA to be able to hire two well-paid professionals who will ensure their permanence, it will need to grow to manage around 4 MWp of photovoltaic installations. Until then, it will need external support, as is currently being provided by the European JALON project under the LIFE program.

However, it's time to address the main bottleneck to CERCA's growth: the voluntary nature of its Board of Directors, which prevents it from having the dedication necessary for its growth. CERCA's daily routine is filled with small decisions, contract signings, evaluating bids from installers, security and insurance companies, analysing financing offers, and so on. Without a flexible structure and the availability of time to carry these out, CERCA's growth is impossible.

This need is being clearly indicated by JALON partners to the current CERCA Board of Directors, which is composed of the core promoter that launched the REC and which is overwhelmed by the magnitude that CERCA has reached..

Therefore, at the time of writing this report, CERCA is undergoing a thorough review to adapt its structure to the current situation of the REC. No decisions have yet been made, but everything indicates that CERCA will be reorganized with two distinct

structures: a Board of Directors, composed of volunteers, responsible for major decisions and establishing an annual master plan approved at the assembly, and a professional Executive Team led by a manager who develops the master plan with the necessary powers. The Executive Team reports to the Board of Directors with quarterly reports, and the Board of Directors oversees this execution. Thus, the Board of Directors sets the course in accordance with the spirit for which CERCA was founded, and the Executive Team develops the plan with the necessary activities. It is a logical and necessary structure, but it requires a process involving the people involved.
Material: ----------