

30

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Are cities the key to making the energy transition a reality?

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This article emphasizes the crucial role of cities in the energy transition, highlighting the limitations of the current energy model marked by fossil fuel dependence, high energy prices, and social inequalities. The text analyzes and advocates for a more sustainable and decentralized energy vision in urban environments, emphasizing the active role of citizens and the environmental and social benefits of the energy transition. The article examines and proposes the Barcelona Climate Agreement, aiming for carbon neutrality by 2030. It underscores the importance of local renewable energy generation and advocates for energy-efficient building rehabilitation. Heat and cold networks and citizen participation are highlighted as essential elements for a successful energy transition. The conclusions emphasize the need to promote an energy culture that drives effective and collective changes.

Introduction

When we talk about energy today, we are discussing a complex reality, a highly uncertain energy market, volatile and highly dependent on a few.

The energy industry is unique: competitors are few, they sell everything they produce, and customers have no option not to consume. It is clear that the current energy model has economic (high energy prices, limited resources), social (inequality, energy poverty), and environmental (greenhouse gas emissions, air pollution) limits. Decidedly, the system is not working, and therefore, nothing is more urgent than changing this energy market and making the energy transition a reality.

By energy transition, we mean the necessary structural changes to move from a system dominated by fossil energy to one that predominantly uses clean and renewable energy sources. This restructuring must significantly change energy generation and consumption patterns, promoting sustainable development based on equity and social justice. This transition encompasses technological, social, cultural, economic, and environmental aspects, including a more active role for citizens.

Moving in this direction will not only involve reducing greenhouse gas emissions but also generating additional benefits such as improved health, air quality, employment opportunities, and promoting equity, among others. In a broader sense, energy transition also involves democratizing energy, as renewable energies can be established in a decentralized manner, benefiting the entire population.

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Ensuring the future means producing locally, using renewable energy sources, managing all local resources well, and being more efficient, learning to spend less for the same services and comfort.

1. We need to change the energy model, and we need to do it quickly

The current situation, with more frequent and intense extreme weather events causing increasingly dangerous impacts on nature and people, is clearly the consequence of climate change that needs to be stopped. Actions must be taken to reduce and avoid greenhouse gas emissions, seeking solutions to move forward without leaving anyone behind.

In this sense, the Barcelona City Council has presented the Climate Agreement of the City, setting the ambitious goal of becoming a carbon-neutral city by 2030¹.

Energy systems and the way we generate and consume energy have a clear impact on greenhouse gas emissions, and therefore, action is needed to change the current energy model. This is why we say that the Energy Transition is no longer a choice but a necessity that must be embraced now, doing more, but above all, doing differently.

To do things differently, we need to create an energy culture, as only with the necessary information and knowledge can we make decisions. Therefore, working on environmental education and communication, technical advice, and creating qualified professionals are essential to developing projects tailored to the needs, promoting significant investments in renewable energy and energy efficiency as an everyday reality.

If we consider energy as a right, then actions need to prioritize energy generation, reduce demand, save energy, reduce dependence on fossil resources, and act to reduce energy poverty, protecting the most vulnerable. These are the pillars on which we must act and make this action possible.

Energy has ceased to be a sectoral area of work to become a structural policy that must bring together all actions related to energy and its stakeholders. Coordinated work in all energy-related areas will generate invaluable synergies, with the joint responsibility of the private sector and the citizenry.

This perspective of energy as a structural policy carried out with joint responsibility will be the firm and necessary steps to transition to the new energy model we need to make a reality.

2. Barcelona Aims to be a Protagonist in Climate Neutrality

In this need, cities become true protagonists of change. Cities are where the most significant progress can be made towards energy transition, as they represent 75% of global energy consumption and 80% of CO2 emissions. Therefore, cities play a crucial role in this challenge.

Barcelona aims to be a protagonist, and for years, it has been part of the group of cities driving innovative projects in sustainable energy. Now, the city wants to create its own energy future by simultaneously developing energy efficiency, net and renewable production, and a collective mindset change to make it possible. This change requires determination, involving and empowering citizens, rethinking financing solutions, designing new governance models, and understanding urban planning as a tool to move towards a more sustainable and low-carbon model.

Local governments do not have competencies in significant areas of energy regulation, such as planning, execution, and operation of infrastructures. However, they have the capacity to

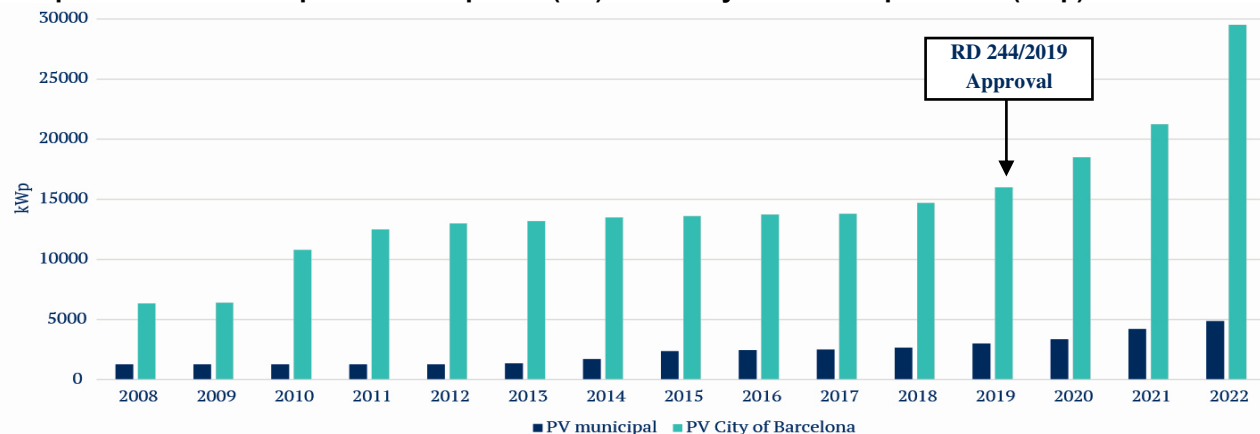
1. For further information, see: <https://ajuntament.barcelona.cat/premsa/2023/09/15/barcelona-presenta-a-europa-el-compromis-per-la-neutralitat-climatica-al-2030/.compromis-per-la-neutralitat-climatica-al-2030/>

influence major axes of energy management. Cities can act on energy access with local generation, purchase, and supply projects; achieve energy savings through demand management and energy efficiency tools, and influence knowledge, awareness, and the extension of a new energy culture.

3. Local and Renewable Energy Generation as Everyday Reality

Moving towards this Energy Transition involves overcoming several challenges. The first is normalizing the presence of generation facilities in the city and increasing the demand for solar self-consumption installations in buildings, both in the public and private sectors.

Graph 1. Accumulated photovoltaic power (PV) at the city and municipal levels (kWp)



Source: Barcelona Energy Agency.

Currently, in the city of Barcelona, we have installed almost 29 megawatts peak (MWp), divided between 17 MWp in private and 4 MWp in public installations². The goal is to have a city where self-generation and self-consumption are widespread. In the case of Barcelona, it is proposed that by 2025, 6 MWp of photovoltaic generation can be achieved in municipal buildings (nurseries, cultural facilities, sports facilities, etc.) and in the public space. Additionally, it is also expected to achieve 35 MWp of photovoltaic generation in the private residential, tertiary, and industrial sectors of the city. To achieve this, promoting shared self-consumption and helping drive the exponential deployment of photovoltaic installations is necessary. All available spaces in the city where it makes sense to generate energy, such as building roofs, facades, various urban infrastructures, and public spaces in general, must be utilized.

Image 1. Photovoltaic installations on municipal buildings



Source: Barcelona Energy Agency

2. The "megawatt peak" (MWp) is the unit of measurement for the output or generation of a solar panel. It reflects the power generated by 1 watt of electrical energy under suitable conditions and orientation of sunlight.

In 2020, a municipal decree was approved to promote renewable energy generation in construction projects and municipal urban planning. Another important tool is facilitating investment in these types of installations, making it profitable as soon as possible. To reduce the investment associated with all of this, one of the avenues available to local administrations is fiscal incentives. Barcelona offers a 50% reduction in Property Tax (IBI) for 3 years to those citizens who have installed a generation facility in their building, whether residential or commercial. In the case of installations in industrial buildings, the IBI discount is 30% for 3 years. Collaborating with the private sector, financing systems for projects are also offered, such as the MES Barcelona program³.

As important as generating energy is considering how the generated energy will be used. In this regard, current regulations allow for different formulas for managing the generated energy. One of them is shared self-consumption, which opens up the possibility of generating energy where it makes the most sense without concern for surpluses. These energy surpluses can be enjoyed by a nearby consumer, or at least they can be offset. The Barcelona City Council is considering making a portion of the generated energy available to residential and commercial consumers in exchange for economic compensation, allowing the City Council to recover the investment made within the installation's useful life. This initiative aims to enable any consumer to cover a portion of their consumption with renewable energy generated in the city, both in public and private spaces, so that everyone can enjoy self-consumption regardless of whether they have the ability to install and finance their own generation facility directly on their property.

As a city, it is imperative for us to deploy solar energy on rooftops as soon as possible. The "Moment Solar Barcelona" project⁴, a joint initiative with Property Administrators and Installers Guild, provides communities with all the information and advice needed for each home or apartment block to generate the energy it requires⁵. This approach aims to persuade and support neighborhood communities throughout the entire process of installing photovoltaic panels, including the preliminary study, commissioning of the panels, and processing available subsidies or offering financing instruments like MES Barcelona.

4. Energy rehabilitation of buildings as a key tool

As important as producing net and sustainable energy is, it is equally crucial not to waste it. This means acting in the field of energy conservation, through initiatives such as building rehabilitation or ensuring that newly constructed energy is nearly zero-consumption.

For a city built as densely and compactly as Barcelona, with a residential roof surface of 62.7 million m² (representing more than half of the total roof area of the city), the residential sector accounts for a significant energy consumer. The demand from homes thus corresponds to approximately 28% of the final energy consumed throughout the city.

It's worth noting that many of these buildings are over 65 years old, predating regulations on building quality and insulation requirements. Consequently, a large portion of the residential buildings in the city of Barcelona has a very low energy certification (mostly in classes E, F, and G, accounting for over 70%).

In most already-built cities, as is the case with Barcelona, the energy retrofitting of buildings is a key tool for reducing energy consumption while simultaneously improving comfort. In Barcelona's case, the goal is to rehabilitate 10,000 homes annually with energy efficiency criteria. Currently, around 6,000 homes are addressed each year, but not always with energy efficiency criteria in mind.

3. Further information may be accessed at: <https://ajuntament.barcelona.cat/agenda2030/ca/mesbarcelona>

4. Further information may be accessed at: <https://www.energia.barcelona/ca/moment-solar>

5. Further information may be accessed at: <https://www.energia.barcelona/ca/moment-solar>

Therefore, energy-efficient rehabilitation is a fundamental element of the city's energy policy, not only to drive improvements in the energy efficiency of homes and communal spaces but also regarding the positive impact this investment has on health. Better housing conditions lead to a higher quality of life and greater comfort. Reducing the energy needs of buildings is also a way to decrease family expenses, thus reducing inequalities and vulnerability in many cases.

The residential sector faces issues of conservation, accessibility, and energy efficiency. Although energy efficiency is one of the most significant deficits, there isn't a sufficient level of concern or social awareness about this matter.

Hence, it's crucial to highlight that when proposing energy-efficient rehabilitation for a building, it requires interventions with substantial initial investments: around 3,500 to 10,000 euros per dwelling when addressing building envelopes⁶, and from 12,000 to 40,000 euros per dwelling for comprehensive interventions (including building envelopes and installations). These amounts are not easy for building and homeowners to assume and, in some social sectors, can be considered nearly impossible.

To amortize the energy savings obtained through rehabilitation, scenarios of high energy prices and high energy consumption for heating (driven by higher energy consumption in homes) would be needed. However, this is not the case in Barcelona. The city's temperate climate with mild winters means that heating consumption is not excessively high. This reality becomes even more apparent with the current climate emergency. Therefore, the city's energy savings potential is lower, making it more challenging to amortize these investments in the short term.

Another crucial factor to consider is property structure. Most city homes have a horizontal property regime, meaning a set of dwellings forming a building established as communities of owners. This implies that decisions need to be made collectively, reaching agreements among different dwelling owners, who may not necessarily be the current residents, given the significant number of homes under lease.

To make energy-efficient rehabilitation a reality, there is a need to enhance the culture of maintenance in society. It must be understood that certain expenses in homes are necessary to ensure minimal efficiency, providing comfort and well-being. Additionally, efforts should be made to find instruments that make these necessary investments more manageable.

5. Heating and Cooling Networks: an interesting solution for advancing the city's climate neutrality

Another important avenue to explore is that of district heating and cooling networks that utilize residual resources, thereby saving network energy and reducing greenhouse gas emissions. This is possible in certain urban environments that have undergone or are undergoing significant urban transformations.

Urban climate control networks are highly efficient systems for producing heat and cold generated from the use of renewable or residual resources, providing heating, cooling, and hot water, resulting in a 30% energy savings compared to individual conventional systems such as boilers or air conditioning units.

These heating and cooling networks also bring significant space and initial investment savings for individual users. Moreover, they reduce noise, vibrations, and eliminate explosion risks. They also minimize CO₂ emissions and reduce maintenance and replacement costs. These networks, therefore, serve as prominent examples of public-private collaboration⁷.

6. The term "envelopes" refers to the set of enclosures that separate the habitable spaces from the external environment (air, ground or other building) and the interior partitions that divide the habitable spaces from the non-habitable ones

7. More information at: <https://www.districtclima.com/ca/>

In the case of Barcelona, there are currently two operational district heating and cooling networks. Firstly, there is the so-called "Districlima," established in 2002, which was the first urban network created in Spain to distribute heat and cold for heating, air conditioning, and hot water.

Districlima began operating with the concession of the production plant at the Forum. At present, the network has 18 kilometers of infrastructure and is connected to 100 buildings. Additionally, a third production plant will be added shortly to reach a potential service provision of one million square meters in the Besós and 22@ areas.

Image 2. Heating and cooling network Districlima



Source: Author's elaboration from Google Earth and Districlima.com.

The second network, Ecoenergies, was founded in 2009 and operates through a joint tender from the City Councils of Barcelona and L'Hospitalet de Llobregat⁸. The project envisions three production plants. The two already in operation will be supplemented by utilizing the residual cold from the Port's regasification plant. This heating and cooling network is ready to supply 15,000 square meters in the Zona Franca and the Marina del Port Vell. The Zona Franca plant, pivotal to the project, also features a biomass plant that generates electricity and heat from the pruning residues of parks and gardens and other forestry waste.

Image 3. Heating and cooling network Ecoenergies



Source: Author's elaboration from Google Earth and Ecoenergies.cat.

8. Further information may be accessed at: <https://www.ecoenergies.cat/cat>

The Barcelona City Council continues to advocate for heating and cooling networks. Together with Barcelona Sagrera Alta Velocitat, it will promote the development of a new centralized heating and cooling system at the Sagrera Station and its surroundings. This would be the third major heating and cooling network available in the city.

Once all networks are implemented, it is expected to provide energy coverage to an approximate area of 18.5 million square meters, equivalent to the sum of the surfaces of the Eixample and Sant Andreu districts. The combination of all heating and cooling networks would also result in the reduction of over 50,000 tons of CO₂ annually, equivalent to removing nearly 87,000 private vehicles from circulation.

6. Energy Culture

Promoting and facilitating citizen intervention and participation in an energy consensus and empowerment dynamic is another function to promote within the energy action strategy.

The best way to ensure that energy actions work to their full potential is by enabling the population to participate in decision-making processes. Therefore, the best available tools will be provided, and new ones will be created to adapt to emerging needs, with the goal of making social participation more efficient and profound.

First-hand experimentation and resource rationalization through co-responsibility are effective strategies for knowledge and change promotion.

The increase in energy culture is primarily directed at citizens in their daily lives but also at individuals working in public buildings, private companies, schools, universities, and training centers in general.

7. Conclusions

We must embark on the path of energy transition, and we must do so expeditiously. Achieving a system based on renewable energies, decarbonized, and with a high level of electrification of energy consumption is essential. The journey ahead will undoubtedly require changes in practices, which are neither easy nor immediate. However, undertaking this route is a matter of intelligence because it is in our best interest, and, in some cases, we might even say, out of selfishness. In any case, improvements and advantages will only come if we manage to make a collective change that leaves no one behind.